Sabine River Basin Summary Report 2018

www.sratx.org

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Introduction

The Sabine River Authority of Texas (SRA-TX) Basin Summary Report is produced every 3rd biennium to provide stakeholders and interested parties with a greater understanding of basin water quality. This report provides an overview of water quality within the Sabine River Basin under the Texas Clean Rivers Program (TCRP). The collection, management, and analysis of water quality data is accomplished through an integrated approach that includes a comprehensive monitoring program, a data management plan, and statistical analyses of historical and current data.

The SRA-TX water quality monitoring program was established in 1972 and was reinforced by the development of the TCRP in 1991. Since its inception, the SRA-TX program has evolved and changed with the needs of the SRA-TX and the State of Texas. Under the TCRP, the Texas Commission on Environmental Quality (TCEQ) partners with regional water authorities to coordinate and conduct water quality monitoring and promote stakeholder participation to improve the quality of surface water within each river basin in Texas. The SRA-TX monitors water quality in the Sabine River Basin to identify trends and prioritize water quality concerns. The SRA-TX is the planning agency for all TCRP activities in the Sabine River Basin.

Water quality information obtained through the TCRP is collected in accordance with a TCEQ-approved Quality Assurance Project Plan (QAPP). Data collected under the TCEQ QAPP is available for a variety of uses such as TCEQ assessments, updating wastewater permits, and various other purposes. For example, data collected through the TCRP for the Sabine River Basin was utilized for the renewal of the Toledo Bend Project's Federal Energy Regulatory Commission license and for documentation required for Texas and Louisiana Clean Water Act, Section 401 Water Quality Certifications.

Water Quality Monitoring

The TCRP and SRA-TX Objectives

- Identify and evaluate water quality issues.
- Provide quality-assured data to the TCEQ for use in decision-making.
- Maintain efficient use of public funds and promote cooperative watershed planning.
- Recommend water quality management strategies.
- Inform and engage stakeholders about local water quality.

Sabine River Basin

Figure 1. Sabine River Basin

The Sabine Basin (Figure 1) is roughly crescent-shaped, with a length of approximately 300 miles and a maximum width of approximately 48 miles. The Sabine River is approximately 580 river miles long from the basin divide in Hunt County near the City of Celeste, to its mouth at Sabine Lake. The watershed area in Texas includes all or part of twenty-one counties. It extends southeasterly for 165 miles from its source in Hunt County to the headwaters of Toledo Bend Reservoir at the Texas-Louisiana border. At the point where it becomes the state line, the Sabine River drains an area of approximately 4,846 square miles. The State of Texas has jurisdiction to the midstream boundary for the state line reach of the Sabine River, of which approximately 2,550 square miles lie within Texas and 2,360 square miles lie within Louisiana. The Texas portion of the watershed makes up approximately 76 percent of the total area of the basin.

Major tributaries to the Sabine River in Texas include Lake Fork Creek, Big Sandy Creek, Big Cow Creek, Adams Bayou, and Cow Bayou. Major tributaries from the State of Louisiana are Bayou Toro and Bayou Anacoco. The Texas Water Development Board [1] lists 3 major aquifers within the basin. These are the Carrizo-Wilcox (outcrop), Carrizo-Wilcox (subcrop), and Gulf Coast. Minor aquifers include the Nacatoch, Queen City (outcrop), Sparta (outcrop), Sparta (subcrop), and Queen City (outcrop).

The Sabine River flows through four major Ecoregions which include the Texas Blackland Prairies, East Central Texas Plains, South Central Plains, and Western Gulf Coastal Plains (Figure 1). Regional geology, climate, topography, land use, and population density have a direct impact on water quality.

The upper portions of Lake Tawakoni and Lake Fork Creek watersheds are located in the Texas Blackland Prairies Ecoregion. The soils of this area are composed of calcareous clays which erode readily and have a tendency to remain suspended in the water. Higher values for pH, conductivity, alkalinity, and total dissolved solids (TDS) are found in this region. Most of the Sabine Basin is located in the East Central Texas and South Central Plains ecoregions. Compared to the Texas Blackland Prairies, these ecoregions contain sand and clay loam soils and have surface waters with lower pH, TDS, conductivity, and alkalinity. Lake Fork and Toledo Bend Reservoirs are located in these ecoregions. The tidal portion of the Sabine Basin is located in the Western Gulf Coastal Plains Ecoregion and has soil that is comprised of calcareous clays and clay loams. The TDS, salinity, and conductivity values in this ecoregion are variable based on tide, wind, and rainfall.

Average annual rainfall ranges from 40 inches near the Sabine River headwaters to 60 inches at the mouth of the Sabine River[2]. Land surface elevations across the basin vary from a few feet above sea level in the tidal region to approximately 700 above mean sea level (AMSL) at the headwaters. General topography varies from moderate to gently sloping hills.

Sabine River Headwaters

[1] https://www.twdb.texas.gov/groundwater/aquifer/major.asp, assessed 3/7/19
[2] National Weather Service accessed 3/12/2019, https://water.weather.gov/precip/

Sabine Basin land use includes mineral production, silviculture, agriculture, manufacturing, shipping, recreation, and tourism. The majority of the population is in the upper basin above the headwaters of Toledo Bend Reservoir.

Public Involvement

Sabine Basin Steering Committee meetings engage stakeholders and inform them of water quality within the basin. The Coordinated Monitoring meetings bring together SRA-TX, TCEQ, other state agencies, and entities with interests in the Sabine Basin to help reduce sampling duplication and maximize resources to assess water quality of the entire basin. Participants that contribute water quality data through the TCRP for the Sabine Basin include the City of Longview, and SRA-TX. All stakeholders collecting water quality data in the Sabine Basin for the TCRP are encouraged to coordinate their efforts with SRA-TX and participate under the SRA-TX QAPP. Collection of water quality data in accordance with a QAPP allows the data to be used by the TCEQ for assessments based on Texas Surface Water Quality Standards (TSWQS), updating wastewater permits, and various other purposes.

Water supply corporations, permitted dischargers, councils of government, municipalities, county officials, and local citizens are part of the diverse group of people invited to attend these meetings. For more information about participating in the Sabine Basin Steering Committee meetings, please contact Terry Wilson at (903) 878-2420 or twilson@sratx.org.

The SRA-TX assists the Texas Stream Team[3] which is a citizen monitoring program of The Meadows Center for Water and the Environment at Texas State University. This group is a cooperative partnership between the TCEQ, Texas State University, the United States Environmental Protection Agency (USEPA), and citizen volunteers. SRA-TX provides sampling kits and supplies to volunteers within the Sabine Basin.

The Orange County Total Maximum Daily Load (OCTMDL) Project was initiated in 2002 to address low dissolved oxygen and elevated bacteria in Adams Bayou (Segment 0508) as well as to address low dissolved oxygen, low pH, and elevated bacteria in Cow Bayou (Segment 0511). On August 5, 2015, the TCEQ Commissioners approved the OCTMDL Implementation Plan (I-Plan). Stakeholders now meet annually to review and evaluate I-Plan management measure activities conducted during the previous year. Currently, TCEQ is in the process of updating the TMDL for Adams Bayou and will present its findings to the stakeholders when complete.

SRA-TX Water Quality Reports[4] provide current and historical monitoring data to the public and monthly water quality updates of SRA-TX's routine monitoring activities. The SRA-TX's website[5] provides access to information related to water resource issues within the Sabine River Basin and the State of the Basin page[6] is a portal to the latest water quality information. Available documents

[3] https://www.meadowscenter.txstate.edu/Service/TexasStreamTeam.html, accessed 3/7/2019
[4] http://www.sratx.org/srwmp/tcrp/state_of_the_basin/monthly_wqmp_reports/default.asp, accessed 3/7/2019
[5] http://www.sratx.org/, accessed 3/7/2019
[6] http://www.sratx.org/srwmp/tcrp/state_of_the_basin/monthly_wqmp_reports/default.asp, accessed 2/28/2019

include Monthly Water Quality Monitoring Reports, Sabine Basin Highlights Reports, and Summary Reports.

Additional public outreach includes providing presentations at area schools, civic groups, and environmental events as well as tours of SRA-TX facilities. Examples include Sabine County Ag Day, March for Parks, information booths at Shangri-La Botanical Garden's Eco-Fest, Career Day at Stephen F. Austin State University, and the City of Longview's East Texas Outdoor Expo.

Steering Committee Meeting

Water Quality Review

The SRA-TX evaluates water quality in accordance with a TCEQ approved QAPP and maintains Texas laboratory accreditation from The NELAC[7] Institute (TNI). The purpose of the SRA-TX CRP QAPP is to clearly delineate data quality objectives, quality assurance specifications, and the data management structure which will be used to validate the data collected is of known and documented quality, deemed acceptable for its intended use. Data collected under a TCEQ-approved QAPP can be used for water quality assessments, total maximum daily load (TMDL) development, establishing water quality standards, making permit decisions, and other programs deemed appropriate by TCEQ. Field sampling is conducted in accordance with the latest versions of the TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods, 2012 (RG-415), and Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data (RG-416).

[7] National Environmental Laboratory Accreditation Conference

Water Quality Terminology

The definition of water quality parameters and how they relate to maintaining water quality standards can be found in Tables 1 - 2.

Table 1. Water Quality Parameter Definitions

Parameter	Definition
Temperature	Temperature is the most common physical measurement of water quality. Temperature impacts both the chemical and biological characteristics of surface water.
pH	A measurement of hydrogen ion concentration used to describe the acidity or alkalinity of a solution. The pH scale is from 0 to 14, with the neutral point at 7.0. Values lower than 7 indicate acidic conditions and greater than 7 indicate alkaline conditions.
Dissolved Oxygen	The amount of oxygen gas dissolved in a given quantity of water at a given temperature and atmospheric pressure. Dissolved oxygen is one of the most important parameters in aquatic systems.
Total Dissolved Solids (TDS)	The amount of inorganic and organic material dissolved in water measured by laboratory analysis or estimated using specific conductance multiplied by a conversion factor, typically 0.65.
Enterococcus *and* *Escherichia coli (E. coli)*	These bacteria groups are used as indicators of possible contamination by the fecal material of warm-blooded animals. Although generally not harmful themselves, they indicate the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoans that also live in human and animal digestive systems. *Enterococcus* testing is used in tidal and high saline waters. *E. coli* testing is used in freshwater areas.
Sulfate	Sulfates are salts of sulfuric acid that occur naturally and are often the result of the breakdown of leaves that fall into a stream, water passing through rock or soil containing gypsum, and other common minerals, or from atmospheric deposition. Sulfates can also come from agricultural runoff and municipal or industrial discharges.
Chlorophyll-a	Chlorophyll-a is a green pigment found in most plants, algae, and cyanobacteria. Excessive amounts of chlorophyll-a can indicate algal blooms, which can cause dissolved oxygen levels to fluctuate and deteriorate to harmful levels.
Chloride	Chloride is the ionic form of chlorine usually in the form of salts. Some common chlorides include sodium chloride and magnesium chloride. High chloride concentrations can affect osmoregulation and treatability of water.
Secchi Disk Depth	Secchi depth is a measure of the depth to which light is transmitted through the water column.
Turbidity	Turbidity is a measure of the water clarity or light transmitting properties. It may be caused by naturally occurring suspended material or plankton and other microscopic organisms.
Ammonia Nitrogen	Ammonia is excreted by animals and is produced during the decomposition of plants and animals. It is also present in sewage, storm water run-off, and industrial wastewaters.
Nitrate Nitrogen	Nitrate-nitrogen containing compounds act as nutrients in streams, rivers, and reservoirs. These nutrients can be found in wastewater treatment plant effluent, fertilizers, and agricultural runoff.
Total Phosphorus	Total phosphorus is an essential nutrient required for growth of organisms. Excessive amounts of total phosphorus increase primary productivity and algal growth.

Table 2. Water Quality Term Definitions[8]

Water Quality Term	Definitions
Concern - CN	Concern for near-nonattainment of the TSWQS based on numeric criteria.
Coordinated Monitoring Site	A site that is sampled by an entity, other than the SRA-TX, with a TCEQ approved QAPP.
Designated Use	A use that is assigned to a specific water body in Appendix A, Appendix B or Appendix G in the TSWQS. Typical uses that may be assigned for specific water bodies include domestic water supply, categories of aquatic-life use, recreational categories, and aquifer protection.
Impairment	When a water body fails to support its designated use based on TSWQS numeric criteria.
Non-Point Source	A pollution source that is diffuse and does not have a single point of origin or is not introduced into a receiving stream from a specific outfall. The pollutants are generally carried off the land by storm water runoff. Commonly used categories are agricultural, forestry, urban, mining, construction, dams and channels, land disposal, and saltwater intrusion.
Noncontact Recreation	Aquatic recreational pursuits not involving a significant risk of water ingestion and limited body contact incidental to shoreline activity, including birding, hiking, fishing, biking, and commercial and recreational boating. Can also be assigned in areas where unsafe conditions occur due to ship or barge traffic.
Outfall	A designated point of effluent discharge.
Point Source	Any discernable, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, item of rolling stock, concentrated animal feeding operation, or vessel, or floating craft, from which pollutants or wastes are or may be discharged into or adjacent to any water in the state.
Primary Contact Recreation 1 (PCR1)	Activities involving a significant risk of ingestion of water, including wading by children, swimming, water skiing, diving, surfing, kayaking, canoeing, and rafting.
Primary Contact Recreation 2 (PCR2)	Activities involving a significant risk of ingestion of water, including wading by children, swimming, water skiing, diving, surfing, kayaking, canoeing, and rafting but occur less frequently than primary contact recreation 1 due to physical characteristics of a water body or limited public access. Presumed risk occurs less frequently than PCR1.
Runoff	The part of precipitation or irrigation water that runs off land into streams and other surface water.
Secondary Contact Recreation 1 (SCR1)	Activities that have limited body contact, including fishing canoeing, kayaking, rafting, and motor boating. Presumed less risk than PCR1 or 2 and more than SCR2.
Secondary Contact Recreation 2 (SCR2)	Activities that have limited body contact, including fishing canoeing, kayaking, rafting, and motor boating. Presumed less risk than SCR1 due to physical characteristics of a water body or limited public access.
Segment	A water body or portion of a water body that is individually defined and classified in the TSWQS. A segment is intended to have relatively homogeneous chemical, physical, and hydrological characteristics. A segment provides a basic unit for assigning site-specific standards and for applying water quality management programs of the agency. Segments may include streams, rivers, bays, estuaries, wetlands, lakes, or reservoirs.
Surface Water Quality Standards	The designation of water bodies for desirable uses and the narrative and numerical criteria deemed necessary to protect those uses.
Total Maximum Daily Load (TMDL)	The total amount of a substance that a water body can assimilate and still meet the TSWQS.
Watershed	The area of land from which precipitation drains to a single point. Watersheds are sometimes referred as drainage basins of drainage areas.

[8] TCEQ Glossary Water Quality Terms accessed 3/7/2019, https://www.tceq.texas.gov/waterquality/monitoring/glossary_viewer.html

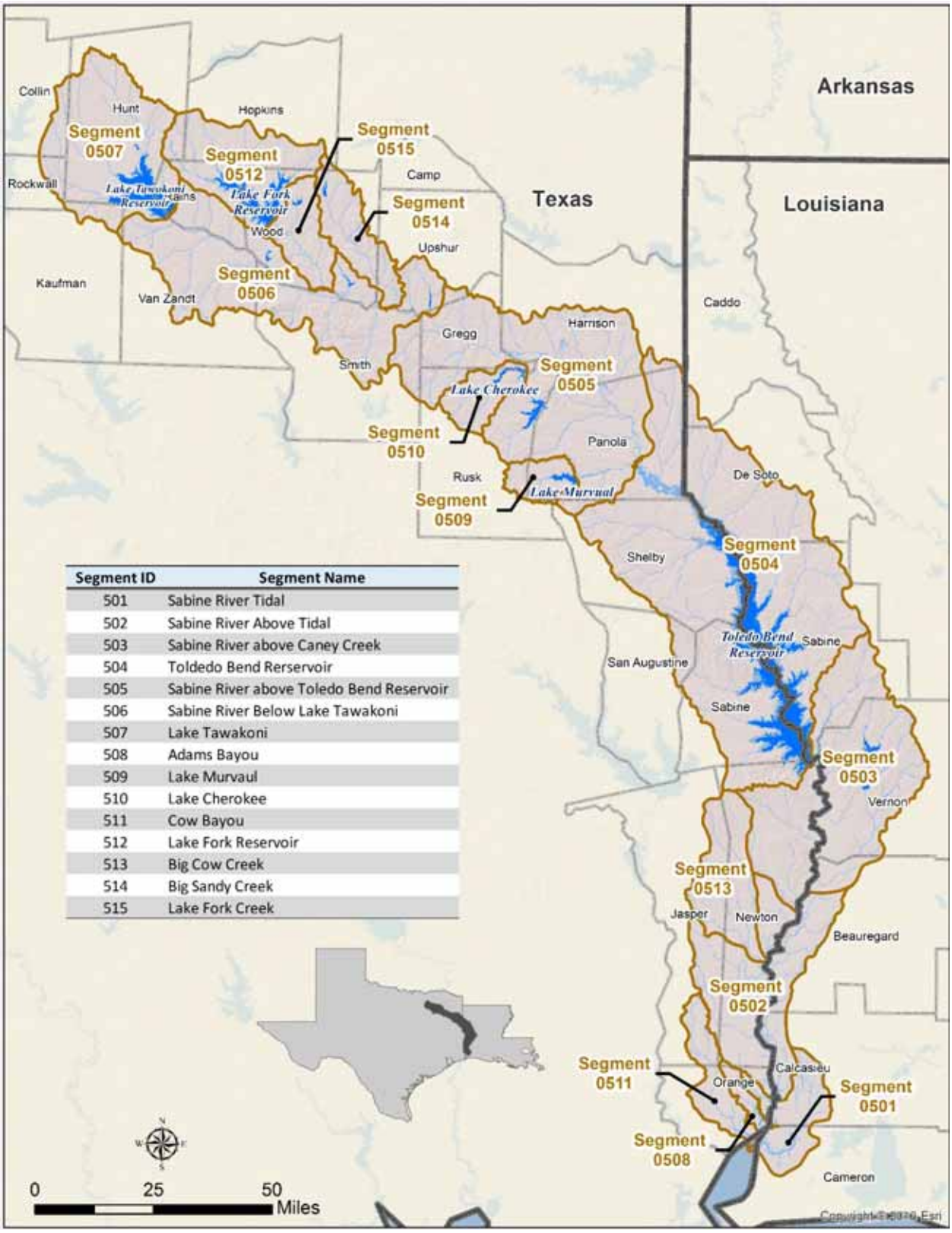
Data Review Methodology

Spatial analyses of land use were generated for each TCEQ-designated segment (Figure 2) in the Sabine Basin. The SRA-TX used a geographic information system (GIS) and National Land Cover Database (NLCD) to provide information on the factors that influence water quality, such as point source locations, land use, and watershed characteristics. Spatial analyses of land use for this report included:

- Highways
- Hydrology
- Land Use
- Historical Monitoring Stations
- Population (Census 2010 block data)
- Permitted Discharges (TCEQ Data)
- Landfills (TCEQ Data)
- Superfund Sites (TCEQ Data)
- Permitted Industrial Hazardous Waste Sites

Trend analyses were conducted on designated use parameters at 13 most downstream sites that exhibited the overall water quality of the segment. The period of record used for the trend analyses was from September 2007 through August 2017. The number of records per parameter varied between 38 and 120, depending on whether the site was sampled quarterly or monthly. A regression analysis was used to determine significance of change in a parameter over time (t-ratio >2 and p–value <0.1). If the regression analysis indicated significance, a trend analysis was conducted. Trend analysis parameters were graphed with corresponding United States Geographic Survey (USGS) flow data. Although trend analyses are useful tools for interpreting data, they do not take into consideration all the variables that could affect the measurement of a particular parameter. The data produced from the trend analyses was compared with the TSWQS and Draft 2016 Integrated Report for Clean Water Act Sections 305(b) and 303(d). Differing slightly from the TCEQ methodology used for the Draft 2016 Integrated Report, the SRA-TX data analysis for this report used a larger data set over a longer period of time and included regression analysis against time to identify significant trends.

Figure 2. Sabine Basin Map with Designated Segments

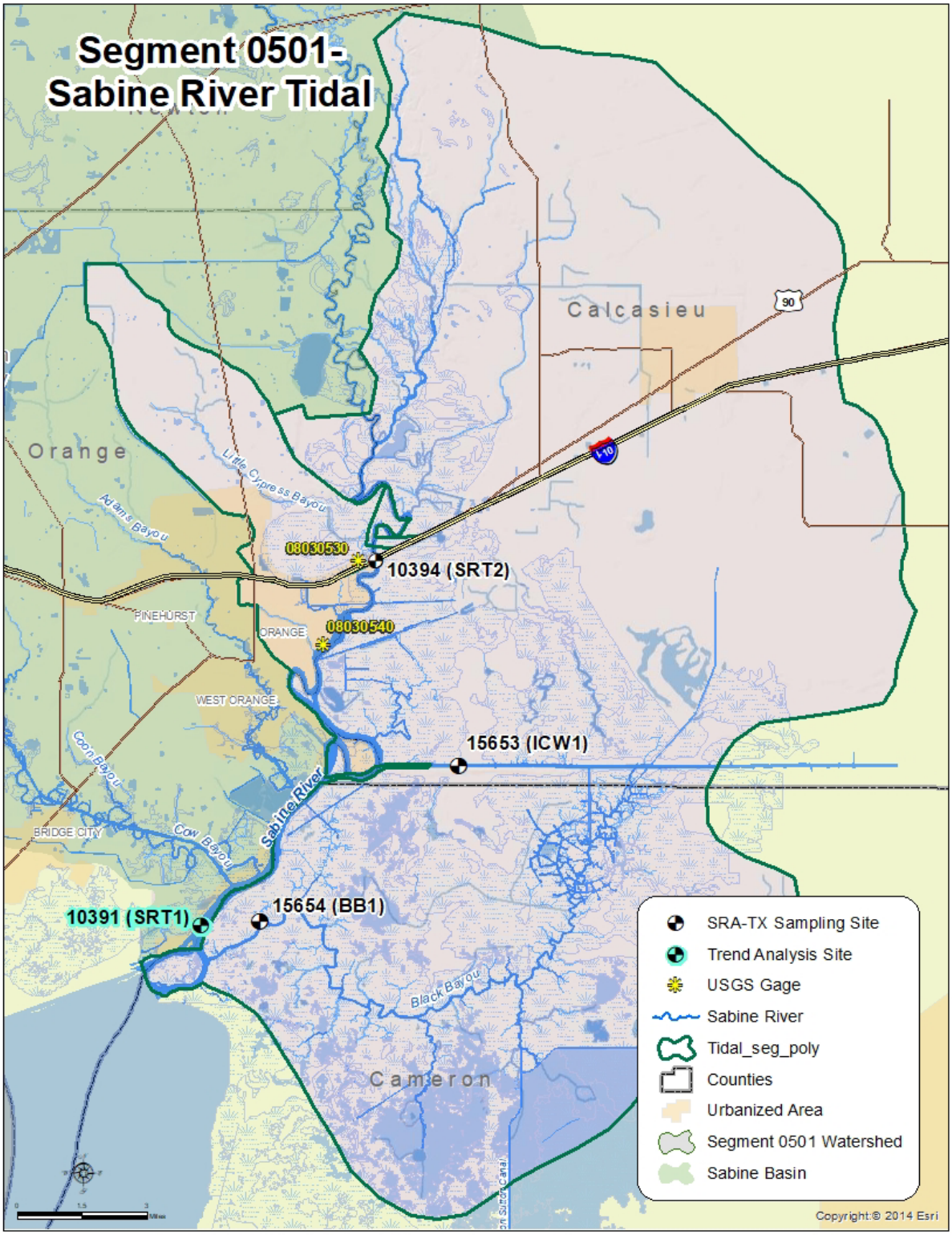


Segment ID	Segment Name
501	Sabine River Tidal
502	Sabine River Above Tidal
503	Sabine River above Caney Creek
504	Toldedo Bend Rerservoir
505	Sabine River above Toledo Bend Reservoir
506	Sabine River Below Lake Tawakoni
507	Lake Tawakoni
508	Adams Bayou
509	Lake Murvaul
510	Lake Cherokee
511	Cow Bayou
512	Lake Fork Reservoir
513	Big Cow Creek
514	Big Sandy Creek
515	Lake Fork Creek

Watershed Summaries

Segment 0501 - Sabine River Tidal

From the confluence with Sabine Lake in Orange County to West Bluff in Orange County.



The Sabine River Tidal watershed, with a drainage area of 251 square miles, is located in the Western Gulf Coastal Plains Ecoregion, an area characterized by relatively flat terrain with emergent herbaceous wetlands and hay pastures (Table 3 - 4). Although some areas are quite rural, Segment 0501 includes the City of Orange, one of the three highest population concentrations in the Sabine Basin. The SRA-TX routinely monitors four sites monthly in this segment (Table 5).

Segment 0508 (Adams Bayou Tidal) and Segment 0511 (Cow Bayou Tidal) are tributaries to this watershed.

The USGS maintains gaging stations located on the Sabine River in Orange, Texas at Navy Pier, and on the Sabine River at IH-10 near Orange, TX.

Spatial Analysis of Land Use

Table 3. Segment 0501 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	10.7
Developed, Open Space	2.2
Developed, Low Intensity	3.6
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	2.0
Evergreen Forest	4.1
Mixed Forest	2.3
Scrub/Shrub	4.1
Woody Wetlands	16.2
Hay Pasture	13.7
Cultivated Crops	5.4
Deciduous Forest	<1
Emergent Herbaceous Wetlands	34.4

*USGS - NLCD 2011

Table 4. Segment 0501 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
12	17,213	7	1	0	69

Table 5. Segment 0501 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10391 (SRT1)	SABINE RIVER AT CHANNEL CAN 3	SRA-TX
15654 (BB1)	BLACK BAYOU IN CAMERON PARISH	SRA-TX
15653 (ICW1)	INTERCOASTAL WATERWAY AT PERRY RIDGE	SRA-TX
10394 (SRT2)	SABINE RIVER AT IH 10	SRA-TX

Water Quality Conditions

Water quality meets the TSWQS except for the Draft 2016 Texas Integrated Report 303d listing for bacteria. The segment was first listed in 2006. In FY 2016, the yearly geomean of stations 10391 (SRT1), 15654 (BB1), and 15653 (ICW1) fell below the TSWQS *Enterococcus* limit of 35 most probable number (MPN) /100mL, which was the first time since Hurricane Ike in 2008. This pattern has continued through FY 2017 and FY 2018.

The Texas Department of State Health Services (TDSHS) issued a fish consumption advisory in December 2011 for the gafftopsail catfish (PCBs in edible tissue) from Texas waters of Sabine Lake in Jefferson and Orange counties. The advisory also covers contiguous Texas waters including Sabine Pass and portions of the Sabine and Neches Rivers.

Little Cypress Bayou (Segment 0501B), an unclassified water body, has been included in the Integrated Report since 2006 for impairments of elevated bacteria and depressed dissolved oxygen, and since 2004 for impairments of toxicity in water. Little Cypress Bayou (Segment 0501B_02) has been removed from the Draft 2016 Texas Integrated Report 303(d) List for impaired fish community. The TCEQ has completed a Recreational Use Attainability Analysis (RUAA) for this waterbody, but no recommendations are available at this time. More information on the RUAA can be found at the TCEQ Recreational Use Attainability Analyses Site[9].

Regression analyses at station 10391 (SRT1) indicated no parameter was significantly related to time.

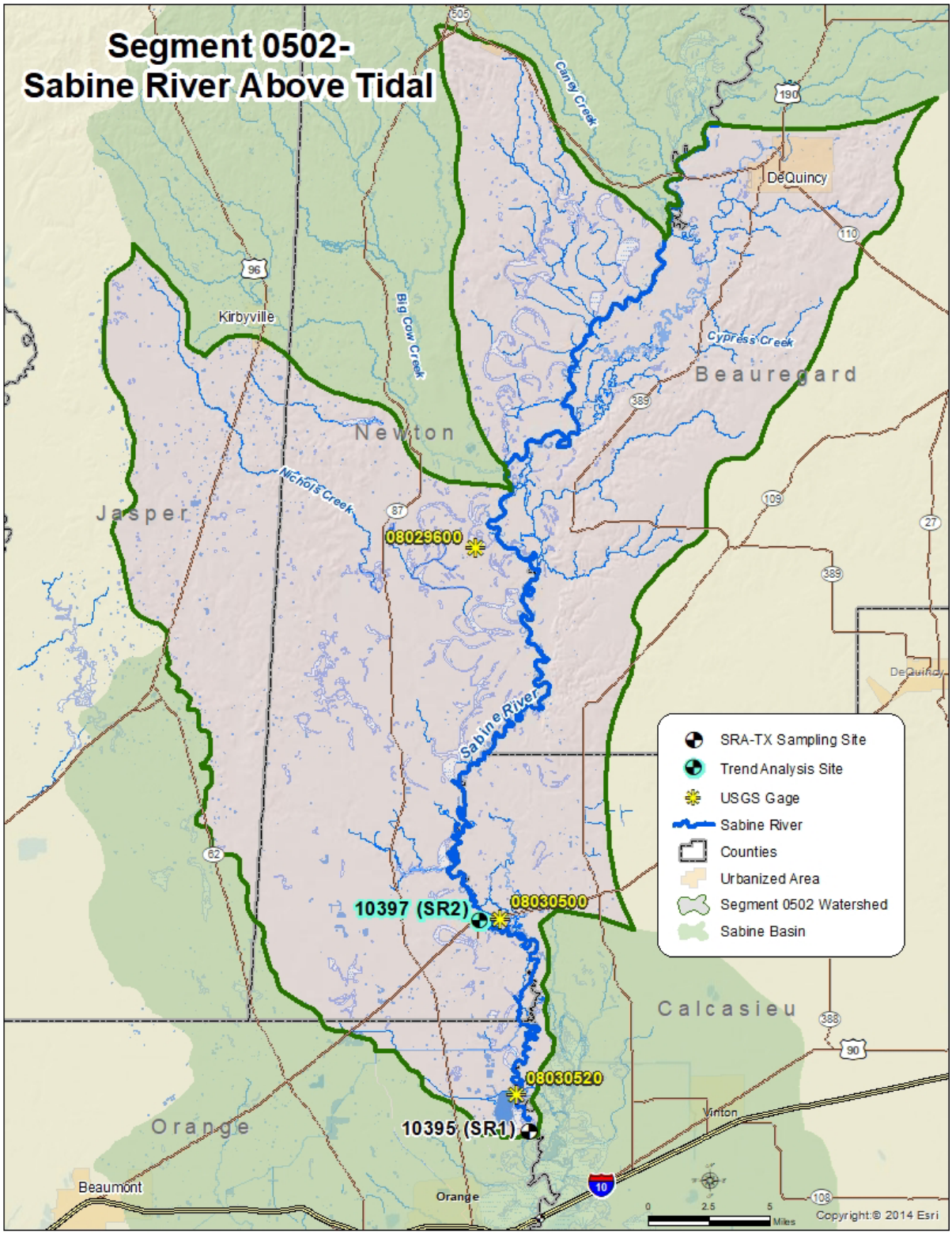
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. Future RUAA recommendations for Little Cypress Bayou will be communicated to stakeholders through our annual Steering Committee meetings. The level of water quality monitoring adequately characterizes water quality and will continue at representative routine sites in this segment.

[9] https://www.tceq.texas.gov/waterquality/standards/ruaas/index, accessed 3/7/2019

Segment 0502 - Sabine River Above Tidal

From West Bluff in Orange County to the confluence with Caney Creek in Newton



The Sabine River Above Tidal watershed, with a drainage area of 739 square miles, is located in the Western Gulf Coastal Plains Ecoregion. This region is characterized by rolling hills to the north and is relatively flat to the south. Segment 0502 is largely rural with no major industries or cities. It is comprised of woody wetlands, evergreen forest, and mixed forest (Tables 6-7). Segment 0513 (Big Cow Creek) is a tributary to this watershed.

The USGS maintains gaging stations located on the Sabine River at SH 12 near Ruliff, TX, the Sabine River at International Paper near Orange, TX, and Sim's Branch near Call, TX. The SRA-TX routinely monitors two sites monthly in this segment (Table 8).

Spatial Analysis of Land Use

Table 6. Segment 0502 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	0.9
Developed, Open Space	2.1
Developed, Low Intensity	2.2
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	4.5
Evergreen Forest	28.0
Mixed Forest	5.3
Scrub/Shrub	19.8
Woody Wetlands	30.8
Hay Pasture	3.9
Cultivated Crops	<1
Deciduous Forest	<1
Emergent Herbaceous Wetlands	1.4

*USGS - NLCD 2011

Table 7. Segment 0502 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
12	15,960	9	7	0	22

Table 8. Segment 0502 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10395 (SR1)	SABINE RIVER 12.00 KM UPSTREAM OF IH 10	SRA-TX
10397 (SR2)	SABINE RIVER AT SH 12 NORTH OF DEWEYVILLE, TX.	SRA-TX

Water Quality Conditions

The Draft 2016 Texas Integrated Report indicated no impairments on the main stem of the Sabine River in Segment 0502. There is a concern for depressed dissolved oxygen in assessment unit (AU) 0502_01.

Nichols Creek (Segment 0502A), an unclassified intermittent stream with pools, has been included on the Texas Integrated Report since 2002 for impairments due to elevated bacteria and depressed dissolved oxygen. The sampling site for this small stream is not close to known human activities that would impact water quality, and the data is thought to characterize natural swamp conditions typical of the relatively flat east Texas bottomlands. An RUAA has been completed on this creek to address these impairments. The TCEQ recommended for the revision from primary contact recreation (PCR) to secondary contact recreation 1 (SCR1) for Nichols Creek. More information on the RUAA can be found at the TCEQ Recreational Use Attainability Analyses website[10].

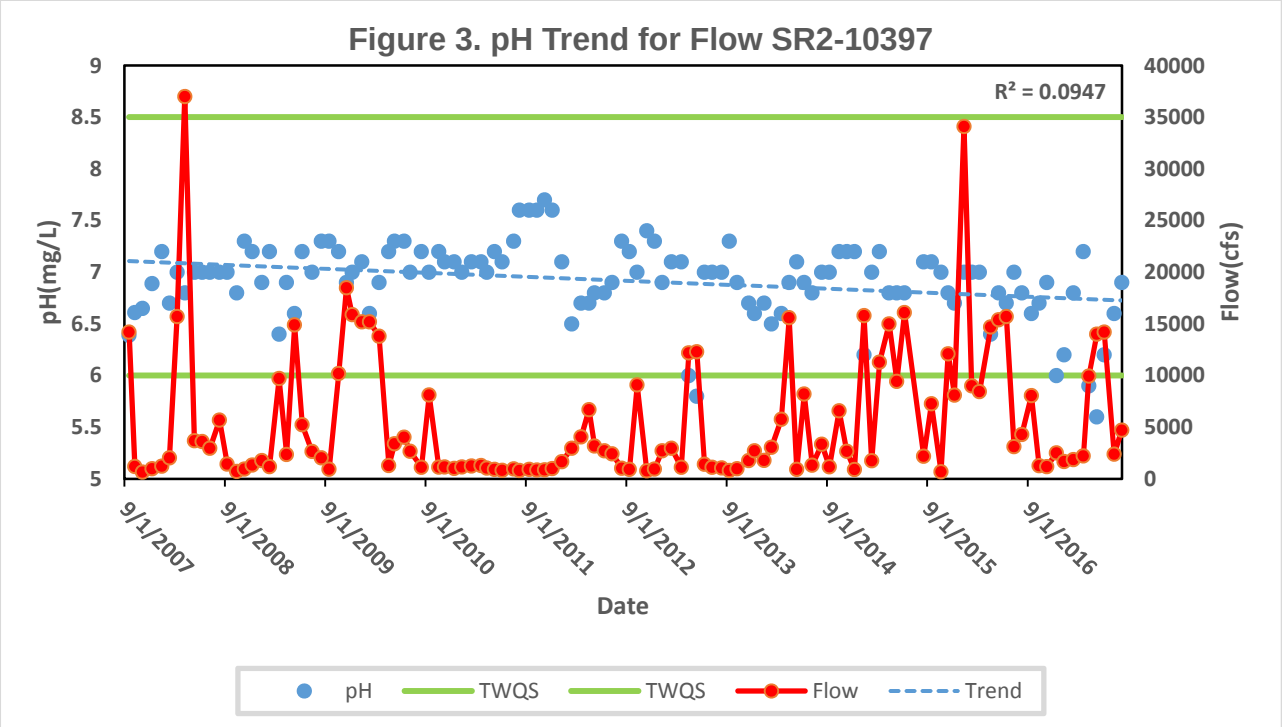
Caney Creek (Segment 0502B), an unclassified perennial stream, has been included on the Integrated Report since 2006 for a bacteria impairment. All known point sources enter downstream of the impairment. Potential causes of the bacteria impairment include wildlife and other non-point sources. An RUAA has been completed on this creek to address these impairments. The RUAA identified the presumed use of PCR for Caney Creek is appropriate. More information on the RUAA can be found at the TCEQ Recreational Use Attainability Analyses website[11].

Cypress Creek (Segment 0502E), an unclassified water body, was first included on the Integrated Report in 2010 for an impairment for depressed dissolved oxygen. The segment also has concerns for impaired habitat and impaired microbenthic community.

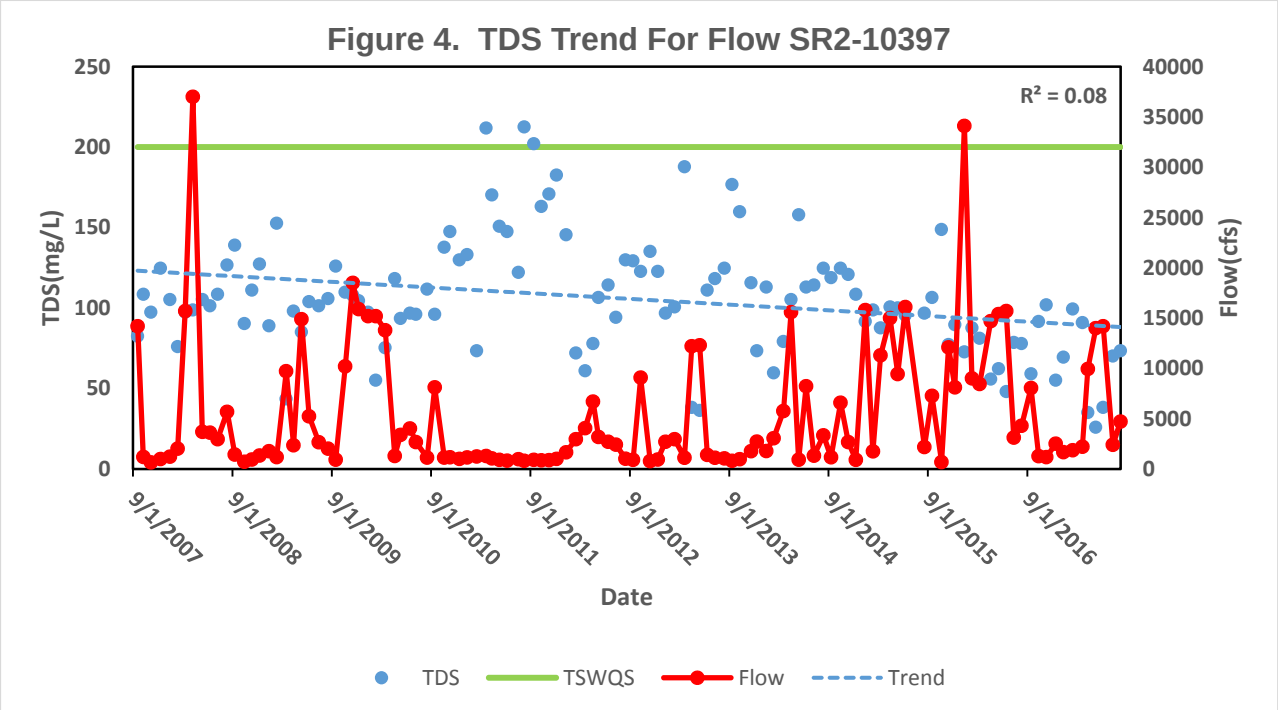
[10] https://www.tceq.texas.gov/waterquality/standards/ruaas/index, accessed 3/7/2019
[11] https://www.tceq.texas.gov/waterquality/standards/ruaas/index, accessed 3/7/2019

Regression analyses at station 10397 (SR2) indicated pH, TDS, nitrate, chloride, sulfate, and *E. coli* data were significantly related to time. Decreasing trends were observed for each parameter except *E. coli*, in which an increasing trend was observed. This could be related to higher flows due to an increase in rainfall that was preceded by a period that was dryer than normal.

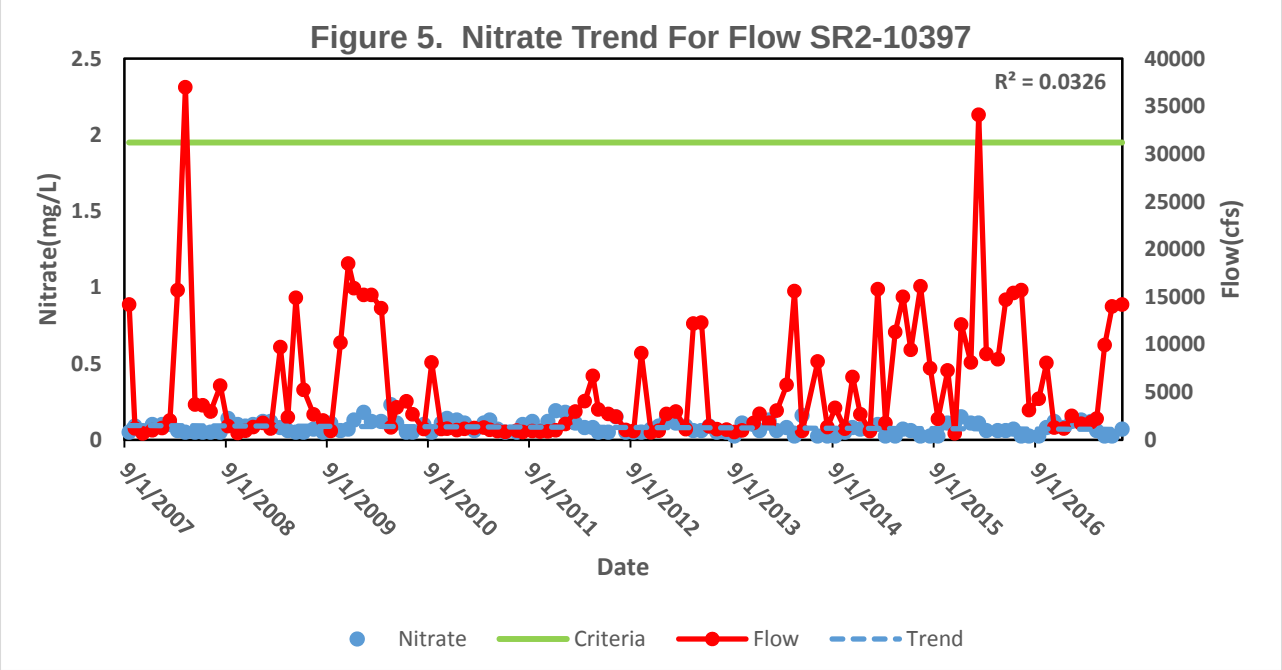
The pH values ranged from 5.6 units to 7.7 units with a mean of 6.9 units, which is between the TSWQS criteria of 6.0 – 8.5 units. Two single grab exceedances were documented from FY 2007 to FY 2017 (Figure 3).



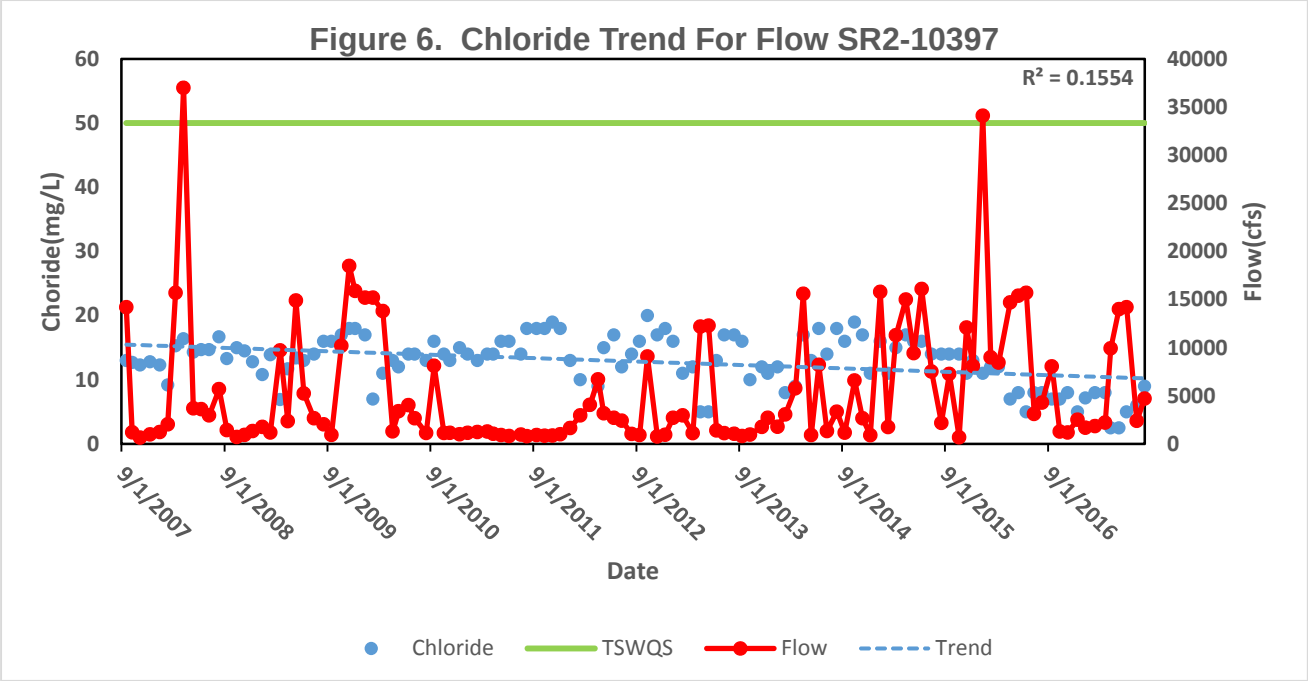
The TDS values ranged from 26 mg/L to 202 mg/L with a mean of 106 mg/L, which is below the TSWQS of 200. Two single grab exceedances were observed from FY 2007 to FY 2017 (Figure 4).



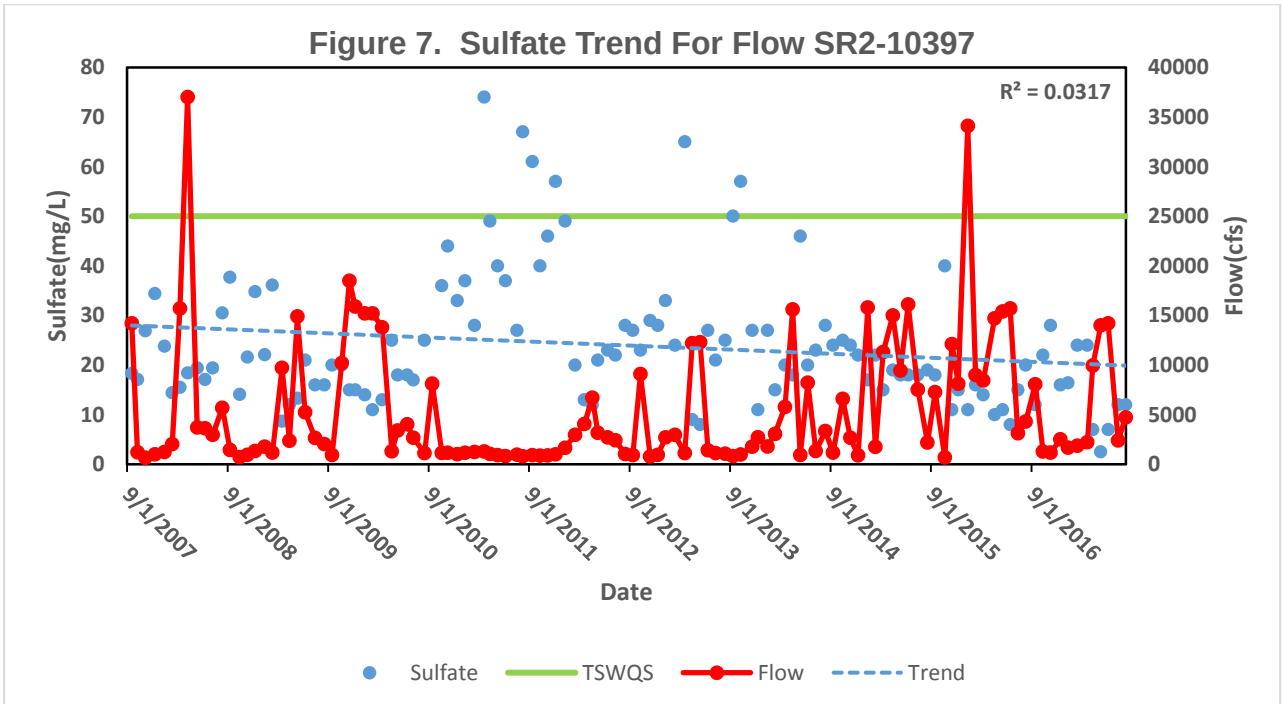
The nitrate values ranged from <0.05 mg/L to 0.23 mg/L with a mean of 0.10 mg/L, which is below the screening criteria of 1.95 mg/L. No single grab exceedance was observed from FY 2007 to FY 2017 (Figure 5).



The chloride values ranged from <5 mg/L to 20 mg/L with a mean of 13 mg/L, which is below the TSWQS of 50 mg/L. No single grab exceedance was observed from FY 2007 to FY 2017 (Figure 6).

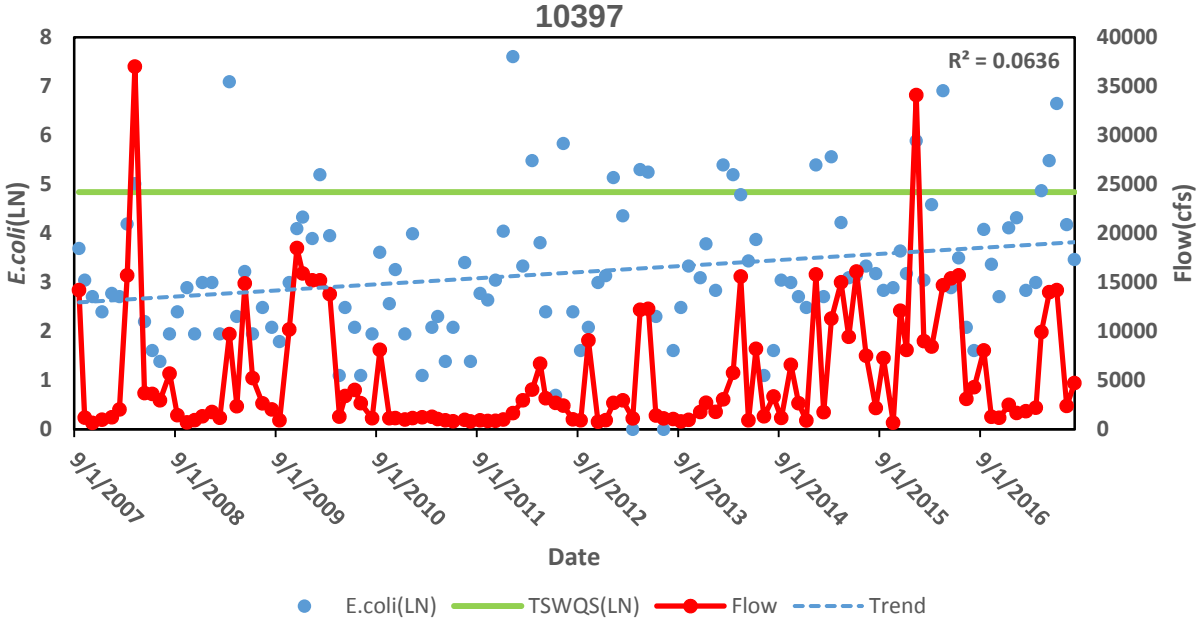


The sulfate values ranged from <5 mg/L to 74 mg/L with a mean of 24 mg/L, which is below the TSWQS of 50 mg/L. Six single grab exceedances were observed from FY 2007 to FY 2017 Figure 7).



The *E. coli* values ranged from 1 MPN/100mL to 2000 MPN/100mL with a geomean of 25 MPN/100mL, which is below the geomean exceedance level of 126 MPN/100mL. Sixteen single grab exceedances were observed from FY 2007 to FY 2017 (Figure 8).

Figure 8. *E. coli* Natural Logarithim (LN) Trend For Flow SR2-10397



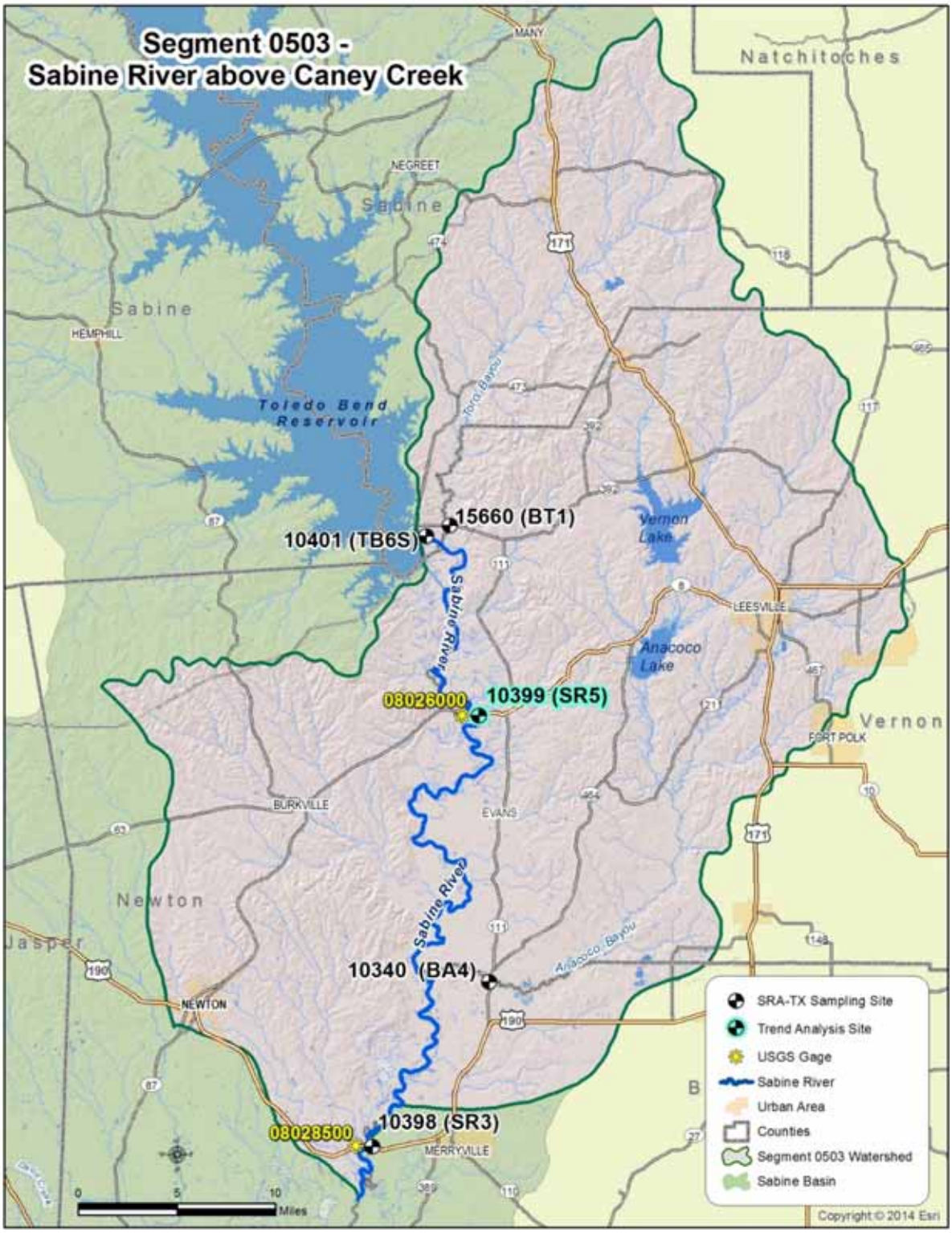
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Sabine River Upstream of SH 12

Segment 0503 - Sabine River above Caney Creek

From a point immediately upstream of the confluence with Caney Creek in Newton County up to Toledo Bend Dam in Newton County.



Segment 0503, Sabine River Above Caney Creek, has a drainage area of 1,176 square miles and is located in the South Central Plains Ecoregion. This region of mostly irregular plains represents the western edge of the southern coniferous forest belt (Table 9) and is locally termed the “pineywoods.”

A large portion of the Segment 0503 watershed is located in Louisiana and is managed by the Louisiana Department of Environmental Quality (LDEQ). The segment is largely rural with no city having a population greater than 5,000 (Tables 9-10). Timber is the main industry in the segment.

The USGS maintains two flow monitoring stations in Segment 0503. They are located on the Sabine River at SH 63 near Burkeville, Texas, and at SH 190 near Bon Wier, Texas. SRA-TX routinely monitors five sites monthly in this segment (Table 11).

Spatial Analysis of Land Use

Table 9. Segment 0503 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	1.3
Developed, Open Space	3.8
Developed, Low Intensity	2.4
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	4.6
Evergreen Forest	31.6
Mixed Forest	5.5
Scrub/Shrub	28.9
Woody Wetlands	16.1
Hay Pasture	3.0
Cultivated Crops	<1
Deciduous Forest	1.3
Emergent Herbaceous Wetlands	<1

*USGS - NLCD 2011

Table 10. Segment 0503 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
15	44,904	5	3	0	38

Table 11. Segment 0503 Monitoring Stations

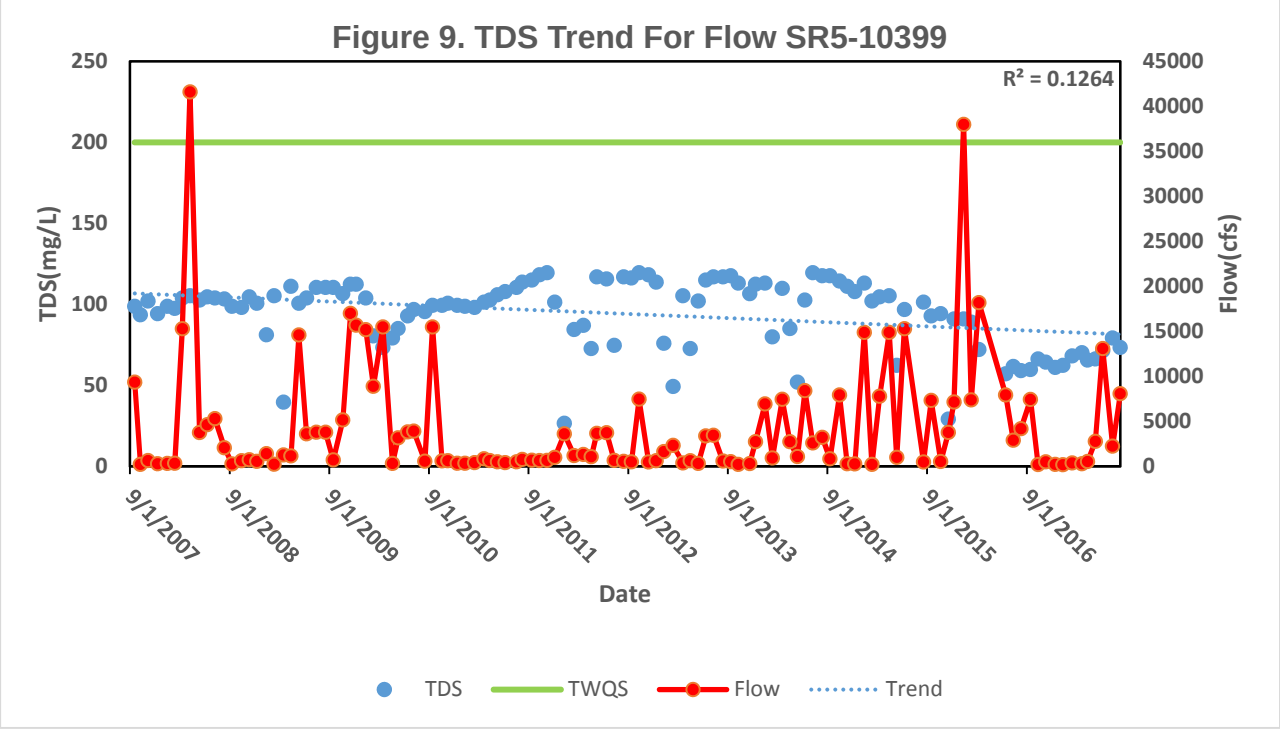
Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10398 (SR3)	SABINE RIVER AT US 190 EAST OF BON WIER, TX.	SRA-TX
10340 (BA4)	ANACOCO BAYOU AT LOUISIANA HWY 111 CROSSING SOUTHWEST OF KNIGHT, LA.	SRA-TX
10399 (SR5)	SABINE RIVER AT SH 63 EAST OF BURKEVILLE, TX.	SRA-TX
10401 (TB6S)	SABINE RIVER BELOW TOLEDO BEND RESERVOIR AT RIGHT ABUTMENT OF SPILLWAY FOR DAM	SRA-TX
15660 (BT1)	BAYOU TORO AT LA SH 392 IN SABINE PARISH SOUTHWEST OF HORNBECK, LA.	SRA-TX

Water Quality Conditions

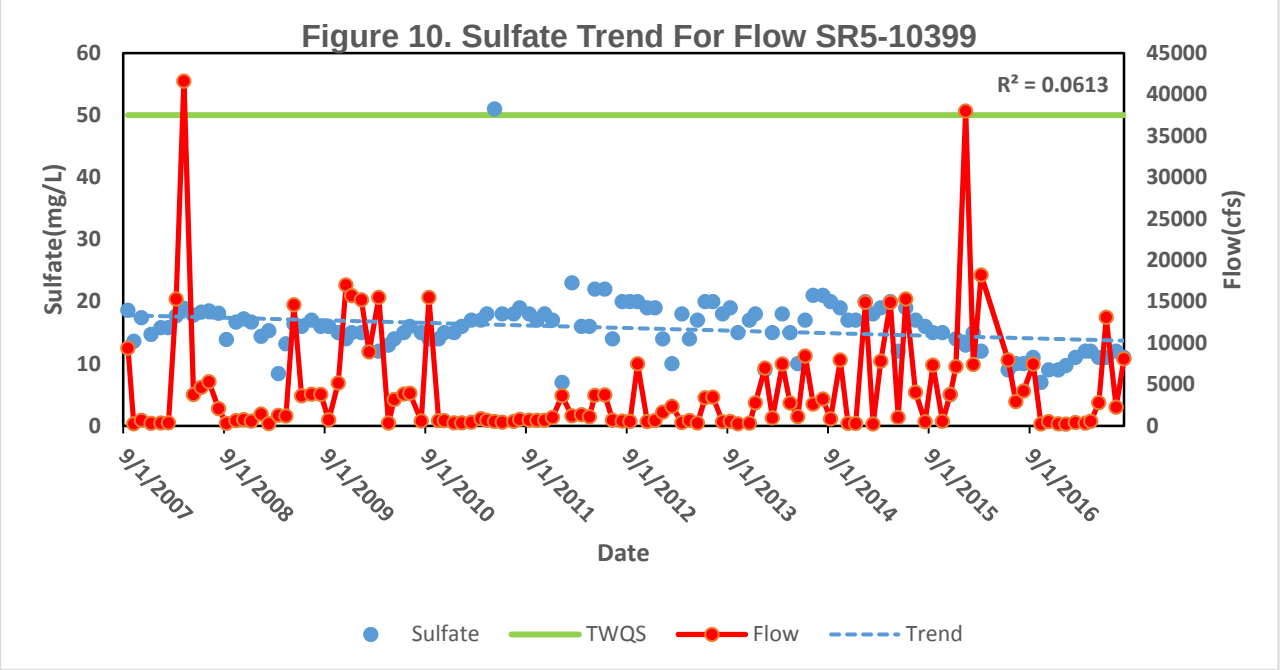
The Draft 2016 Texas Integrated Report indicated no impairments or concerns on the main stem of the Sabine River in Segment 0503. All measured water quality parameters meet TSWQS and fully support this segment's designated uses.

Regression analyses at station 10399 (SR5) indicated TDS, sulfate, and chloride data were significantly related to time. Decreasing trends for each parameter were observed and could be related to increased flows due to an increase in rainfall that was preceded by a period that was dryer than normal.

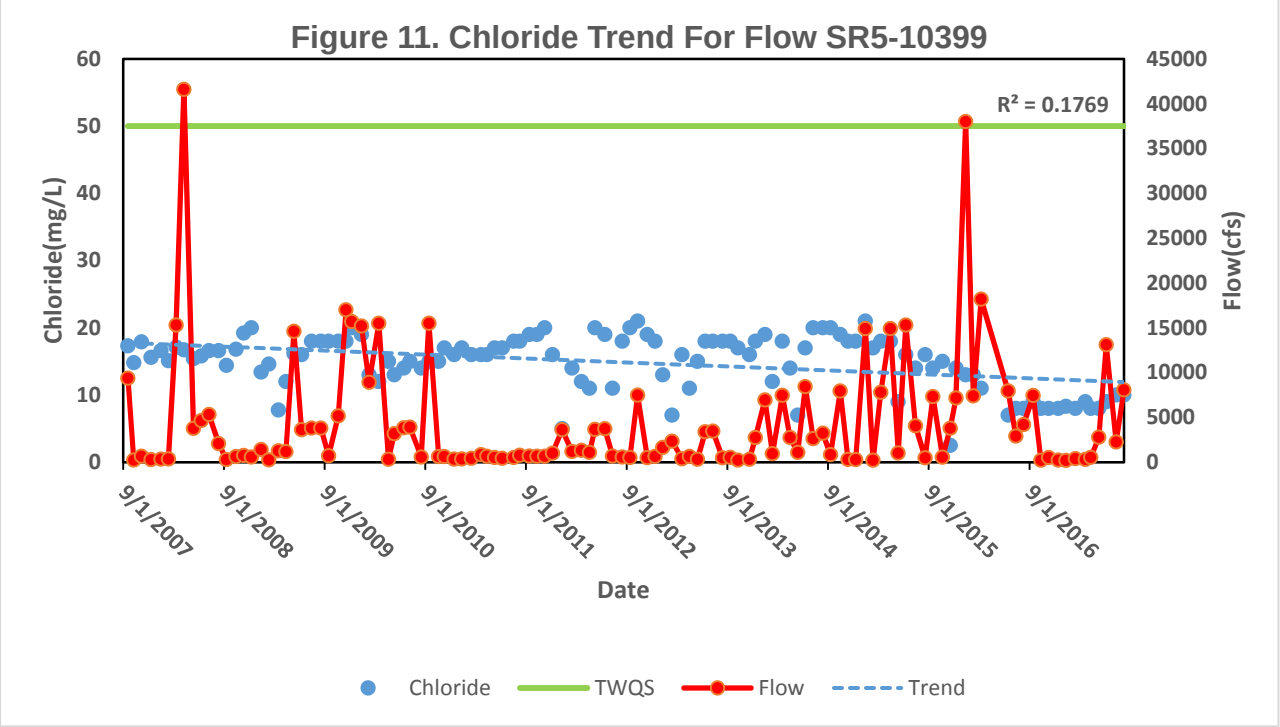
The TDS values ranged from 27 mg/L to 120 mg/L with a mean of 94 mg/L, which is below the TSWQS of 200 mg/l. No single grab exceedances were documented from FY 2007 to FY 2017 (Figure 9).



The sulfate values ranged from 5 mg/L to 51 mg/L with a mean of 16 mg/L, which is below the TSWQS of 50 mg/L. One single grab exceedance was recorded in 2010 (Figure 10).



The chloride values ranged from 2 mg/L to 21 mg/L with a mean of 15 mg/L, which is below the TSWQS of 50 mg/L. No single grab exceedances were documented from FY 2007 to FY 2017 (Figure 11).



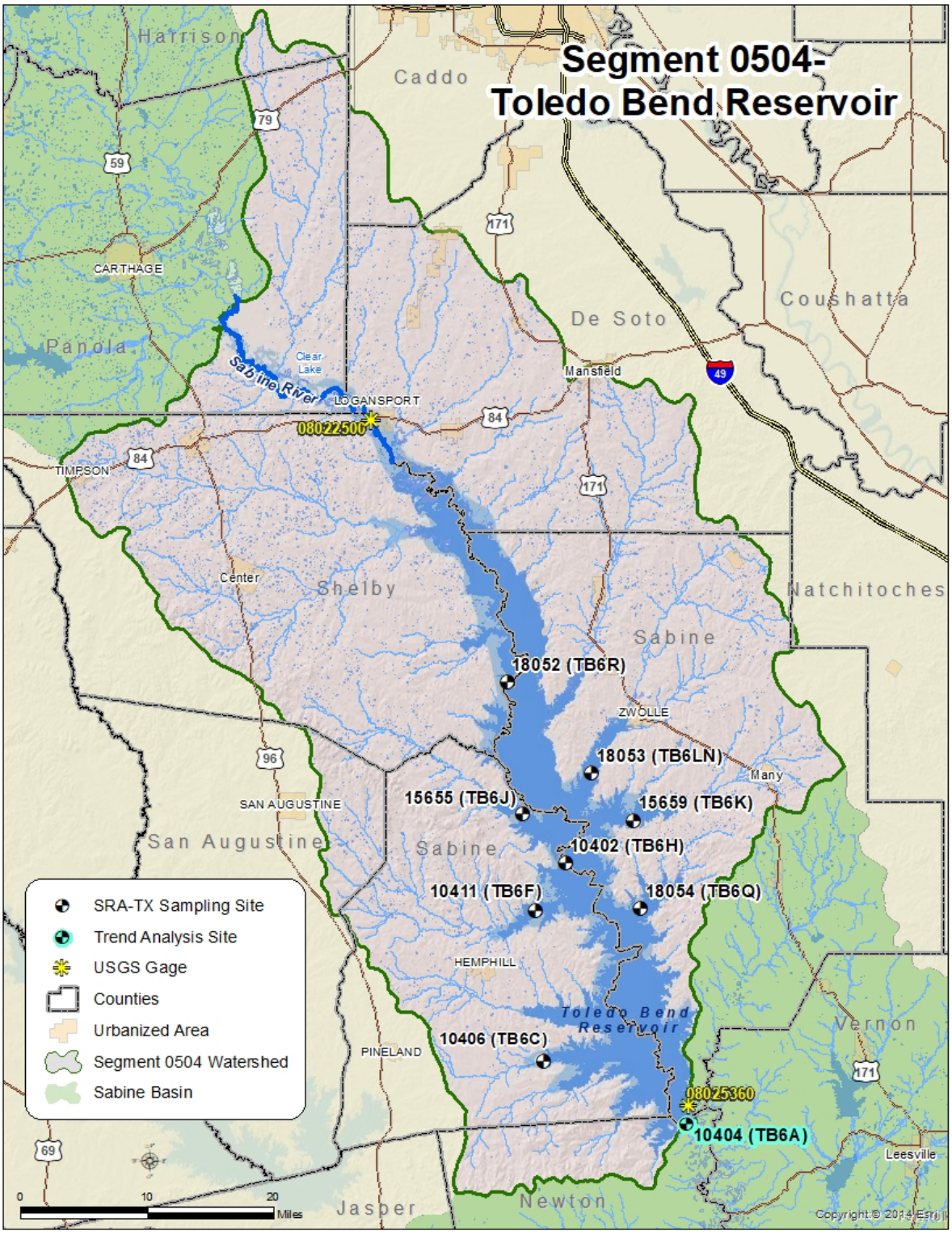
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Sabine River Downstream of US 190

Segment 0504 - Toledo Bend Reservoir

From Toledo Bend Dam in Newton County to a point immediately upstream of the confluence of Murvaul Creek in Panola County, up to the normal pool elevation of 172 feet (impounds Sabine River).



The Toledo Bend Reservoir watershed, with a drainage area of 2,396 square miles, is located in the South Central Plains Ecoregion. This region is locally termed the “pineywoods.” This region of mostly irregular plains represents the western edge of the southern coniferous forest belt and is primarily composed of evergreen forest and woody wetlands (Table 12).

Segment 0504 includes one city of over 5,000 in population, the City of Center, but the segment is largely rural (Table 13).

The USGS maintains gaging stations located on the Sabine River at Logansport, LA, and the Sabine River at Toledo Bend Reservoir near Burkeville, TX. The SRA-TX routinely monitors nine sites monthly in this segment (Table 14).

Spatial Analysis of Land Use

Table 12. Segment 0504 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	8.5
Developed, Open Space	3.0
Developed, Low Intensity	0.9
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	6.0
Evergreen Forest	30.5
Mixed Forest	8.5
Scrub/Shrub	16.4
Woody Wetlands	13.3
Hay Pasture	7.5
Cultivated Crops	<1
Deciduous Forest	3.0
Emergent Herbaceous Wetlands	1.5

*USGS - NLCD 2011

Table 13. Segment 0504 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
34	70,149	15	22	0	29

Table 14. Segment 0504 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10404 (TB6A)	TOLEDO BEND RESERVOIR MAIN LAKE ABOVE THE DAM AT THE OLD RIVER CHANNEL	SRA-TX
10406 (TB6C)	TOLEDO BEND RESERVOIR IN SIX MILE BOAT LANE 0.8 KM EAST OF SH 87	SRA-TX
10411 (TB6F)	TOLEDO BEND RESERVOIR IN SUNSHINE BAY NEAR FM 3121 BRIDGE	SRA-TX
18054 (TB6Q)	TOLEDO BEND RESERVOIR IN NEGREET BAYOU	SRA-TX
10402 (TB6H)	TOLEDO BEND RESERVOIR AT SH 21 NORTHEAST OF MILAM	SRA-TX
15659 (TB6K)	TOLEDO BEND RESERVOIR IN LANANA BAYOU AT LOUISIANA SH 191 IN SABINE PARISH LOUISIANA WEST OF MANY	SRA-TX
15655 (TB6J)	TOLEDO BEND RESERVOIR PATROON BAYOU BRANCH AT FM 276	SRA-TX
18053 (TB6LN)	TOLEDO BEND RESERVOIR SAN MIGUEL ARM BOAT LANE	SRA-TX
18052 (TB6R)	TOLEDO BEND RESERVOIR AT RAGTOWN	SRA-TX

Water Quality Conditions

The Draft 2016 Texas Integrated Report indicated no water quality impairments on Toledo Bend Reservoir.

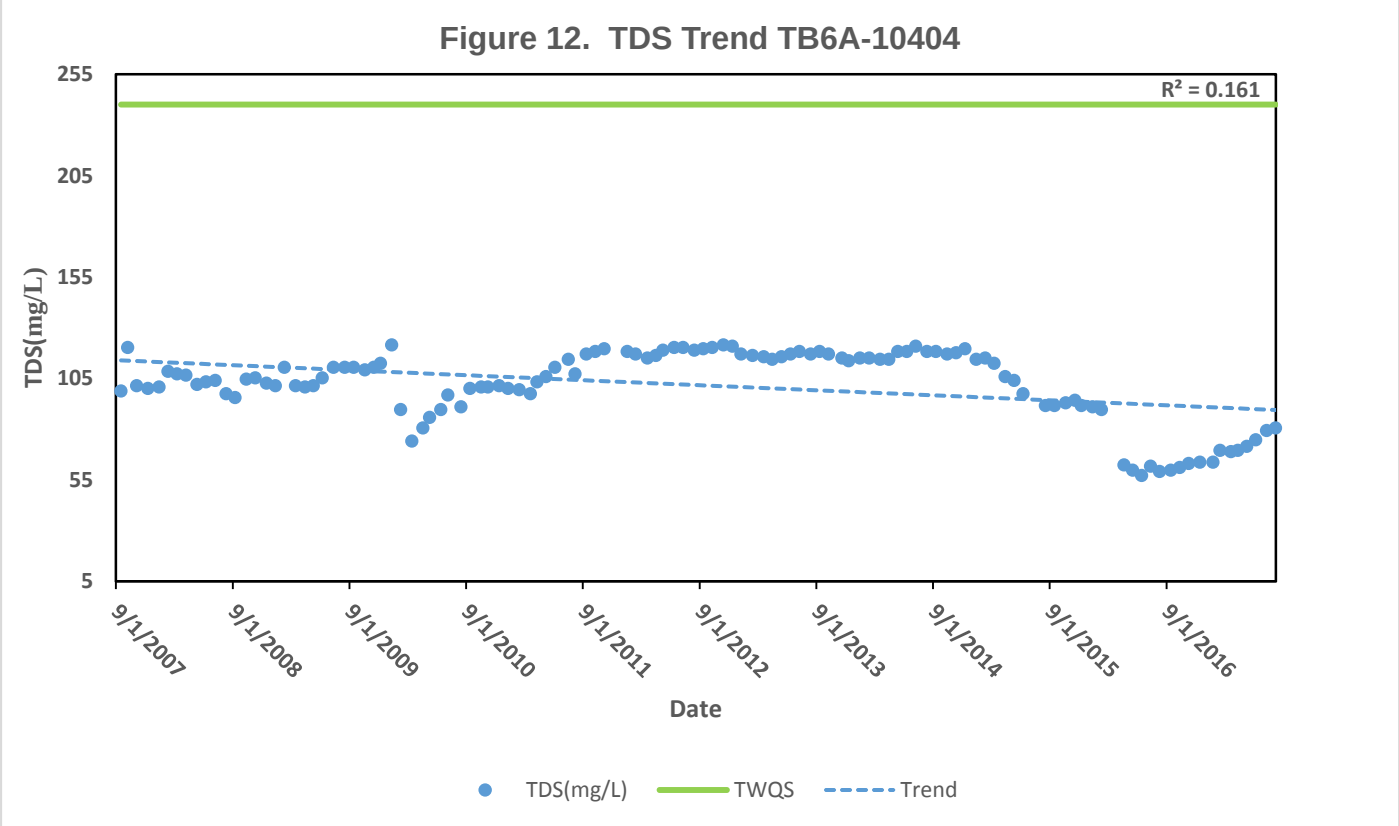
The TDSHS fish consumption advisory issued in November 1995 is still in effect for largemouth bass and freshwater drum due to elevated levels of mercury in fish tissue. Mercury in fish tissue has been found in many water bodies in Texas as well as other southern states. For more information, please see: Mercury in Texas: Background, Federal Rules, Control Technologies, and Fiscal Implications[12]. Four AU's in this segment, 0504_08, 0504_09, 0504_10, and 0504_13, were removed from the Texas 303(d) list for the presence of mercury in edible tissue because of an error in the basis of the original listing. These four AU's are assessed by the LDEQ.

[12]https://www.tceq.texas.gov/assets/public/comm_exec/pubs/sfr/085.pdf, accessed 3/7/2019

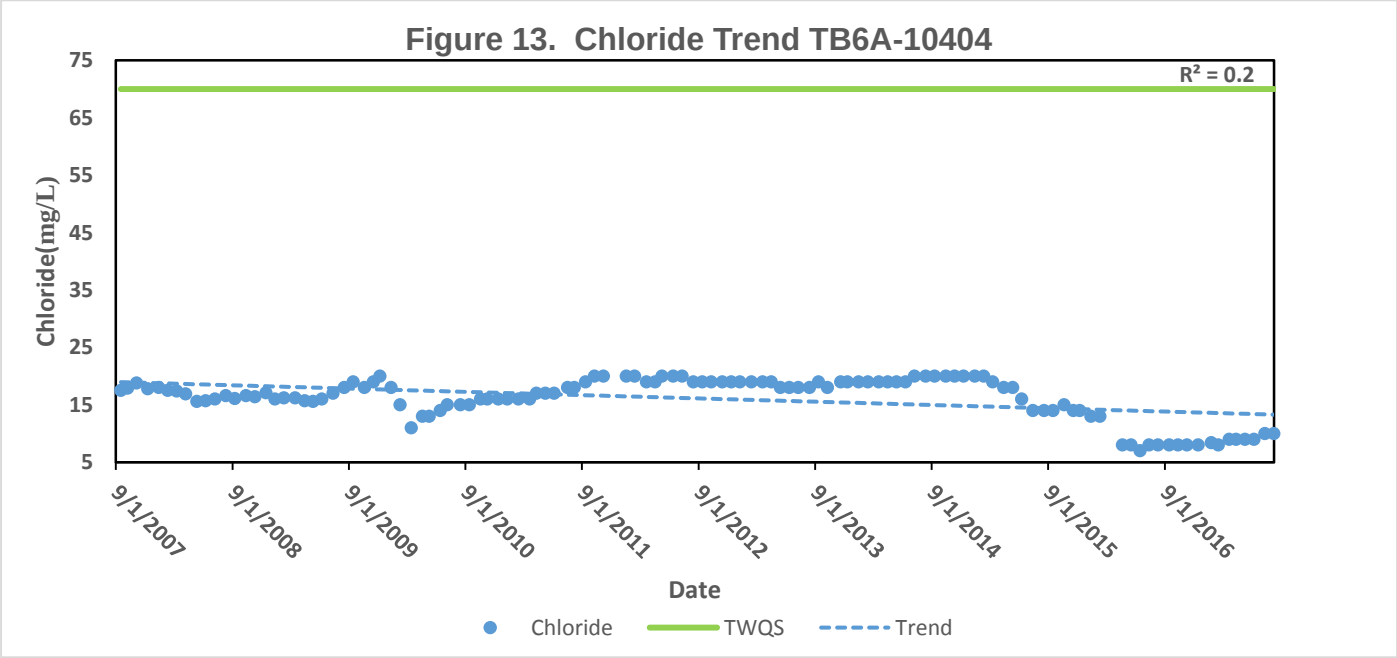
Clear Lake (Segment 0504E), an unclassified water body, is an oxbow lake located 12 miles northwest of Logansport, Louisiana. It is on the 303d list due to a TDSHS consumption advisory for mercury in edible tissue. The segment was first listed in 2006.

Regression analyses at station 10404 (TB6A) indicated TDS, chloride, sulfate, and nitrate data were significantly related to time. Decreasing trends were observed for each parameter.

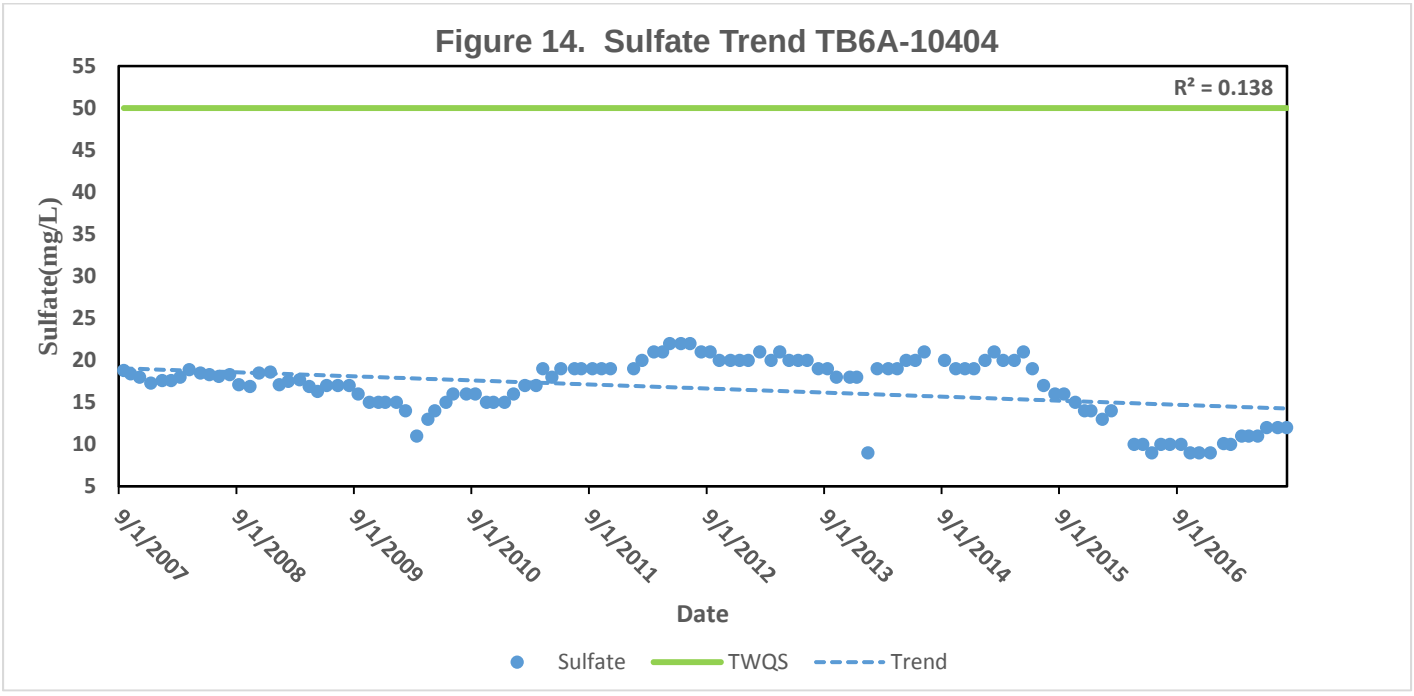
The TDS values ranged from 57 mg/L to 122 mg/L with a mean of 102 mg/L, which is below the TSWQS of 240 mg/L. No single grab exceedance was observed from FY 2007 to FY 2017 (Figure 12).



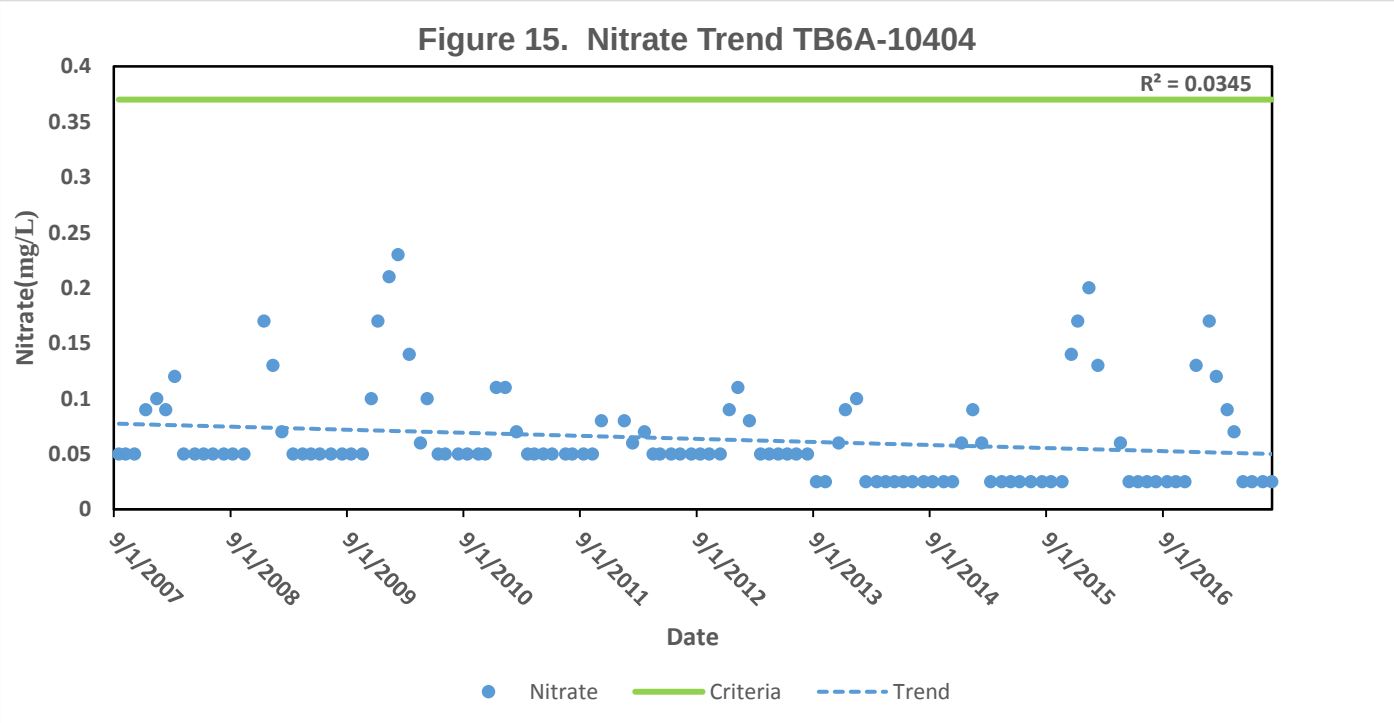
The chloride values ranged from 7 mg/L to 20 mg/L with a mean of 16 mg/L, which is below the TSWQS of 70 mg/L. No single grab exceedance was observed from FY 2007 to FY 2017 (Figure 13).



The sulfate values ranged from <5 mg/L to 22 mg/L with a mean of 17 mg/L, which is below the TSWQS of 50 mg/L. No single grab exceedance was observed from FY 2007 to FY 2017 (Figure 14).



The nitrate values ranged from <0.05 mg/L to 0.23 mg/L with a mean of 0.06 mg/L, which is below the screening criteria of 0.37 mg/L. No single grab exceedance was observed from FY 2007 to FY 2017 (Figure 15).



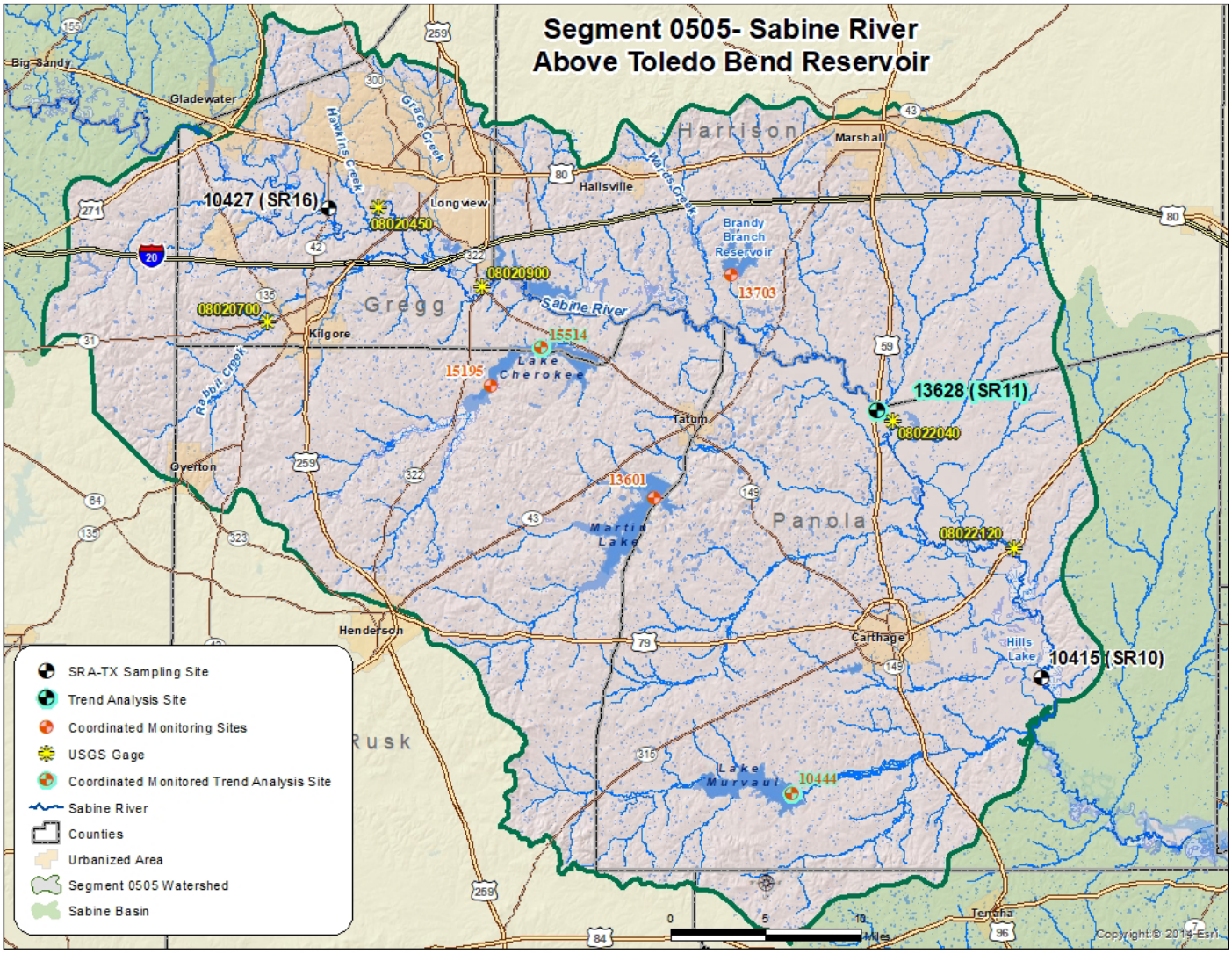
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Toledo Bend Reservoir

Segment 0505 - Sabine River above Toledo Bend Reservoir

From a point immediately upstream of Murvaul Creek in Panola County to a point 100 meters (110 yards) downstream of US 271 in Gregg County.



Segment 0505, with a drainage area of 1,698 square miles, is located in the South Central Plains Ecoregion and is characterized by evergreen and mixed forest and hay pasture (Table 15).

This segment includes numerous industries, oilfields, and all or part of six cities (Carthage, Marshall, Kilgore, Longview, White Oak, and Gladewater) with populations greater than 5,000, the highest concentration of population in the Sabine Basin (Table 16).

Tributary watersheds within this segment include Segment 0509 (Murvaul Lake), and Segment 0510 (Lake Cherokee). The SRA-TX routinely monitors four sites monthly and the TCEQ monitors two sites quarterly in this segment (Table 17).

The USGS maintains gaging stations located on the Sabine River near Carthage, TX, the Sabine River near Beckville, TX, the Sabine River below Longview, TX, the Sabine River above Longview, TX, and Rabbit Creek at Kilgore, TX.

Spatial Analysis of Land Use

Table 15. Segment 0505 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	2.1
Developed, Open Space	3.9
Developed, Low Intensity	5.7
Developed, Medium Intensity	1.4
Developed, High Intensity	<1
Barren Land	1.1
Herbaceous	2.3
Evergreen Forest	18.0
Mixed Forest	11.5
Scrub/Shrub	11.2
Woody Wetlands	11.5
Hay Pasture	17.8
Cultivated Crops	<1
Deciduous Forest	11.7
Emergent Herbaceous Wetlands	<1

*USGS - NLCD 2011

Table 16. Segment 0505 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
13	208,922	71	41	3	123

Table 17. Segment 0505 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10415 (SR10)	SABINE RIVER AT FM 2517	SRA-TX
13628 (SR11)	SABINE RIVER AT US 59	SRA-TX
10427 (SR16)	SABINE RIVER AT SH 42	SRA-TX
13703	BRANDY BRANCH RESERVOIR AT MID LAKE NEAR DAM APPROXIMATELY 6 MI SOUTHEAST OF HALLSVILLE	TCEQ
13601	MARTIN CREEK RESERVOIR HISTORICAL AREA 2 OF SOUTHEAST MONITORING PROGRAM AREA SOUTH AND WEST FROM AREA 1 TO 1ST BRIDGE OF WEIR CREEK	TCEQ

Water Quality Conditions

Sabine River Segment 0505_04, first listed in 2002, was included on the Draft 2016 Texas Integrated Report 303(d) List for bacteria. The geometric mean for data collected from FY 2007 through FY 2014 was 174 MPN/100ML, which exceeds the TSWQS criteria of 126 MPN/100ML. This data was collected by the TIAER for a special study to address contact recreation in Grace Creek and the Sabine River in the City of Longview. This data was used for the Draft 2016 Texas Integrated Report, but not for the analysis in this report because the site was not a trend site. All remaining water quality parameters in this segment meet the TSWQS and support their designated uses.

Grace Creek (Segment 0505B), first listed in FY 2000, is on the Draft 2016 Integrated Report 303(d) List for bacteria and a concern for depressed dissolved oxygen. An RUAA to address elevated bacteria has been completed on Grace Creek. The RUAA findings support the revision of Grace Creek from PCR to SCR1. More information on the RUAA can be found at the TCEQ Recreational Use Attainability Analyses Site[13]. Grace Creek (Segment 0505B_02) has been removed from the Draft 2016 Texas Integrated Report 303(d) List for depressed dissolved oxygen.

[13] https://www.tceq.texas.gov/waterquality/standards/ruaas/multisabine05 accessed 3/7/2019

Rabbit Creek (Segment 0505D), an unclassified water body, is listed on the Draft 2016 Integrated Report with a concern for bacteria.

Wards Creek (Segment 0505G), first listed in FY 2000, remains on the Draft 2016 Integrated Report 303(d) List for depressed dissolved oxygen. Wards Creek also has a concern for impaired habitat. Depressed dissolved oxygen levels are not uncommon in small, rural, low gradient streams with seasonal flow.

Hills Lake (Segment 0505O), an oxbow lake 13 miles east of Carthage, was first listed in 2006 and remains on the Draft 2016 Integrated Report 303(d) List due to a TDSHS fish consumption advisory for mercury in edible tissue.

Regression analyses at station 13628 (SR11) indicated no parameters were significantly related to time.

Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Sabine River at US 59

Segment 0506 - Sabine River Below Lake Tawakoni
From a point 100 meters (110 yards) downstream of US 271 in Gregg County to Iron Bridge Dam in Rains County.

The Segment 0506 watershed has a drainage area of 1,091 square miles. The majority of this watershed is located in the East Central Texas Plains Ecoregion with the remainder in the South Central Plains Ecoregion. This segment is characterized by low rolling hills with hay pasture and deciduous forest (Tables 18 – 19).

Segments 0512 (Lake Fork Reservoir), 0514 (Big Sandy Creek), and 0515 (Lake Fork Creek) are tributaries to Segment 0506. The SRA-TX routinely monitors three sites monthly and the TCEQ monitors four sites quarterly in this segment (Table 20).

The USGS maintains gaging stations located on the Sabine River near Gladewater, TX, the Sabine River near Hawkins, TX, and the Sabine River near Mineola, TX.

Spatial Analysis of Land Use

Table 18. Segment 0506 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	1.6
Developed, Open Space	2.0
Developed, Low Intensity	5.7
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	<1
Evergreen Forest	4.0
Mixed Forest	<1
Scrub/Shrub	8.1
Woody Wetlands	13.6
Hay Pasture	36.9
Cultivated Crops	3.4
Deciduous Forest	22.5
Emergent Herbaceous Wetland	<1

*USGS - NLCD 2011

Table 19. Segment 0506 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
45	87,106	27	25	1	80

Table 20. Segment 0506 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10428 (SR17)	SABINE RIVER AT US 271	SRA-TX
10429 (SR19)	SABINE RIVER AT SH 14 SOUTH OF HAWKINS	SRA-TX
10430 (SR21)	SABINE RIVER AT US 69	SRA-TX
17062	LAKE GLADEWATER AT RAW WATER INTAKE STRUCTURE FOR THE CITY OF GLADEWATER APPROXIMATELY 2.5 KM NORTHWEST OF THE INTERSECTION OF US 271 AND US 80	TCEQ
14422	LAKE HAWKINS 34 M UPSTREAM FROM DAM AND 233 M EAST OF WEST BANK	TCEQ
18512	LAKE HAWKINS 435 M SOUTH AND 165 M EAST OF FM 2869 BRIDGE AT WOOD CR 4320	TCEQ
21823	TYLER STATE PARK 125 M EAST OF THE CENTER OF THE DAM AND APPROXIMATELY 1.2 KM NORTH AND 2.5 KM WEST OF THE INTERSECTION OF I-20 AND SH 14 IN SMITH COUNTY	TCEQ

Water Quality Conditions

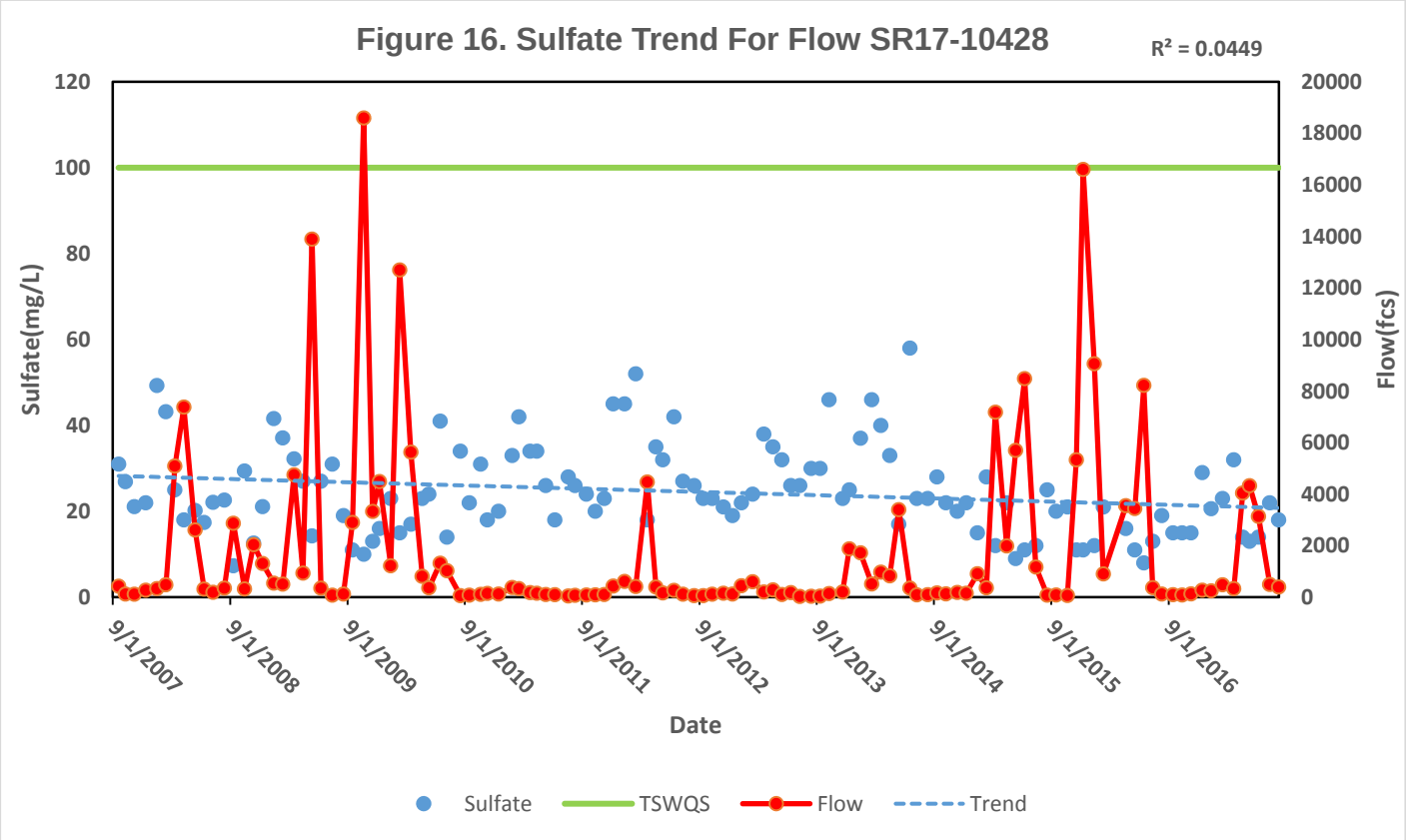
The Draft 2016 Integrated Report indicated a concern for near non-attainment in AUs 0506_01 and 0506_03 for bacteria. Elevated bacteria levels were associated with increased flows and elevated turbidity from rainfall runoff. This area is largely rural and potential sources of elevated bacteria include wildlife and other non-point sources.

Harris Creek (Segment 506A), first listed in 2000, was included on the Draft 2016 Integrated Report 303(d) list for depressed dissolved oxygen and a concern for near non-attainment for bacteria.

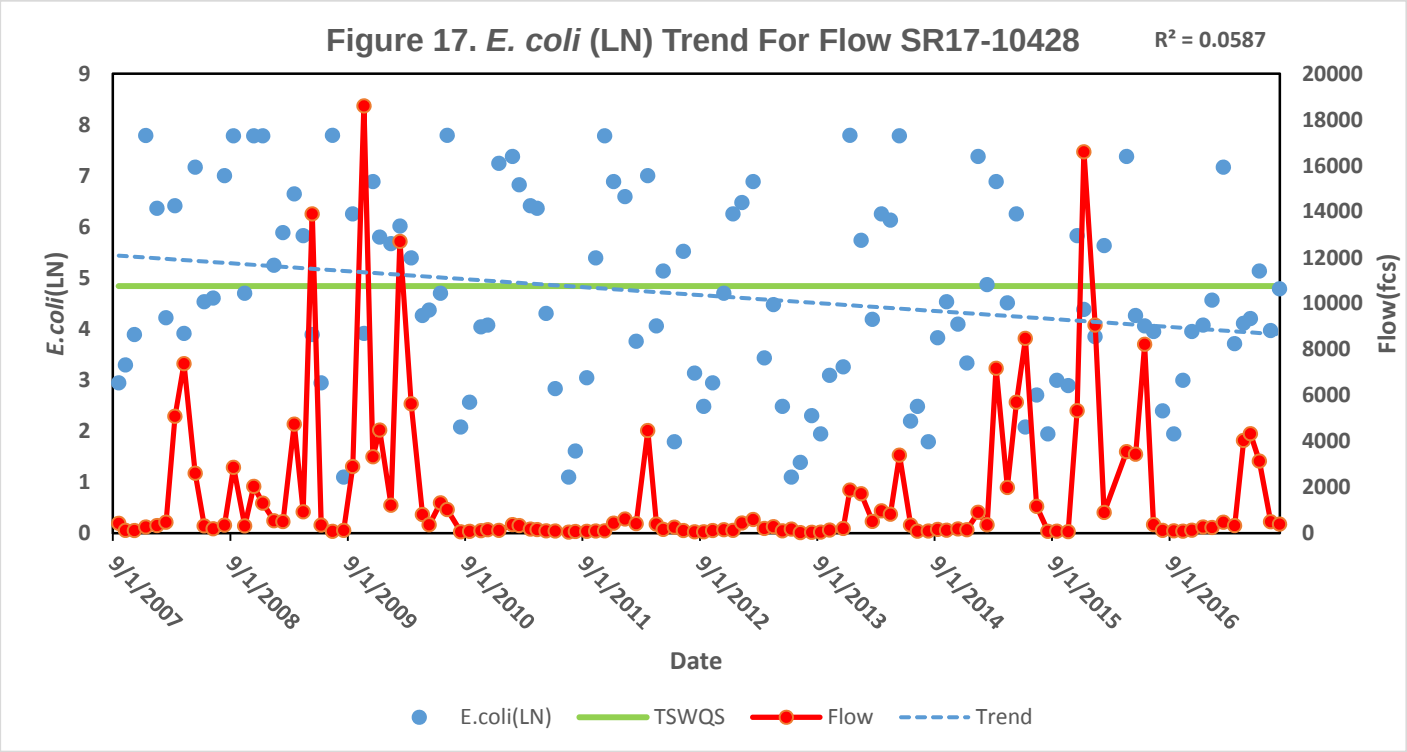
Wiggins Creek (Segment 0506C) has a concern for near non-attainment for depressed dissolved oxygen and a screening level concern for ammonia.

Regression analyses at station 10428 (SR17) indicated sulfate and *E. coli* data were significantly related to time. Decreasing trends for each parameter were observed. The sulfate trend could be related to increased flows due to an increase in rainfall that was preceded by a period that was dryer than normal. The decreasing trend in bacteria may be flow and drought related.

The sulfate values ranged from 7 mg/L to 58 mg/L with a mean of 25 mg/L, which is below the TSWQS of 100 mg/L. No single grab exceedances were documented from FY 2007 to FY 2017 (Figure 16).



The geometric mean for *E. coli* was 107 MPN/100mL, which is below the TSWQS of 126 MPN/100mL. The minimum *E. coli* value was 3 MPN/100mL and the maximum was 2420 MPN/100mL. Thirty-five single grab exceedances were observed from FY 2007 to FY 2017 (Figure 17).



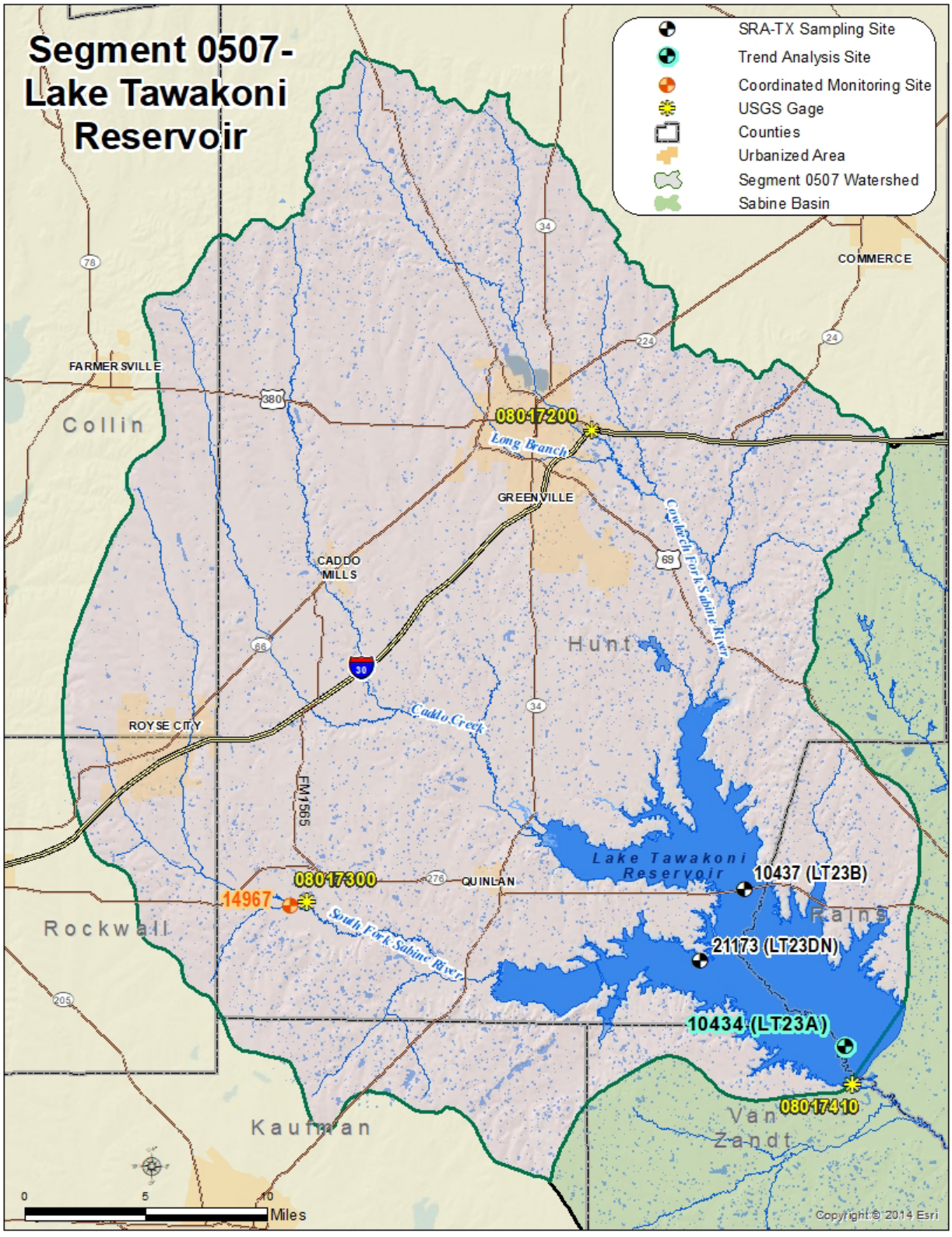
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Sabine River Upstream of SH 19

Segment 0507 - Lake Tawakoni Reservoir

From Iron Bridge Dam in Rains County up to normal pool elevation of 437.5 feet AMSL (impounds Sabine River).



Lake Tawakoni Reservoir, with a drainage area of 710 square miles, is in the Texas Blackland Prairies Ecoregion and is characterized by low rolling hills with areas of post oaks, elms, and pines. The Texas Blackland Prairies Ecoregion is composed of black, calcareous, alkaline, heavy clay soils. Although mostly rural pasture this watershed includes Greenville, one of the four largest cities in the basin. The significant influences in this segment to the water quality are urban and agricultural activities (Tables 21-22).

The USGS maintains gaging stations located on the Sabine River near Wills Point, TX, the South Fork of the Sabine River near Quinlan, TX, and the Cowleech Fork of the Sabine River near Greenville, TX. The SRA-TX routinely monitors three sites monthly and the TCEQ monitors one site monthly in this segment (Table 23).

Spatial Analysis of Land Use

Table 21. Segment 0507 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	7.3
Developed, Open Space	5.6
Developed, Low Intensity	3.2
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	26.2
Evergreen Forest	<1
Mixed Forest	<1
Scrub/Shrub	1.6
Woody Wetlands	2.5
Hay Pasture	24.0
Cultivated Crops	12.8
Deciduous Forest	14.1
Emergent Herbaceous Wetlands	<1

USGS - NLCD 2011

Table 22. Segment 0507 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
37	93,657	36	8	0	132

Table 23. Segment 0507 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10434 (LT23A)	LAKE TAWAKONI IN THE MAIN LAKE NEAR DAM	SRA-TX
10437 (LT23B)	LAKE TAWAKONI AT SH 276	SRA-TX
21173 (LT23DN)	LAKE TAWAKONI IN WACO BAY EQUIDISTANT FORM FINGER POINT AND SPRING POINTS 1.17 KM BEARING 18.61 DEGREES FROM IRON BRIDGE PUMPING STATION	SRA-TX
14967	SOUTH FORK OF SABINE RIVER AT FM 1565 APPROXIMATELY 8.34 KM WEST OF QUINLAN	TCEQ

Water Quality Conditions

The Cowleech Fork Arm of Lake Tawakoni (0507_04) has been removed from the Draft 2016 Integrated Report 303(d) List for elevated pH. All measured water quality parameters meet TSWQS and fully support this segment's designated uses.

The Draft 2016 Integrated Report indicated a concern for depressed dissolved oxygen and nitrate in Cowleech Fork of the Sabine River (Segment 0507A) and chlorophyll-a in 0507A_02, an unclassified water body. Depressed dissolved oxygen levels are not uncommon in small, rural, low gradient streams with seasonal flow.

Long Branch (Segment 0507B), an unclassified water body, was included on the Draft 2016 Integrated Report with a concern for nitrate. Potential causes for this concern are municipal non-point sources.

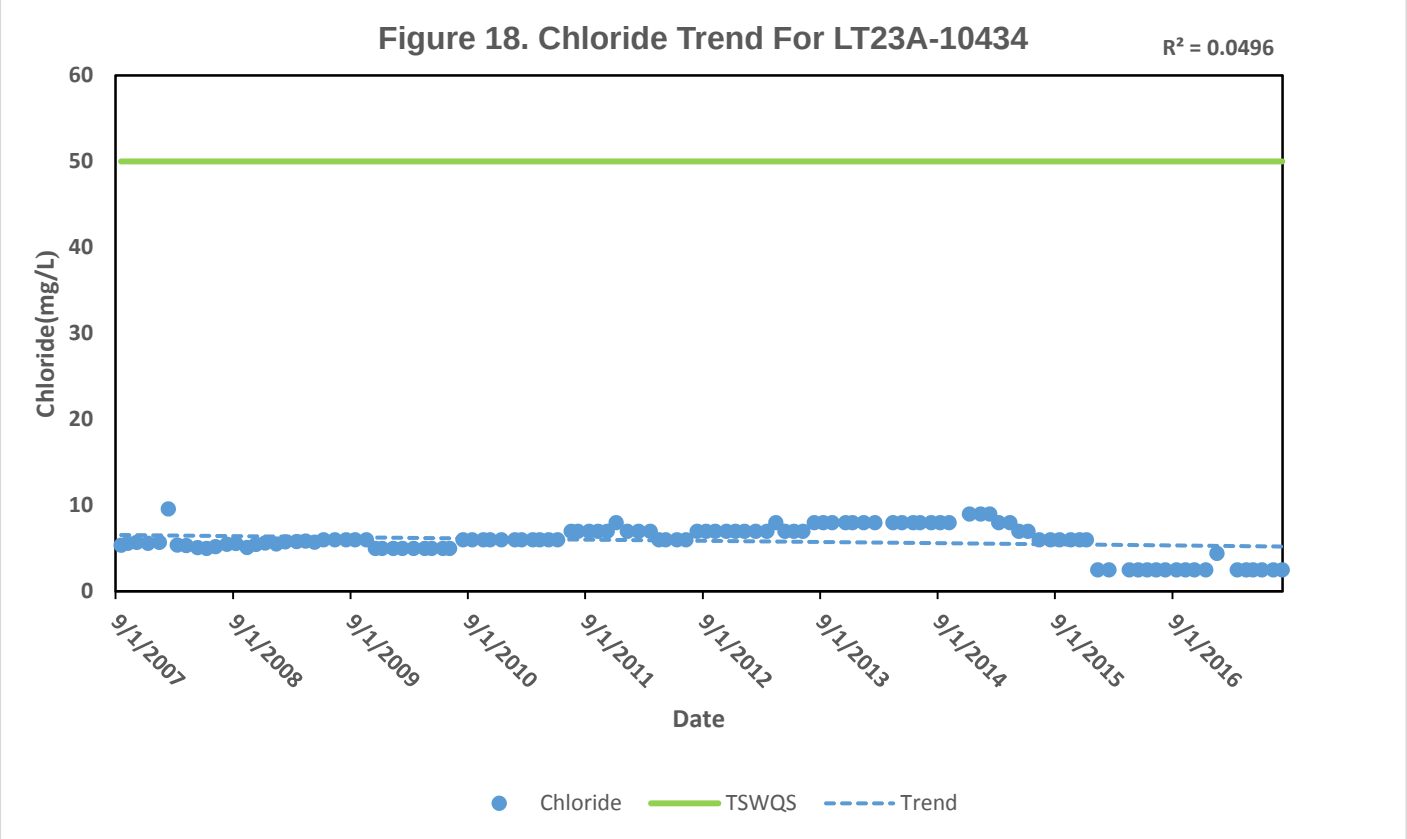
The South Fork of Sabine River (Segment 0507G), first listed in 2006, is on the Draft 2016 Integrated Report 303(d) List for bacteria. An RUAA has been completed and RUAA findings support the

revision of the South Fork of the Sabine River from PCR1 to SCR1. More information on the RUAA can be found at the TCEQ Recreational Use Attainability Analyses website[14].

Caddo Creek (Segment 0507H), an unclassified water body, was included on the Draft 2016 Integrated Report for a concern for depressed dissolved oxygen.

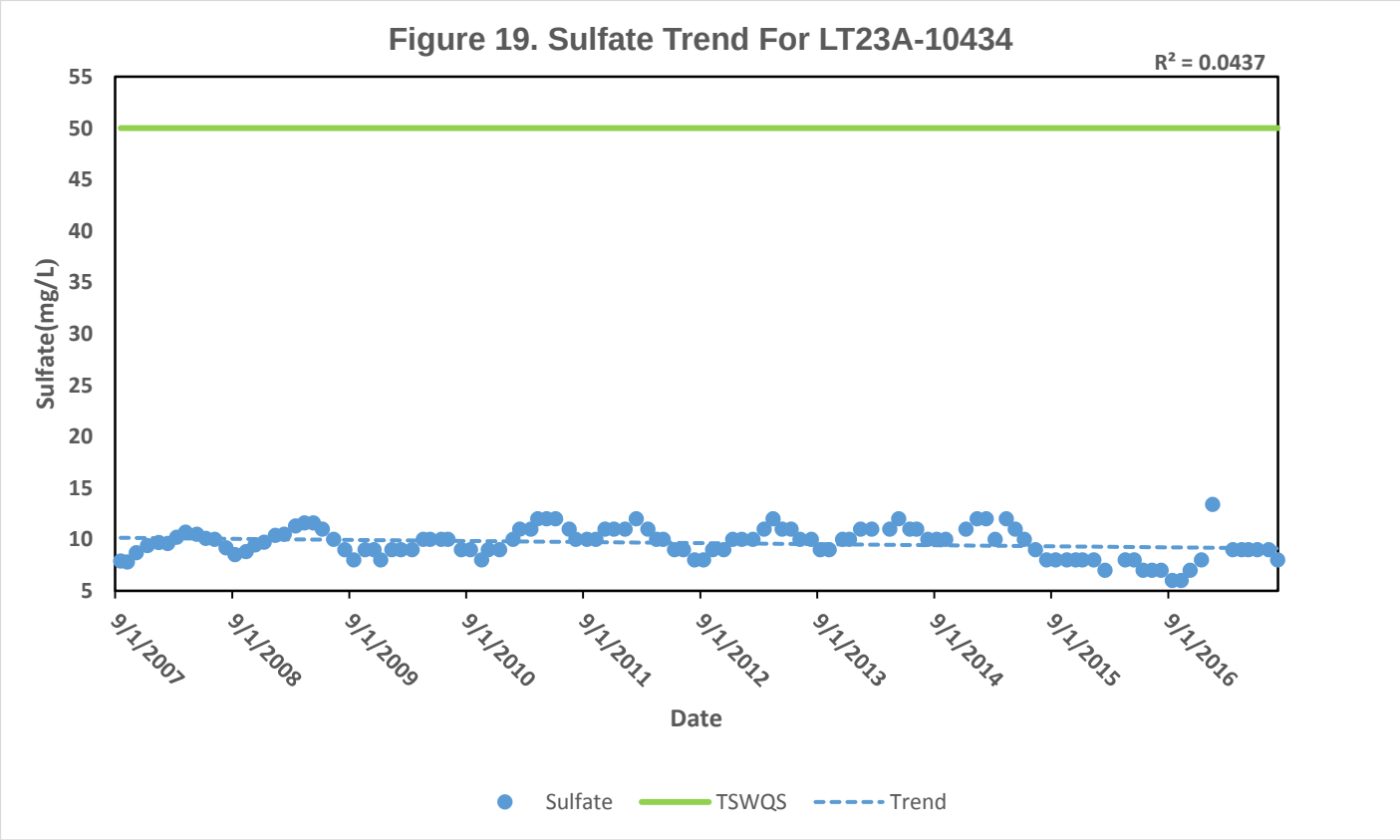
Regression Analyses at station 10434 (LT23A) indicated chloride and sulfate data were significantly related to time. Decreasing trends for each parameter were observed and could be related to non-drought conditions and higher lake levels.

The chloride values ranged from 3 mg/L to 10 mg/L with a mean of 6 mg/L, which is below the TSWQS of 50 mg/L. No single grab exceedances were documented from FY 2007 to FY 2017 (Figure 18).



The sulfate values ranged from 6 mg/L to 13 mg/L with a mean of 10 mg/L, which is below the TSWQS of 50 mg/L. No single grab exceedances were documented from FY 2007 to FY 2017 (Figure 19).

[14] https://www.tceq.texas.gov/waterquality/standards/ruaas/multisabine05, accessed 3/7/2019



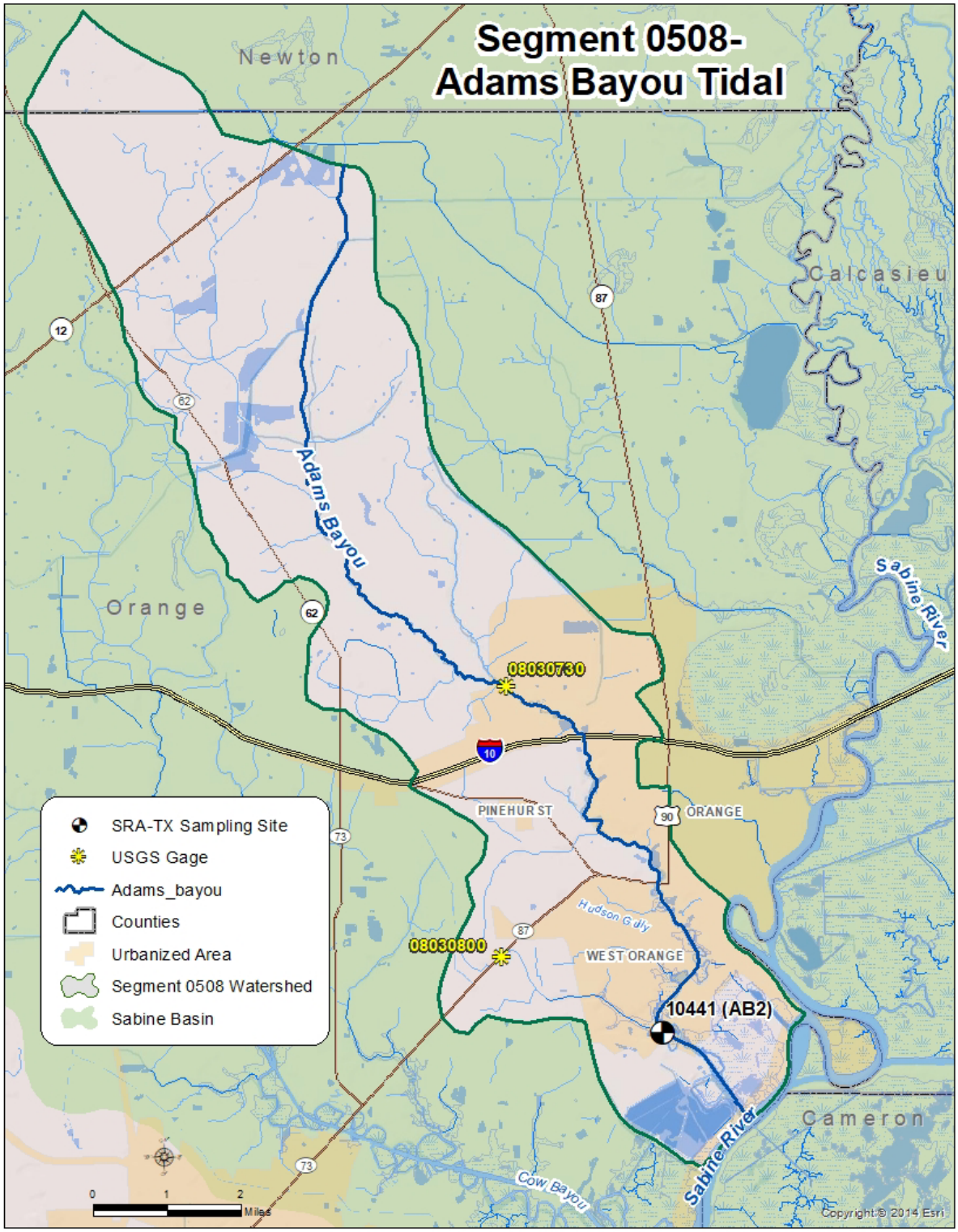
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Lake Tawakoni

Segment 0508 - Adams Bayou Tidal

From the confluence with the Sabine River in Orange County to a point 1.1 kilometers (0.7 miles) upstream of IH 10 in Orange County.



The Adams Bayou Tidal watershed, with a drainage area of 51 square miles, is located in the Western Gulf Coastal Plains Ecoregion. This area is characterized by hay pasture, woody wetlands, and relatively flat terrain (Tables 24 - 25). The watershed includes part of the City of Orange and has a significant rural population. Adams Bayou Tidal is a tributary to the Sabine River Tidal (Segment 0501) watershed.

The SRA-TX routinely monitors one site monthly in this segment (Table 26).

The USGS maintains gaging stations located on Adams Bayou at FM 3247 near Orange, TX, and Adams Bayou at SH 87 near Orange, TX.

Spatial Analysis of Land Use

Table 24. Segment 0508 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	2.7
Developed, Open Space	11.0
Developed, Low Intensity	12.8
Developed, Medium Intensity	3.3
Developed, High Intensity	2.5
Barren Land	<1
Herbaceous	4.4
Evergreen Forest	3.5
Mixed Forest	3.9
Scrub/Shrub	4.4
Woody Wetlands	20.0
Hay Pasture	23.6
Cultivated Crops	2.5
Deciduous Forest	<1
Emergent Herbaceous Wetlands	5.1

*USGS - NLCD 2011

Table 25. Segment 0508 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
23	18,301	4	2	1	359

Table 26. Segment 0508 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10441 (AB2)	ADAMS BAYOU AT FM 1006	SRA-TX

Water Quality Conditions

Segment 0508 was included in the OCTMDL Project, initiated in 2002, to address impairments for depressed dissolved oxygen and elevated bacteria in Adams Bayou. The Draft 2016 Integrated Report indicated concerns for depressed dissolved oxygen and depressed pH on the main stem of the segment.

Adams Bayou above Tidal (Segment 0508A), an unclassified water body, is impaired for depressed dissolved oxygen) on the Draft 2016 Integrated Report.

Gum Gully (Segment 0508B), an unclassified water body, is listed as impaired for depressed dissolved oxygen and bacteria (recreational use) on the Draft 2016 Integrated Report.

Hudson Gully (Segment 0508C), an unclassified water body, has a concern for depressed dissolved oxygen and an impairment for bacteria and depressed dissolved oxygen on the Draft 2016 Integrated Report.

Segment 0508 showed a decreasing trend for *Enterococcus*, much like Segment 0501, but has not rebounded as quickly as Segment 0501.

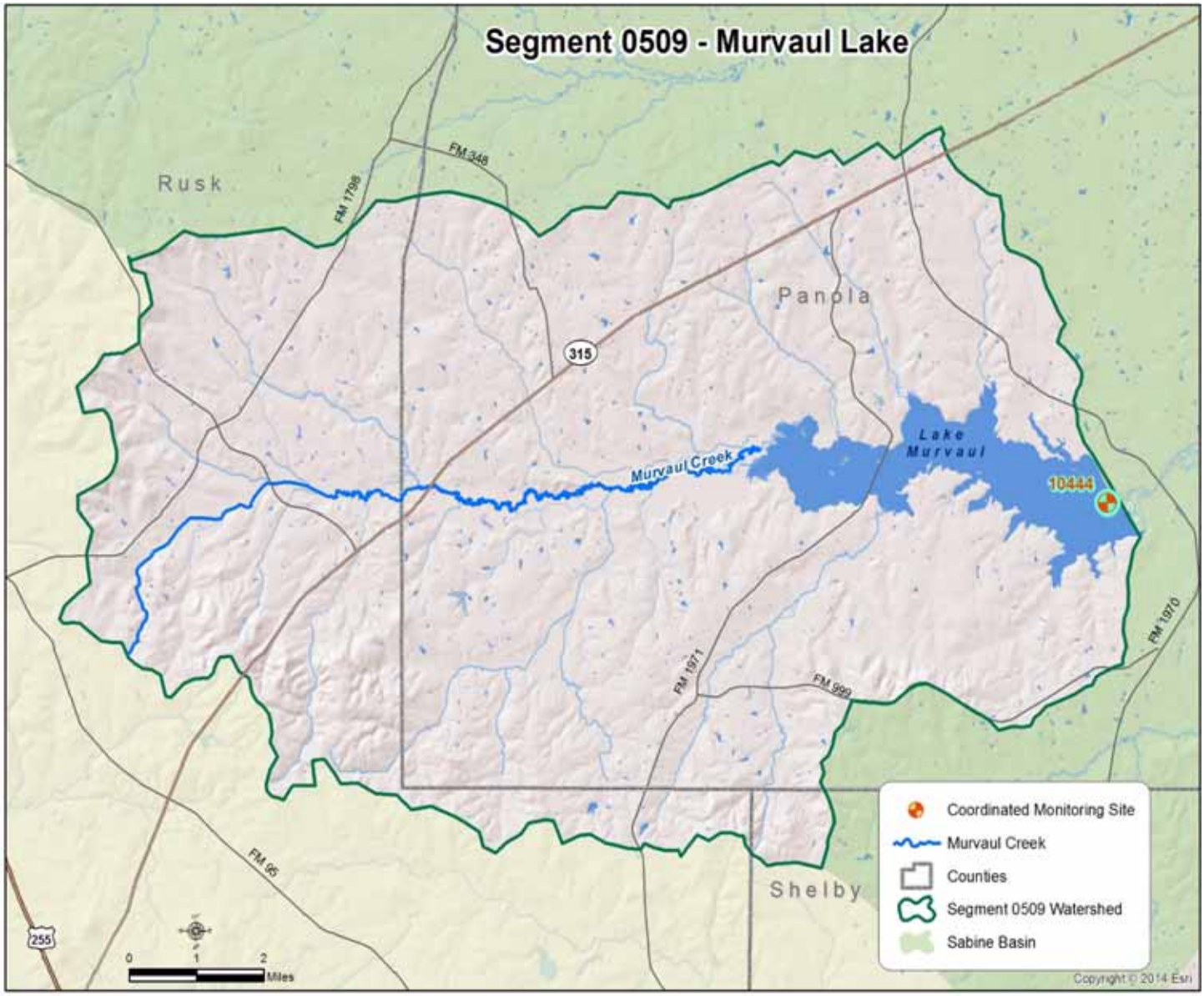
Regression analyses were not performed on this segment due to a limited data set. The OCTMDL I-Plan was approved in August 2015 restricting the amount of time available to amass a sufficient amount of data.

Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment. Sampling sites may be added at a later date to help assess the effectiveness of I-Plan management measure activities conducted during the previous years.

Segment 0509 - Murvaul Lake

From Murvaul Dam in Panola County up to the normal pool elevation of 266.3 feet AMSL (impounds Murvaul Bayou).



The Lake Murvaul watershed, with a drainage area of 201 square miles, is located in the South Central Plains Ecoregion and is characterized by low rolling hills with hay pasture and mixed forest (Tables 27-28). The reservoir controlling authority is the Panola County Freshwater District. Water quality influences include residential, agricultural, and oil field activities.

The TCEQ monitors one site quarterly in this segment (Table 29).

Spatial Analysis of Land Use

Table 27. Segment 0509 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	4.9
Developed, Open Space	2.5
Developed, Low Intensity	1.4
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	1.2
Evergreen Forest	20.3
Mixed Forest	21.1
Scrub/Shrub	9.0
Woody Wetlands	4.9
Hay Pasture	22.9
Cultivated Crops	<1
Woody Wetlands	4.9
Deciduous Forest	11.2
Emergent Herbaceous Wetlands	<1

*USGS - NLCD 2011

Table 28. Segment 0509 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
3	2,246	1	1	0	19

Table 29. Segment 0509 Monitoring Stations

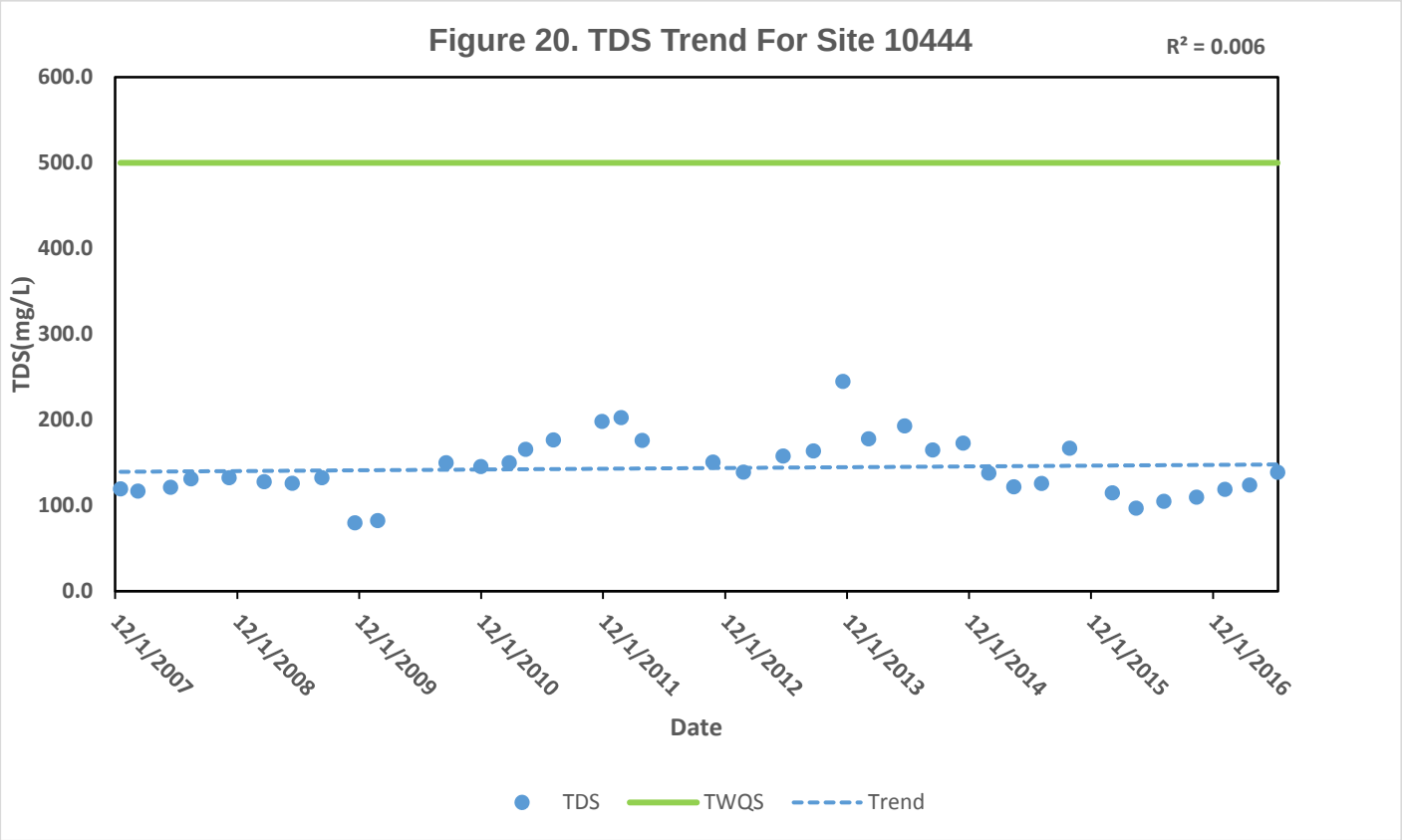
Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10444	LAKE MURVAUL 40 M UPSTREAM OF CENTER DAM	TCEQ

Water Quality Conditions

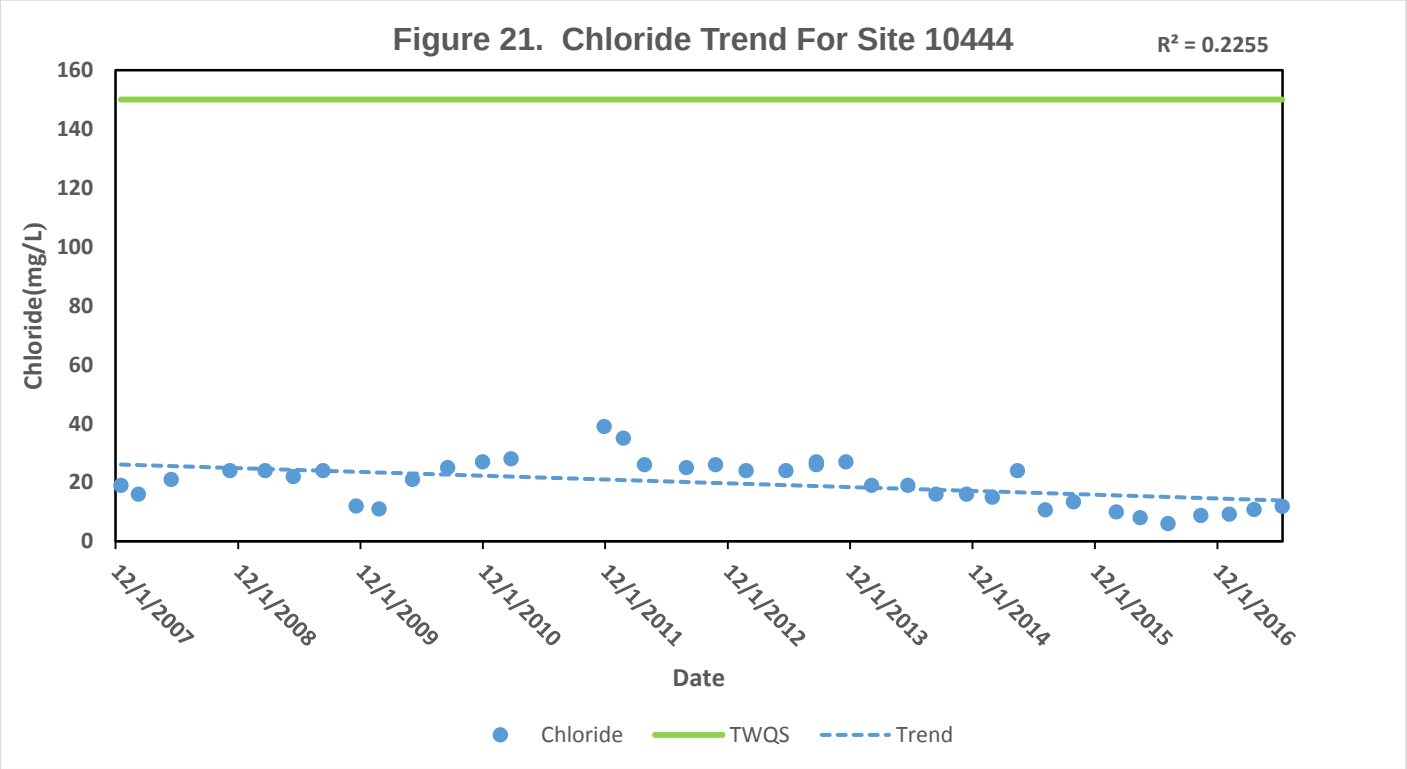
The Draft 2016 Integrated report indicated no impairments or concerns for Lake Murvaul (Segment 0509). The segment is largely rural with no city having a population greater than 5,000.

Regression analyses at station 10444 indicated TDS, chloride, sulfate, and chlorophyll-a data were significantly related to time. An increasing trend was observed for TDS possibly due to increasing inflows. The decreasing trends were observed for sulfate, chloride, and chlorophyll-a, which could be related to non-drought conditions and higher lake levels.

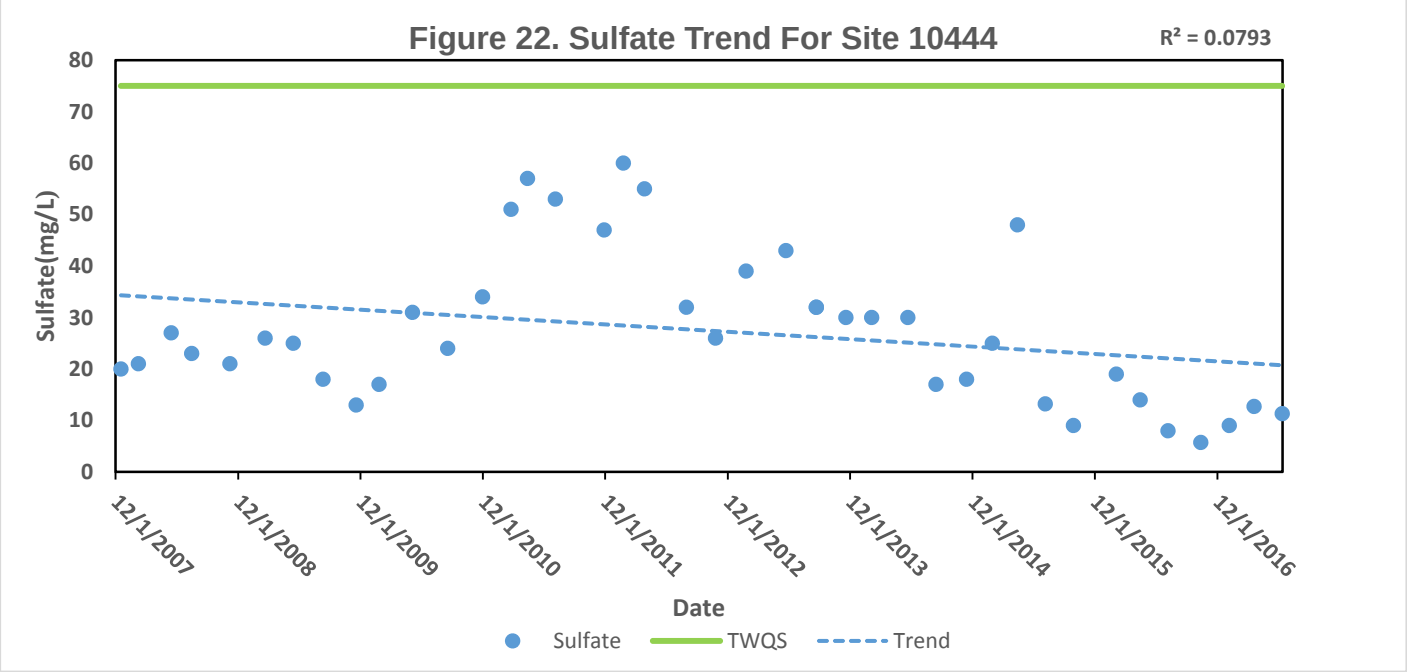
The TDS values ranged from 80 mg/L to 245 mg/L with a mean of 144 mg/L, which is below the TSWQS of 500 mg/L (Figure20).



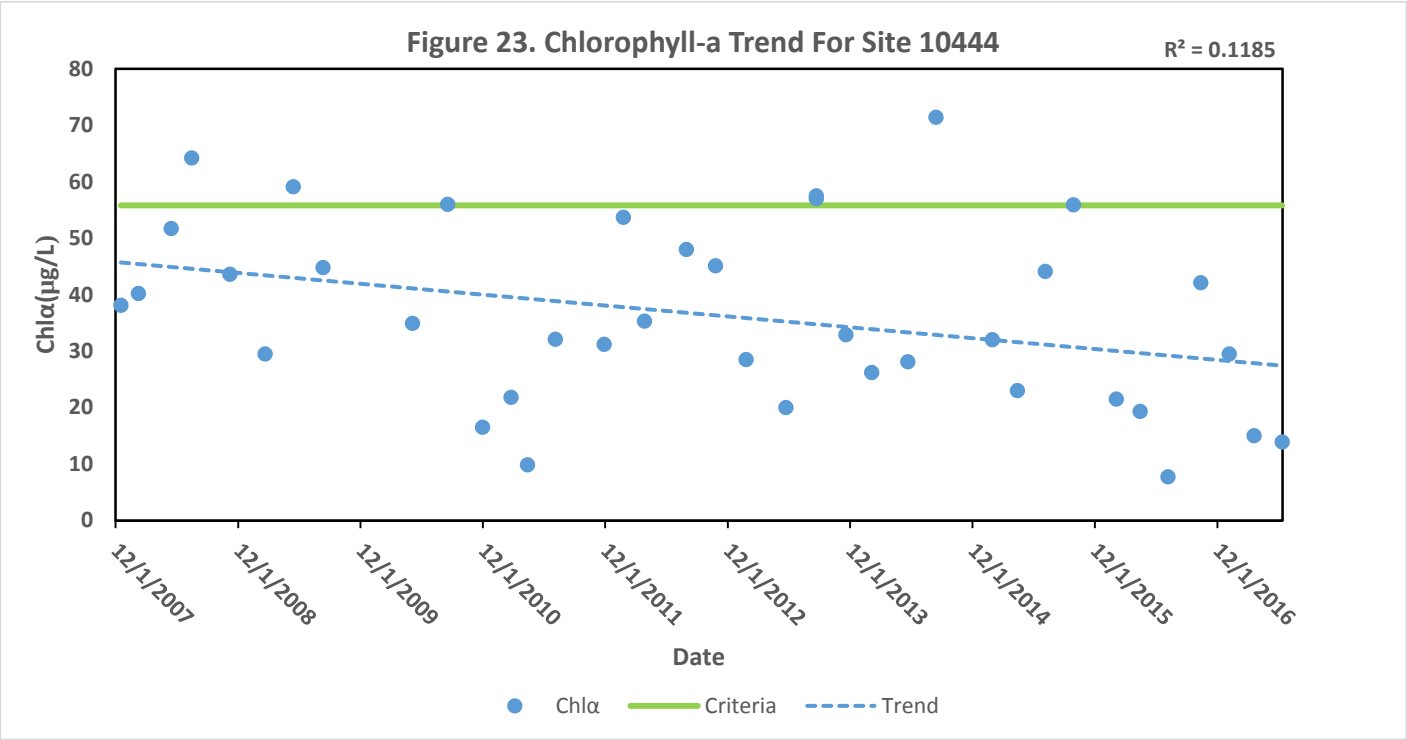
The chloride values ranged from 6 mg/L to 60 mg/L with a mean of 28, which is below the TSWQS of 150 mg/L (Figure 21).



The sulfate values ranged from 6 mg/L to 60 mg/L with a mean of 28 mg/L, which is below the TSWQS of 75 mg/L (Figure 22).



The chlorophyll-a values from 8 µg/L to 71 µg/L with a mean of 36 µg/L which is below the screening criteria of 55.8 µg/L. From December 2007 through June 2017, seven grab samples exceeded the TSWQS for chlorophyll-a at Lake Murvaul (Figure 23).



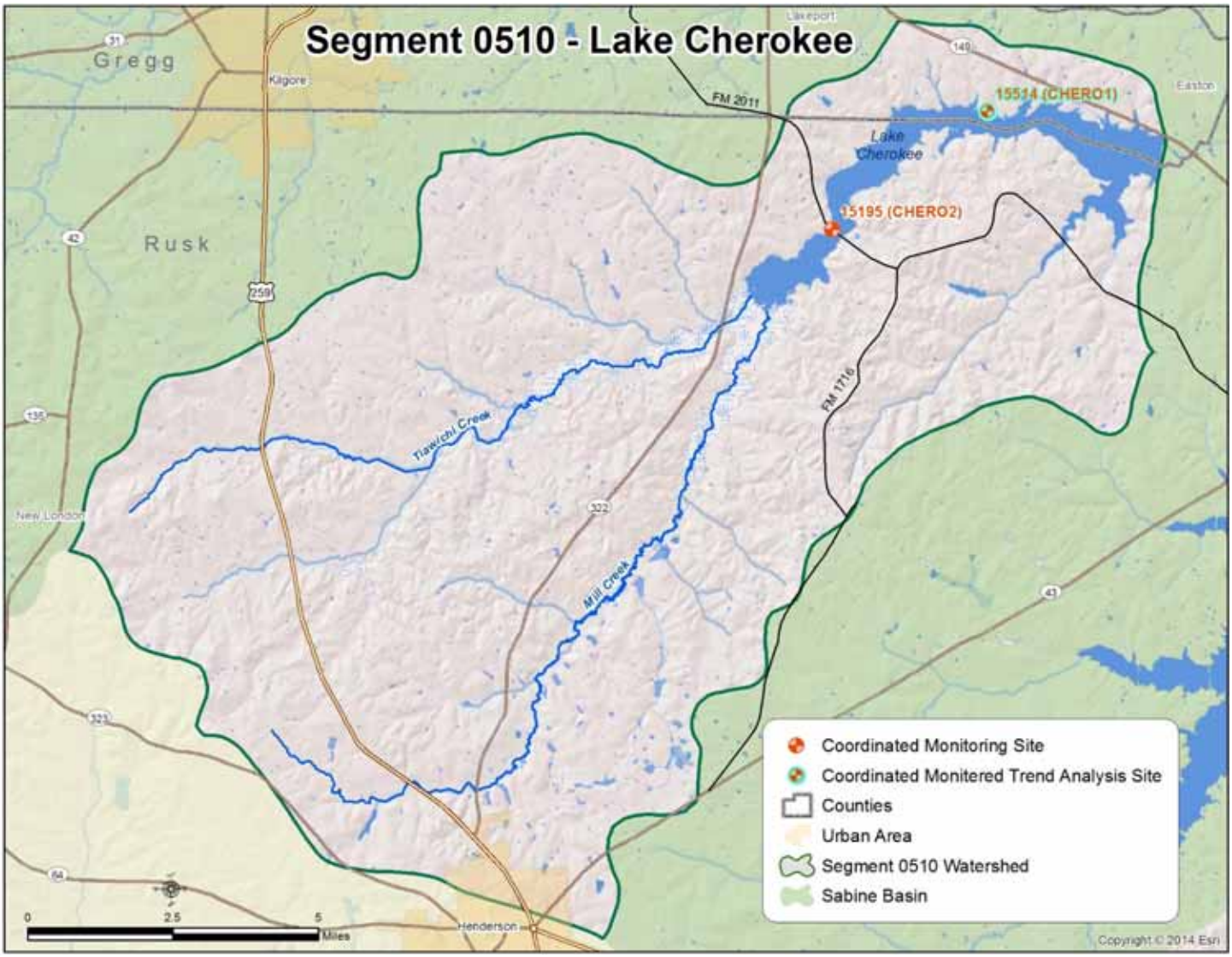
Recommendations

Future TCEQ water quality monitoring plans will be discussed during the annual coordinated monitoring meeting with stakeholders. The SRA-TX will continue to coordinate with the stakeholders in this segment.

Lake Murvaul at FM 1791

Segment 0510 - Lake Cherokee

From Cherokee Dam in Gregg/Rusk County up to normal pool elevation of 280 feet above mean sea level (AMSL) (impounds Cherokee Bayou).



The Lake Cherokee watershed, with a drainage area of 201 square miles, is located in the South Central Plains Ecoregion and is characterized by low rolling hills with hay pastures and evergreen forests (Table 30 - 31).

With a surface area of 3,987 acres, Lake Cherokee is owned and operated by the Cherokee Water Company to supply water for municipal, industrial, and recreational purposes. The City of Longview monitors two sites nine times per year in this segment (Table 32). Significant water quality influences include industry (mining) and oil field activities.

Spatial Analysis of Land Use

Table 30. Segment 0510 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	3.9
Developed, Open Space	3.1
Developed, Low Intensity	4.3
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	1.9
Herbaceous	2.5
Evergreen Forest	18.6
Mixed Forest	8.1
Scrub/Shrub	11.8
Woody Wetlands	8.7
Hay Pasture	25.8
Cultivated Crops	<1
Deciduous Forest	9.8
Emergent Herbaceous Wetlands	<1

*USGS - NLCD 2011

Table 31. Segment 0510 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
9	11,935	2	2	0	77

Table 32. Segment 0510 Monitoring Stations

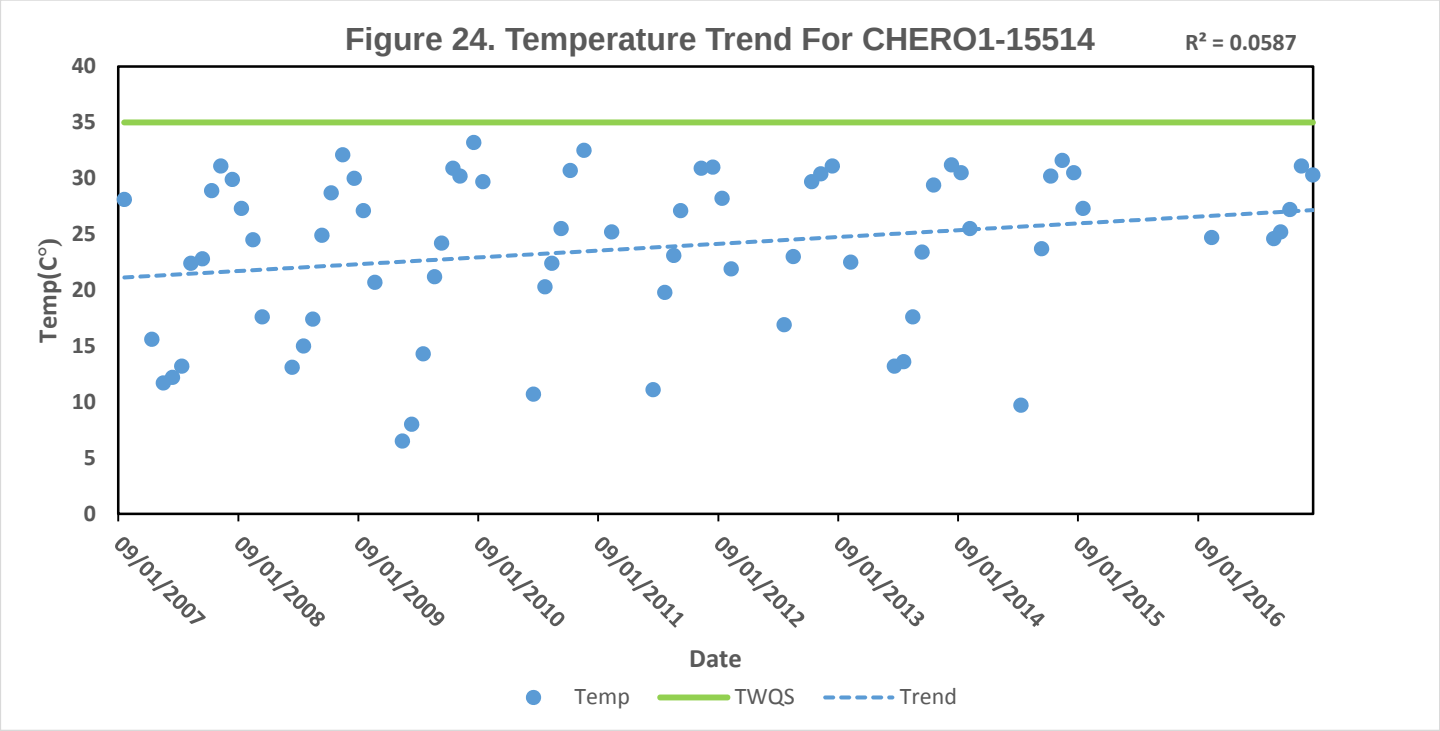
Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
15514 (CHERO1)	LAKE CHEROKEE CITY OF LONGVIEW WATER INTAKE 2.51 MILES EAST OF FM 2963	LONGVIEW
15195 (CHERO2)	LAKE CHEROKEE 23 M UPSTREAM FROM FM 2011 SILVEY BRIDGE APPROXIMATELY 150 M EAST OF LAKE CHEROKEE MAINTENANCE BOAT RAMP	LONGVIEW

Water Quality Conditions

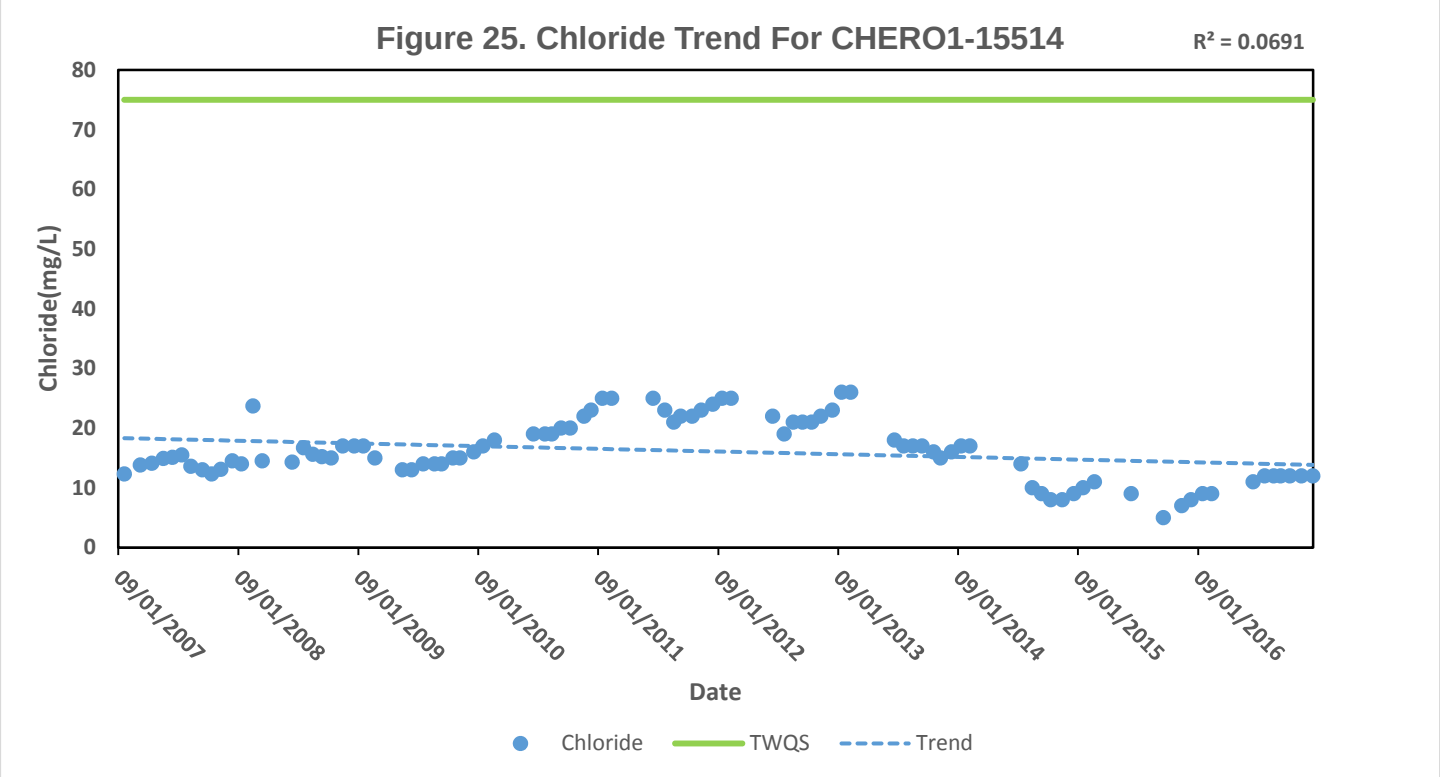
Lake Cherokee Segment 0510_02, first listed in 2014, is on the Draft 2016 Texas Integrated Report 303(d) List for depressed pH and has a screening level concern for depressed dissolved oxygen. Depressed pH in Lake Cherokee and Tiawichi Creek has been investigated by SRA-TX, TCEQ, and City of Longview personnel and is normally observed following periods of extended drought. Local geography and natural conditions are potential sources for depressed pH in Lake Cherokee. In 2018, The City of Longview personnel initiated additional sampling to address the depressed pH issue. Data collected will be available for future assessments.

Regression analyses at station 15514 (CHERO1) indicated temperature and chloride data were significantly related to time. An increasing trend was observed for temperature and a decreasing trend was observed for chloride. The temperature variations appear to be cyclical, but a gap in the data may have affected the trend. The decreasing trend observed for chloride could be related to non-drought conditions and higher lake levels.

The temperature values ranged from 7°C to 33°C with a mean of 24°C, which is below the TSWQS of 35°C (Figure 24).



The chloride values ranged from 5 mg/L to 26 mg/L with a mean of 16 mg/L, which is below the TSWQS of 75 mg/L (Figure 25).



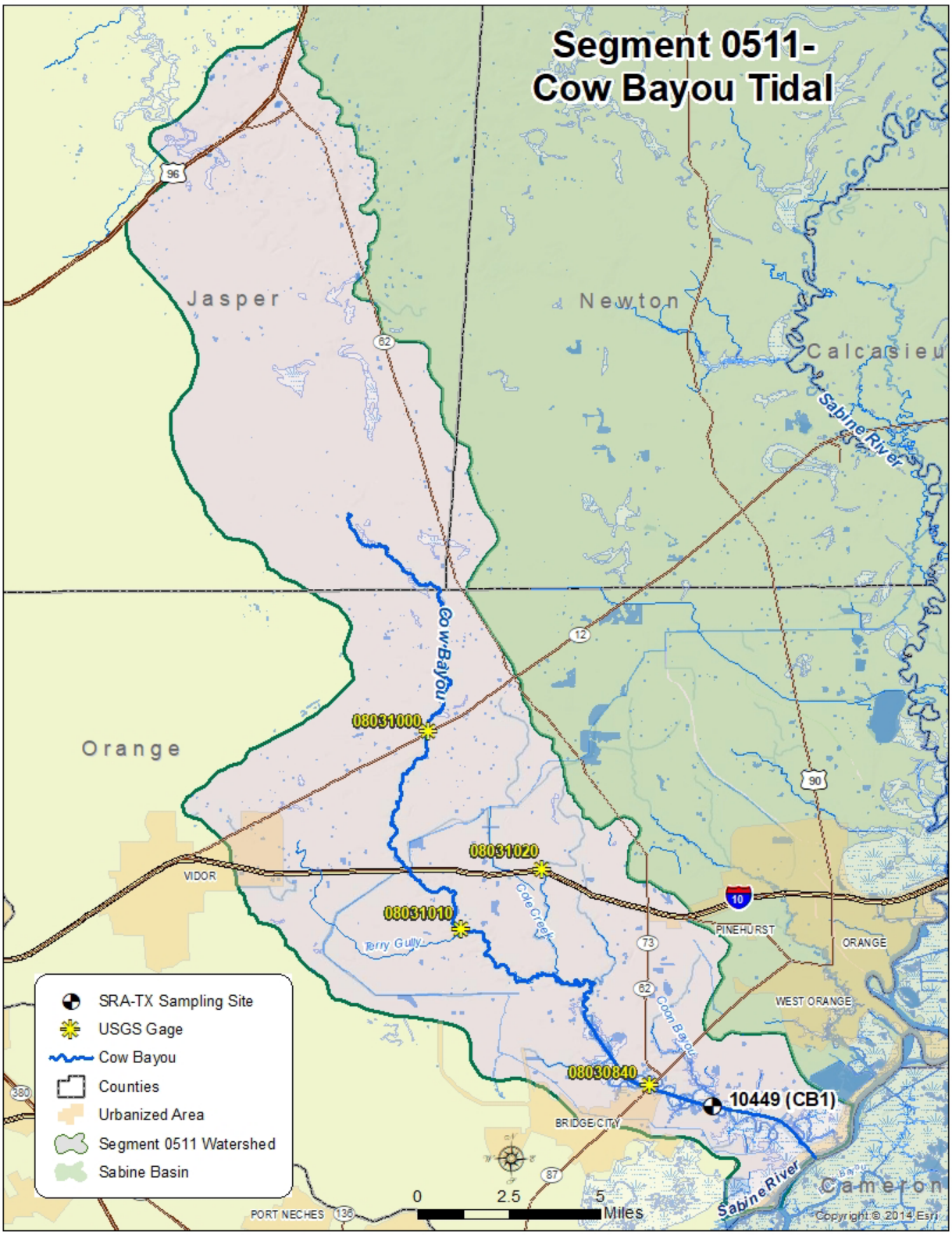
Recommendations

The SRA-TX will continue to coordinate with stakeholders in this segment. Future water quality monitoring plans by the City of Longview will be discussed during the annual coordinated monitoring meeting with stakeholders.

Lake Cherokee

Segment 0511 - Cow Bayou Tidal

From the confluence with the Sabine River in Orange County to a point 4.8 kilometers (3.0 miles) upstream of IH 10 in Orange County.



The Cow Bayou Tidal watershed, with a drainage area of 193 square miles, is located in the Western Gulf Coastal Plains Ecoregion, an area characterized by woody wetlands, mixed forest, and relatively flat terrain (Tables 33 - 34). The watershed includes the City of Bridge City and a large rural population. Cow Bayou Tidal is included in the Sabine River Tidal (Segment 0501) watershed.

The USGS maintains gaging stations on Cow Bayou located at SH 12 near Mauriceville, TX, Cow Bayou at SH 87 near Bridge City, TX, Cow Bayou at FM 1442 near Orangefield, TX, and Cole Creek at IH-10 near Orange, TX. The SRA-TX routinely monitors one site monthly in this segment (Table 35).

Spatial Analysis of Land Use

Table 33. Segment 0511 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	1.0
Developed, Open Space	7.0
Developed, Low Intensity	5.0
Developed, Medium Intensity	1.3
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	5.0
Evergreen Forest	11.2
Mixed Forest	10.5
Scrub/Shrub	11.2
Woody Wetlands	30.5
Hay Pasture	10.4
Cultivated Crops	1.4
Deciduous Forest	<1
Emergent Herbaceous Wetlands	4.1

*USGS - NLCD 2011

Table 34. Segment 0511 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
47	25,631	18	3	1	133

Table 35. Segment 0511 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10449 (CB1)	COW BAYOU AT ROUNDBUNCH ROAD	SRA-TX

Water Quality Conditions

Segment 0511 was included in the OCTMDL Project initiated in 2002 to address low dissolved oxygen, low pH, and bacteria. The Draft 2016 Integrated Report indicated concerns for depressed dissolved oxygen and depressed pH on the main stem of the segment.

Segment 0511 showed a decreasing trend for *Enterococcus*, much like Segment 0501, but has not rebounded as quickly as Segment 0501.

Cow Bayou above Tidal (Segment 0511A), an unclassified water body, has an impairment and a concern for depressed dissolved oxygen.

Coon Bayou (Segment 0511B), an unclassified water body, has impairments for bacteria, and depressed dissolved oxygen along with a concern for depressed dissolved oxygen.

Cole Creek (Segment 0511C), an unclassified water body, has an impairment and a concern for depressed dissolved oxygen.

Terry Gully (Segment 0511E), an unclassified water body, has impairments for bacteria, and depressed dissolved oxygen along with a concern for depressed dissolved oxygen.

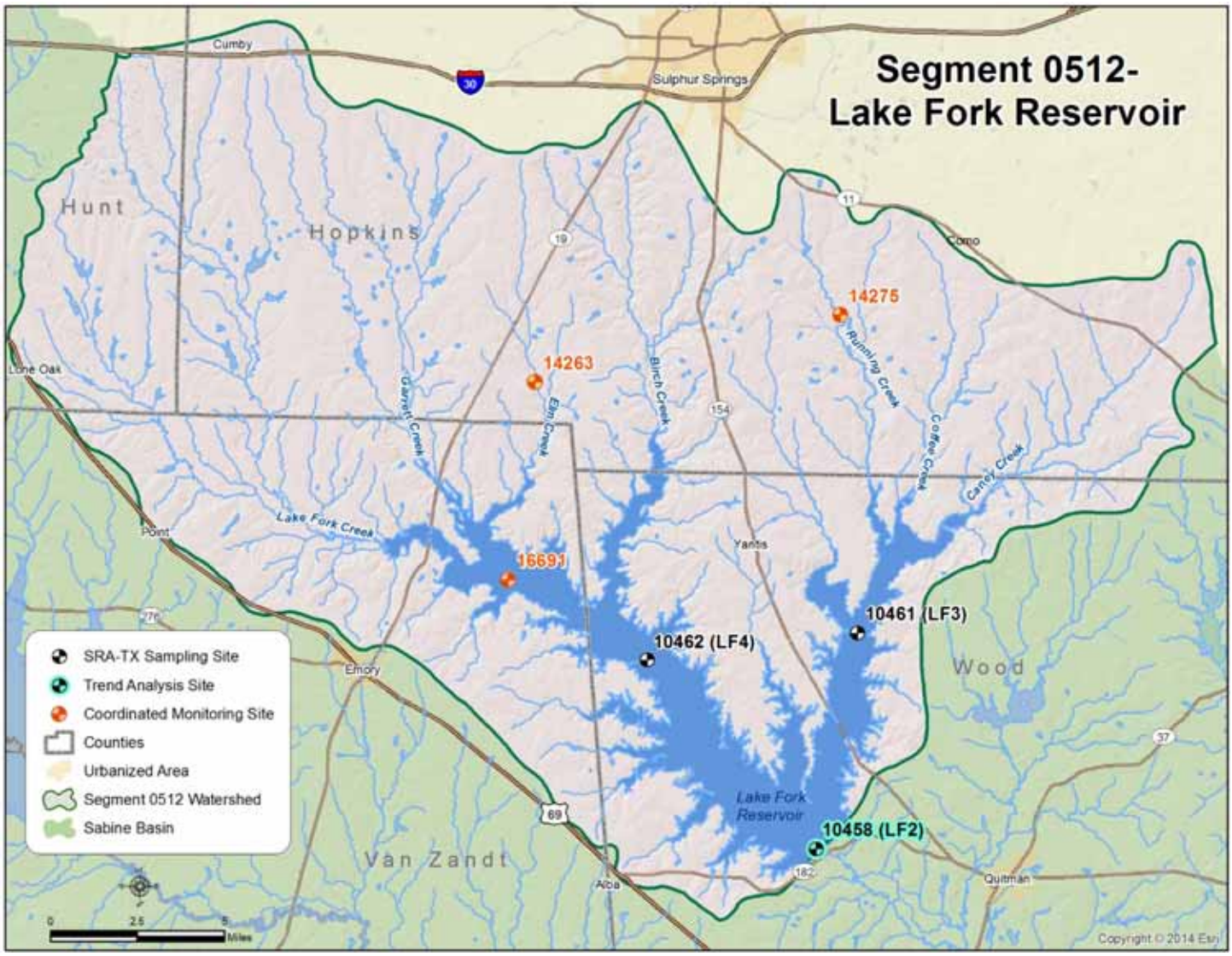
Regression analyses were not performed on this segment due to a limited data set. The OCTMDL I-Plan was approved in August 2015 restricting the amount of time available to amass a sufficient amount of data for analyses.

Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment. Sampling sites may be added at a later date to help assess the effectiveness of I-Plan management measure activities conducted during the previous years.

Segment 0512 - Lake Fork Reservoir

From Lake Fork Dam in Wood County up to normal pool elevation of 403 feet AMSL (impounds Lake Fork Creek).



Lake Fork Reservoir has 315 miles of shoreline and a surface area of 27,690 acres at a conservation pool elevation of 403 feet (AMSL). Lake Fork, Garrett, Elm, Birch, Running, Coffee, Glade, Little Caney, and Caney Creeks are the major tributaries that contribute to the 438 square miles of the Lake Fork Reservoir drainage area.

Lake Fork Reservoir is located in the East Central Texas Plains and South Central Plains Ecoregions. This segment is characterized by low rolling hills with pastures, wetlands and deciduous forests (Tables 36 – 37). This area is largely rural with numerous dairies.

The SRA-TX routinely monitors three sites monthly and the TCEQ monitors one site quarterly and two sites monthly in this segment (Table 38).

Spatial Analysis of Land Use

Table 36. Segment 0512 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	9.2
Developed, Open Space	2.1
Developed, Low Intensity	3.4
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Evergreen Forest	<1
Mixed Forest	<1
Scrub/Shrub	3.6
Woody Wetlands	8.9
Hay Pasture	49.5
Cultivated Crops	7.0
Deciduous Forest	14.8
Emergent Herbaceous Wetlands	<1

*USGS - NLCD 2011

Table 37. Segment 0512 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
45	18,484	16	6	0	42

Table 38. Segment 0512 Monitoring Stations

Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10458 (LF2)	LAKE FORK RESERVOIR NEAR DAM IN CREEK CHANNEL	SRA-TX
10461 (LF3)	LAKE FORK RESERVOIR MID-ARM IN CANEY CREEK ARM AT FM 515	SRA-TX
10462 (LF4)	LAKE FORK RESERVOIR MID COVE IN LAKE FORK CREEK ARM AT FM 515	SRA-TX
16691	LAKE FORK RESERVOIR 3.7 KM UPSTREAM OF FM 2946 AT BUOY 63 NEAR THE OLD LAKE FORK CREEK CHANNEL	TCEQ
14275	RUNNING CREEK AT HOPKINS CR 2322 2.5 MILES NORTHEAST OF REILLY SPRINGS	TCEQ
14263	ELM CREEK AT HOPKINS CR 1163 2 MILES SOUTHEAST OF GREENVIEW	TCEQ

Water Quality Conditions

Sabine River AU 0512_05 has a new listing on the Draft 2016 Integrated Report 303(d) list for elevated pH. These elevated pH measurements were recorded at site 16691, which is located in a transitional area of Lake Fork Reservoir. During periods of drought and low reservoir levels, this site may become non-representative. All measured water quality parameters in the remaining Lake Fork Reservoir segment AUs meet TSWQS and fully support their designated uses.

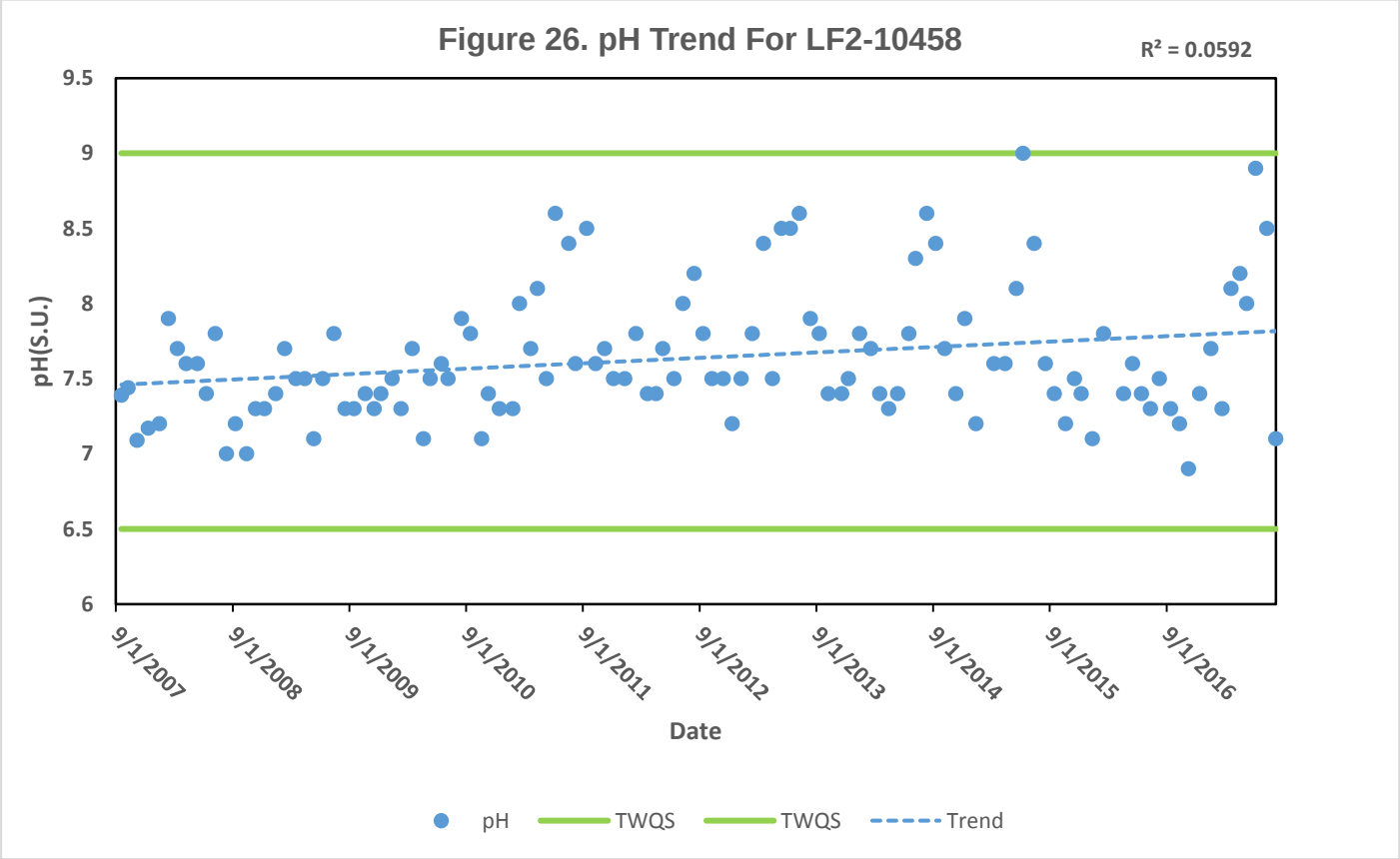
Running Creek (Segment 5012A) and Elm Creek (Segment 0512B), first listed in 2002, are on the Draft 2016 Integrated Report 303(d) List for bacteria. An RUAA to address bacteria listings has been completed on each of these creeks. The RUAA findings support the revision of Running and Elm Creeks from PCR to SCR1. More information on the RUAA can be found at the TCEQ Recreational Use Attainability Analyses website[15].

[15] https://www.tceq.texas.gov/waterquality/standards/ruaas/multisabine05, accessed 3/7/2019

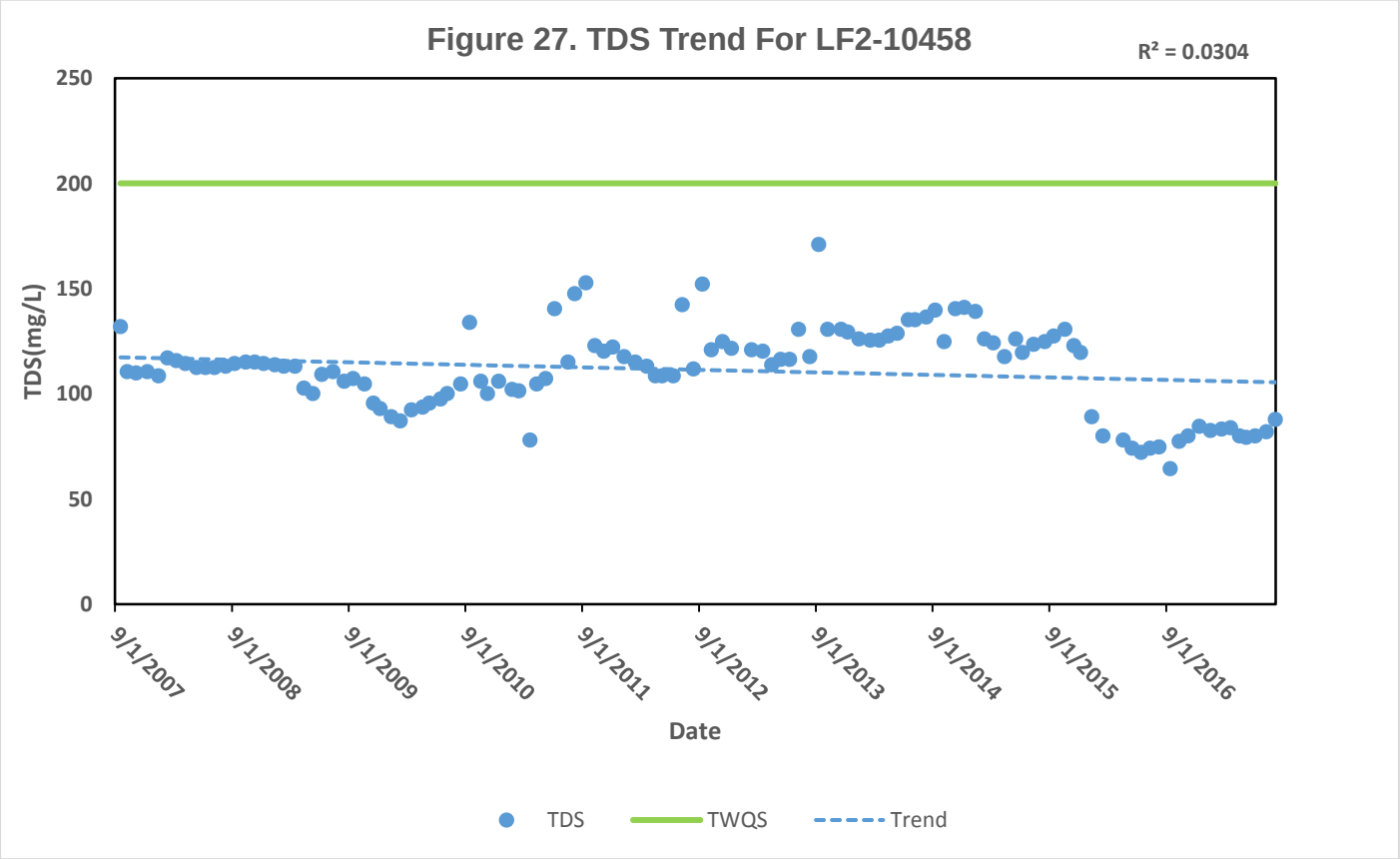
Running Creek also had screening level concerns for depressed dissolved oxygen, nitrate, and ammonia. Elm Creek had screening level concerns for depressed dissolved oxygen and ammonia.

Regression analyses at station 10458 (LF2) indicated pH, TDS, and chloride data were significantly related to time. Trend analyses indicated an increasing trend for pH and a decreasing trend for TDS and chloride. The increasing trend for pH was may be related to drought conditions, elevated temperatures, and lower reservoir levels.

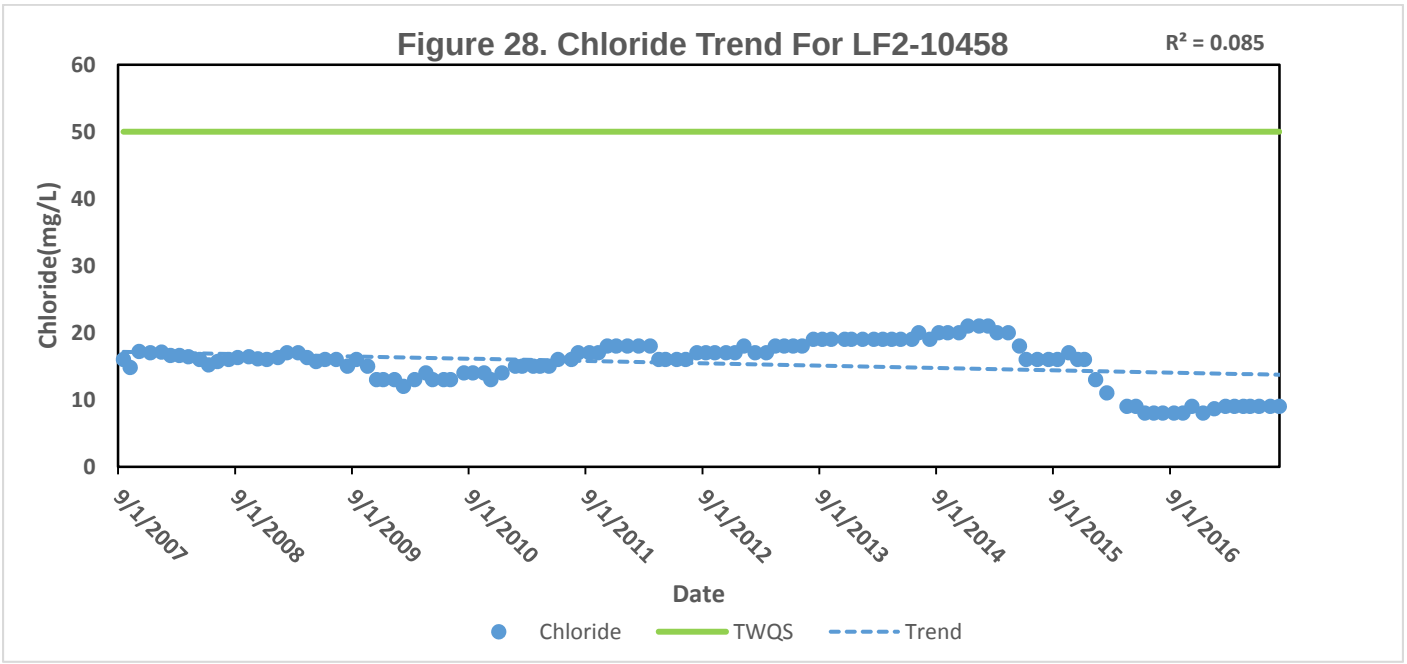
The pH values ranged from 6.9 to 9.0 units with no single grab exceedances documented from FY 2007 to FY 2017 (Figure 26)



The TDS values ranged from 64mg/L to 171 mg/L with a mean of 111 which is below the TSWQS of 200 mg/L (Figure 27).



The chloride values ranged from 8 mg/L to 21 mg/L with a mean of 16 mg/L which is below the TSWQS of 50 mg/L (Figure 28).



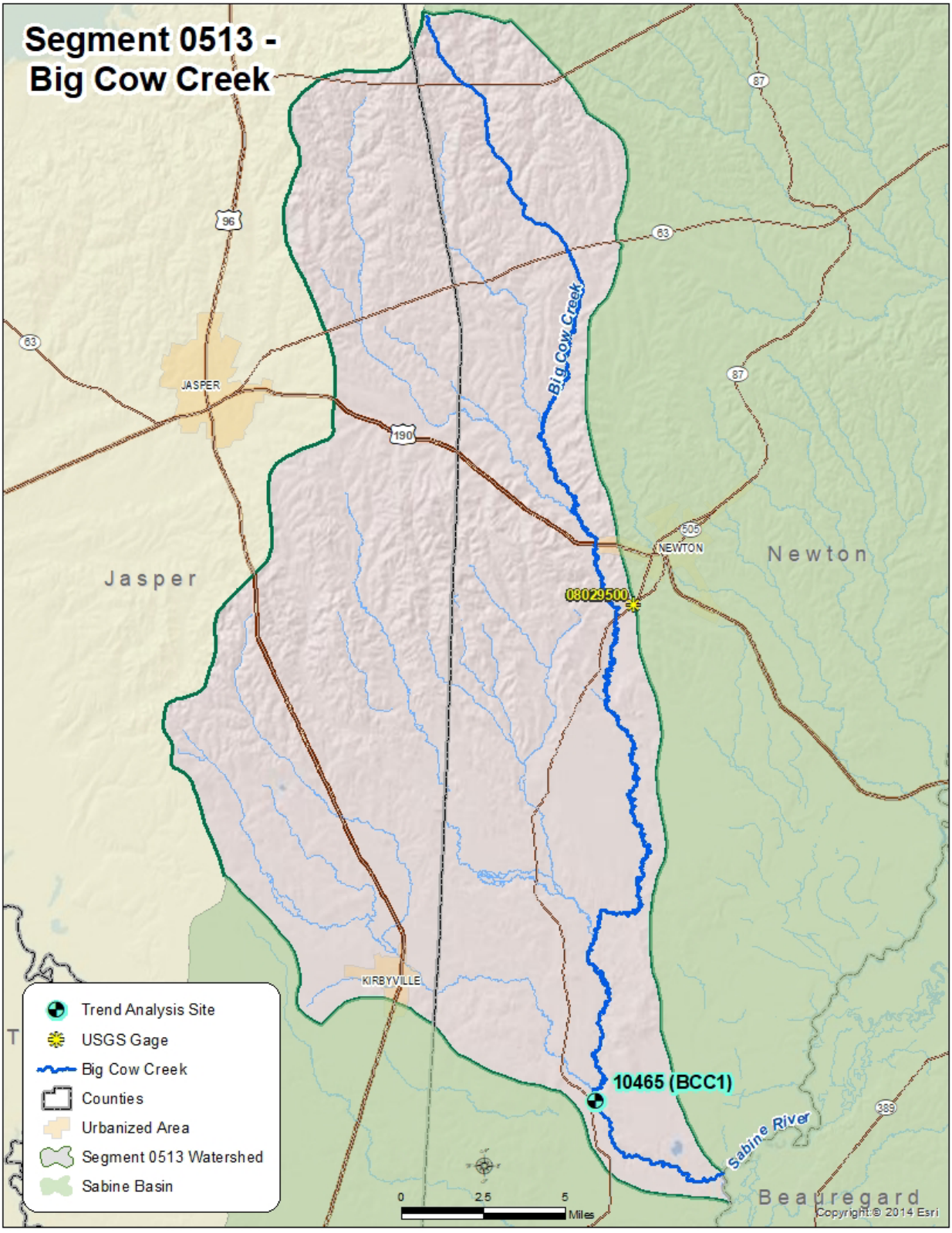
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Lake Fork Reservoir

Segment 0513 - Big Cow Creek

From the confluence with the Sabine River in Newton County to a point 4.6 kilometers (2.9 miles) upstream of R 255 in Newton County.



The Big Cow Creek watershed, with a drainage area of 349 square miles, is located in the Western Gulf Coastal Plains Ecoregion. This region is characterized by evergreen forest, woody wetlands, and small rolling hills to the north and flatlands to the south. Segment 0513 is largely rural with no major industries or cities (Tables 39 - 40).

The USGS maintains one flow monitoring station on Big Cow Creek located on SH 87 near Newton, Texas. The SRA-TX routinely monitors one site monthly in this segment (Table 41).

Spatial Analysis of Land Use

Table 39. Segment 0513 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	<1
Developed, Open Space	3.5
Developed, Low Intensity	1.4
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	6.6
Evergreen Forest	34.9
Mixed Forest	6.4
Scrub/Shrub	22.3
Woody Wetlands	18.5
Hay Pasture	3.9
Cultivated Crops	<1
Deciduous Forest	1.6
Emergent Herbaceous Wetlands	<1

*USGS - NLCD 2011

Table 40. Segment 0513 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
4	8,392	2	5	0	24

Table 41. Segment 0513 Monitoring Stations

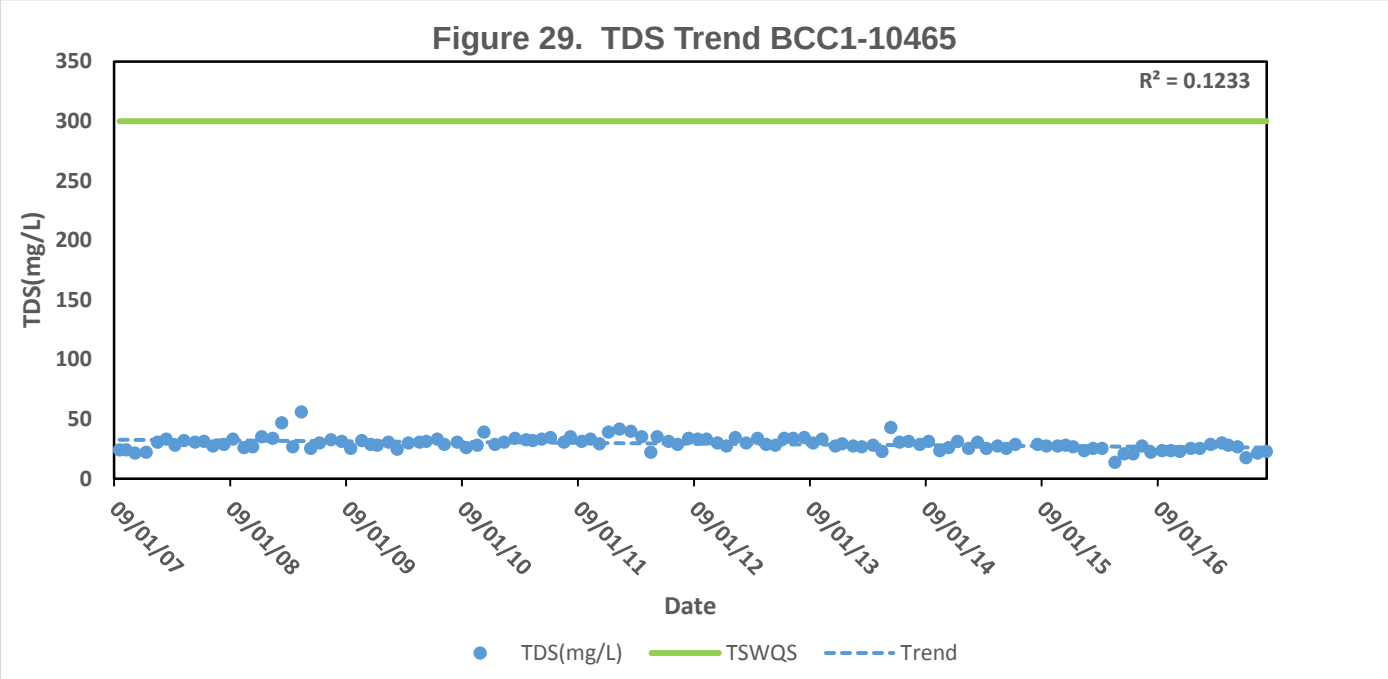
Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10465 (BCC1)	BIG COW CREEK AT FM 1416 SOUTH OF BON WIER	SRA-TX

Water Quality Conditions

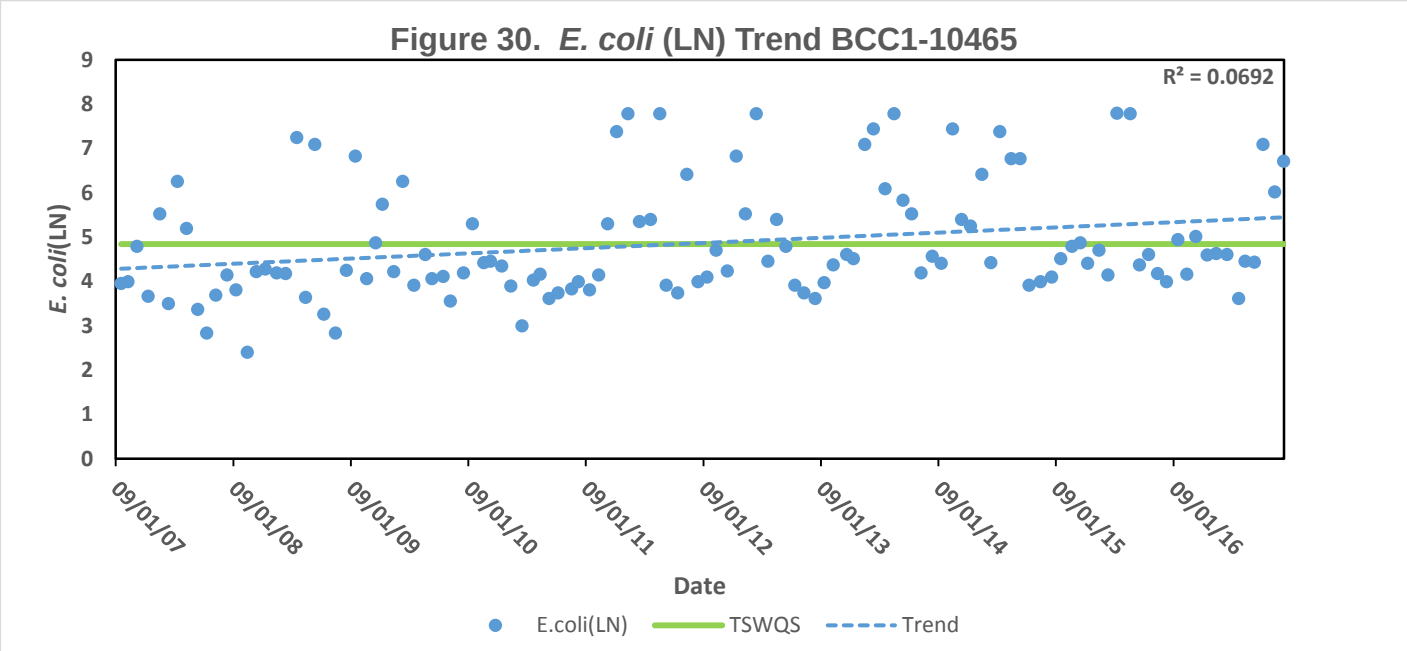
The Draft 2016 Integrated Report indicated no impairments in Segment 0513. Concerns were listed for lead in water and bacteria. All other measured water quality parameters meet TSWQS and fully support this segment's designated uses.

Regression analyses at station 10465 (BCC1) indicated TDS, *E. coli* and pH data were significantly related to time. Trend analyses indicated a decreasing trend for TDS and for pH. An increasing trend for *E. coli* was observed and could be related to higher flows produced by increased rainfall events preceded by a period that was dryer than normal.

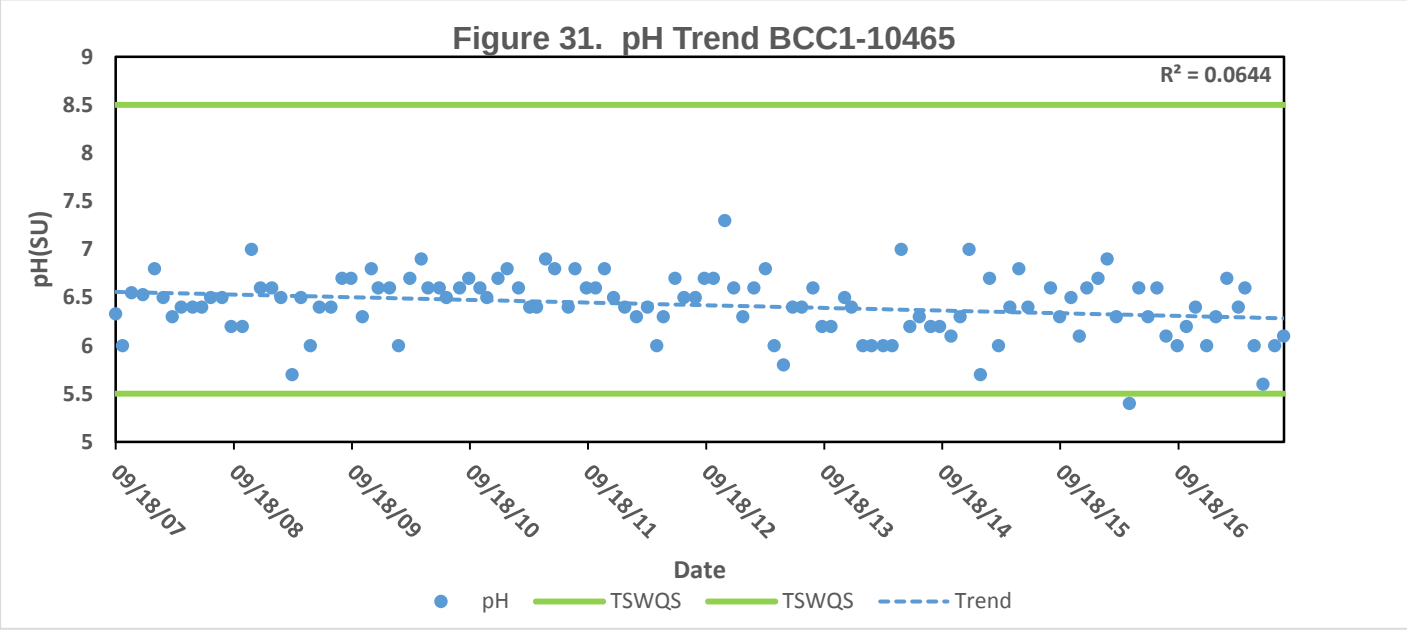
The TDS values ranged from 14 mg/L to 56 mg/L with a mean of 29 mg/L, which is below the TSWQS of 300 mg/L. No single grab exceedances were documented from FY 2007 to FY 2017 (Figure 29).



The *E. coli* values ranged from 11 MPN/mL to 2420 MPN/100mL with a geomean of 130 MPN/100mL, which is above the geomean exceedance level of 126 MPN/100mL. Twenty-three single grab exceedances were documented from FY 2007 to FY 2017 (Figure 30).



The pH values ranged from 5.4 units to 7.3 units with a mean of 6.4 units, which is between the TSWQS criteria of 5.5 – 8.5 units. One single grab exceedance was documented from FY 2007 to FY 2017 (Figure 31).



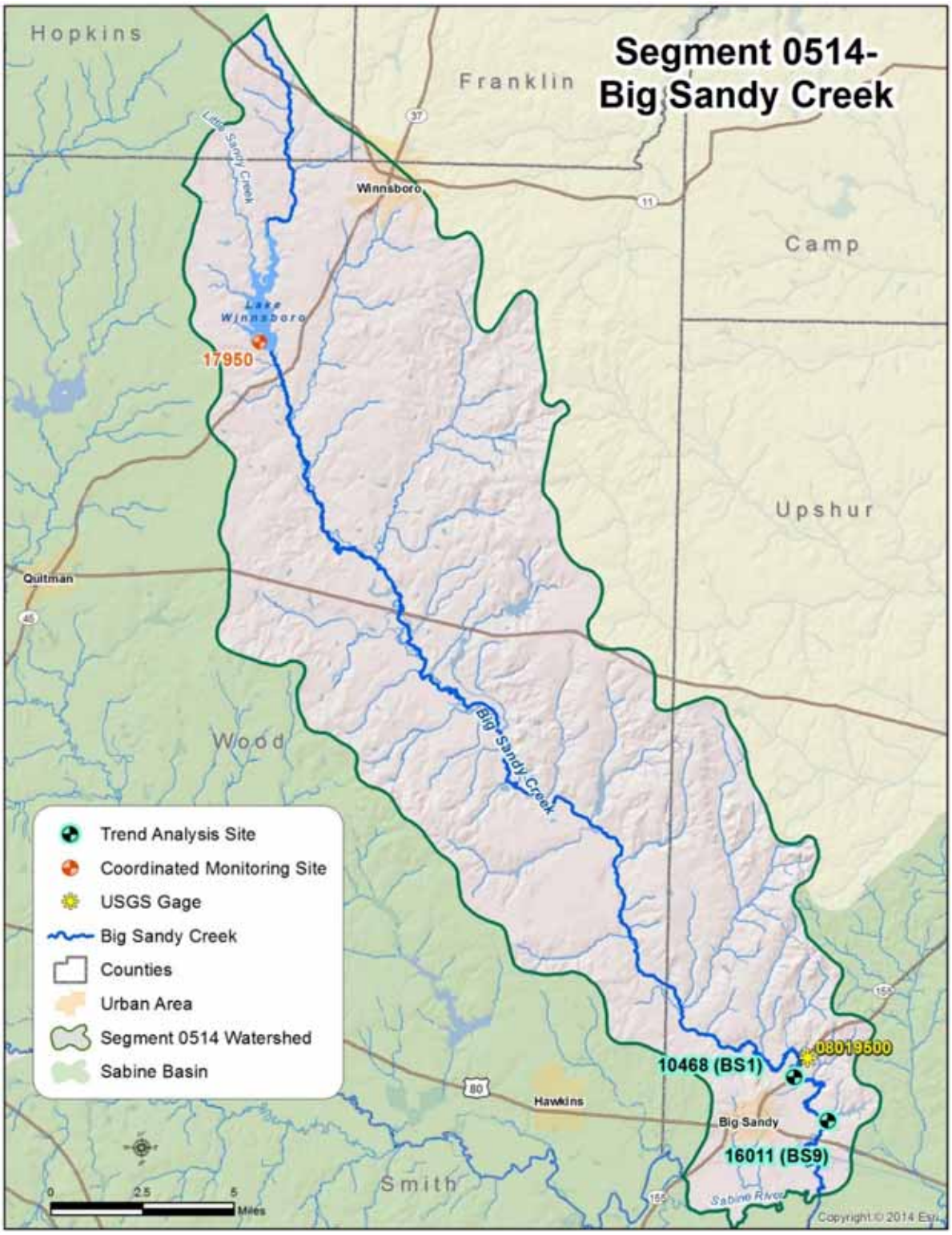
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Big Cow Creek Downstream of FM 1416

Segment 0514 - Big Sandy Creek

From the confluence with the Sabine River in Upshur County to a point 2.6 kilometers (1.6 miles) upstream of SH11 in Hopkins County.



The Big Sandy Creek watershed is 58 miles long, has an approximate drainage area of 245 square miles, and is located in the South Central Plains Ecoregion. This watershed is characterized by low rolling hills, deciduous forest, hay pastures, woody wetlands, and is predominately rural (Tables 42-43). The cities of Big Sandy and Winnsboro and the community of Holly Lake are located within this watershed and all have a population under 5,000.

The USGS maintains one flow monitoring station on Big Sandy Creek located on SH 155 north of Big Sandy, TX. The SRA-TX routinely samples one site monthly and the TCEQ samples one site quarterly in this segment (Table 44).

Spatial Analysis of Land Use

Table 42. Segment 0514 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	1.6
Developed, Open Space	2.3
Developed, Low Intensity	5.4
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	1.2
Evergreen Forest	8.4
Mixed Forest	<1
Scrub/Shrub	9.6
Woody Wetlands	12.1
Hay Pasture	25.2
Cultivated Crops	2.4
Deciduous Forest	30.3
Emergent Herbaceous Wetlands	<1

*USGS - NLCD 2011

Table 43. Segment 0514 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
7	14,469	4	8	0	59

Table 44. Segment 0514 Monitoring Stations

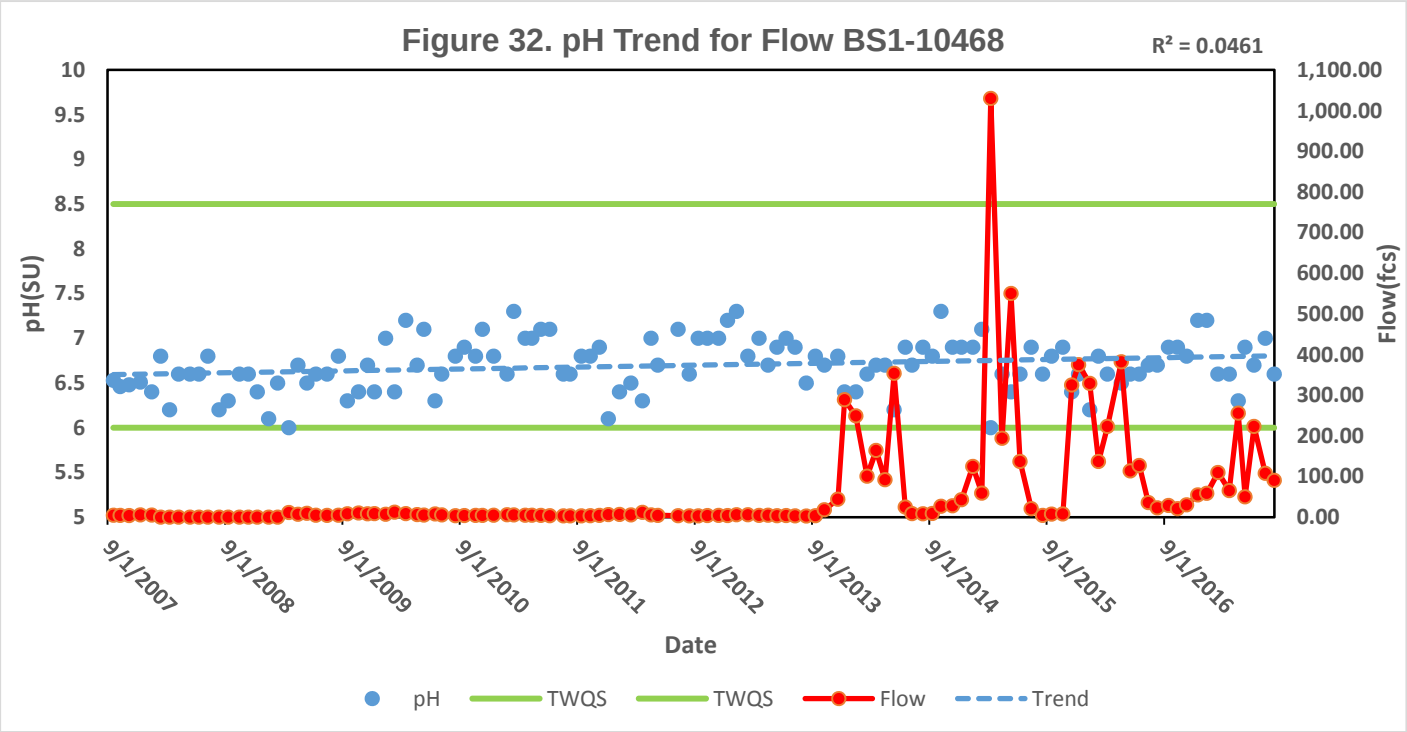
Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
16011 (BS9)	BIG SANDY CREEK AT WHITE OAK ROAD	SRA-TX
10468 (BS1)	BIG SANDY CREEK AT SH 155	SRA-TX
17950	LAKE WINNSBORO IN MAIN POOL 0.4 KM NORTH NORTHWEST OF CENTER OF DAM STRUCTURE 9.7 KM SOUTHWEST OF WINNSBORO	TCEQ

Water Quality Conditions

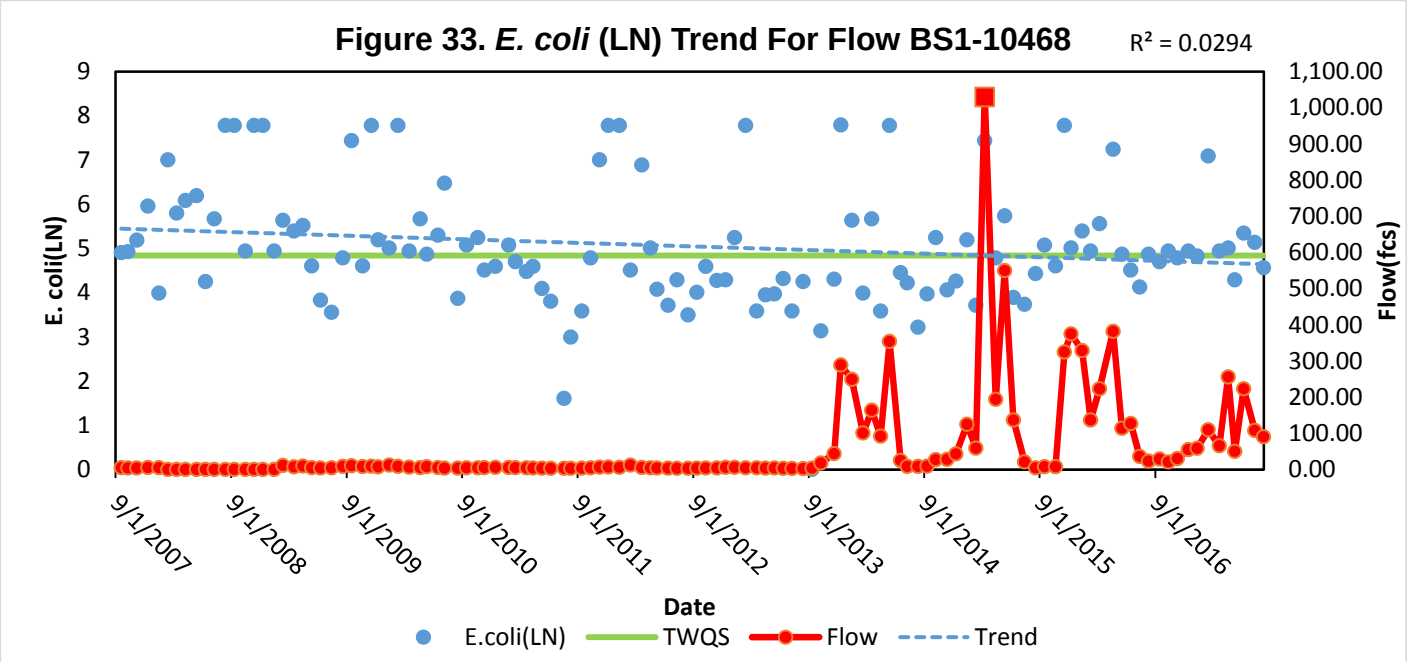
This segment, first listed in 2006, remains on the Draft 2016 Integrated Report 303(d) List for bacteria. Data from station 10468 (BS1) and station 16011 (BS9) were combined to provide a complete data set for this assessment. Elevated bacteria levels are consistently observed during periods of increased flows, increased turbidity, and reduced Secchi transparencies from rainfall runoff. Potential non-point sources for bacteria within this watershed include urban runoff, agriculture practices, wildlife, and private septic systems. There are also screening level concerns for depressed dissolved oxygen and chlorophyll-a in the upper AU, 0514_02.

Regression analyses at station 10468 (BS1) indicated pH, *E. coli,* and sulfate data were significantly related to time. An increasing trend was observed for pH and decreasing trends were observed for *E. coli* and sulfate. The increasing trend and variation in pH cannot be explained by increased flows and a return to non-drought conditions.

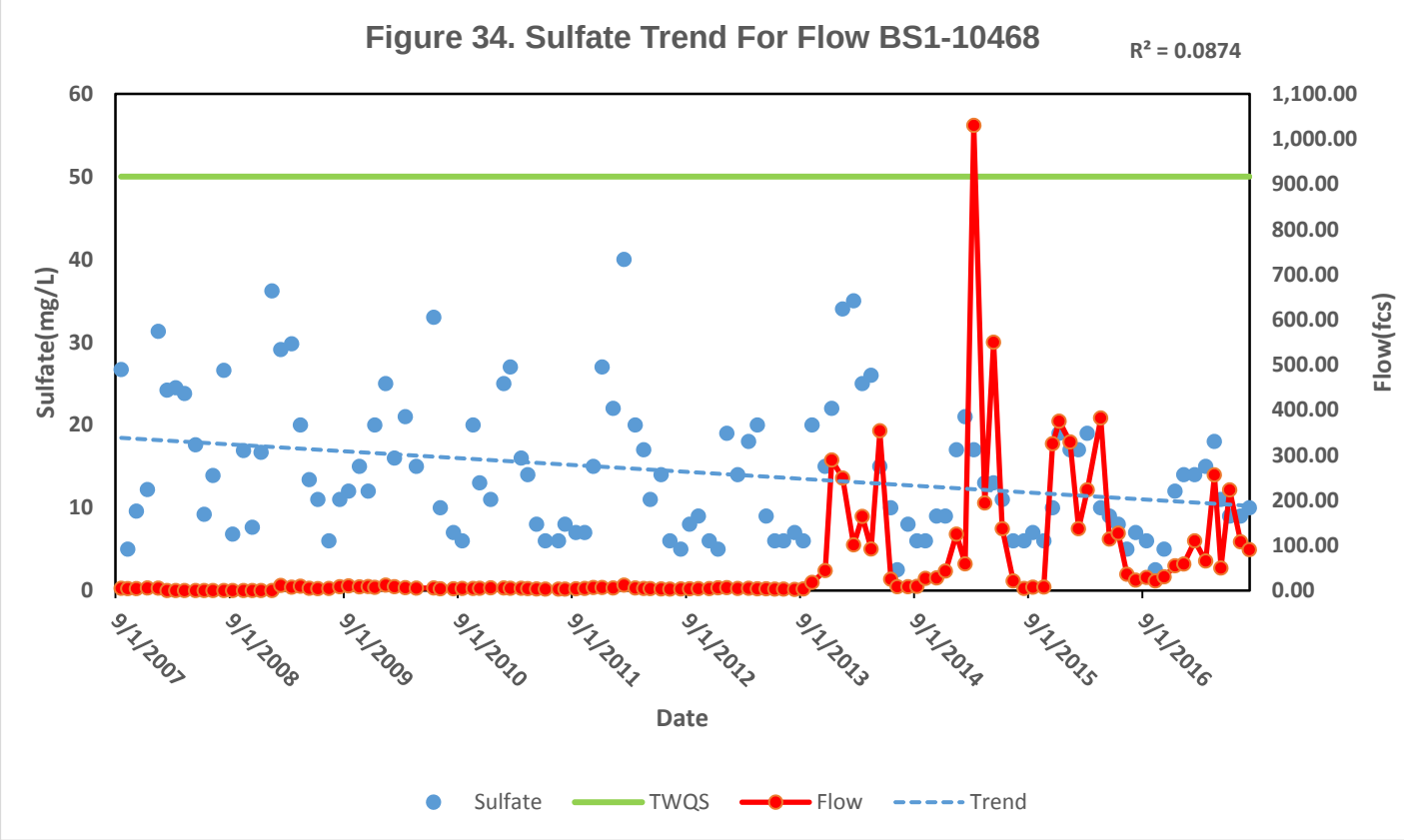
The pH values ranged from 6.0 to 7.3 units with no single grab exceedances observed from FY 2007 to FY 2017 (Figure 32).



The geometric mean for *E. coli* was 156 MPN/100mL, which is above the TSWQS of 126 MPN/100mL. The minimum *E. coli* value was 1 MPN/100mL and a maximum was 2420 MPN/100mL (Figure 33).



The sulfate values ranged from 3 mg/L to 40 mg/L with a mean of 14 mg/L, which is below the TSWQS of 50 mg/L. No single grab exceedances were documented from FY 2007 to FY 2017 (Figure 34).



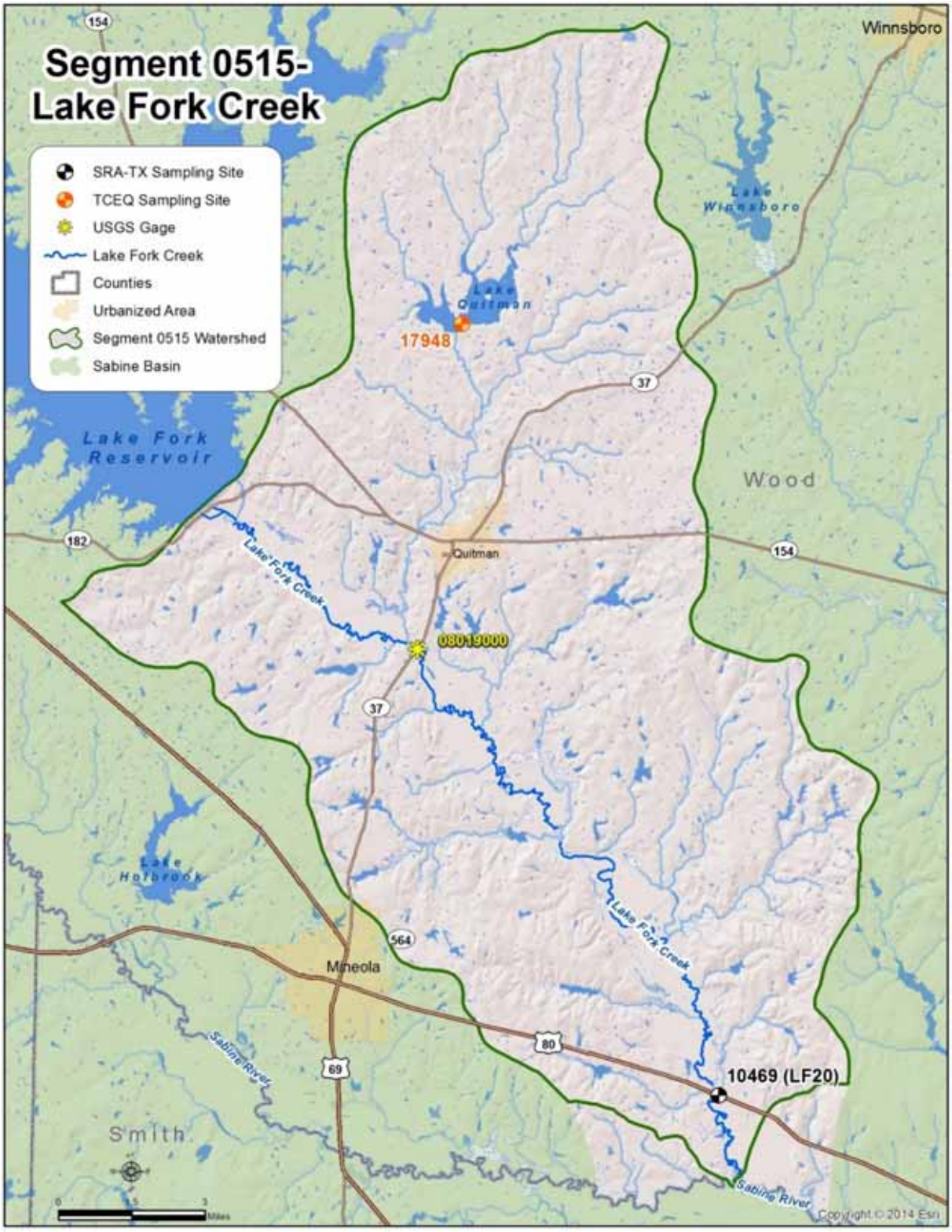
Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Lake Winnsboro near Dam

Segment 0515 - Lake Fork Creek

From the confluence with the Sabine River in Wood County up to the Lake Fork Dam in Wood County.



The Lake Fork Creek watershed, with a drainage area of approximately 201 square miles, is located in the East Central Texas Plains and in the South Central Plains Ecoregion and is characterized by hay pasture and herbaceous vegetation with low rolling hills (Tables 45 - 46). Lake Quitman Reservoir is located on Dry Creek, a major tributary to Lake Fork Creek.

The USGS maintains one flow monitoring station on Lake Fork Creek located on SH 37 south of Quitman, Texas. The SRA-TX routinely monitors one site monthly and the TCEQ monitors one site quarterly in this segment (Table 47).

Spatial Analysis of Land Use

Table 45. Segment 0515 Spatial Analysis

Delineated Land Use*	% Watershed Coverage
Open Water	1.6
Developed, Open Space	2.2
Developed, Low Intensity	5.2
Developed, Medium Intensity	<1
Developed, High Intensity	<1
Barren Land	<1
Herbaceous	<1
Evergreen Forest	3.3
Mixed Forest	0.2
Scrub/Shrub	6.9
Woody Wetlands	16.8
Hay Pasture	36.0
Cultivated Crops	2.4
Deciduous Forest	23.8
Emergent Herbaceous Wetlands	<1

*USGS - NLCD 2011

Table 46. Segment 0515 Spatial Data

Historical Monitoring Stations	Population	Permitted Discharges	Landfills	Superfund Sites	Population Per Sq. Mile
5	9,998	2	9	0	50

Table 47. Segment 0515 Monitoring Stations

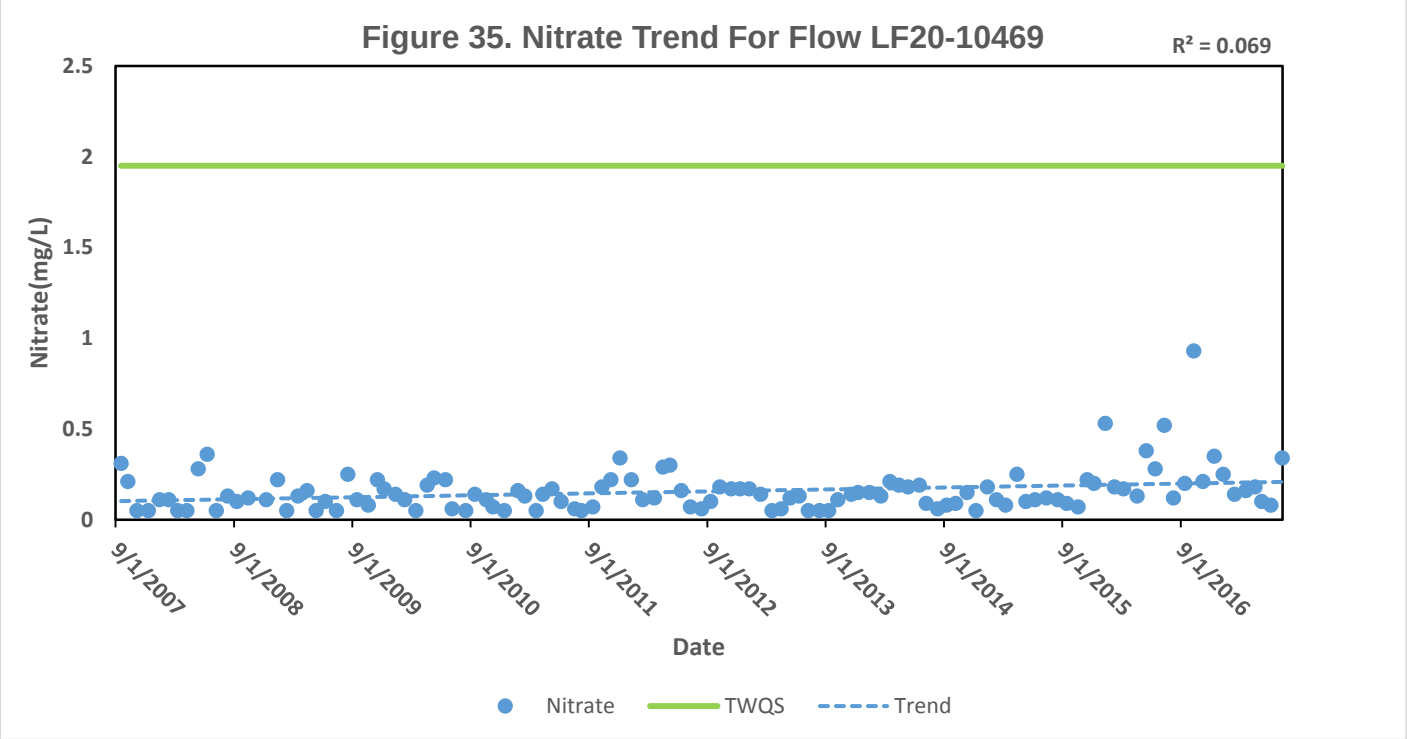
Station TCEQ ID (SRA-TX ID)	Location	Sampling Entity
10469 (LF20)	LAKE FORK CREEK AT US 80	SRA-TX
17948	LAKE QUITMAN IN MAIN POOL 0.4 KM NORTH-NORTHWEST OF CENTER OF DAM STRUCTURE 8 KM NORTH OF QUITMAN, TEXAS	TCEQ

Water Quality Conditions

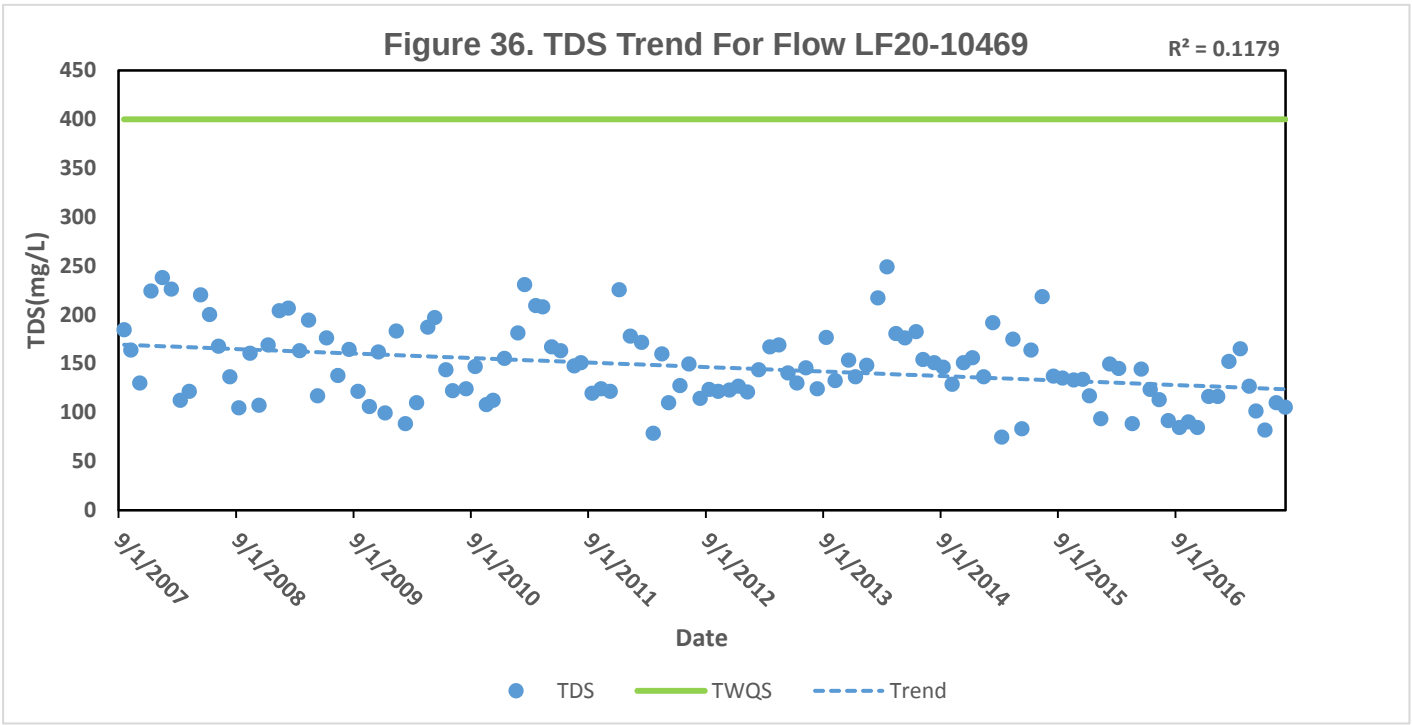
The Draft 2016 Texas Integrated Report indicated no impairments or concerns on Lake Fork Creek (Segment 0515_01). All measured water quality parameters meet TSWQS and fully support this segment's designated uses.

Regression analyses at station 10469 (LF20) indicated nitrate, TDS, chloride, and sulfate data (Figures 35 - 38) were significantly related to time. An increasing trend was observed for nitrate, which could be related to higher flows and run-off created by an increase in rainfall that was preceded by a period that was dryer than normal. Decreasing trends were observed for TDS, chloride, and sulfate,

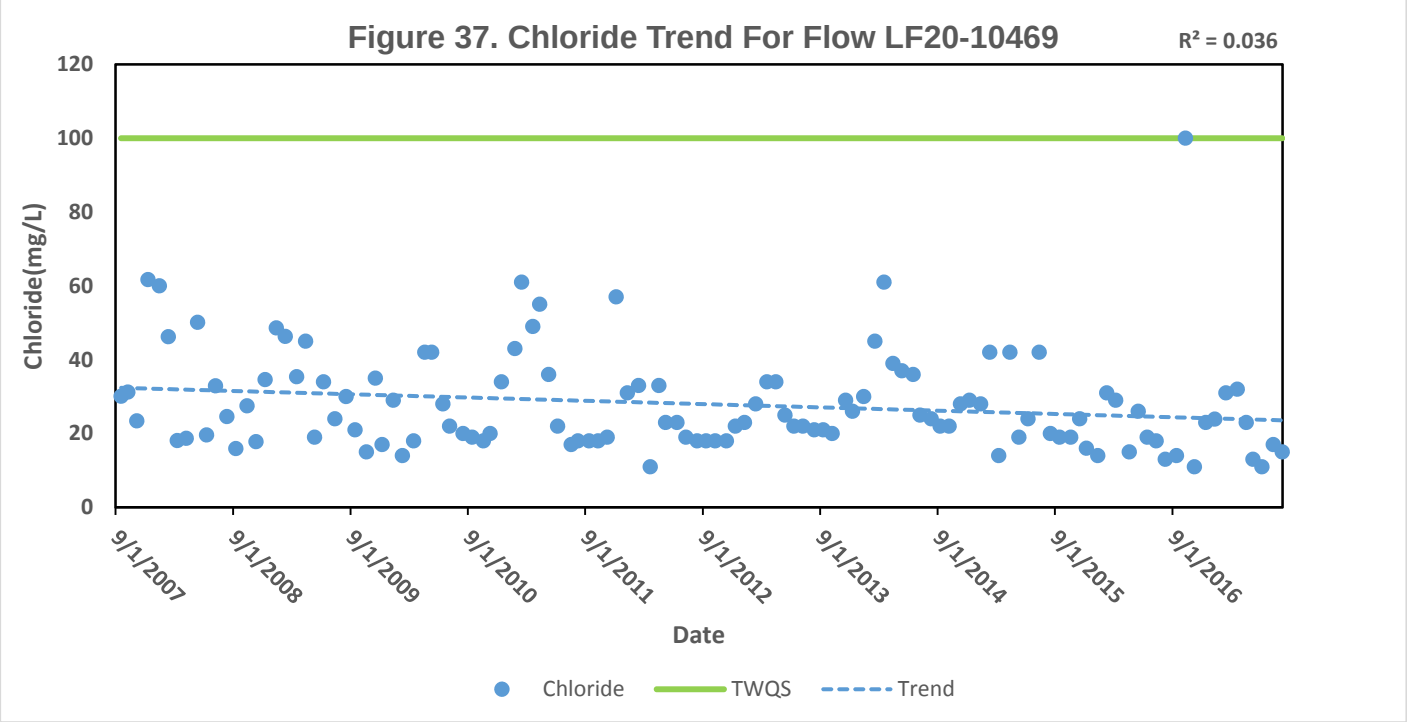
The nitrate values ranged from 0.05 mg/L to 0.93 mg/L with a mean of 0.16 mg/L, which is below the TSWQS of 1.95 mg/L. No single grab exceedances were observed from FY 2007 to FY 2017 (Figure 35).



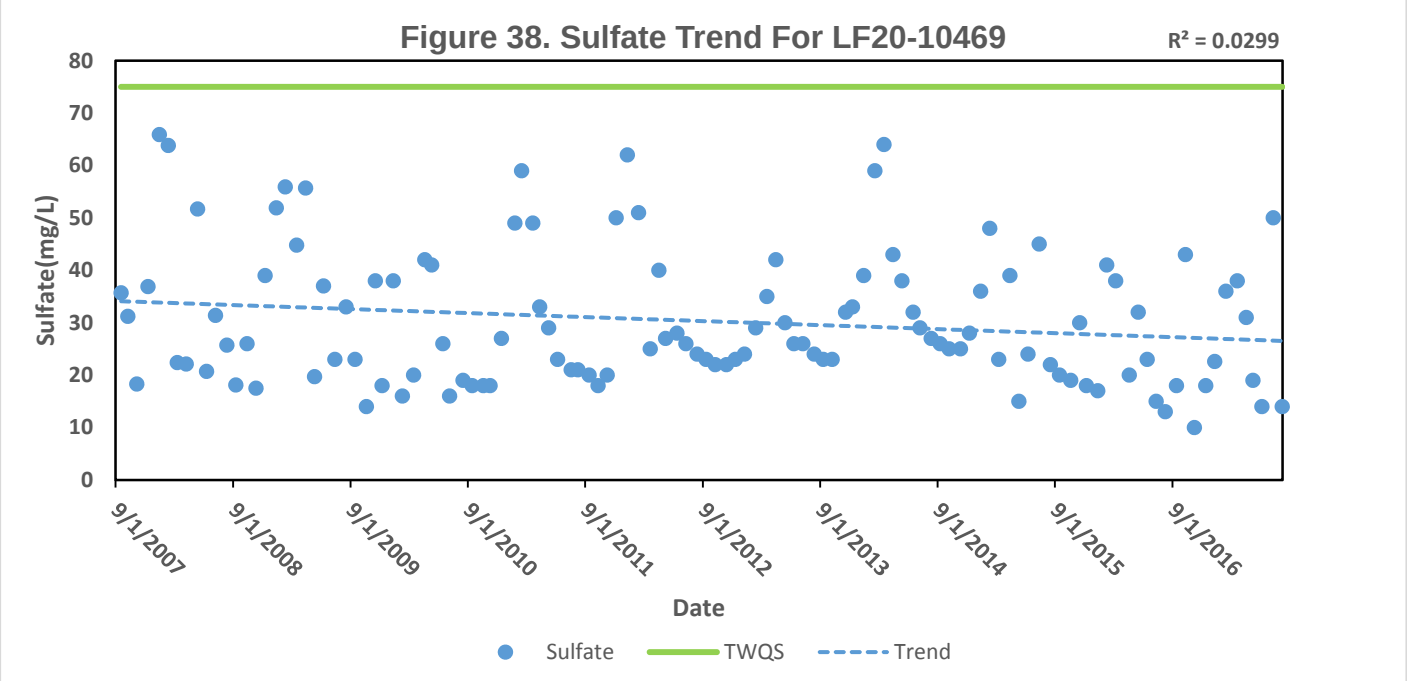
The TDS values ranged from 75 mg/L to 249 mg/L with a mean of 147 mg/L, which is below the TSWQS of 400 mg/L (Figure 36).



The chloride valued ranged from 11 mg/L to 100 mg/L with a mean of 28 mg/L, which is below the TSWQS of 100 mg/L. No single grab exceedances were observed from FY 2007 to FY 2017 (figure 37).



The sulfate values ranged from 10 mg/L to 66 mg/L with a mean of 30 mg/L, which is below the TSWQS of 75 mg/L (Figure 38).



Recommendations

The SRA-TX will coordinate and cooperate with stakeholders and provide education through public outreach activities. The same level of water quality monitoring will continue at representative routine sites in this segment.

Lake Fork Creek below Lake Fork Reservoir

Conclusions

Since the 2013 Summary Report, the most substantial factor affecting water quality within the Sabine Basin was the end of drought and abnormally dry conditions. During 2016, precipitation totals in the upper Sabine Basin ranged from 70 inches to 80 inches, with some areas exceeding 80 inches of rain. In the lower Sabine Basin, precipitation amounts ranged from 80 to 100 inches with some areas receiving in excess of 100 inches of rainfall[16]. In August 2017, Tropical Storm Harvey hit the Orange area and produced record breaking amounts of rainfall. Over a six-day period, 36.47 inches fell at the Orange County Airport and a new tropical cyclone rainfall record of 64.58 inches fell in Nederland, Texas, twenty-two miles southwest of Orange. Average annual rainfall in the basin ranges from 40 to 60 inches[17].

The majority of water quality data continues to meet TSWQS and screening criteria. The most frequently exceeded TSWQS parameter within the basin was bacteria, *Enterococcus* or *E. coli.* During periods of significant rainfall and increased stream turbidity, elevated levels of bacteria continued to be measured. Elevated levels of bacteria are attributed primarily to wildlife and non-point sources, but additional sources may include industrial and municipal point source discharges, on-site treatment systems, sanitary sewer overflow discharges, and package plant or other permitted small flow discharges[18]. Of the 37 SRA-TX sites assessed, 32 fully supported their designated uses. Five classified assessment units (AUs) and 10 unclassified AUs are on the Draft 2016 Texas Integrated Report 303d List for bacteria and are not meeting their designated recreational uses.

[16] National Weather Service accessed 1/8/2019, https://water.weather.gov/precip/
[17] National Weather Service accessed 3/12/2019, https://water.weather.gov/precip/
[18] TCEQ Potential Sources of Impairments and Concerns , https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_sources.pdf

Although five additional assessed sites supported their designated uses, they are listed as a concern for near non-attainment for bacteria, depressed dissolved oxygen, lead in water, or chlorophyll-a.

New listings on the Draft 2016 Texas Integrated Report 303(d) List include Segment 0512_05 for elevated pH and Segment 0505_04 List for bacteria. The following segments were removed from the Draft 2016 Texas Integrated Report 303(d) List: 0501B_02 for impaired fish community; 0504_08, 0504_09, 0504_10, and 0504_13 for mercury in edible tissue; 0505B_02 for depressed dissolved oxygen; 0507_04 for elevated pH.

Recommendations

The SRA-TX will continue to advance the knowledge and understanding of water quality in the Sabine Basin through:

- Involvement in the Texas Stream Team, public presentations, and facility tours;
- Participation in the TCEQ-facilitated Surface Water Quality Standards Workgroup, which provides input into nutrient and toxic criteria, recreational indicators and uses, and site-specific criteria changes;
- Continue to provide sampling in areas to support effective permit requirements, as well as provide input to assist the TCEQ in the development of attainable water quality standards;
- Providing web-based monthly SRA-TX Water Quality Monitoring Reports, which benefit stakeholders;
- Coordination and support of the TCRP activities within the Sabine Basin with other agencies and interested entities to identify and prioritize water quality concerns;
- Hosting the TCRP Basin Steering Committee and Coordinated Monitoring meetings to promote and engage public involvement.

Stakeholders Input

The SRA-TX presented the 2018 Sabine Basin Summary Report at three Steering Committee meetings held in Emory, Longview, and Orange, Texas. Water supply corporations, permitted dischargers, Texas Department of Agriculture, Texas Parks and Wildlife, TCEQ, SRA-TX Board members, industry representatives, Texas Railroad Commission, Sabine River Compact Commissioner, consulting firm, and city and county officials, and members of the public were present at the meetings. Steering Committee discussions included the Draft 2016 Texas Integrated Report, water quality updates and concerns, the SRA-TX Water Conservation and Contingency Plan, the SRA-TX Community Assistance Program, the SRA-TX Hazard Mitigation Plan, future monitoring needs, and updates on invasive species. Stakeholder comments and questions involved bacteria impairments and non-point sources, differences between primary and secondary contact recreation, mercury impairments in fish tissue, and Texas river basin impairment similarities.