WATER QUALITY SAMPLING IN BAYOU CHENE, SUBSEGMENT 050603
DRAFT FINAL REPORT

2018

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FY12-391NPS (C9-99610219)
PROJECT 11

WATER QUALITY SAMPLING IN BAYOU CHENE

Draft Final Report

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Project Timeline: ~28 months

Project Area: Bayou Chene, subsegment 050603

Grant Number: FFY12-319NPS (C9-99610219), Program Element 11

Grant Source: Section 319 Federal Funds

Start Date: June 15, 2015

Ending Date: September 30, 2017

Actual Project Cost: federal $466,344.14   match $315,979.12

Table 1Water Quality Sampling in Bayou Chene, subsegment 050603, actual project cost

		Contract Amount		Cumulative	
Task	**Task Description**	**Federal ($)**	**ULL Match ($)**	**Federal Funds invoiced**	**Match Reported**
1.1	QAPP/SP Development	$1,000	$0	$1,000	$0
1.2	QAPP/SP Reviews & Revisions	$500	$0	$0	$0
2.1	Conduct targeted water quality sampling	$464,112.00	$320,113.00	$431,099.42	$297,308.14
2.2	Outreach	$16,000.00	$2,159.00	$8,192.72	$1,104.98
3.1	Quarterly Monitoring Reports	$3,517.00	$5,727.00	$3,517.00	$5,727.00
3.2	Annual Reports	$3,517.00	$5,727.00	$3,517.00	$5,727.00
3.3	Final Reports	$19,018.00	$6,112.00	$19,018.00	*$6,112.00*
Total		**$507,664.00**	**$339,838.00**	**$466,344.14**	**$315,979.12**

1.0 Introduction

In Federal Fiscal Years (FFYs) 2010-2013, the United States Department of Agriculture (USDA) allocated approximately eighty 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, there were eleven 12-digit Hydrologic Unit Codes (HUCs) chosen, which included Bayou Chene, 050603. Data for Bayou Chene was obtained under the MRBI grant, from June 20, 2012. The University of Louisiana Lafayette (ULL) worked collaboratively with the United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS), Louisiana Department of Agriculture and Forestry (LDAF), Louisiana State University (LSU) AgCenter, and the Louisiana Department of Environmental Quality's (LDEQ) Nonpoint Source (NPS) section. These entities 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 the watershed;
2) If monitoring data supports 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; and
3) A success story may be prepared, based on water quality improvements and/or delisting of the waterbody for targeted parameters.

During the Bayou Chene MRBI sampling period, implementation was concentrated in HUC 080802020205. There were two practices implemented in 2012, nineteen in 2014, and twenty-one in 2015. Water quality sampling concluded on June 14, 2015. Water quality changes from June 2012 to June 2015 were documented and fully discussed in the MRBI final report. An analysis of the water quality data collected after project completion did not reveal that BMPs were effective in reducing all targeted parameters; however, improvements in nutrient concentrations were noted. DO concentrations did not attain the state's standard of 5.0 mg/L year round by the end of the implementation project; therefore, Bayou Chene remained listed on LDEQ's 2016 IR for not supporting its designated uses. For these reasons, a success story was not developed.

LDEQ and LDAF remained dedicated to improving the water quality in the Bayou Chene watershed. Surface water quality analysis results made it evident that additional BMP implementation was needed; therefore, in an effort to pinpoint additional critical areas where BMPS could be implemented in Bayou Chene, after the closing of the MRBI project, LDEQ nonpoint source (NPS) and University of Louisiana Lafayette (ULL) personnel entered into a new contract in which the ULL continued to collect weekly water quality data and analysis in the watershed. In consulting with LDAF, it was decided that in addition to the BMPs that were currently being implemented in HUC 080802020205, BMPs would also need to be implemented in HUCs 080802020203 and 080802020201, in hopes of furthering efforts for improving water quality in the bayou.

Utilizing LDEQ's FFY 2012 Section 319 grant, the goal of this project was to continue to document water quality changes following BMP implementation by LDAF with Section 319 funding, to reduce nutrient loading into the Bayou Chene watershed in southwestern Louisiana. The objectives of the project were:

1) To collect data on field parameters and water chemistry on a weekly basis for the duration of the project; and
2) To collected flow data at site 1C (0658), with the help of LDEQ Water Surveys group.

2.0 Background Information

Bayou Chene, subsegment 050603 (Figure 1), flows for 33 miles from the headwaters to Lacassine Bayou and includes Bayou Grand Marais. There are three Grand Marais waterbodies: the East Bayou Grand Marais, the Middle Bayou Grand Marais, and the 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 and crosses back to the east and stops at Linscomb Rd. at Hwy 26, just south of the town of Elton on Hwy 190.

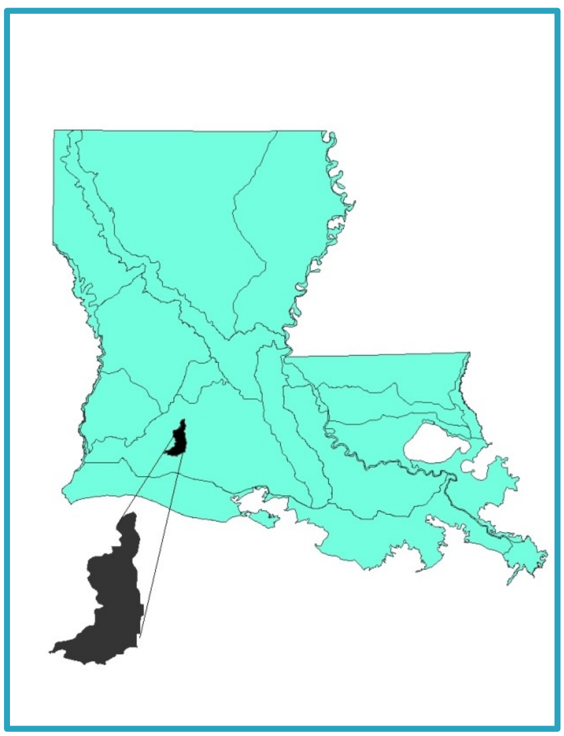

Figure 1 Location of the Bayou Chene watershed, in Louisiana

Bayou Chene was listed on Louisiana's 2014 Integrated Report (IR) (Table 2) as being impaired for primary contact recreation (PCR) due to increased fecal coliform concentrations due to drought related impacts, rural related impacts, and runoff from forest/grassland/parkland. The standard for PCR states no more than 25 percent of the total samples collected on a monthly or near-monthly basis shall exceed a fecal coliform density of 400 colony-forming units (cfu)/100 ml., May 1 through October 31. The waterbody is also listed as not supporting its designated uses of fish and wildlife propagation (FWP) due to increased concentrations of mercury in fish tissue, stemming from atmospheric deposition, and unknown sources. LDEQ does not have a mercury standard. Decreased DO concentrations, due to agriculture are an additional suspected cause of impairment for Bayou Chene's FWP use. Increased sulfate concentrations are also listed as a suspected cause of impairment for its FWP use. The suspected source of impairment is natural sources. LDEQ does not have a standard for sulfates. Increased concentrations of fipronil, from agriculture, are a suspected cause of impairment. LDEQ does not have a standard for fipronil. This project targeted low DO concentrations due to agriculture. Although the waterbody is also impaired for mercury in fish tissue, fecal coliform, and sulfates, these parameters were not be sampled, as they were beyond the scope of this sampling effort.

Table 2 LDEQ's 2014 Integrated Report for Bayou Chene, subsegment 050603

Subsegment Number	Water Body Type	Size	Designated Water Body Uses			Impaired Use for Suspected Cause	Suspected Causes of Impairment	Suspected Sources of Impairment
			PCR	SCR	FWP			
LA050603_00	R	33	N	F	N	FWP	Fipronil	Agriculture
LA050603_00	R	33	N	F	N	FWP	Mercury in Fish Tissue	Atmospheric Deposition - Toxics
LA050603_00	R	33	N	F	N	FWP	Mercury in Fish Tissue	Source Unknown
LA050603_00	R	33	N	F	N	FWP	Oxygen, Dissolved	Agriculture
LA050603_00	R	33	N	F	N	FWP	Sulfates	Natural Sources
LA050603_00	R	33	N	F	N	PCR	Fecal Coliform	Drought-related Impacts
LA050603_00	R	33	N	F	N	PCR	Fecal Coliform	Runoff from Forest/Grassland/Parkland
LA050603_00	R	33	N	F	N	PCR	Fecal Coliform	Rural (Residential Areas)

Bayou Chene encompasses 86,107 acres, which includes rice, pasture, soybeans, deciduous forest, developed low density area, developed medium density area, developed high density area, sugarcane, sweet potato, and evergreen forest (Figure 2). The primary land use in the watershed is agriculture, particularly rice and soybeans. Irrigation of rice and other crops have a significant impact on water quality in this area. Effective management of surface water quality in these agricultural watersheds requires an understanding of natural and anthropogenic impacts. In watersheds where agriculture is a suspected source of impairment, best management practices (BMPs) may be implemented to remove the waterbodies from the IR. In watersheds where a natural source is a suspected source of impairment, special water quality criteria may be adopted.

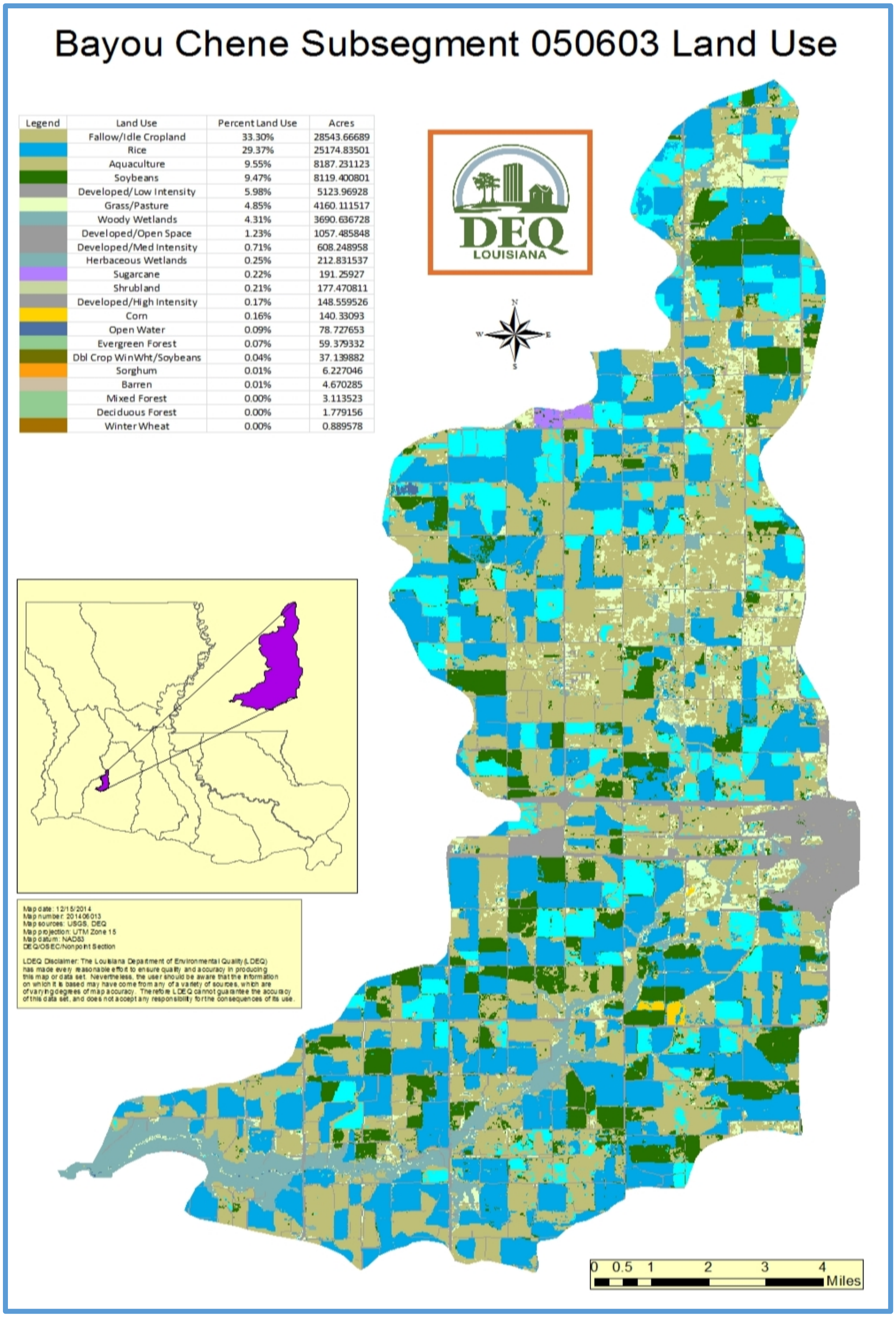

Figure 2 Land Use/Land Cover, Bayou Chene

3.0 Project Goals and Objectives

The goal of this project was to continue to document water quality changes (using base Section 319 funding) following BMP implementation by LDAF (incremental Section 319 funding), to reduce nutrient loading into the Bayou Chene watershed. Section 319 funding from LDEQ was used to continue data collection and analysis. The specific objective of this project was to collect data on field parameters and water chemistry on a weekly basis for the duration of the project. Water quality data collected was used to evaluate changes in water quality due to BMP implementation. Flow data was collected at site 1C (0658), with the help of LDEQ Water Surveys group during the project. Flow data was collected in accordance with LDEQ SOP #1597 *Stream Discharge Measurements*. Water quality sampling dates were provided to the survey team in advance, and when possible, flow measurements were coordinated on the same day of water quality sampling.

3.1 LDEQ QAPP/SP Review

Prior to initiating data collection activities, a sampling plan (SP) for Bayou Chene was required to be drafted. LDEQ-NPS provided a draft LDEQ SP to Dr. Durga Poudel, Project Principle Investigator, for review and comment. ULL submitted requested changes for the SP, as appropriate for this project. LDEQ-NPS subsequently reviewed and provided a draft SP to USEPA for review. Once approved by USEPA, the SP was noted as final, and LDEQ provided a digital copy of the document to the contractor. The SP was approved on May 11, 2015, and again on May 10, 2017. The SP/QAPP can be referenced as QTrak#17-289. To review the LDEQ SP, the contract allotted one thousand dollars in federal funding, to ULL. Matching funding was not required for this task.

3.2 LDEQ QAPP/SP Reviews and Revisions

Dr. Durga Poudel was responsible for initiating the annual review of the LDEQ SP 90 days prior to the annual anniversary of the original approval date. Whether or not revisions were needed to the LDEQ SP, the contractor submitted signature pages to LDEQ-NPS, with current dates at least 60 days prior to the annual anniversary date of the original approval date. If revisions were needed at the annual review, a draft indicating revisions were submitted to LDEQ at least 60 days prior to the annual anniversary date of the original LDEQ QAPP/SP approval date along with new signature pages with current dates. If no substantive technical or programmatic changes occurred in the project, a letter was submitted stating no changes were needed, along with new signature pages with current dates. The contract allotted five hundred dollars in federal funding, towards the review and revisions of the SP, which comprised of two hundred fifty dollars per review. Matching funding was not required for this task.

3.3 Water Quality Sampling

The ULL contractor conducted water quality sampling in the Bayou Chene watershed in accordance with the USEPA approved LDEQ QAPP/SP.

3.3.1 Conduct Targeted Water Quality Sampling Along Selected Watershed

Water quality sampling commenced once USEPA approved the LDEQ SP. Water quality sampling involved the weekly collection of surface water samples from each sampling location

(Table3, Figure 3). 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), 5-day biological oxygen demand (BOD_5), nitrate/nitrite-nitrogen (NO_3/NO_2-N), total kjeldahl nitrogen (TKN), soluble reactive phosphate (SRP), total phosphorus (TP), chloride (Cl), fluoride (Fl), and sulfate (SO_4). Surface water temperature, DO, turbidity, conductivity and pH were determined in the field, using the YSI Sonde. All data was collected and analyzed according to approved quality assurance/quality control (QA/QC) procedures. See Figures 4, 5 and 6 showing UL employees conducting water quality sampling. Water quality monitoring dates were provided to the survey team in advance and when possible, flow measurement was coordinated on the same day as water quality sampling. Flow data was collected at site 1C (0658), with the help of LDEQ Water Surveys during the project. Flow data was collected in accordance with LDEQ SOP #1597 *Stream Discharge Measurements*. Discharge measurement results prior to the beginning of the project showed frequent negative flows, primarily at the outlet of Bayou Chene and Middle Bayou Grand Marais, a tributary of Bayou Chene. The lower end of Bayou Chene is affected by tidal flux from the Gulf of Mexico and occasionally experiences reverse flows. While negative flows at the outlet were distributed throughout the year, negative flows for the tributary were more concentrated generally during late spring months.

Water quality sampling conducted by ULL was completed on July 31, 2017. The contract allotted $464,112.00 in federal funding and $320,113.00 in matching funding.

	2015	**2016**	**2017**
January		6, 14, 20, 28	5, 12, 19, 25
February		4, 11, 18, 25	2, 9, 16, 23
March		3, 10, 17, 24, 31	2, 9, 16, 23, 30
April		7, 14, 21, 28	6, 13, 20, 27
May		5, 12, 19, 26	4, 11, 28, 25
June	18, 25	2, 9, 16, 23, 30	1, 8, 15, 26, 28
July	2, 9, 16, 23, 30	7, 13, 21, 28	6, 13, 20, 18
August	6, 13,20, 27	4, 11, 25	
September	3, 10, 16, 24	1, 8, 15, 22, 28	
October	1,8,15,22, 29	6, 13, 20, 27	
November	5, 12, 19, 25	3, 10, 17, 23	
December	3, 9, 17	1, 7, 14	

Table 3 Water quality sampling dates in Bayou Chene, 2015-2017

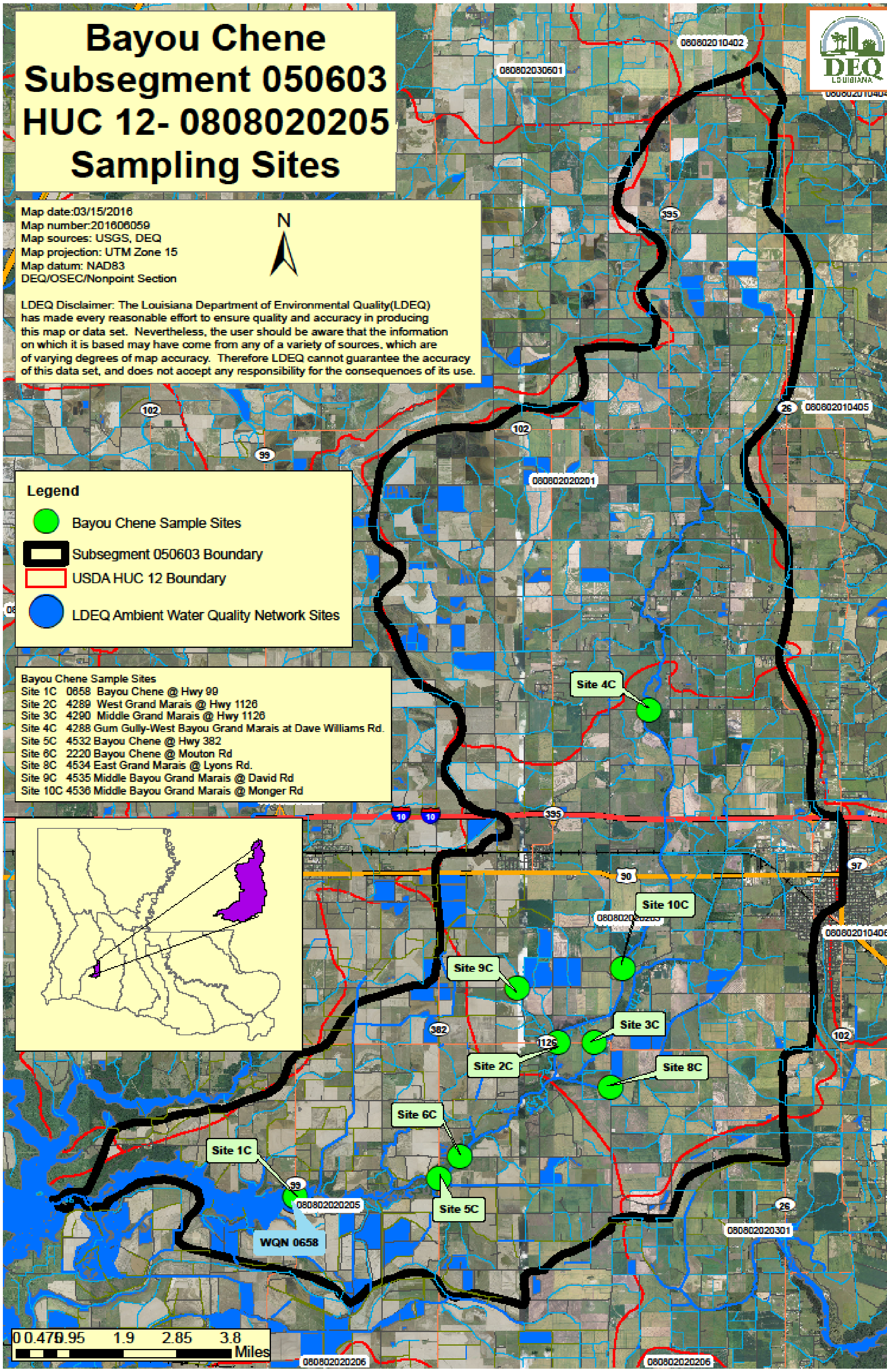

Figure 3 Bayou Chene water quality sampling sites

Figure 4 UL employees using a Van Dorn sampler for water quality sampling in Bayou Chene

Figure 5 UL employee writing in situ data collected at a sampling site

Figure 6 UL employee preparing water quality sample to be delivered to laboratory

3.3.2 Water Quality Sampling Results, conducted by ULL

Water quality sampling began June 15, 2015, in which ULL monitored nine locations in the Bayou Chene watershed on a weekly basis. Sampling sites were selected based on critical areas of highest sediment loadings were determined by land use data, accessibility, LDAF 12-digit BMP implementation areas, safety of sampling locations, and by the Soil and Water Assessment Tool (SWAT) Model. The SWAT model is a watershed scale model that estimates the impact of land management practices on water, sediment, and agricultural chemical yields. The data collected during this project will be used to pinpoint critical areas for future LDAF BMP implementation, to prioritize them according to DO exceedance rates, and to determine water quality changes in the subsegment following BMP implementation conducted by LDAF.

Bayou Chene has low concentrations of DO, documented as far back as 1998, through ambient data. Figure 7 outlines all DO concentrations collected from 2015 through 2017 at the WQN site. The DO standard is shown by a red line on the graph. DO concentrations ranged from 0.19 mg/L (June 2017) to 7.64 mg/L (December 2015). The trendline shows DO concentrations are slightly increasing. Data also shows DO levels were highest in the cooler months (October through March) and lowest in the warmer months (May through September) of each year. The exceedance rates were calculated for DO from 2015 through 2017 (Figure 8). Rates fluctuated as high as 89 percent in 2015 and as low as 80 percent in 2017; however, sampling years 2015 and 2017 were not sampled for a full year. In 2015, there were a total of 28 samples taken, of which 25 samples did not meet the standard. In 2016, there were 50 samples taken, of which 42 did not meet the state's standard. In 2017, there were a total of 30 samples taken, of which 24 samples did not meet the standard. Only 17 of 108 samples collected from 2015 through 2017 were above the 5 mg/L standard.

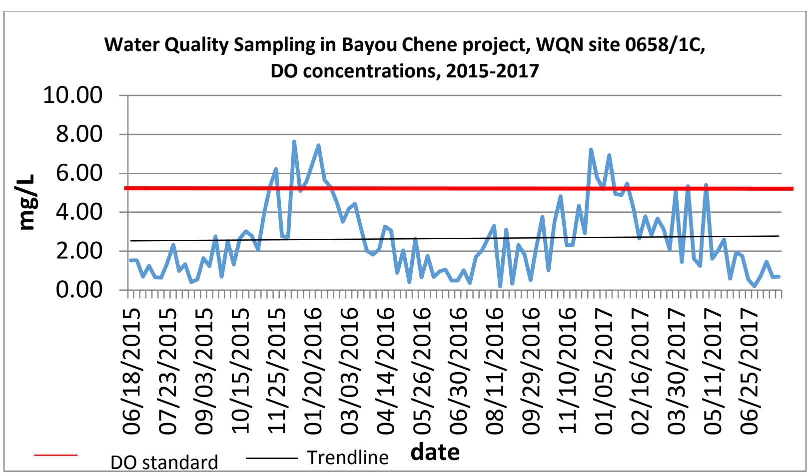

Figure 7 Water Quality Sampling in Bayou Chene project, WQN site 0658/1C, DO concentrations, 2015-2017

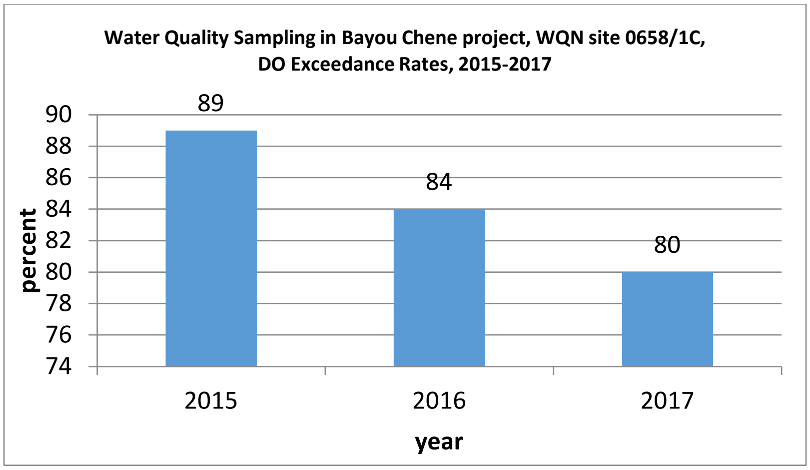

Figure 8 Water Quality Sampling in Bayou Chene project, WQN site 0658/1C DO Exceedance rates, 2015-2017

Figure 9 outlines all DO concentrations collected from 2015 through 2017 at the site 4289/2C. The DO standard is shown by a red line on the graph. DO concentrations ranged from 0.40 mg/L (July 2016 2017) to 10.18 mg/L (January 2017). The trendline shows DO concentrations are slightly increasing. Data also shows DO levels were highest in the cooler months (October through March) and lowest in the warmer months (May through September) of each year. The exceedance rates were calculated for DO from 2015 through 2017 (Figure 10). Rates fluctuated as high as 81 percent in 2015 and as low as 67 percent in 2017; however, sampling years 2015 and 2017 were not sampled for a full year. In 2015, there were a total of 27 samples taken, of which 22 samples did not meet the standard. In 2016, there were 50 samples taken, of which 34 did not meet the state's standard. In 2017, there were a total of 30 samples taken, of which 20 samples did not meet the standard. Only 31 of 107 samples collected from 2015 through 2017 were above the 5 mg/L standard.

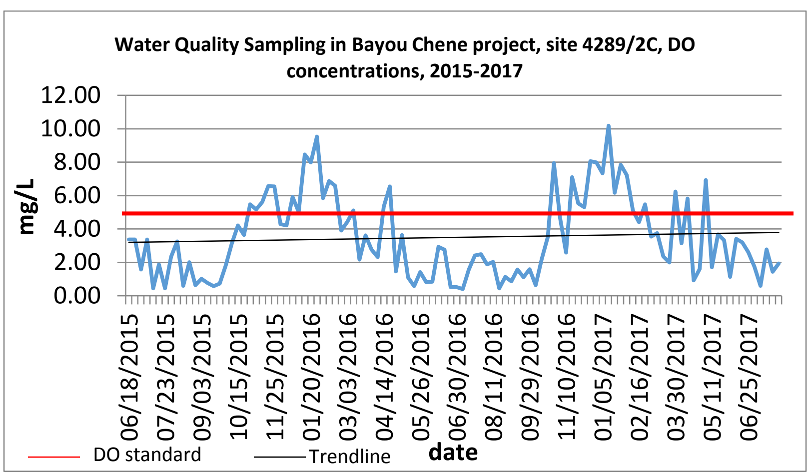

Figure 9 Water Quality Sampling in Bayou Chene project, site 4289/2C, DO Concentrations, 2015-2017

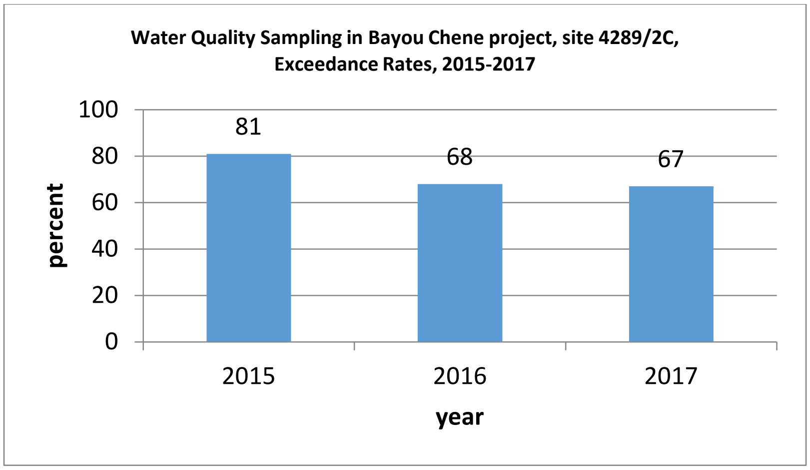

Figure 10 Water Quality Sampling in Bayou Chene, project, site 4289/2C, Exceedance Rates, 2015-2017

Figure 11 outlines all DO concentrations collected from 2015 through 2017 at the site 4290/3C. The DO standard is shown by a red line on the graph. DO concentrations ranged from 0.35 mg/L (June 2016) to 9.02 mg/L (January 2017). The trendline shows DO concentrations are increasing. Data also shows DO levels were highest in the cooler months (October through March) and lowest in the warmer months (May through September) of each year. The exceedance rates were calculated for DO from 2015 through 2017 (Figure 12). Rates fluctuated as high as 86 percent in 2015 and as low as 62 percent in 2017; however, sampling years 2015 and 2017 were not sampled for a full year. In 2015, there were a total of 28 samples taken, of which 24 samples did not meet the standard. In 2016, there were 50 samples taken, of which 35 did not meet the state's standard. In 2017, there were a total of 29 samples taken, of which 18 samples did not meet the standard. Only 30 of 107 samples collected from 2015 through 2017 were above the 5 mg/L standard.

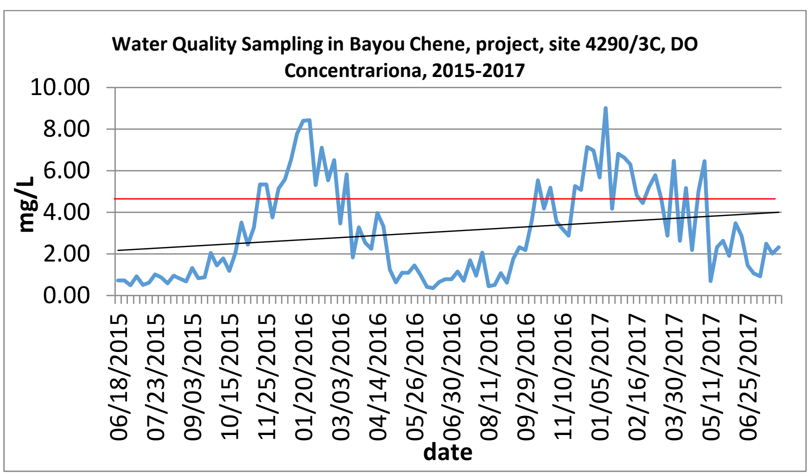

Figure 11 Water Quality Sampling in Bayou Chene project, site 4290/3C, DO Concentrations, 2015-2017

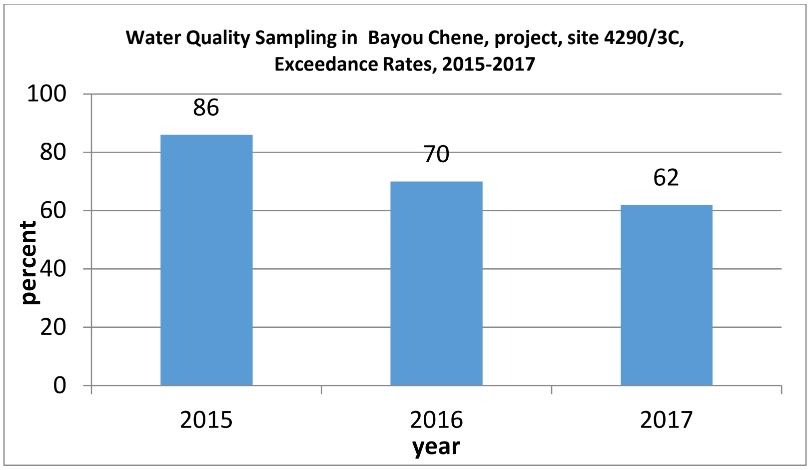

Figure 12 Water Quality Sampling in Bayou Chene project, site 4290/3C, DO Exceedance Rates, 2015-2017

Figure 13 outlines all DO concentrations collected from 2015 through 2017 at the site 4288/4C. The DO standard is shown by a red line on the graph. DO concentrations ranged from 1.92 mg/L (July 2015) to 11.64 mg/L (January 2016). The trendline shows DO concentrations are slightly increasing. Data also shows DO levels were highest in the cooler months (September through April) and lowest in the warmer months (May through August) of each year. The exceedance rates were calculated for DO from 2015 through 2017. Rates fluctuated as high as 86 percent in 2015 and as low as 62 percent in 2017; however, sampling years 2015 and 2017 were not sampled for a full year. In 2015, there were a total of 28 samples taken, of which 24 samples did not meet the standard. In 2016, there were 50 samples taken, of which 35 did not meet the state's standard. In 2017, there were a total of 29 samples taken, of which 18 samples did not meet the standard. Only 30 of 107 samples collected from 2015 through 2017 were above the 5 mg/L standard.

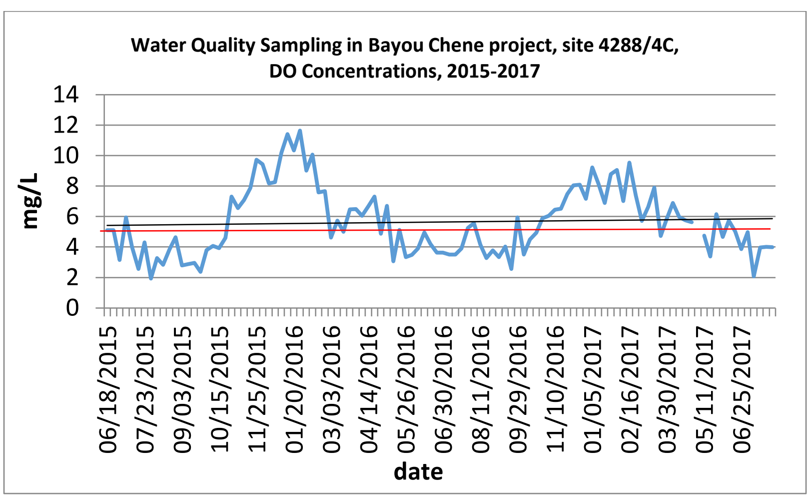

Figure 13 Water Quality Sampling in Bayou Chene, site 4288/4C, DO Concentrations, 2015-2017

Figure 14 illustrates DO exceedance rates at each sampling site for sampling year 2016. Water quality sampling collected by ULL was completed by July 31, 2017; therefore, a full year of sampling data was not collected in 2017.

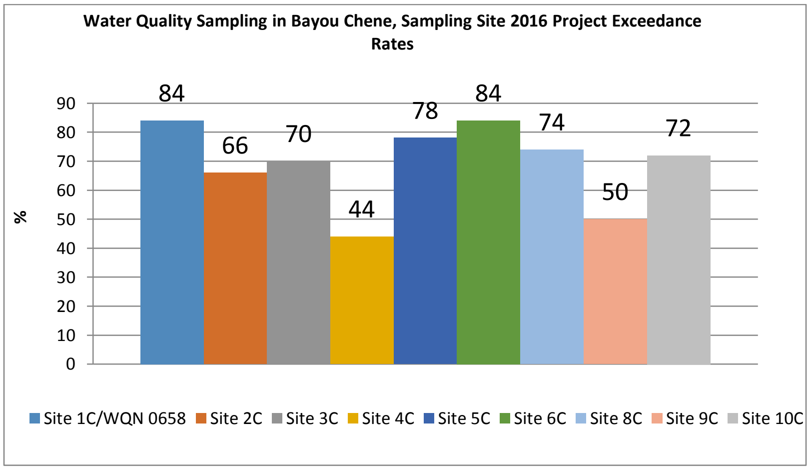

Figure 14 Water Quality Sampling in Bayou Chene, 2016 sampling site project exceedance rates

Figure 15 illustrates the future critical areas for BMP implementation in Bayou Chene. Critical areas were based on water quality samples collected during year 2016, to calculate DO exceedance rates at each sampling site. The highest priority ranking (#1) for future implementation was assigned to the sites with the highest exceedance rate, 84 percent (sites 1C and 6C). The lowest priority (#8) was given to the site with the lowest exceedance rate, 44 percent (site 4C). Site 1C is the ambient site, which is where subsegments are listed and restored. Future implementation should begin around the ambient site and above site 6C in hopes of restoring the ambient site expeditiously.

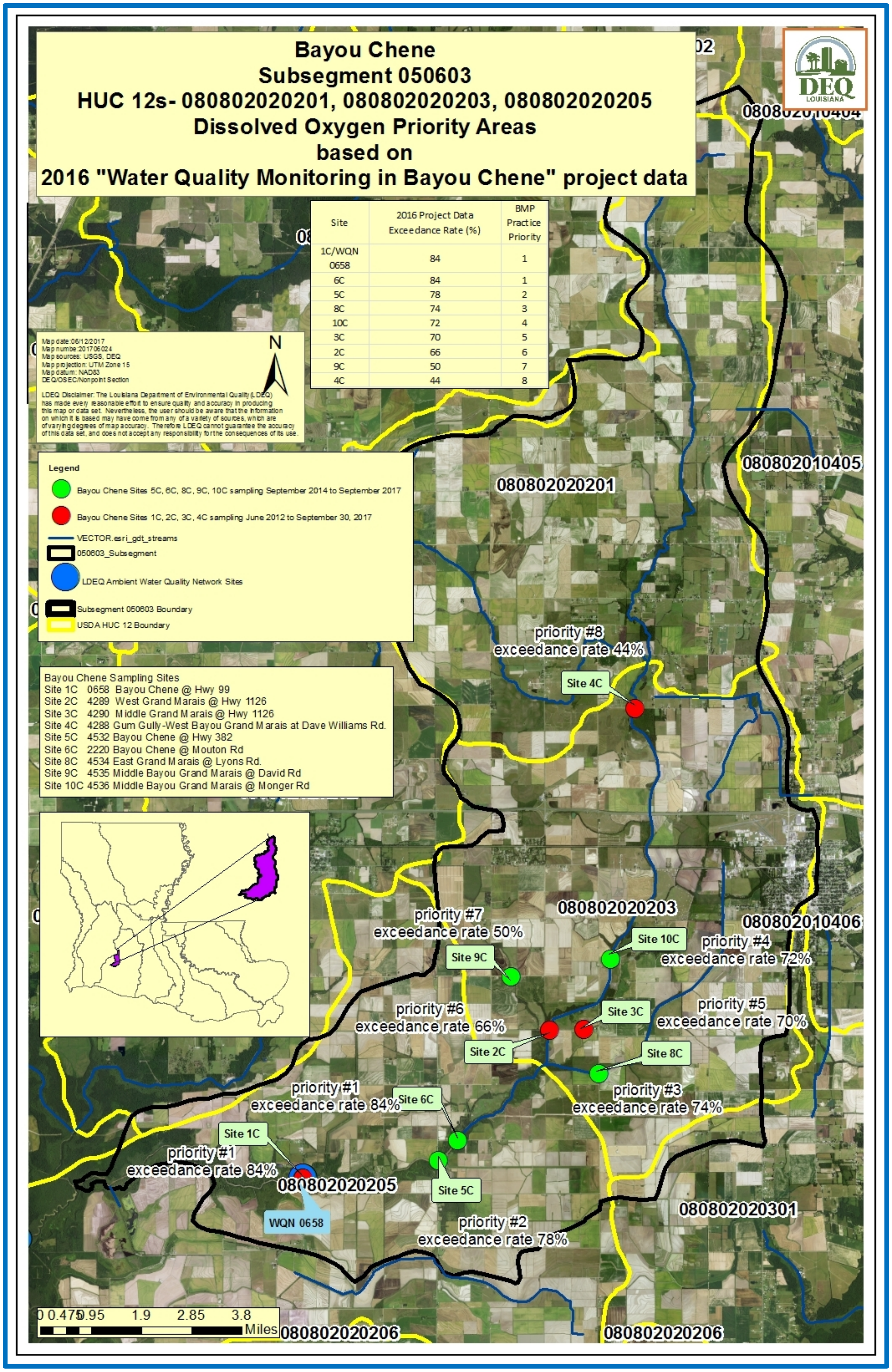

Figure 15 Bayou Chene sampling site priorities depicting critical areas in which future BMPs may be implemented. Priorities are based on 2016 DO exceedance rates calculated from data collected by the University of Louisiana under the "Water Quality Monitoring in Bayou Chene" project (2015-2017)

Average DO values for Bayou Chene's upstream water quality sites were more elevated, compared to concentrations in the lower sites. DO concentrations begin to decline in the spring, and continue to fall through the summer months. DO values in the waterbody did not meet LDEQ'S DO standard of 5mg/L, from March through November, in all sampling sites; however, concentrations were above 5 mg/L during the winter months of December, January, and February. Upstream site 4C displayed increased concentrations of DO, which may possibly be associated with a more rapid speed of water, at this site, compared to the other sampling sites. Although DO values were found highly correlated with surface water temperatures, the elevated suspended solids and the turbidity values especially in spring months should be of major concern as water with high turbidity and enriched with oxygen-demanding substances cause depletion of DO. Turbidity and DO are inversely related. The more turbidity, the less dissolved oxygen there is for living organisms to breath, negatively affecting animal populations, and water quality. Human impact has played an extensive role in keeping the turbidity levels high in water samples (Russell Argenal Robert Gomez, 2006). Turbidity can also increase water temperature because suspended particles absorb more heat. These factors lead to a decrease in dissolved oxygen (Tabor, Brock 2015).

Table 4 summarizes data collected in each of the three 12-digit HUCs in Bayou Chene, in addition to the average of each parameter collected at each site in the corresponding 12-digit HUC. Figures 17 to 34 illustrate DO, turbidity, TSS, TDS, 2 NO_3/NO^2-N, and SRP concentrations in each of the three HUCS, from 2015-2017. Graphs of each water quality parameter sampled, at each site can be found in the Appendix.

A strong seasonality between the concentration of sediments, turbidity, NO_3/NO^2-N, and SRP values were observed. Highly elevated sediments and turbidity values were recorded for all sites during the months of February, March, and April. However, site 4C and its downstream site 10C, displayed the greatest concentrations of sediments and turbidity values during these months. On average, the turbidity concentrations at site 4C were 1.4 times higher than the middle water quality sites, and 1.7 times greater than the lower water quality sites. Turbidity values in the bayou began increasing in February and peaked in March, suggesting large amounts of sediments enter into the bayou through the upstream regions of site 4C, beginning in February. By March, the water in Bayou Chene's upstream sites is turbid. As a result, in April, the increased amounts of sediment in the bayou contribute to the elevated turbidity concentration values in the downstream sites. Turbidity values in all sites began declining in May, and continued to fall through July. Concentrations were constant from approximately July through January, and the cycle initiates again. In addition, site 4C displayed higher concentrations of TSS, TDS, TS, conductivity, NO_3/NO^2-N, TP, TKN, and BOD_5, compared to the remaining water quality sampling sites. ULL employees speculate the agricultural activities, water leveling and mud rutting, are contributing to the high turbidity values from February through April. Water leveling involves land leveling in a flooded rice field. Mud rutting constitutes making "v-ditches" to allow drainage in the fields.

HUC-12	Site	Sample size (n)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	Turb (NTU)	TSS (mg/L)	TDS (mg/L)	TS (mg/L)	N03/N02-N (mg/L)	Cl (mg/L)	Fl (mg/L)	S04 (mg/L)	SRP (mg/L)	TP (mg/L)	TKN (mg/L)	BOD-5 (mg/L)
080802020201	**4C**	**105**	**22.32**	**224.65**	**5.66**	**7.05**	**371.51**	**216.19**	**427.14**	**638.57**	**0.34**	**26.69**	**0.28**	**4.59**	**0.10**	**0.54**	**3.44**	**6.65**
080802020203	2C	106	22.82	198.35	3.52	6.95	258.12	118.35	324.50	436.11	0.30	23.21	0.30	3.72	0.10	0.42	2.86	6.00
080802020203	3C	106	22.65	236.43	3.12	6.94	288.49	135.34	362.58	496.81	0.28	27.05	0.22	2.83	0.10	0.41	2.75	4.86
080802020203	8C	105	22.38	216.50	3.16	6.93	245.16	145.77	307.32	452.38	0.23	23.77	0.21	2.71	0.10	0.40	2.86	5.41
080802020203	9C	106	21.35	213.76	4.93	7.02	202.06	87.27	372.61	453.39	0.29	28.77	0.25	2.53	0.11	0.44	2.90	4.56
080802020203	10C	106	22.59	213.10	3.68	6.98	323.27	143.43	380.94	521.70	0.33	24.84	0.26	4.14	0.10	0.47	3.01	6.54
080802020203	**Average**	**529**	**22.36**	**215.63**	**3.68**	**6.96**	**263.45**	**125.99**	**349.67**	**472.12**	**0.29**	**25.53**	**0.25**	**3.19**	**0.10**	**0.43**	**2.87**	**5.48**
080802020205	1C	106	22.82	164.12	2.68	6.87	194.88	91.84	253.29	335.87	0.24	18.69	0.18	3.03	0.09	0.34	2.23	4.76
080802020205	5C	106	22.82	183.31	2.83	6.88	226.83	96.64	291.62	381.56	0.25	20.76	0.21	3.24	0.09	0.37	2.55	4.77
080802020205	6C	105	22.91	189.12	2.67	6.86	235.50	103.08	296.79	398.06	0.26	21.32	0.22	3.24	0.09	0.38	2.69	4.95
080802020205	**Average**	**317**	**22.85**	**178.82**	**2.73**	**6.87**	**219.02**	**97.16**	**280.52**	**371.74**	**0.25**	**20.25**	**0.20**	**3.17**	**0.09**	**0.36**	**2.49**	**4.83**

Table 4 Average temperature, conductivity, DO, turbidity, TSS, TDS, TS, NO_3/NO_2-N, Cl, FL, SO4, SRP, TP, TKN, and BOD_{-5} values for nine water quality sampling sites in Bayou Chene watershed (June, 2015 to July, 2017)

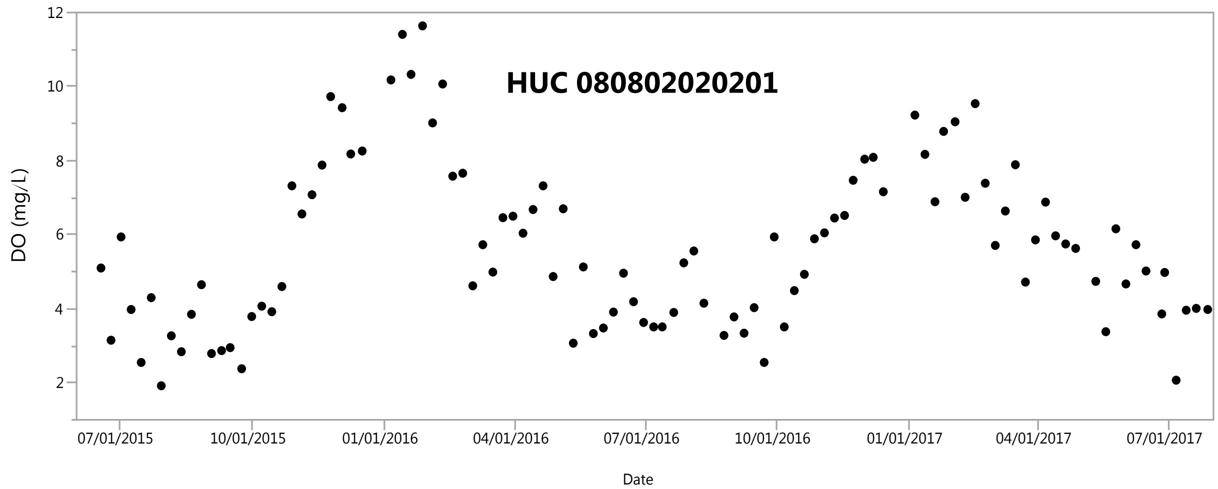

Figure 16 Bayou Chene HUC 080802020201 dissolved oxygen concentrations, 2015-2017

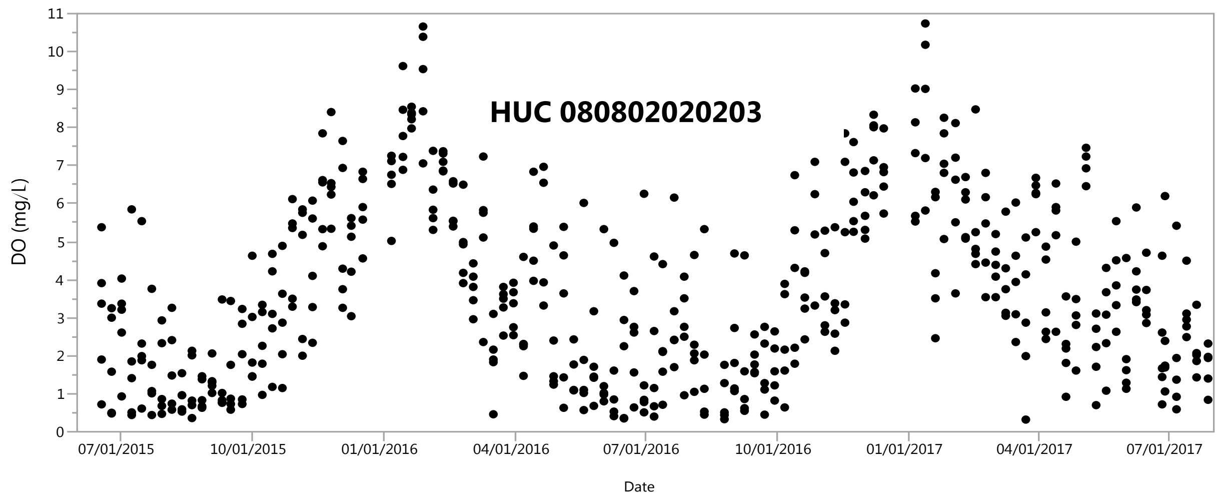

Figure 17 Bayou Chene HUC 080802020203 dissolved oxygen concentrations, 2015-2017

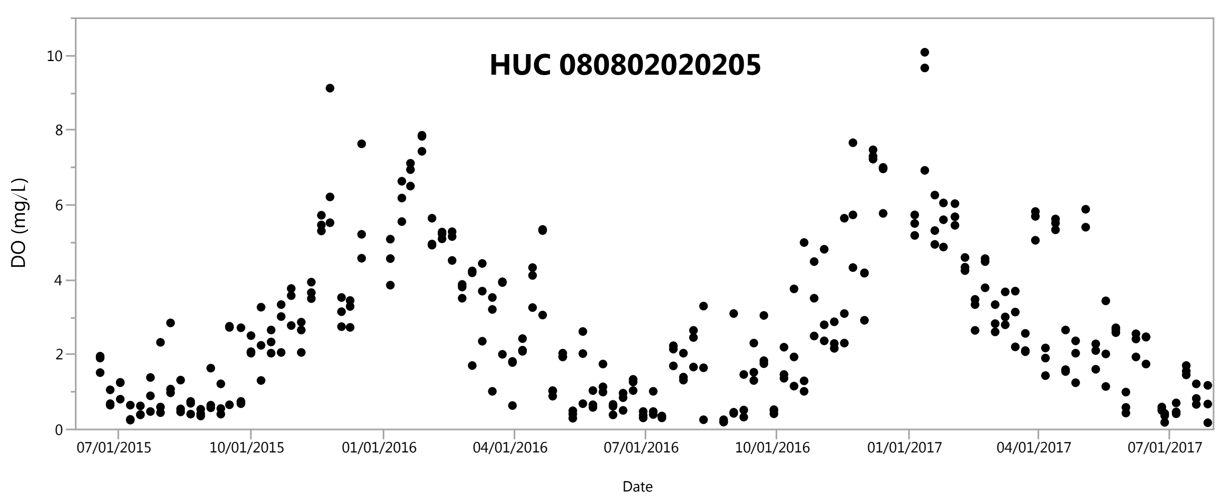

Figure 18 Bayou Chene HUC 080802020205 dissolved oxygen concentrations, 2015-2017

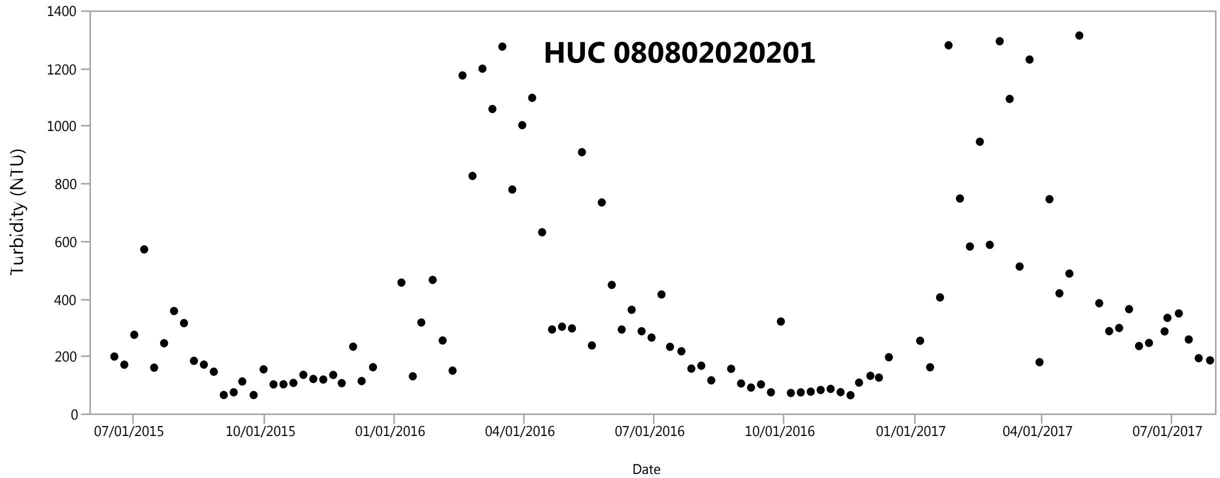

Figure 19 Bayou Chene HUC 080802020201 turbidity concentrations, 2015-2017

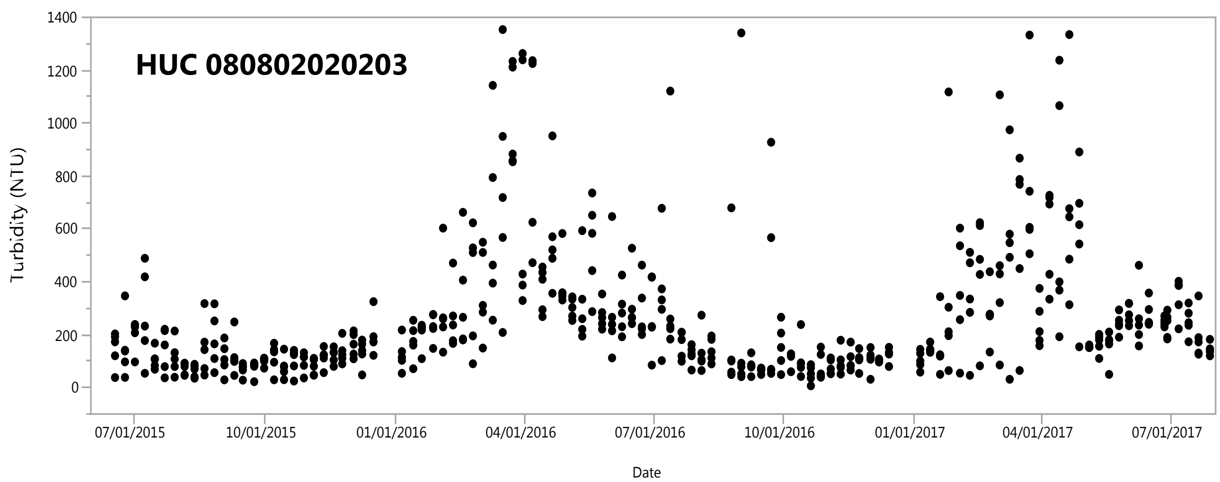

Figure 20 Bayou Chene HUC 080802020203 turbidity concentrations, 2015-2017

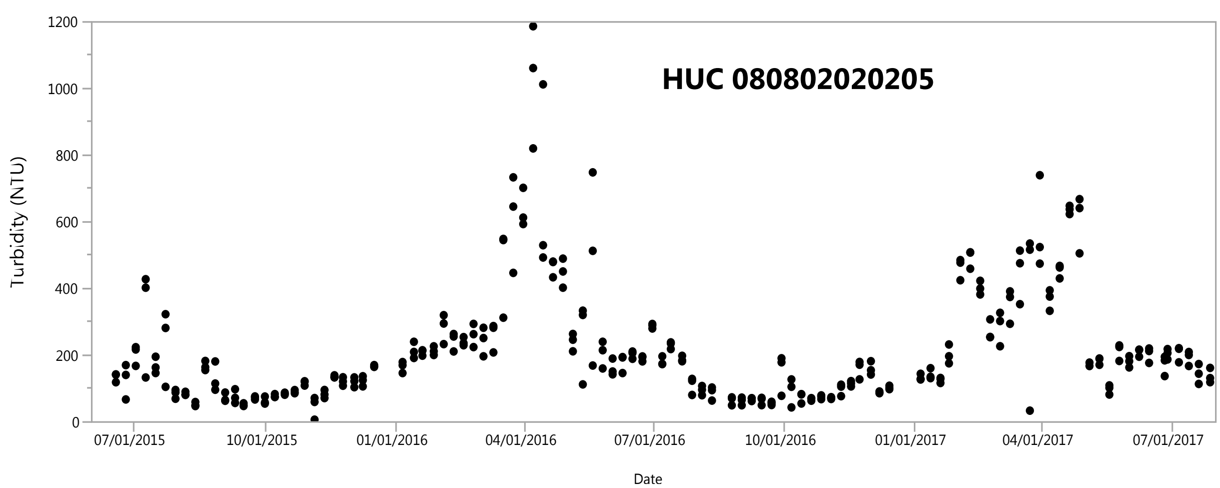

Figure 21 Bayou Chene, HUC 080802020205, turbidity concentrations, 2015-2017

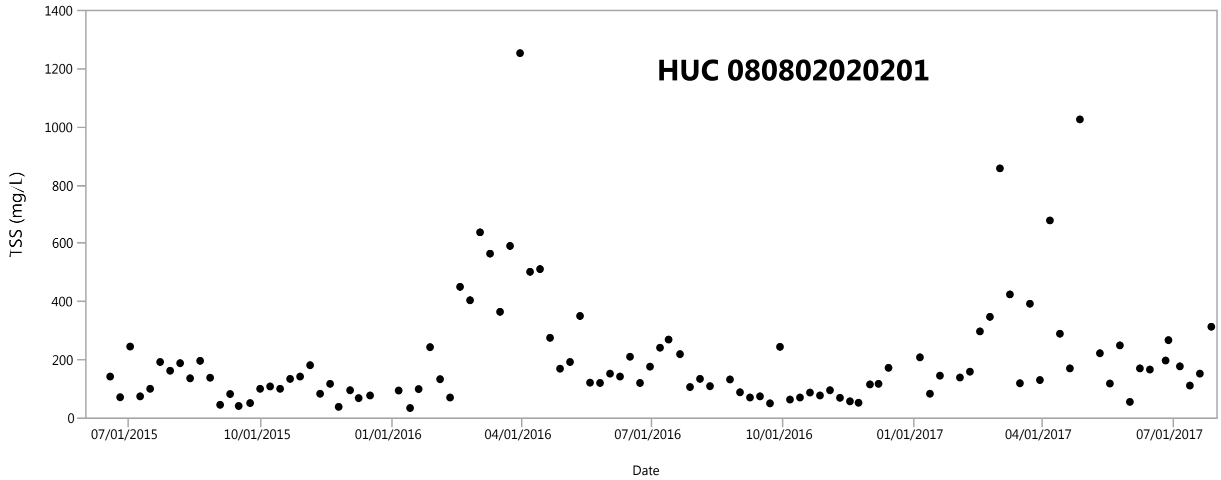

Figure 22 Bayou Chene, HUC 080802020201, TSS concentrations, 2015-2017

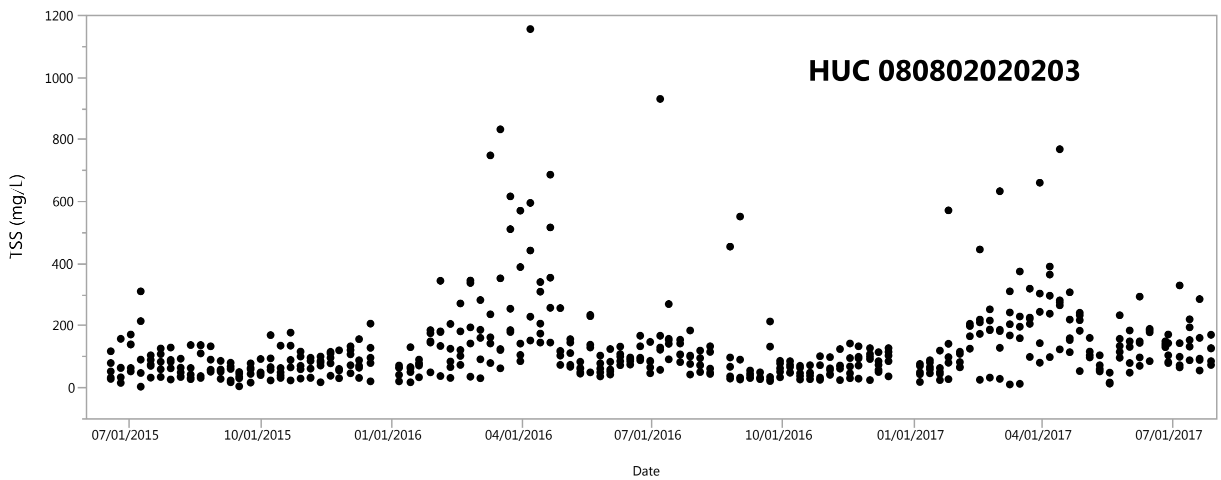

Figure 23 Bayou Chene HUC 080802020203, TSS Concentrations, 2015-2017

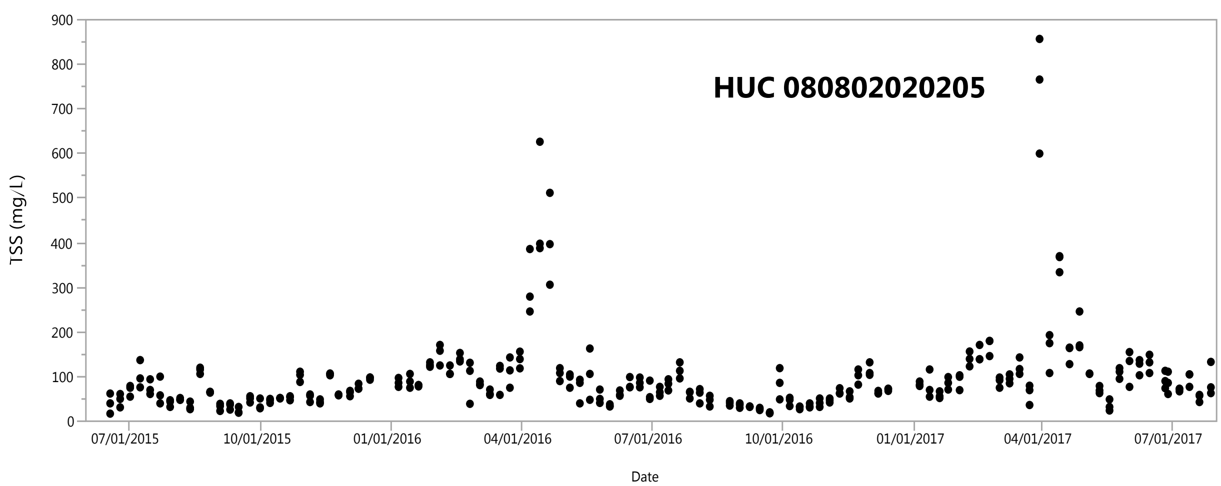

Figure 24 Bayou Chene, HUC 080802020205, TSS concentrations, 2015-2017

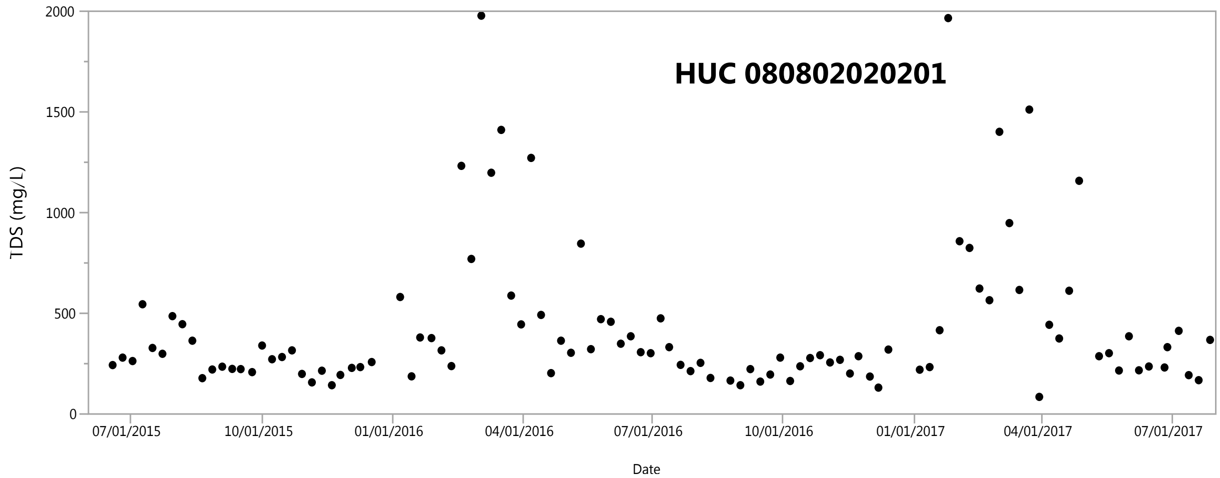

Figure 25 Bayou Chene HUC 080802020201, TDS concentrations, 2015-2017

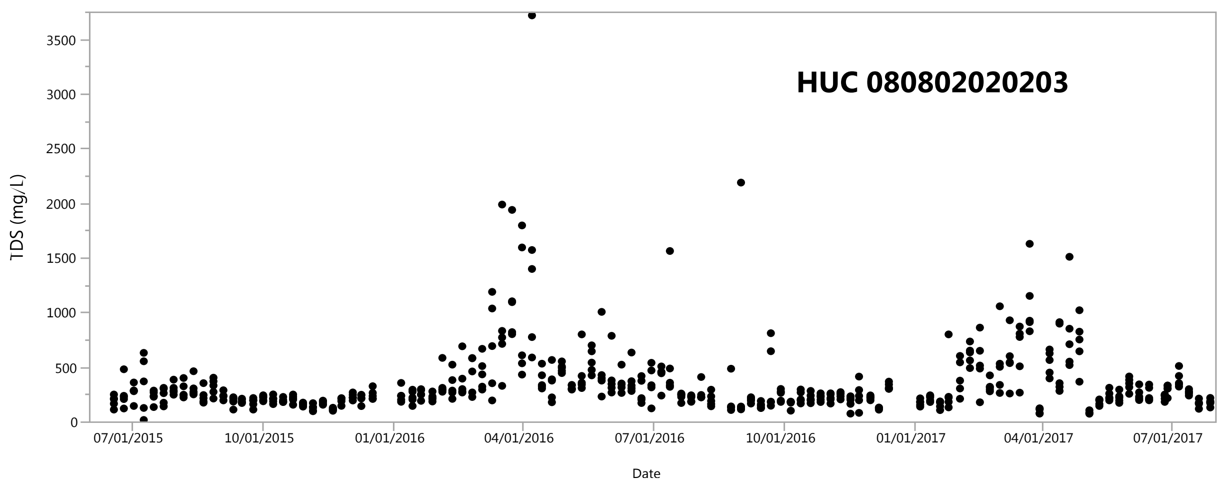

Figure 26 Bayou Chene, HUC 080802020203, TDS concentrations, 2015-2017

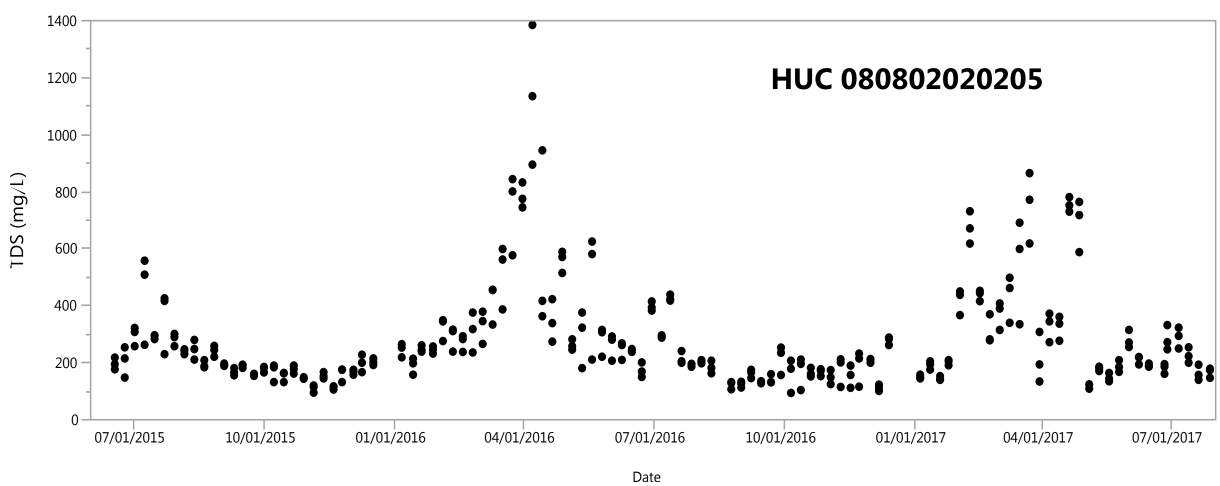

Figure 27 Bayou Chene, HUC 080802020205, TDS concentrations, 2015-2017

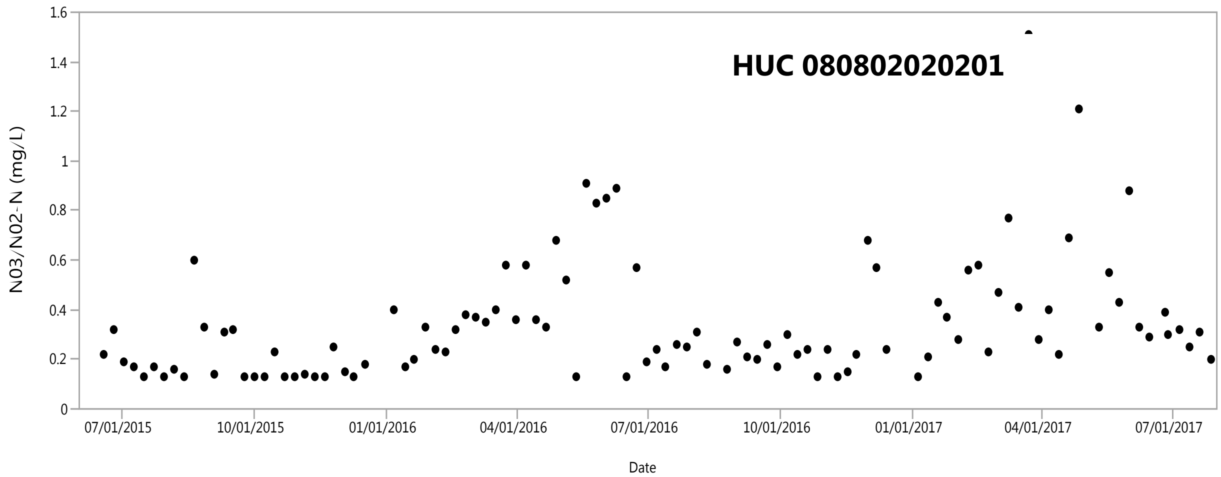

Figure 28 Bayou Chene HUC 080802020201 NO_3/NO^2-N concentrations, 2015-2017

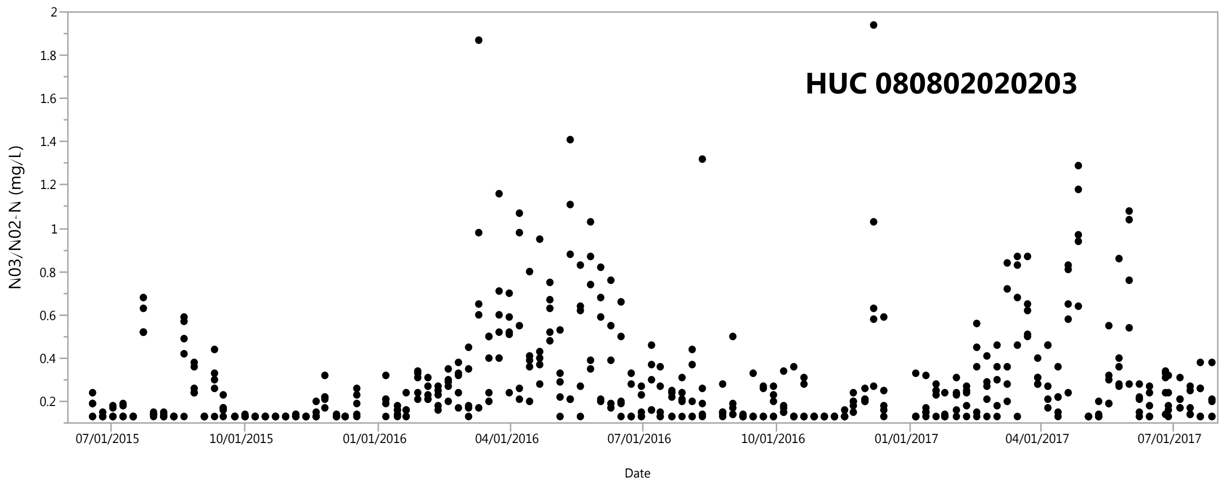

Figure 29 Bayou Chene HUC 080802020203 NO_3/NO^2-N concentrations, 2015-2017

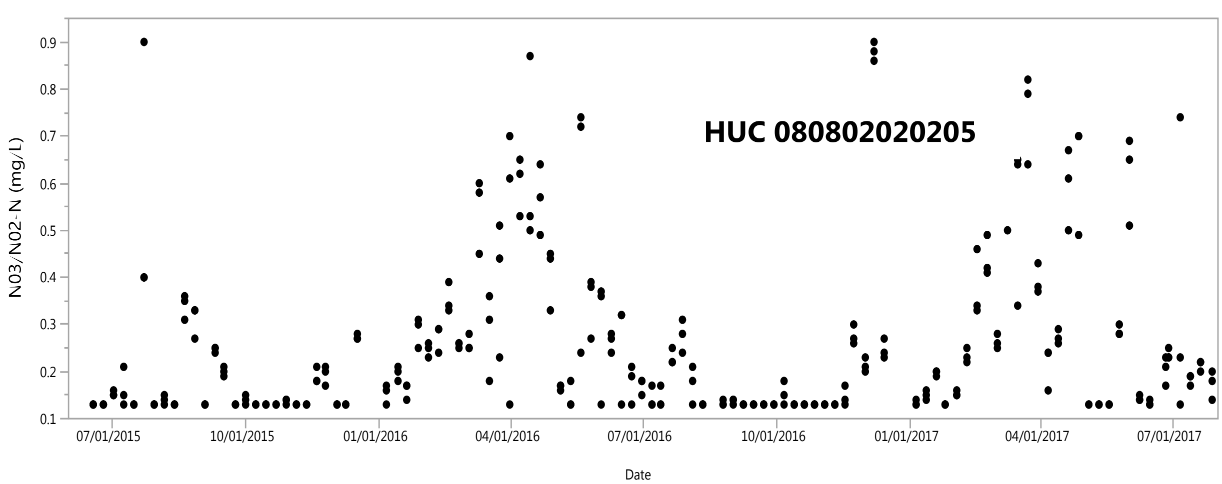

Figure 30 Bayou Chene HUC 080802020205 NO_3/NO^2-N concentrations, 2015-2017

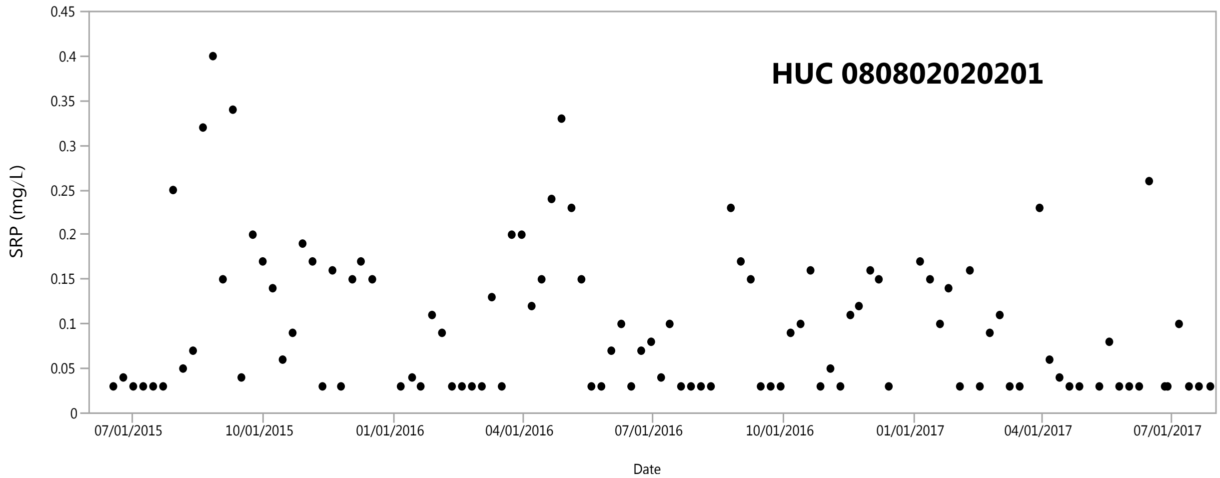

Figure 31 Bayou Chene HUC 080802020201 SRP concentrations, 2015-2017

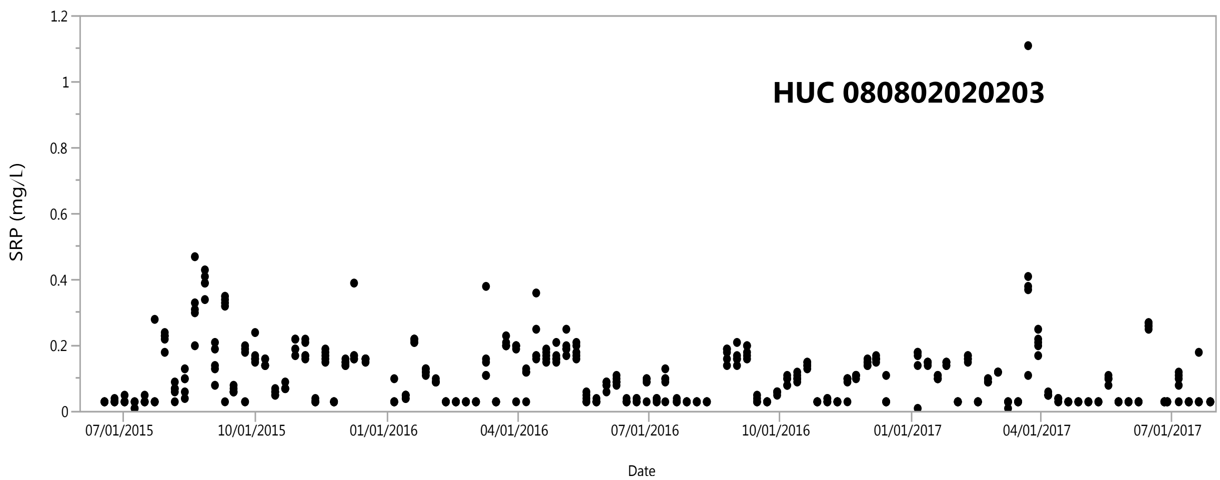

Figure 32 Bayou Chene HUC 080802020203 SRP concentrations, 2015-2017

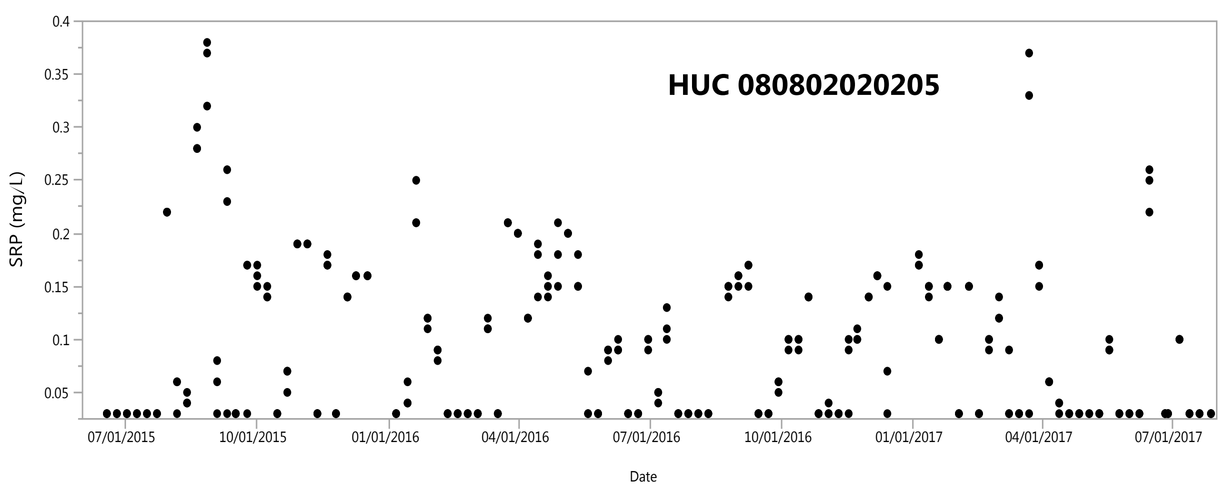

Figure 33 Bayou Chene HUC 080802020205 SRP concentrations, 2015-2017

3.3 Flow Measurements conducted by LDEQ Water Surveys

Flow measurements collected by LDEQ Water Surveys, at site 1C, are presented in Figure 35. Flow measurement techniques included: discharge measurement, using Son Tek RiverCAT from a stationary boat, and discharge measurements collected by a moving boat, using an Acoustic Doppler Current Profiler (ADCP). The Son Tek RiverCAT is most commonly towed from a bridge or attached to a line held by two people on either side of a river. The device collects vertical profiles of water velocity, water depth, vessel velocity, and sequentially calculates discharge in vertical increments from one bank of a river to the other. This is achieved by sending out acoustic pulses and using the Doppler shift to measure 3-D motion. The device is compact, portable, and easy to use, allowing great flexibility in deployment configurations and make the RiverCat especially advantageous for obtaining profiles in remote areas and dangerous waters. Use of the RiverCat eliminates risks associated with personnel working on boats and greatly reduces the time spent making discharge measurements using conventional current meters. The ADCP is commonly used to measure water velocity and discharge in streams as shallow as one foot deep. The development of the ADCP has provided hydrographers and hydrologists with a tool that can substantially reduce the time for making discharge measurements and can measure water velocities at a spatial and temporal scale that was previously unattainable. These instruments are used regularly to measure riverine and estuarine water discharge, to collect data for hydrodynamic model calibration and verification, to assess aquatic habitat, and to study sediment transport processes. Using both instruments, negative or low flow conditions were detected more frequently; however, flow conditions at 1C seem to be improving (Figure 34).

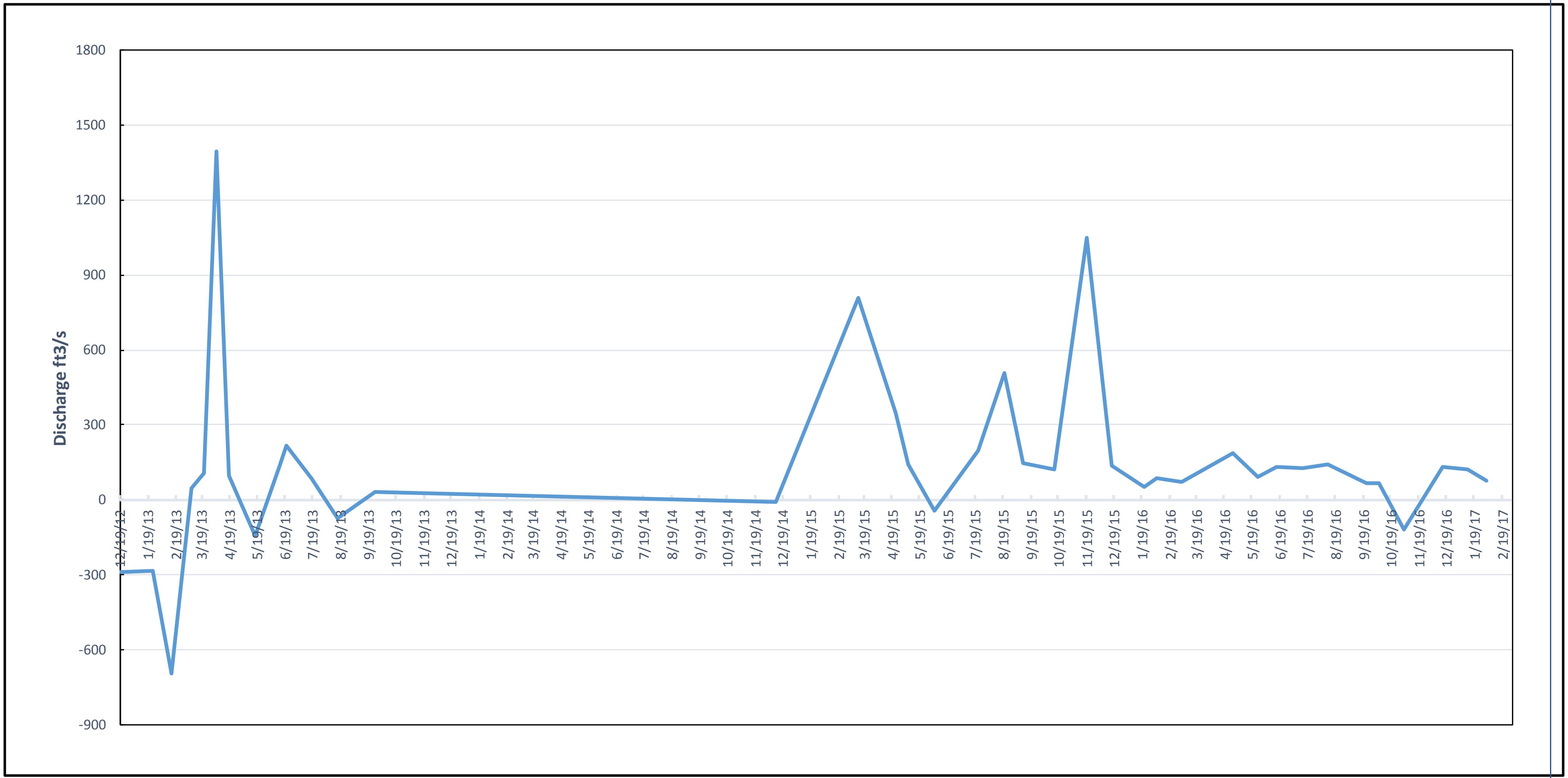

Figure 34 Bayou Chene discharge data collected at site 1C

3.4 Outreach

Education and outreach in Bayou Chene is an important component of watershed restoration, and is the initial step in understanding how to improve water quality in the bayou. When landowners/producers understand the objectives of watershed restoration and benefits to the community, they are more likely to implement and maintain BMPs. Understanding the problem often results in a greater concern and encourages the community to take actions without regulation. Educational program activities are crucial components of watershed protection and water quality improvement. These activities were initiated prior to LDAF BMP implementation, under the MRBI project, and continued throughout this sampling project. Federal funding during this cooperative agreement period in the amount of $16,000 and matching funding in the amount of $2,159 was allotted to host stakeholders' meetings, outreach, and presentation of project findings.

3.4.1 Stakeholder's meetings

ULL hosted stakeholders' meetings, outreach, and presentations of project findings at various regional and national level professional meetings, workshops, and conferences which allowed useful venues for the interpretation of water quality data, data sharing, understanding about the status of BMPs in the watershed, the overall coordination of project activities among various agencies, speaking with and answering questions from citizens during water quality sampling, and engaging students in class projects whenever possible. Three stakeholders' meetings were hosted during the project period. Watershed stakeholders include LDAF, LDEQ NPS, UL stakeholders group, LDEQ Water Surveys, USDA-NRCS, Jefferson Davis SWCD, university students, community leaders, interested citizens, university professors, government, and state employees.

On September 17, 2015 the first stakeholder's meeting was held in Jennings, Louisiana (Figure 36, Figure 37). Thirty participants who attended the meeting represented various agencies and institutions including Jeff Davis SWCD, UL Lafayette, LSU AgCenter, LDAF, LDEQ, USAD-NRCS, and farming communities. Various presentations included background and a path forward for the NPS Program (Gwen Berthelot, LDEQ), The Mississippi River Basin Initiative (MRBI) Watershed Water Quality Monitoring in Bayou Chene and Lacassine Bayou, and Water Quality Sampling in Bayou Chene Project (Durga D. Poudel, UL Lafayette), BMP implementation in Bayou Chene watershed, past and present 319 projects (Nikki McGee, Jefferson Davis SWCD), Conservation practices in rice production (Dan Didier, USDA-NRCS), The Louisiana Conservation Partnerships (Joey Breaux, LDAF/Office of Soil and Water Conservation), and Use of Circular Irrigation in controlling Nonpoint Source Pollution and Nutrient Management (Ernest Girouard, LSU AgCenter). Stakeholder's group discussions included MRBI activities, BMP implementation, and NPS pollution issues.

On July 14, 2016 the second stakeholder's meeting was held in Jennings, Louisiana (Figure 38 and Figure 39). Twenty participants attended the meeting, representing various agencies and institutions including, Jeff Davis SWCD, UL Lafayette, LSU AgCenter, LDAF, LDEQ, USDA-NRCS, and farming communities. Presentations and speakers included the NPS program (Rhyshima Parms-Green, LDEQ), 319 Project Implementation Update (Faran Dietz, LDAF/Office of Soil and

Water Conservation), Water Quality Best Management Practices/Nutrient Management – Precision Agriculture (Chris Coreil, USDA-NRCS), and Giant Salvinia Management in Louisiana: Current state and future outlook (Lori Moshman, Graduate Assistant, and LSU Department of Entomology). Stakeholder's group discussion on NPS pollution, MRBI, and BMPs implementation in Bayou Chene session was moderated by Nikki McGee, Jefferson Davis SWCD. In addition to other NPS pollution issues, elevated TSS concentrations in the bayou were pinpointed to upwelling. There was a high interest among the farmers to sign up for cost-share programs and other conservation practices. Tail water recovery in crawfish production, drainage water management and land leveling were other topics discussed.

The last stakeholder meeting was conducted on June 29, 2017 in Jennings, Louisiana (Figure 40, Figure 41). Twenty eight participants attended the meeting representing various agencies and institutions including Jeff Davis SWCD, UL Lafayette, LSU AgCenter, LSU Callegari Lab, LDAF, USDA-NRCS, and farming communities. Various presentations and the speakers in the meeting included Water Quality Sampling in Bayou Chene (Durga D Poudel, UL Lafayette), Mid-Autumn to Mid-Spring Turbidity Values in Bayou Chene (Natalie Morrel and Jacob Cohn, UL students), Rice Soil Health Update (Chris Coreil, Agronomist, NRCS), 319 project implementation update (Nikki McGee, Jefferson Davis SWCD), and The Louisiana Conservation Partnerships/future of 319 projects (Faran Dietz, LDAF/Office of Soil and Water Conservation). Stakeholder's group discussion rallied around NPS pollution and BMP implementation. In addition, NPS pollution issues discussed included water leveling, mud-rutting, spring flooding and drainage requirements, gravel roads contributing to sediment pollution, cover crops, data interpretation and sharing, giant salvinia, and recycling of irrigation water to improve water quality in the bayou.

Figure 35 September 17, 2015, first Bayou Chene stakeholder's meeting, Jennings, Louisiana

Figure 36 September 17, 2015, Joey Breaux presenting at first Bayou Chene stakeholder's meeting, Jennings, Louisiana


Figure 37 Rhyshima Parms-Green presenting at Bayou Chene's second stakeholder's meeting, July 14, 2016, Jennings, Louisiana


Figure 38 Dr. Durga Poudel presenting at Bayou Chene's second stakeholder's meeting, July 14, 2016, Jennings, Louisiana

Figure 39 June 29, 2017, Bayou Chene's third stakeholders meeting, Jennings, Louisiana

Figure 40 Bayou Chene third stakeholder's meeting, June 29, 2017, Jennings, Louisiana

3.4.2 Scientific Presentations

A poster titled "Water Quality Sampling and Assessment for Bayou Chene in Louisiana, USA" was presented at the 71st Soil and Water Conservation Society Annual Conference July 24- 27, 2016, Louisville, Kentucky. Another poster titled "Elevated Spring Turbidity Values in Bayou Chene, Louisiana: Causes and Consequences" was presented at the 72nd Soil and Water Conservation Society Annual Conference July 30- August 2, 2017, Madison, Wisconsin. An oral presentation was conducted at ASA-CSSA-SSSA Annual Meeting, Nov. 6-9, 2016, Phoenix, AZ. The title of the presentation was "Water Quality Sampling and Assessment in a Coastal Agricultural Watershed in Louisiana, USA." These presentations were very helpful in terms of sharing data collected during the Bayou Chene project term with the scientific communities. In addition, valuable insight was gained in regards to data interpretation.

4.0 The Great Flood of 2016, and its impact in the Bayou Chene Watershed

From August 12-22, 2016, prolonged rainfall in southern Louisiana resulted in catastrophic flooding that submerged thousands of houses and businesses. Though sampling was conducted before the flood on August 11th, sampling was canceled on August 18th due to interstate 10 closure and unsafe driving conditions. On August 25th, sampling was conducted after Jefferson Davis SWCD reported a detailed site safety assessment. Though ULL employees were able to conduct sampling at all nine of the project sites, the roads leading to sites 6C and 8C were flooded, yet passable. Roadside ditches and coulees were filled to capacity, causing water to overflow across the roads and into areas where water was not normally present. Extreme flooding was observed in nearly every agricultural field and personal residence. The actual water level at each sampling site was higher than it had been in project history, and was close to approaching the tops of several bridges. Debris such as trees, refrigerators, televisions, ice chests, and other waste was observed steadily flowing downstream. Figures 42-46 show flooded fields and roads in the watershed from heavy rainfall throughout the area between August 12, 2016 and August 22, 2016. Water in the sampling site areas was murky to slightly clear, as opposed to the usual gray color, due to the amount of water flow. The smell of the water was described as a mix of decomposing marsh vegetation, sewage, and petrochemicals. It is interesting to note that the DO levels on August 25th were much lower than on August 11th, for all sites (Table 5). It is possible that the cause of low DO readings on August 25th was due to the higher surface water temperature. On September 1st, water levels at the sampling sites, as well as the surrounding areas, had begun to slowly subside. The pungency of the water had somewhat diminished, and the DO concentrations had begun to slowly increase, as surface water temperatures dropped almost to the pre-flood levels.

Table 5 Average temperature, conductivity, DO, turbidity, TSS, TDS, TS, NO_3/NO_2-N, Cl, Fl, SO4, SRP, TP, TKN, and BOD_5 values for nine water quality sampling sites in Bayou Chene watershed before, during, and after 2016 Louisiana Great Flooding.

Date	Site	Temp (oC)	Cond (uS/cm)	DO (mg/l)	pH	Turb. (NTU)	TSS (mg/L)	TDS (mg/L)	TS (mg/L)	NO3/NO2-N (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	SRP (mg/L)	TP (mg/L)	TKN (mg/L)	BOD-5 (mg/L)
8/11/2016	10C	27.93	284.00	1.13	6.91	195.10	116.00	236.00	364.00	0.19	8.48	0.04	6.76	0.03	0.44	1.85	4.46
8/11/2016	1C	29.17	271.00	3.30	6.90	64.30	33.00	163.00	256.00	0.13	21.78	0.23	2.38	0.03	0.37	2.80	6.96
8/11/2016	2C	27.60	171.00	2.03	6.91	135.50	45.00	166.00	286.00	0.26	27.10	0.29	2.75	0.03	0.37	2.45	11.16
8/11/2016	3C	29.35	443.00	0.45	7.09	89.30	49.00	297.00	414.00	0.14	26.97	0.30	3.12	0.03	0.36	2.53	4.32
8/11/2016	4C	27.89	315.00	4.15	7.14	117.70	110.00	179.00	345.00	0.18	42.92	0.21	1.00	0.03	0.27	1.18	3.52
8/11/2016	5C	29.29	261.00	0.26	6.95	103.50	48.00	207.00	284.00	0.13	48.16	0.66	0.87	0.03	0.43	3.77	8.31
8/11/2016	6C	29.23	268.00	1.65	6.98	95.40	57.00	182.00	271.00	0.13	29.72	0.26	4.21	0.03	0.34	2.45	3.74
8/11/2016	8C	28.19	243.00	0.53	6.99	111.90	62.00	194.00	299.00	0.13	28.26	0.30	2.87	0.03	0.23	1.87	2.92
8/11/2016	9C	26.11	100.00	5.33	6.77	182.00	134.00	145.00	320.00	1.32	34.26	0.29	3.14	0.03	0.50	1.95	6.12
AVERAGE		**28.31**	**261.78**	**2.09**	**6.96**	**121.63**	**72.67**	**196.56**	**315.44**	**0.29**	**29.74**	**0.29**	**3.01**	**0.03**	**0.37**	**2.32**	**5.72**
8/25/2016	10C	28.78	129.00	1.28	6.64	104.30	98.00	144.00	224.00	0.15	11.08	0.20	2.67	0.16	0.80	7.25	
8/25/2016	1C	30.27	116.00	0.20	6.41	50.10	35.00	107.00	129.00	0.13	5.62	0.38	0.33	0.14	0.36	1.71	
8/25/2016	2C	29.62	150.00	0.44	6.57	48.80	30.00	137.00	163.00	0.14	6.35	0.14	1.20	0.15	0.40	1.40	4.70
8/25/2016	3C	29.08	123.00	0.51	6.53	100.40	68.00	136.00	204.00	0.13	6.55	0.16	0.73	0.14	0.38	2.10	
8/25/2016	4C	27.94	134.00	3.28	6.65	157.80	133.00	166.00	305.00	0.16	10.25	0.24	4.37	0.23	0.48	2.18	
8/25/2016	5C	30.00	128.00	0.20	6.45	70.90	41.00	132.00	173.00	0.14	7.30	0.14	1.30	0.18	0.42	2.24	
8/25/2016	6C	29.91	129.00	0.26	6.48	73.90	45.00	129.00	180.00	0.15	11.41	0.23	1.47	0.19	0.41	2.25	7.68
8/25/2016	8C	29.48	114.00	0.33	6.36	58.10	37.00	111.00	147.00	0.13	6.05	0.15	0.68	0.15	0.32	1.24	
8/25/2016	9C	27.92	172.00	1.76	6.65	679.30	455.00	489.00	950.00	0.28	8.83	0.19	2.32	0.19	0.38	1.90	
AVERAGE		**29.22**	**132.78**	**0.92**	**6.53**	**149.29**	**104.67**	**172.33**	**275.00**	**0.16**	**8.16**	**0.20**	**1.67**	**0.17**	**0.44**	**2.47**	**6.19**
9/1/2016	10C	28.52	132.00	1.81	6.68	92.20	91.00	117.00	204.00	0.17	5.08	0.23	5.67	0.14	1.67	8.20	4.21
9/1/2016	1C	28.63	124.00	3.10	6.47	50.20	30.00	113.00	128.00	0.14	7.98	0.18	0.79	0.21	0.29	1.96	4.84
9/1/2016	2C	28.76	133.00	1.14	6.60	78.70	32.00	136.00	154.00	0.14	8.16	0.18	1.47	0.16	0.32	1.75	4.73
9/1/2016	3C	28.94	147.00	1.07	6.62	51.40	33.00	143.00	154.00	0.13	7.81	0.19	1.52	0.16	0.31	1.87	4.39
9/1/2016	4C	28.97	143.00	3.78	6.74	106.80	89.00	143.00	220.00	0.27	8.64	0.24	2.42	0.17	0.36	1.77	3.96
9/1/2016	5C	28.60	128.00	0.46	6.50	73.20	40.00	127.00	167.00	0.14	7.55	0.20	0.86	0.17	0.30	1.63	3.67
9/1/2016	6C	28.77	129.00	0.43	6.55	66.20	37.00	133.00	160.00	0.17	9.79	0.22	2.48	0.16	0.27	1.63	4.11
9/1/2016	8C	28.68	134.00	2.73	6.67	41.00	27.00	122.00	139.00	0.14	6.91	0.18	1.11	0.15	0.30	1.61	5.61
9/1/2016	9C	27.56	87.00	4.69	6.51	1340.70	551.93	2192.00	2550.00	0.52	8.47	0.34	2.57	0.16	0.33	1.83	2.87
AVERAGE		**28.60**	**128.56**	**2.13**	**6.59**	**211.16**	**103.44**	**358.44**	**430.67**	**0.20**	**7.82**	**0.22**	**2.10**	**0.16**	**0.46**	**2.47**	**4.27**

Figure 41 Extremely high water levels in Bayou Chene, overflowing onto surrounding land at Site 1C at HWY 99 on August 23, 2017, in Bayou Chene

Figure 42 Flood roads, ditches, and fields, in Bayou Chene, site 1C, on August 23, 2017, due to heavy rainfall and drainages that are backed-up.

Figure 43 On August 23, 2017, overflow from nearby Bayou Chene, caused flooding in fields and ditches, due to extensive rainfall and filled drainage areas, near site 5C at HWY 382W-SArtemond

Figure 44 Bayou Chene overflowing onto surrounding land and over Mouton Road, at site 6C, on August 23, 2017

Figure 45 Bayou Chene overflowing onto surrounding agricultural fields at Site 5C at HWY 382 on August 23, 2017, in Bayou Chene watershed.

5.0 Implementation of BMPs, by LDAF, during the Bayou Chene sampling period, 2015-2017

Major BMPs implemented in the Bayou Chene watershed during the duration of the project in HUC 080802020201, include conservation crop rotation, irrigation land leveling, residue management, nutrient management, no-till, irrigation pipeline, shallow water development and management, dry seeding, precision agriculture, and integrated pet management. Conservation crop rotation, irrigation land leveling, and residue management constituted major BMPs implemented in HUC 080802020201. Major BMPs implemented in HUC 080802020205, included conservation crop rotation, irrigation land leveling, residue management, nutrient management, dry seeding and integrated pest management. BMPs in HUC implemented in 080802020203 included irrigation land leveling, fencing, seasonal high tunnel system for crops, and shallow water development and management. Table 6 shows BMPs implemented in Bayou Chene watershed from January 2015 to April 2017.

The number of BMP's implemented in the watershed increases each year, and the number of exceedances at WQN site 0658 has fluctuated through the years; therefore, improvements in water quality after implementation may take time. The goal of implementing additional BMPS would be to only target those that will reduce FC loads and increase DO concentrations in Bayou Chene, with the aim of restoring designated use support for FWP and PCR. Currently, on-site disposal systems (OSDS) education and outreach is being conducted in rural residential areas to inform homeowners of proper operation and maintenance of their systems. Additionally, LDAF will be implementing livestock waste management BMPs to reduce FC loads from agricultural sources. Mercury, though an impairment, will not be addressed through NPS funding. With continued implementation within the critical areas, projected watershed restoration for FWP and PCR is estimated for 2027.

Table 6 Implementation of best management practices from January 2015 through April 2017, in the Bayou Chene watershed

HUC-12	Practice code	Practice name	Measure-ment unit	Applied amount through NRCS programs	Applied amount through 319 program	Total applied amount
080802020201	328	Conservation crop rotation	acre	1959.4		1959.4
	410	Grade stabilization structure	number	4	3	7
	464	Irrigation land leveling	acre	805.4	708.5	1513.9
	430	Irrigation pipeline	ft	5190		5190
	590	Nutrient management	acre	51.1		51.1
	344	Residue management seasonal	acre	1069.6		1069.6
	798	Seasonal high tunnel system for crops	sq ft	4938		4938
	646	Shallow water development and management	acre	1152		1152
	645	Upland wildlife habitat management	acre	36.8		36.8
	351	Well decommissioning	number	2		2
080802020203	382	Fence	ft	920		920
	410	Grade stabilization structure	number	1		1
	464	Irrigation land leveling	acre	91.8	197.3	289.1
	528	Prescribed grazing	acre	17.5		17.5
	798	Seasonal high tunnel system for crops	sq ft	2880		2880
	646	Shallow water development and management	acre	118.5		118.5
	642	Water well	number	1		1
080802020205	410	Grade stabilization structure	number	3	5	8
	464	Irrigation land leveling	acre	99.7	1545.1	1644.8
	590	Nutrient management	acre	202.2	144	346.2
	329	Residue and tillage management, no-till	acre	435.4		435.4
	646	Shallow water development and management	acre	994.7		994.7
	645	Upland wildlife habitat management	acre	416		416
	328	Conservation crop rotation	acre		952.4	952.4
	344	Residue management seasonal	acre		466.2	466.2
	449	Irrigation water management	acre		75.2	75.2
	DS	Dry seeding	acre		262.1	262.1
	590PA	Nutrient management precision agriculture	acre		193.3	193.3
	595	Integrated pest management	acre		648.7	648.7

6.0 Reporting

The Contractor has communicated with LDEQ-NPS on all aspects of the project during the course of the contract term. Reports, invoices, and deliverables were submitted according to the contract and schedule.

6.1 Quarterly Monitoring Reports

Quarterly monitoring reports were submitted to LDEQ-NPS, by an ULL employee, and included documentation of all project activities, field observations and results. The analysis and interpretation of project results were submitted via electronic deliverable. Draft monitoring reports were submitted on time. Federal funding allotted to this task was in the amount of $3,517.00, and matching funding was allotted in the amount of $5,727.00.

6.2 Annual Reports

An annual report was submitted to LDEQ-NPS, documenting project activities, for the time period covering June 15, 2015 through September 30, 2016. The report included photographs and data analysis. The annual report was submitted on time. In lieu of an annual report being submitted for the period of October 1, 2016 through September 30, 2017, the final report was submitted instead. Federal funding allotted to this task was in the amount of $3,517.00, and matching funding was allotted in the amount of $5,727.00.

6.3 Final Report

The contractor has drafted and submitted a draft final report that provides a thorough account of all project related activities, a summary table itemizing all services performed during the project, maps, and applicable photographs. In addition, an analysis of water quality data collected during the project period, BMP implementation performed by LDAF, from 2015-2017, and critical areas for additional BMPs needed. The draft final report was submitted on time. Federal funding allotted to this task was in the amount of $19,018 and matching funding was allotted in the amount of $6,112.00.

7.0 Conclusions

Bayou Chene fully meets water quality criteria for SCR; however, the waterbody does not meet its criteria for PCR and FWP due to increased concentrations of fecal coliform, and low concentrations of DO. The state's 2016 IR identified suspected sources of impairment as agriculture, drought-related impacts, runoff from forest/grass/and/parkland, and rural (residential areas). Potential long-term effects of runoff from agricultural pollutants include high concentrations of nitrogen, phosphorus, sediments, turbidity, and pesticides entering the watershed and decreasing DO concentrations.

The goal of continuing to document water quality changes following BMP implementation by LDAF, to reduce nutrient loading into the Bayou Chene watershed, was completed. Water quality data was collected from June 2015 through July 2017. Working collaboratively with LDAF, LDEQ Water Surveys, W.A. Callegari Environmental Center, LSU AgCenter, and ULL, LDEQ-NPS, was able to work towards meeting the objectives of the project, which were:

1) *To collect data on field parameters and water chemistry on a weekly basis for the duration of the project* in Bayou Chene. This task has been completed. Water quality data was collected at nine monitoring sites, on a weekly basis, for insitu parameters, which included pH, temperature, DO/percent saturation, and conductivity/salinity. Water quality parameters included NO_3^-/NO_2^-, TKN, TP, TS, TSS, TDS, BOD_5, turbidity, sulfate, chloride, phosphate, and fluoride. Water quality data collected was used to by ULL and LDEQ-NPS to determine where the highest concentrations of nutrients occur. By continuing to sample the sites on a consistent basis, this data may be used for water quality assessment, and has been shared with stakeholders in the watershed on a quarterly basis.

2) *To collect flow data at site 1C (0658), with the help of the LDEQ Water Surveys group.* This task has been completed.

The measurable results of the project included:

1) *Development of a Quality Assurance Project Plan (QAPP) for water quality sampling in the Bayou Chene watershed;*
2) *Water quality data collection and compilation in conformance with QAPP/SP protocols; and*
3) *Providing dataset to LDEQ for storing in LDEQ's database and uploading it into the United States Environmental Protection Agency's (USEPA's) database STORage and RETrieval (STORET)/ Water Quality eXchange (WQX).*

The monitoring data collected does not indicate that BMPs implemented correlated to extensive positive changes in water quality data. During the Bayou Chene project term, implementation occurred in HUCs 080802020201, 080802020203, and 080802020205, from January 2015 to April 2017. Despite the implementation of BMPs in the watershed, DO, in the bayou, did not improve. 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. Though the number of BMPs implemented in the watershed increases each year, improvements in water quality after implementation may take time.

Highly elevated sediments and turbidity values were observed during the months of February, March and April, even before the crop growing season starts. Winter rain events and subsequent runoff from the landscape as well as winter land management activities such as water-levelling and mud rutting appear to have been associated with the elevated spring turbidity concentrations. Additional investigation is necessary to confirm water-levelling and mud-rutting practices are causing increased winter/spring sediment loads and turbidity in the waterways. The upstream section of the bayou is in need of special consideration for future BMP implementation, as most elevated sediments and nutrient concentrations and turbidity values were observed at site 4C, the uppermost sampling site of the project.

In addition, DO critical areas were based on sampling year 2016, project DO exceedance rates at each sampling site. The highest priority ranking (#1) for future implementation was assigned to the sites with the highest exceedance rate, 84 percent (sites 1C and 6C). The lowest priority (#8) was given to the site with the lowest exceedance rate, 44 percent (site 4C). Site 1C is the ambient site, which is where subsegments are listed and restored. Future implementation should begin around the ambient site and above site 6C in hopes of restoring the ambient site expeditiously

Beginning August 2017, LDEQ Water Surveys began monitoring water quality data in Bayou Chene at the same nine locations, in place of ULL. Water quality sampling has been conducted twice a month; however, beginning with revision two approval of the Bayou Chene Water Quality Sampling Plan, sampling will only be conducted once a month for the remainder of the project term. Flow will continue to be collected once a month. In addition to *in- situ* parameters, the following will be sampled: nitrate-nitrite, TKN, TP, turbidity, and fecal coliform. TSS and TS do not have criteria; therefore, these parameters will not be sampled. TDS does have criteria; however, the watershed is not impaired and therefore will not be sampled. Long-term sampling will end in 2022and post BMP monitoring will be collected from 2022 through 2023. At this time, ambient data for FC is available to be utilized to pinpoint critical areas for FC related implementation. The data collected during this project will be used to evaluate water quality changes in the watershed. LDEQ-NPS will share all data with its stakeholders on a quarterly basis. Current water quality results have been stored in LDEQs water quality database, Environmental Quality Information System (EQUIS), and also EPA's water quality database, Storage and Retrieval Data Warehouse (STORET)/ Water Quality eXchange (WQX). LDEQ-NPS will continue to coordinate with LDAF and LDEQ Water Surveys, to select sampling points to gauge changes in water quality during watershed implementation in the three HUCs of focus.

Project deliverables received during the project included:

1) *LDEQ QAPP/SP Review:* ULL reviewed and provided comments for the draft and final LDEQ QAPP/SP, which was subsequently submitted to USEPA for approval. Once the LDEQ QAPP/SP was USEPA approved, LDEQ provided a digital copy of the document to ULL.
2) *LDEQ QAPP/SP Reviews and Revisions: ULL provided* a draft and final LDEQ QAPP/SP to LDEQ for review and comments. LDEQ subsequently reviewed and provided a draft and final LDEQ QAPP/SP to USEPA for approval. Once the revised LDEQ QAPP/SP was USEPA approved, LDEQ provided a digital copy of the document to ULL.
3) *Water Quality Sampling:* Electronic files of all data collected, photo documentation of sampling events, and copies of results of sampling analysis, were delivered to LDEQ-NPS.
4) *Outreach*: ULL submitted stakeholders meeting reports, pictures, and PowerPoint slides as evidence of meetings, workshops, and conferences held and/or attended.
5) *Reporting:* Quarterly monitoring reports included narrative documentation of all project activities detailing progress, along with applicable deliverables, problems and/or issues, and Invoices equipment purchased were submitted to LDEQ-NPS during the course of the project. The annual report dated 06/15/15 through September 30, 2016, documented the results of project accomplishments during that FFY, and included an analysis of results. The final report was submitted to LDEQ-NPS on September 19, 2017. The report included an analysis of data collected and a discussion of results and findings.

Table 7 illustrates Bayou Chene's tasks and descriptions, federal and match funding, including contract and cumulative amounts, project schedule, and percent complete, for each task.

Table 7 Bayou Chene's tasks and descriptions, federal and match funding amounts, schedule, and percent complete for each task

		Contract Amount		Cumulative				
Task	**Task Description**	**Federal ($)**	**ULL Match ($)**	**Federal Funds invoiced**	**Match Reported**	**Schedule**	**Task Completed?**	**% complete**
1.1	QAPP/SP Development	$1,000	$0	$1,000	$0	As outlined in Task 1.1	Yes	100
1.2	QAPP/SP Reviews & Revisions	$500	$0			As outlined in Task 1.2		
2.1	Conduct targeted water quality sampling	$464,112.00	$320,113.00	$431,099.42	$297,308.14	Commence after EPA approves LDEQ QAPP/SP and complete by July 31, 2017	no	92.88
2.2	Outreach	$16,000.00	$2,159.00	$8,192.72	$1,104.98	As outlined in Task 2.2	no	51.18
3.1	Quarterly Monitoring Reports	$3,517.00	$5,727.00	$3,517.00	$5,727.00	As outlined in Task 3.1	yes	100
3.2	Annual Reports	$3,517.00	$5,727.00	$3,517.00	$5,727.00	As outlined in Task 3.2	yes	100
3.3	Final Reports	$19,018.00	$6,112.00	$19,018.00	*$6,112.00*	September 30, 2017	*yes*	*100*
Total		**$507,664.00**	**$339,838.00**	**$466,344.14**	**$315,979.12**			

8.0 Acknowledgements

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9.0 References

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