Mission and Aransas TMDL Effectiveness Monitoring

Texas Water Resources Institute TR-527
August 2020

Texas Water Resources Institute
make every drop count

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TCEQ Contract Number 582-18-80208

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August 2020

PREPARED IN COOPERATION WITH THE
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND
U.S. ENVIRONMENTAL PROTECTION AGENCY

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement (99614622) to Texas Commission on Environmental Quality. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

Cover photo: Aransas River by Ennis Rios, Texas Water Resources Institute.

Contents

Abbreviations

AU	Assessment Unit
BMP	Best Management Practice
DO	Dissolved Oxygen
E. coli	*Escherichia coli*
I-Plan	Implementation Plan
L	Liter
mg	Milligram
mL	Milliliter
MPN	Most Probable Number
N	Nitrogen
NNN	Nitrate-Nitrite Nitrogen
P	Phosphorus
QAPP	Quality Assurance Project Plan
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TWRI	Texas Water Resources Institute
WWTF	Wastewater Treatment Facility

List of Figures

List of Tables

Introduction

The Mission and Aransas rivers, located adjacent to each other on the Texas Gulf Coast, are each comprised of above-tidal and tidal segments; the former consisting of freshwater streams and the latter influenced by seawater from the Mission and Copano bays (Figure 1).

Water quality monitoring data had indicated that the tidal sections of the Mission and Aransas rivers did not meet water quality standards for recreation due to elevated levels of *Enterococci* above the water quality standard of 35 Most Probable Number (MPN) per 100 milliliters (mL) of water (TCEQ 2016). The tidal segments of the Mission and Aransas rivers were first classified as impaired in the *2004 Texas Water Quality Inventory and 303(d) List* (TCEQ 2005). Due to these impairments, a Total Maximum Daily Load (TMDL) Implementation Plan (I-Plan) was developed to address pollutants in the Mission and Aransas rivers' watersheds (TCEQ 2016; TWRI 2019).

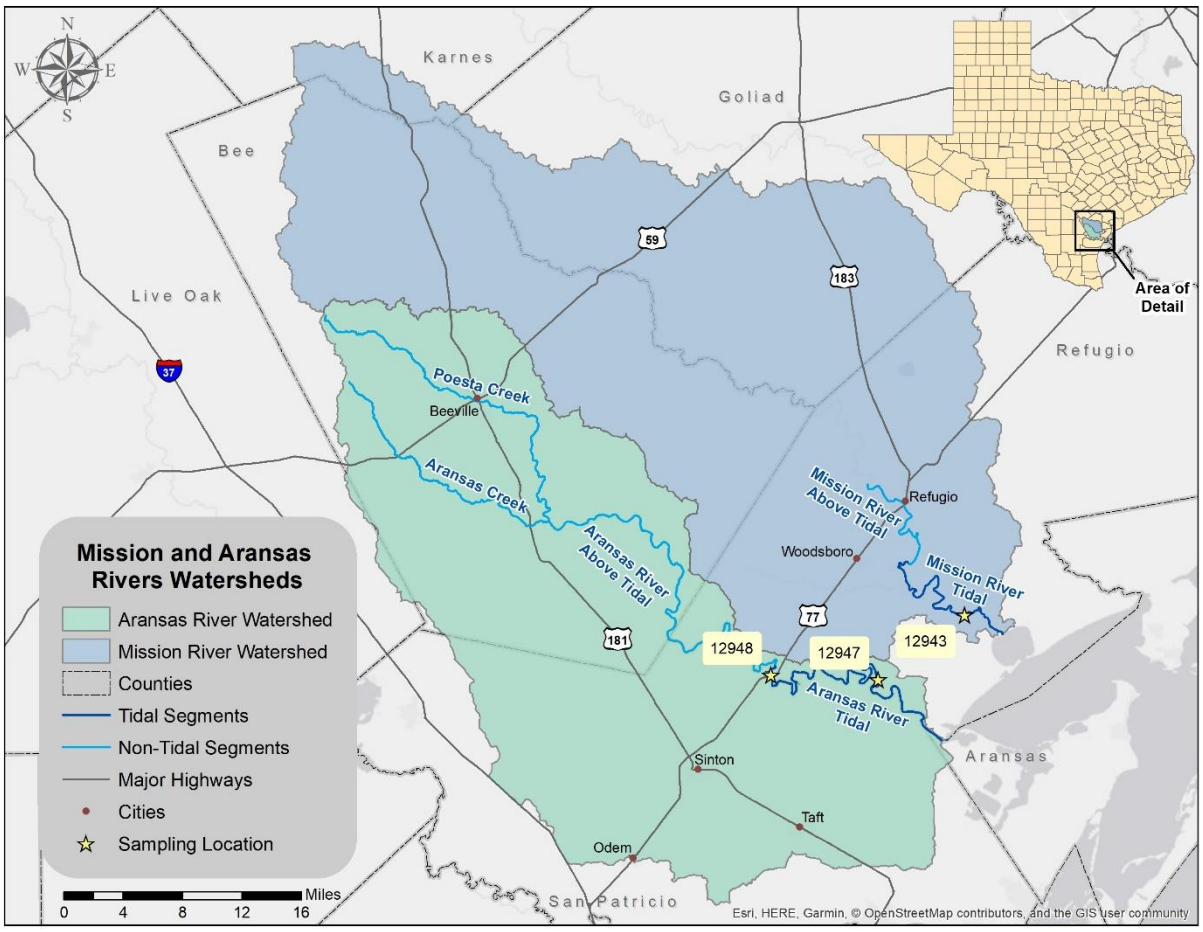

Figure 1. Overview of the Mission and Aransas rivers' watersheds.

Water Quality

Bacteria

Concentrations of fecal indicator bacteria are evaluated to assess the risk of illness during contact recreation. In freshwater environments, concentrations of *Escherichia coli* (*E. coli)* bacteria are measured to evaluate the presence of fecal contamination in water bodies from warm-blooded animals and other sources. In marine-influenced environments, *Enterococci* are measured due to higher survival rates in saltwater environments. The presence of these fecal indicator bacteria may indicate that associated pathogens from the intestinal tracts of warm-blooded animals could be reaching water bodies and can cause illness in people that recreate in them. Indicator bacteria can originate from numerous sources including wildlife, domestic livestock, pets, malfunctioning on-site sewage facilities, urban and agricultural runoff, sanitary sewer overflows and direct discharges from wastewater treatment facilities (WWTFs).

Under the primary contact recreation standards, the geometric mean criterion for bacteria is 35 MPN of *Enterococcus* per 100mL in saltwater. According the 2020 Texas Integrated Report (Table 1; TCEQ 2020), the tidal segments of the Mission and Aransas rivers are impaired. This listing is based on the geometric mean value from bacteria samples collected at stations in each assessment unit (AU) between December 2011 and November 2018 (Figure 2).

Table 1. 2020 Texas Integrated Report assessment results for bacteria in the Mission and Aransas rivers' watersheds (TCEQ 2020).

AU	Description	Current Standard	Geomean	Supporting/Not Supporting
2001_01	Mission River Tidal	35 MPN/100mL *Enterococcus*	41.57	Not Supporting
2003_01	Aransas River Tidal	35 MPN/100mL *Enterococcus*	45.20	Not Supporting

most probable number, MPN; milliliter, mL

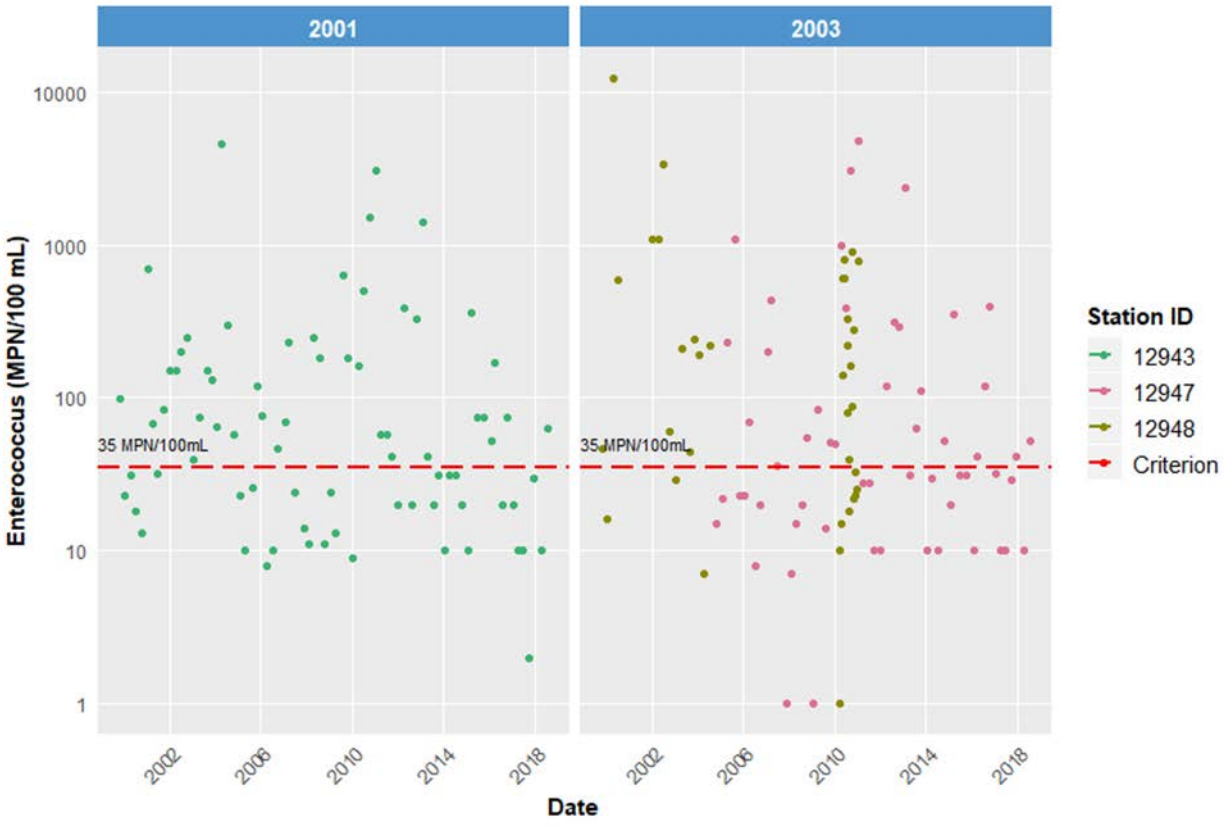

Figure 2. Historical Enterococcus *concentrations at impaired tidal Segments 2001 and 2003.*

Nutrients

Nutrients, specifically nitrogen and phosphorous, are used by aquatic plants and algae to grow. However, excessive nutrients can lead to plant and algal blooms that can result in reduced dissolved oxygen (DO) levels. High levels of nitrates and nitrites can directly impact respiration in fish. Sources of nutrients can include fertilizers that run off from yards and agricultural fields in addition to effluent from WWTFs. Nutrients also bind to soil and sediment particles. Therefore, runoff and erosion events that result in heavy loads of sediment can increase nutrient levels in water bodies as well. Currently, the Texas Commission on Environmental Quality (TCEQ) does not have approved numeric criteria for these nutrients in water bodies. Screening levels provided by TCEQ are used as a preliminary indication of possible concerns. The current nitrate screening level in freshwater streams for nitrate is 1.95 milligram (mg)/liter (L) and 0.69 mg/L for total phosphorous. The 2014 Integrated Report identified screening concerns for nitrate and total phosphorus in the Aransas River Above Tidal.

Project Background

Stakeholder action began in the spring of 2006 with several meetings to discuss water quality in the two watersheds. Based upon an extensive review of the land and water resources, potential sources of bacteria pollution were identified and quantified in the TMDL and I-Plan. These data were integrated into basic load assessment tools to determine the best management practices (BMPs) needed to

address and lower bacteria loads as part of a watershed protection plan that is currently under development (TWRI 2020).

Local involvement was crucial to the development of the I-Plan and throughout the process, stakeholders expressed the want and need for additional water quality monitoring to be conducted. Stakeholders believed a more intensive monitoring schedule (monthly, rather than quarterly) may provide a more robust understanding of water quality issues within the watershed. Because of the wishes of the stakeholders, additional monitoring was included as a standalone management measure in the I-Plan (TWRI 2019). Through this project, the Texas Water Resources Institute (TWRI) collected additional water quality data twice quarterly from October 2018 through May 2020 as a supplement to the once quarterly data collected by the Nueces River Authority.

Supplemental Monitoring

The sample design rationale for the water quality monitoring aspect of the study was based on the intent to collect additional water quality data for the Mission and Aransas watersheds TMDL I-Plan at an enhanced temporal scale through monthly sampling. To accomplish this goal, routine monitoring was employed at three sites (Figure 1) twice per quarter for 14 sampling events. Data were collected following guidance laid out in the project Quality Assurance Project Plan (QAPP). All field personnel participated in a field readiness review to ensure knowledge of, and compliance with, methods outlined within the QAPP. Field data collection was performed regardless of flow conditions and submitted to TCEQ's Surface Water Quality Monitoring Information Systems (SWQMIS) for future water body assessment purposes.

The targeted water quality constituent for all sampling is *Enterococcus* and associated field parameters including pH, DO, specific conductance, turbidity, water temperature, nitrate-nitrite nitrogen (NNN), ammonia nitrogen (Ammonia N), total Kjeldahl nitrogen (TKN), total phosphorous and total suspended solids (TSS). Sampling occurred twice quarterly; the remaining months of the year were sampled by the Nueces River Authority as part of the Clean Rivers Program.

Site Description

Sites 12947 and 12948 are in the Aransas River watershed on the boundary of San Patricio and Refugio counties between the cities of Sinton and Refugio (Figure 1). The watershed is mostly rural/agricultural, with the city of Beeville upstream of both sampling locations. Site 12947 is a tidal site located at a boat ramp near the terminus of FM 629 in Refugio County. Site 12948 is also a tidal site, located on the upstream side of the US Highway 77 Bridge, also in Refugio County.

Site 12943 is located along the Mission River, southeast of the town of Refugio. The watershed is mostly rural/agricultural with the cities of Refugio and Woodsboro upstream. The sampling location is a tidal site located on the south bank of the Mission River, downstream of the FM 2678 Bridge.

Technical Report/Water Quality Results

Bacteria

Since May of 2016, there appears to have been a steady decline in observable bacterial loads in the watershed (Figure 3). Using a rolling 20-sample geomean, it is evident that water quality has been consistently below the 35 MPN/100mL contact recreation standard since about February of 2019 (Figure 3), indicating possible effectives of TMDL implementation within the watershed.

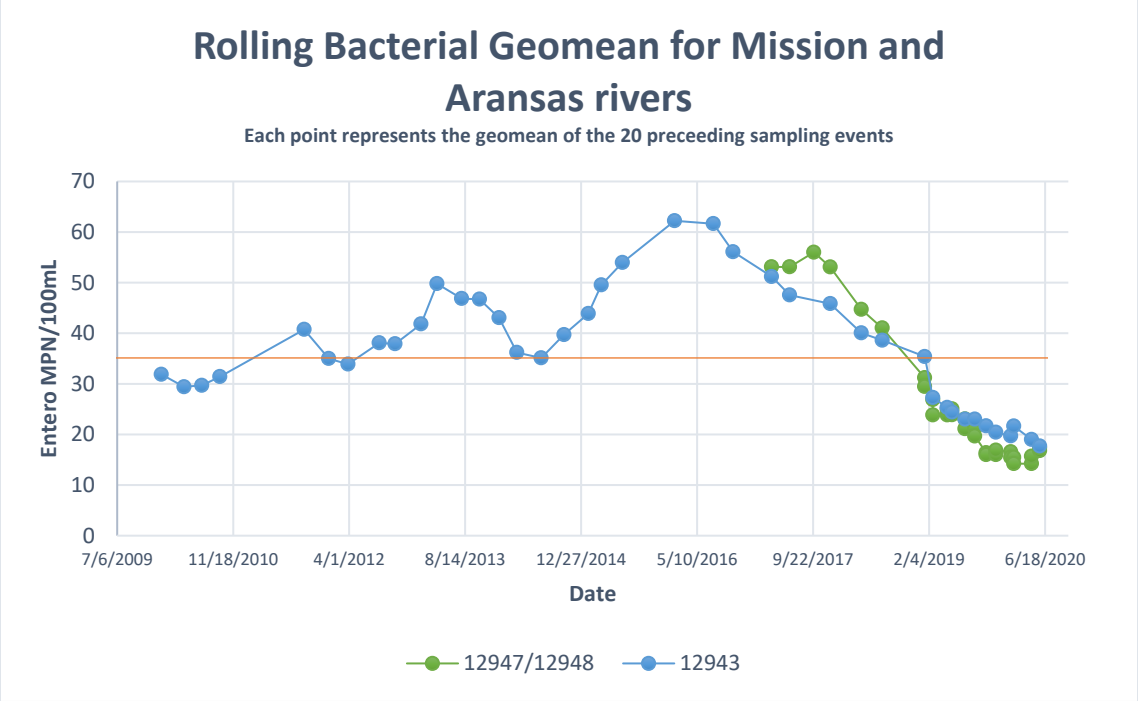

Figure 3. Rolling 20-sample geomean of bacterial loads in the tidal segments of the Mission (12943) and Aransas (12947/12948) rivers. Orange line denotes water quality standard of 35 MPN/100mL. Enterococcus, Entero.

Nutrients/Dissolved Oxygen

NNN mostly stayed below the criterion of concern of 2 mg/L throughout the project (Figure 4). There were two occasions where it was slightly above the criterion on the Aransas River. Ammonia N has remained consistent since data collection began in 2000 (Figure 5). TKN was highly variable prior to 2018 but has remained consistently at or below 1.5 mg/L since then (Figure 6). Total phosphorus loads in the Aransas River seem to have risen above the criterion of 0.7 mg/L during many of the sampling events during this project, while the phosphorus loads in the Mission River have remained consistent with historical data trends (Figure 7). DO has mainly stayed above the criterion of 5 mg/L; however, there have been some instances in recent years of reduced DO (< 5 mg/L) on the Mission River (Figure 8). Finally, TSS have remained consistent since data collection began in 2000, with only minor outliers scattered through the years (Figure 9).

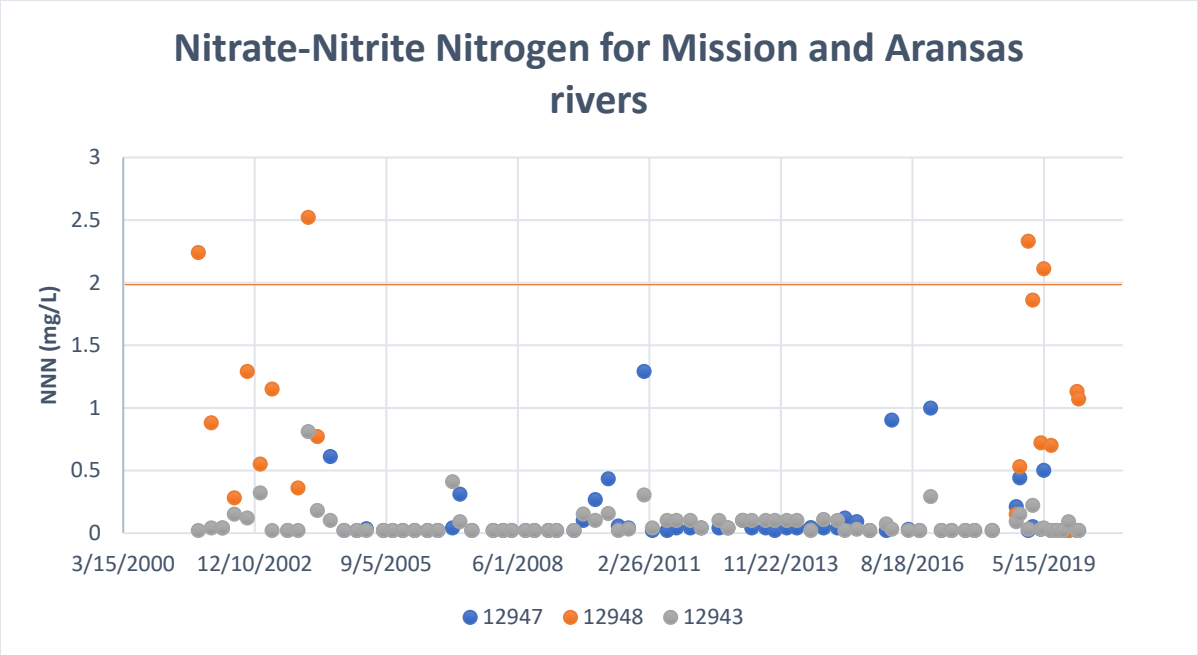

Figure 4. Nitrate-Nitrate Nitrogen (NNN) concentrations for the Mission (12943) and Aransas rivers (12947, 12948). Orange line denotes water quality criterion of 2 mg/L.

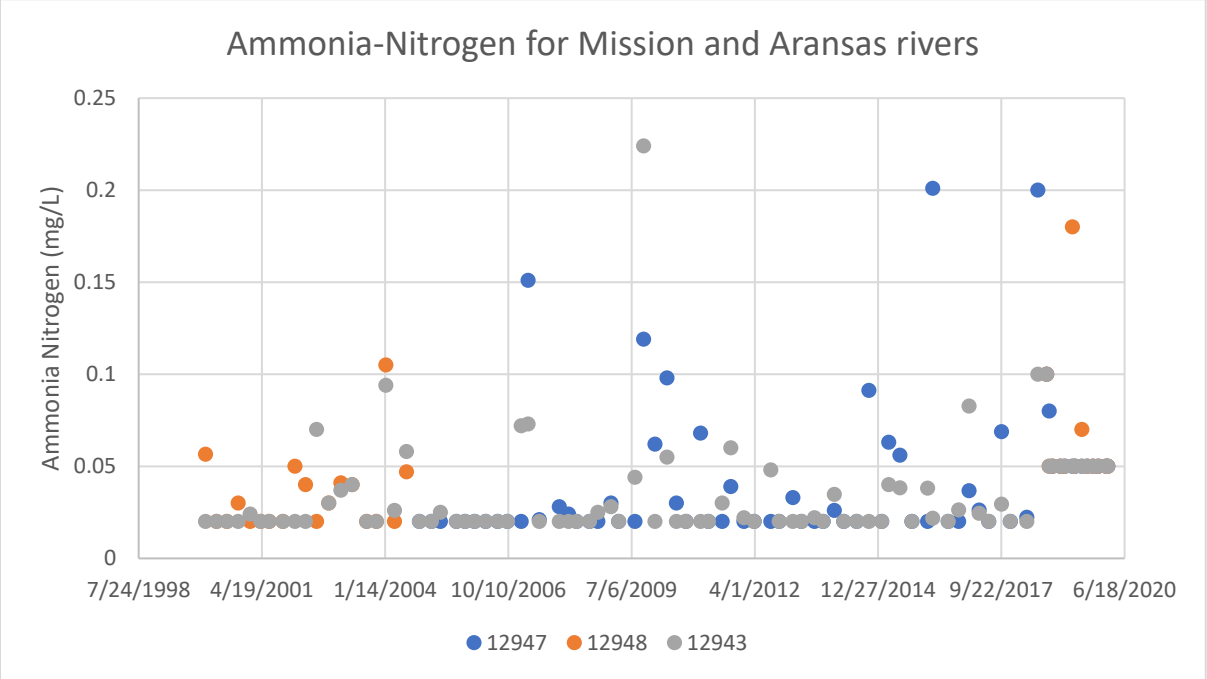

Figure 5. Ammonia-Nitrogen concentrations for the Mission (12943) and Aransas rivers (12947, 12948).

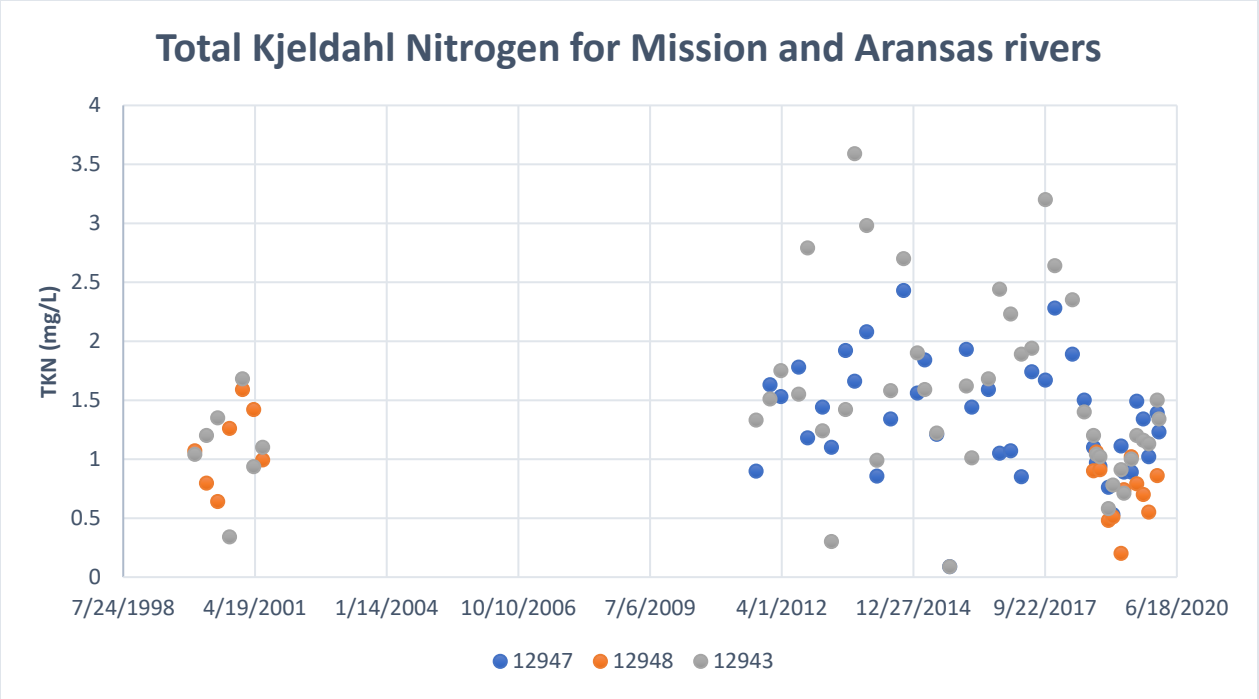

Figure 6. Total Kjeldahl Nitrogen (TKN) concentrations for the Mission (12943) and Aransas rivers (12947, 12948).

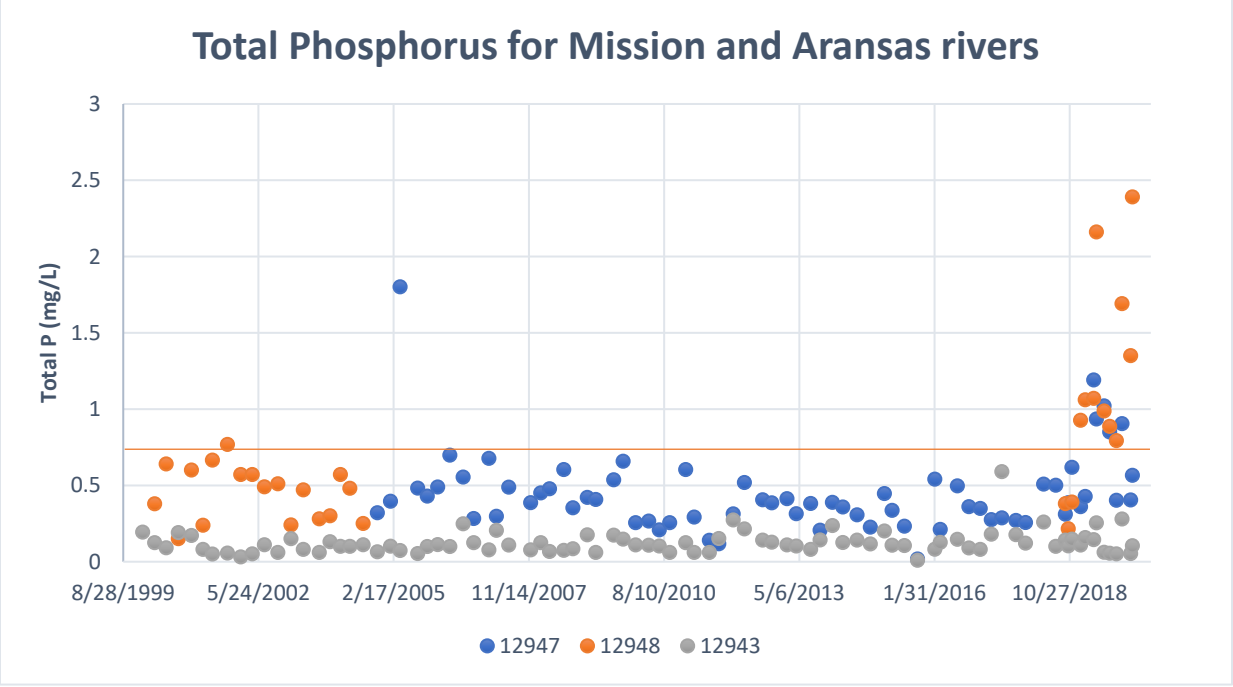

Figure 7. Total Phosphorus (P) concentrations for the Mission (12943) and Aransas rivers (12947, 12948). Orange line denotes water quality criterion of 0.7 mg/L.

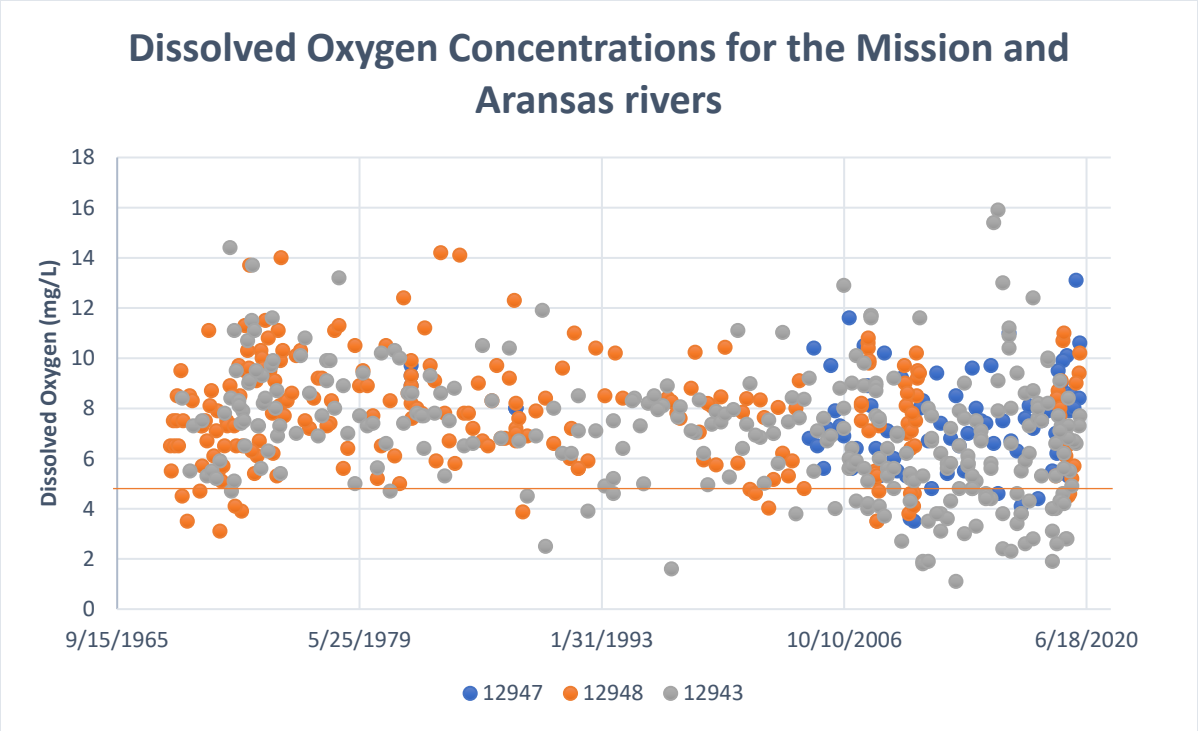

Figure 8. Dissolved Oxygen concentrations for the Mission (12943) and Aransas rivers (12947, 12948). Orange line denotes water quality criterion of 5 mg/L.

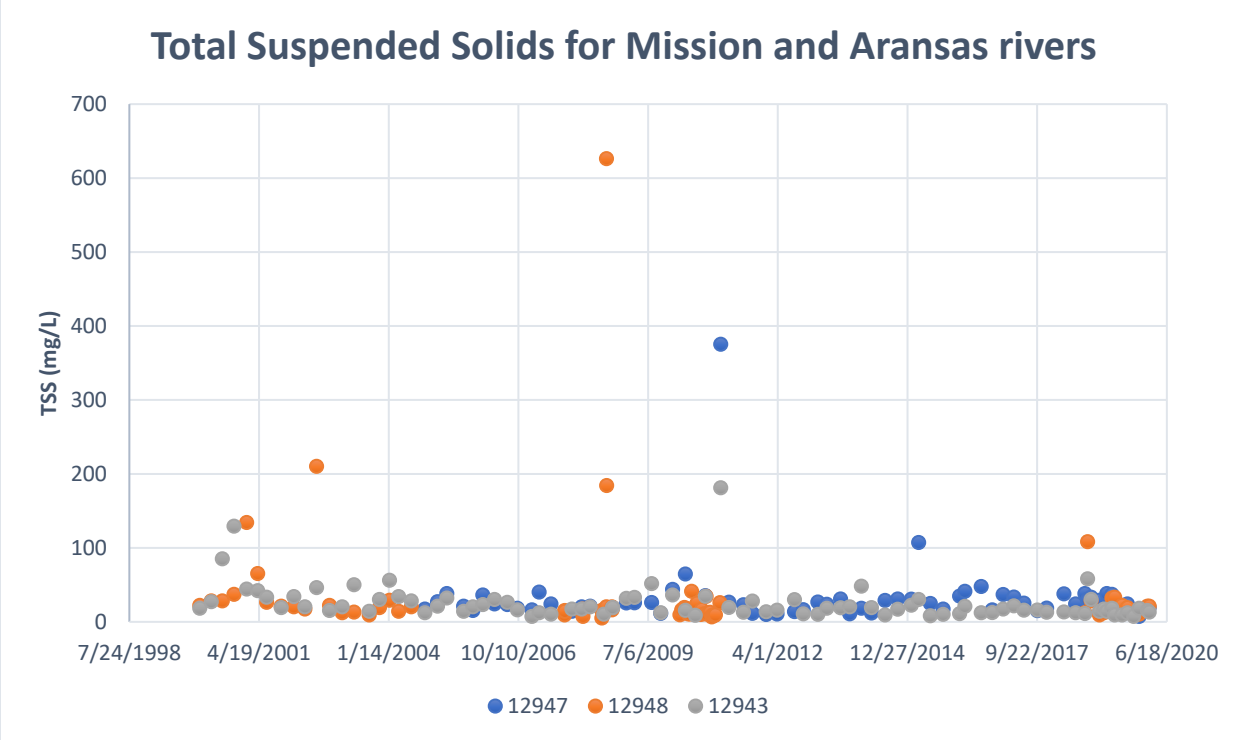

Figure 9. Total Suspended Solids (TSS) for the Mission (12943) and Aransas rivers (12947, 12948).

Discussion

This project completed its objective of supplemental monitoring the effectiveness of TMDL implementation within the Mission and Aransas rivers' watersheds, by documenting a steady decline over time in the geomean of *Enterococcus* concentrations. Additionally, we noticed a slight increase in phosphorus and NNN concentrations in the Aransas River watershed, and slightly lowered DO occurring in the Mission River watershed. Continued quarterly monitoring through the Clean Rivers Program should shed some more light on this, and this data will be useful to stakeholders to adapt and address any current and potential water quality issues.

References

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TWRI. 2020. DRAFT Mission and Aransas River Watersheds Watershed Protection Plan. College Station, TX.

Appendix A: Task Summary/Final QPR

ID#	Sub Task #	Deliverable	Date Submitted
7344	1.2	QPR (FY18Q1)	12/15/17
7345	1.2	QPR (FY18Q2)	03/12/18
7346	1.2	QPR (FY18Q3)	06/14/18
7347	1.2	QPR (FY18Q4)	09/14/18
7348	1.2	QPR (FY19Q1)	12/14/18
7349	1.2	QPR (FY19Q2)	03/14/19
7350	1.2	QPR (FY19Q3)	06/14/19
10260	1.2	QPR (FY19Q4)	09/04/19
10261	1.2	QPR (FY20Q1)	12/14/19
10262	1.2	QPR (FY20Q2)	03/10/20
10263	1.2	QPR (FY20Q3)	06/15/20
7351	1.3	Invoice (FY18Q1)	02/28/18
7352	1.3	Invoice (FY18Q2)	02/28/18
7353	1.3	Invoice (FY18Q3)	05/31/18
7354	1.3	Invoice (FY18Q4)	09/30/18
7355	1.3	Invoice (FY19Q1)	12/17/18
7356	1.3	Invoice (FY19Q2)	03/12/19
7357	1.3	Invoice (FY19Q3)	06/12/19
10264	1.3	Invoice (FY19Q4)	09/12/19
10265	1.3	Invoice (FY20Q1)	11/30/19
10266	1.3	Invoice (FY20Q2)	02/29/20
10267	1.3	Invoice (FY20Q3)	05/31/20
10268	1.3	Invoice (FY20Q4) - June	06/30/20
10269	1.3	Invoice (FY20Q4) - July	Combined w/Aug
10270	1.3	Invoice (FY20Q4) - Aug	09/30/20
7362	1.4	Conference Call (FY18Q2)	01/22/18
7363	1.4	Conference Call (FY18Q3)	05/08/18
7364	1.4	Conference Call (FY18Q4)	09/06/18
7365	1.4	Conference Call (FY19Q1)	11/07/18
7366	1.4	Conference Call (FY19Q2)	02/08/19
7367	1.4	Conference Call (FY19Q3)	05/09/19
7368	1.4	Conference Call (FY19Q4)	07/26/19
10272	1.4	Conference Call (FY20Q2)	01/31/20
10273	1.4	Conference Call (FY20Q3)	04/22/20
10274	1.4	Conference Call (FY20Q4)	07/22/20
7361	1.4	Post-Award Orientation Mtg notes with action items	12/15/17
7369	1.5	EPA Coordination Mtg (on request)	Not Requested
7370	1.6	Annual Report article and pictures (on request)	Not Requested

ID#	Sub Task #	Deliverable	Date Submitted
7372	1.7	Annual Budget Update	11/05/18
7371	1.7	Contract Budget Updates (Discussed quarterly and updated as needed)	8/31/20
7373	2.1	QAPP Planning Mtg	09/14/17
7374	2.2	Draft QAPP	03/09/18
7375	2.3	Final QAPP	08/10/18
7379	3.1	All field datasheets and instrument calibration sheets from first sampling event (within 30 days of first event)	11/08/18
7378	3.1	Documentation of sampling events (with QPRs)	06/15/20
7384	3.2	Data Submission (FY19Q2)	03/21/19
7385	3.2	Data Submission (FY19Q3)	06/07/19
7386	3.2	Data Submission (FY19Q4)	09/04/19
10275	3.2	Data Submission (FY20Q1)	12/10/19
10276	3.2	Data Submission (FY20Q2)	03/02/20
10277	3.2	Data Submission (FY20Q3)	06/09/20
7387	3.3	Documentation of field monitoring readiness review (Before first sampling event)	10/15/18
7388	3.4	Draft Technical Report	06/15/20
7389	3.4	Final Technical Report	10/23/20
7390	4.1	Draft Final Report to TCEQ	06/15/20
7391	4.2	Address TCEQ/EPA comments (within 30 days of TCEQ comments)	08/25/20
7392	4.3	Final Report	10/23/20

Appendix B: Budget Summary

Total Project Budget					
Match Amount:	$57,333.33	**Total Match as of this Report:**	$57,326.08	**Balance:**	$7.25
Federal Amount:	$86,000	**Total Federal Spent as of this Report:**	$85,989.12	**Balance:**	$10.88
Total Contract Amount:	$143,333.33	**Total Spent as of this Report:**	$143,315.20	**Balance:**	$18.13