Angelina & Neches River Authority

2015 Basin Summary Report

For the Upper Portion of the Neches River Basin

TCEQ

THE TEXAS CLEAN RIVERS PROGRAM

Angelina & Neches River Authority
P.O. Box 387 • Lufkin, TX 75902
936-632-7795 • 800-282-5634
www.anra.org • info@anra.org

ANRA

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Report Contributors

Environmental Division Manager
Clean Rivers Program Project Manager / Quality Assurance Officer
Brian Sims

Information Systems Coordinator
Clean Rivers Program Data Manager
Jeremiah Poling

On-Site Sewage Facilities Program Coordinator
Clean Rivers Program Field Technician
Mike Parrish

Environmental Laboratory Manager
Trey Reeves

Environmental Laboratory Technician
Sheri Smith

Office Manager
Dyan Stanford

Executive Summary for the 2015 Basin Summary Report

Jack Creek at SH 94

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Executive Summary for the 2015 Basin Summary Report

The Angelina and Neches River Authority's 2015 Basin Summary Report provides a comprehensive review of water quality in the upper portion of the Neches River Basin. This report is prepared every five years.

The report includes descriptions of water quality conditions and issues, trend analysis of water quality by station and parameter, discussion of watershed characteristics, and potential influences on water quality. Furthermore, recommendations of management strategies for correcting identified water quality impairments are also included in the report.

To determine whether designated uses are supported, water quality parameters were examined and compared to criteria and screening levels as listed in the Texas Surface Water Quality Standards. Assessment data from the Draft 2014 Texas Integrated Report for Clean Water Act Section 305(b) and 303(d) was used in this report.

Activities and Accomplishments

The Texas Commission on Environmental Quality's (TCEQ) Clean Rivers Program (CRP) utilizes a watershed management approach to identify and evaluate water quality issues, establish priorities for corrective action, and outline strategies to implement those actions. CRP funds are shared equally among the Angelina and Neches River Authority (ANRA) and the Lower Neches Valley Authority (LNVA) to monitor water bodies in the Neches River Basin. ANRA's jurisdictional service area consists of approximately 8,500 square miles that lie wholly or in part of 17 counties.

Beginning in FY 2014, ANRA increased its number of routine monitoring stations from twenty-six to forty stations. This allowed ANRA to have more coverage of the basin and address some specific stakeholder concerns, particularly with Lake Striker (Segment 0611R), Cedar Creek (Segment 0604A), and Hurricane Creek (Segment 0604B). Although there was a reduction in funds for the Clean Rivers Program, ANRA was able to make this change by reallocating employee salaries to other departments and by improved efficiencies in laboratory operations owing to the acquisition of automated analysis equipment.

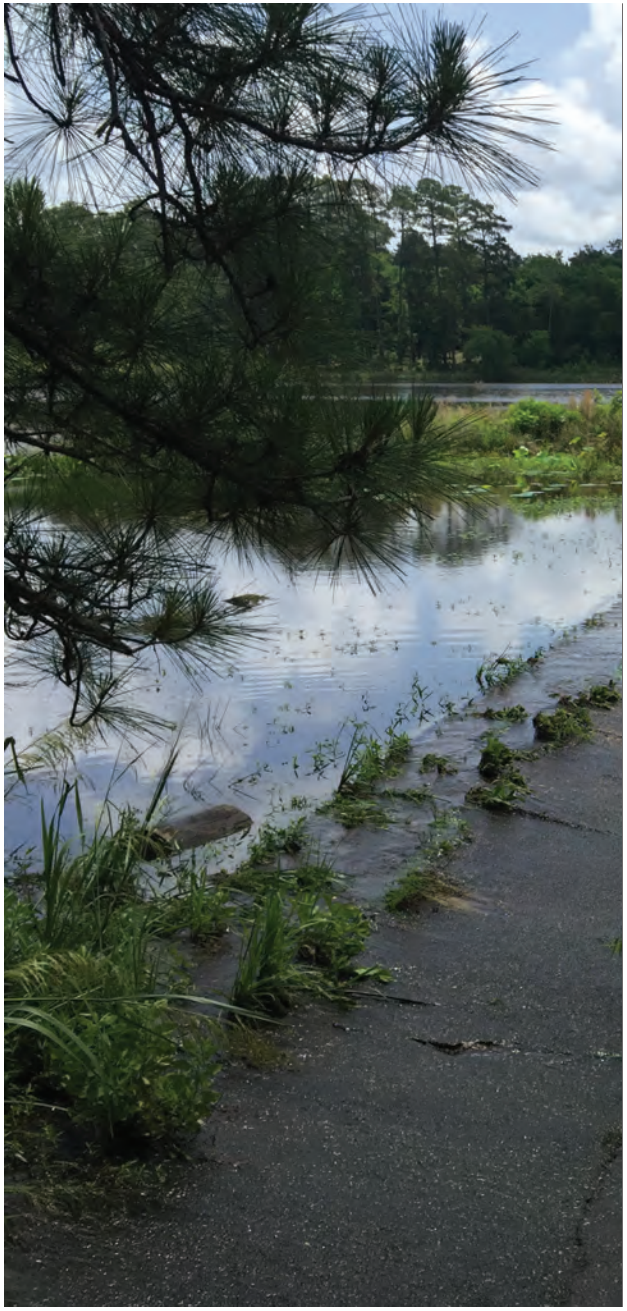
ANRA worked closely with the Texas Water Resources Institute (TWRI), Stephen F. Austin State University (SFASU), Texas A&M AgriLife Research, and other partners as part of a federal Clean Water Act §319(h) grant funded through the Texas State Soil and Water Conservation Board (TSSWCB). The purpose of this collaborative project was to develop a Watershed Protection Plan (WPP) for the Attoyac Bayou (Segment 0612), an impaired water body listed on the 303(d) List due to bacterial impairment. As part of this project, ANRA's Environmental Laboratory performed laboratory analysis for an intensive two-year monitoring program on the Attoyac Bayou and several of its tributaries. In April 2015, the Environmental Protection Agency (EPA) accepted the *Attoyac Bayou Watershed Protection Plan* document.

As a follow-up to the Attoyac Bayou WPP, ANRA was funded through a TCEQ Clean Water Act §319(h) grant to replace failing or non-existent on-site sewage facilities in the Attoyac Bayou watershed. In addition, this project is funding the development of a database of all permitted septic systems in the Control Zone Rayburn (the 2000-ft buffer zone around Sam Rayburn Reservoir) as well as the unincorporated portion of San Augustine County, including the portion that is within the Attoyac Bayou watershed. ANRA is also conducting monthly water quality monitoring on five additional stations within the watershed as part of this project.

Significant Findings

In general, historical and current water quality data of the Neches River basin included elevated bacteria levels, depressed dissolved oxygen, and dioxin and mercury in edible fish tissue. Data analysis displayed several concerns in regards to nutrients. However, there are several segments, tributaries, and reservoirs within the basin that are fully supporting their designated uses.

Executive Summary for the 2015 Basin Summary Report



Bacterial Impairments

Bacterial impairments are the most common reason for water bodies in the upper and middle portions of the Neches River Basin to be listed on the 303(d) List. Three classified segments (Neches River Above Lake Palestine, Angelina River Above Sam Rayburn Reservoir, and Attoyac Bayou) have a bacterial impairment listed in the Draft 2014 Integrated Report. Additionally, thirteen unclassified segments have impairments or concerns for *E. coli* bacteria.

Depressed Dissolved Oxygen

Depressed Dissolved Oxygen levels were common in the basin. These impairments and concerns are most likely due to a combination of low flows and elevated nutrient levels.

Concerns for Nutrient Levels

Numerous segments had concerns for nutrients, particularly Ammonia and Total Phosphorus. However, decreasing trends for these parameters were often observed.

Mercury and Dioxin in Edible Fish Tissue

Fish advisories issued by the Texas Department of State Health Services (DSHS) cover several water bodies in the Neches Basin. Lake Ratcliff has a fish consumption advisory due to mercury, while an advisory for mercury and dioxin covers the Neches River Below Lake Palestine, Sam Rayburn Reservoir, and B.A. Steinhagen.

Recommendations

Through the Coordinated Monitoring Meeting process, ANRA collaborates with other agencies in the basin to establish a monitoring program in the basin to best address water quality issues. ANRA is also an active participant in the TCEQ's Watershed Action Planning process. These two processes are integral to the success of the Clean Rivers Program.

Recreational Use Attainability Analyses (RUAAs) are being utilized in the basin to assess the contact recreational use of numerous water bodies in the basin. Through this process, it can be determined if Primary Contact Recreation is the correct designation for the segment, or if a more appropriate use designation is warranted.

Continued monitoring efforts within the basin are an important issue to stakeholders. In addition to monitoring activities funded by the Clean Rivers Program, ANRA is looking to expand its surface water quality monitoring program by developing partnerships with other entities in the state and the basin. One of the primary goals of the current water quality monitoring program at ANRA is to identify and foster collaborative relationships with other entities to pool resources and talents in addressing water quality issues throughout the Neches River Basin. An example of this approach is the collaborative project to develop a watershed protection plan for the Attoyac Bayou.

Introduction

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Introduction to the Basin Summary Report

About the Basin Summary Report

The Basin Summary Report, assembled every five years, provides a comprehensive review of water quality data and water quality related issues for the Upper Neches River Basin. The report serves to develop a greater understanding of water quality within the basin, which can be used to aid regulatory agencies in decision making.

The report consists of a comprehensive review including descriptions of water quality conditions and issues, trend analysis of water quality by station and parameter, discussion of watershed characteristics, and potential influences on water quality. Furthermore, recommendations of management strategies for correcting identified water quality impairments are also included in the report. The report details activities performed by the Angelina & Neches River Authority (ANRA) under the Texas Clean Rivers Program (CRP).

The 2015 Basin Summary Report was prepared by the Angelina & Neches River Authority in cooperation with the Texas Commission on Environmental Quality (TCEQ) under the authorization of the Texas Clean Rivers Act.

About the Angelina and Neches River Authority

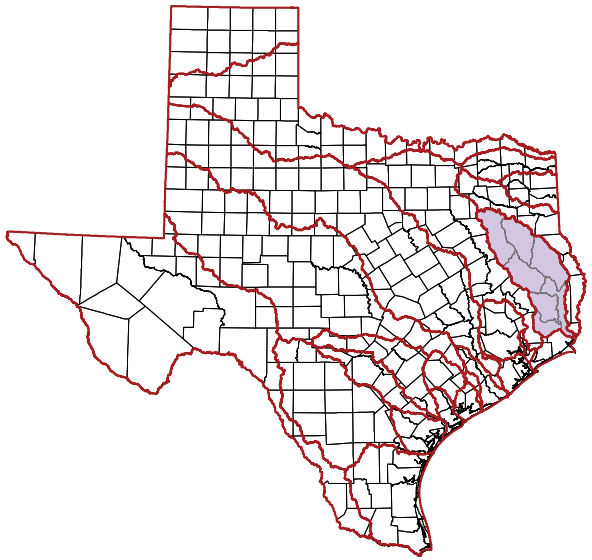
The Angelina & Neches River Authority, originally named the Sabine & Neches Conservation District, was created in 1935 by the Texas legislature as a conservation and reclamation district. The legislature divided the territory of the Sabine & Neches Conservation District into the Sabine River Authority and the Neches River Conservation District in 1949. It was not until 1971 that the Neches River Conservation District was activated and began operating as a water resource agency. In 1977, Senate Bill 125 changed the name of the Neches River Conservation District to the Angelina & Neches River Authority.

ANRA's office is located in Lufkin, Texas. ANRA's territorial jurisdiction consists of 8,500 square miles that lie wholly or in part of the following counties: Van Zandt, Smith, Henderson, Newton, Cherokee, Anderson, Rusk, Houston, Nacogdoches, San Augustine, Shelby, Angelina, Trinity, Sabine, Polk, Jasper, and Orange.

The Angelina & Neches River Authority has the responsibility for monitoring, protecting, and enhancing water resources in the Neches River Basin.

ANRA

Angelina & Neches River Authority



Goals and Objectives of the Texas Clean Rivers Program

The Texas Clean Rivers Program

Texas Clean Rivers Act

Senate Bill 818, known as the Texas Clean Rivers Act, was enacted in 1991 by the Texas legislature in response to heightened concerns that water resource issues were not being pursued in an integrated, systematic fashion as intended under the Clean Water Act (CWA). The Texas Clean Rivers Act requires that each Texas River Basin conduct ongoing water quality assessments, integrating water quality issues using a watershed management approach. The Clean Rivers Program (CRP) implements the Clean Rivers Act through water quality monitoring, assessment, and public outreach. Currently, monitoring in the state of Texas includes over 1800 sites and regional water quality assessments within the 23 major river and coastal basins and their sub-watersheds. The CRP legislation mandates that each governing entity submit quality-assured data collected in each river basin to the TCEQ. A regional Quality Assurance Project Plan (QAPP) has been developed between the ANRA and the TCEQ to accomplish the activities mandated by the legislation.

The Clean Rivers Program Long-Term Plan

The mission of the CRP is to maintain and improve the quality of water within each river basin in Texas through an ongoing partnership involving the Texas Commission on Environmental Quality, river authorities, other agencies, regional entities, local governments, industry, and citizens. The program's watershed management approach is designed to identify and evaluate water quality issues, establish priorities for corrective action, work to implement those actions, and adapt to changing priorities.

CRP's long-term plan is implemented through the biennial Clean Rivers Program Guidance developed by TCEQ project management staff with input from the partner agencies. The Guidance document describes seven key tasks to be performed by partner agencies.

Clean Rivers Program Long-Term Plan	
Objective	**Goal**
1	Provide quality-assured data to the TCEQ for use in water quality decision making
2	Identify and evaluate water quality issues
3	Promote cooperative watershed planning
4	Inform and engage stakeholders
5	Maintain efficient use of public funds
6	Adapt program to emerging water quality issues

Clean Rivers Program Tasks	
Task	**Responsibility**
1	Project Administration
2	Quality Assurance
3	Water Quality Monitoring
4	Data Management
5	Data Analysis and Reporting
6	Stakeholder Participation and Public Outreach
7	Special Projects

Ayish Bayou at SH 103

Coordination and Cooperation with Other Basin Entities

The Neches Basin is divided between the Angelina & Neches River Authority in Lufkin and the Lower Neches Valley Authority (LNVA) in Beaumont. ANRA monitors the upper and middle portions of the Neches Basin, with LNVA monitoring the lower portion. The TCEQ also monitors within the Neches Basin, with the regional offices in Tyler and Beaumont conducting monitoring activities.

The Clean Rivers Program enables stakeholders, citizens, and state entities to meet periodically to review and discuss water quality related issues. ANRA works with TCEQ regional offices in Tyler (Region 5) and Beaumont (Region 10) to coordinate monitoring activities. ANRA also coordinates activities with other agencies, such as Texas Parks and Wildlife Department (TPWD), the United States Geological Survey (USGS), the Texas State Soil and Water Conservation Board (TSSWCB), and the Lower Neches Values Authority.

Coordinated Monitoring Schedule

Every year the annual Coordinated Monitoring Meeting (CMM) allows entities in the basin to meet, establish basin monitoring priorities, and coordinate sampling schedules to make sure that adequate coverage is maintained with minimal duplication of effort. The CMM process is used to develop the Coordinated Monitoring Schedule (CMS) for the basin. The CMS is a comprehensive schedule of monitoring in the basin and is located at http://cms.lcra.org.

Watershed Action Planning

The Watershed Action Planning (WAP) process, established in 2011, is the state's coordinated approach to develop, coordinate, and track action to address water quality issues. The WAP process coordinates planning and activities among numerous agencies and interested parties, including the TCEQ, the Texas State Soil and Water Conservation Board (TSSWCB), the Texas Clean Rivers Program (CRP) partners, and stakeholders from the watershed. The WAP process is a flexible approach that utilizes a range of strategy options for addressing impaired water bodies on the 303(d) List and other water quality issues and provides a framework that each program area, partner agency, and stakeholder can use for planning, budgeting, and implementing activities to address water quality issues. The WAP process can also be used to address potential water quality issues before they develop to the level of an impairment.

A major product of the WAP process, the **Watershed Action Planning Strategy Table**, is a comprehensive strategy for protecting and improving the quality of water bodies. This table lists:

- impaired and special interest water bodies
- the recommended strategies to improve water quality in impaired segments to protect water bodies of special interest
- the status of each strategy
- the lead agency and program for tracking each strategy

A critical aspect of the WAP process in input from stakeholders. The type of data and information to be gathered through local watershed discussions include:

- **Watershed Evaluation** – Develop and prepare watershed maps, land use classifications, and models; identify data gaps and data acquisition projects.
- **Pollution Sources** - Identify potential point and non-point sources of pollution; evaluate pollution sources; identify pollution control practices; identify data gaps.
- **Water Quality Monitoring** - Identify water quality monitoring sites; identify water quality indicators; identify data gaps.
- **Watershed Stakeholders** - Identify key stakeholders; characterize stakeholder support; identify issues of concern and watershed goals.
- **Public** – Characterize public support and identify issues of concern and watershed goals.
- **Watershed Planning Strategy** – Identify what option(s) (e.g. Use Attainability Analysis, Total Maximum Daily Load, Watershed Protection Plan, etc.) the public and local stakeholders recommend be considered to address each water quality issue.

Descriptive Overview of the Neches Basin

The Upper Neches River Basin originates in southwest Van Zandt County and flows easterly through the Piney Woods of East Texas to the confluence of the Angelina and Neches Rivers at B.A. Steinhagen Lake. The Neches River continues to meander prior to emptying into the Sabine Lake estuary. The tidal portion of the river has undergone dredging, widening, and straightening to accommodate seagoing vessels. The Northeastern one-third of the basin is drained by the Angelina River, while the remaining two-thirds of the 10,011 square mile area are drained by the Neches River, Pine Island Bayou, and Village Creek.

Segments

The Neches River Basin has been divided into sixteen classified segments, including nine stream segments encompassing 710.1 stream miles and six reservoirs yielding 163,515 acres. ANRA performs monitoring in the upper and middle regions of the Neches Basin, with the Lower Neches Valley Authority (LNVA) being responsible for monitoring in the lower region. In the Upper Neches River Basin, there are nine classified river segments consisting of two major reservoirs and eight water supply lakes. The principle tributaries in the basin are Mud Creek, Striker Creek, East Fork Angelina River, Piney Creek, Attoyac Bayou, and Ayish Bayou.

The two major river basins are the Angelina and Neches Rivers, which comprise an estimated 1.2 billion gallons of water discharge annually into the Gulf of Mexico. Two major reservoirs, Sam Rayburn Reservoir and Lake Palestine, are also included in the Upper Neches River Basin. Ten minor reservoirs are included in the Upper Neches River Basin, including Lake Tyler, Lake Tyler East, Lake Naconiche, Lake Jacksonville, Lake Athens, Striker Lake, Lake Nacogdoches, Kurth Lake, Lake Pinkston, and Lake Ratcliff.

Rainfall

Rainfall patterns vary across the basin. In the northern half of the basin, average annual precipitation is 43 inches. Annual precipitation increases as the location is closer to the Gulf of Mexico, where the climate is subtropical to temperate.

Annual Precipitation in the Upper Neches Basin

Area of Basin	Average Annual Precipitation (in inches)
Upper Neches Sub-Basin	
Lake Athens area	40 - 42
Lake Jacksonville	42 - 44
Middle Neches Sub-Basin	
Most of the middle and upper portion	42 - 44
Junction of middle and lower sub-basin	46 - 48
Lower Neches Sub-Basin	48 - 58
Upper Angelina Sub-Basin	
Upper portion	42 - 44
Lower area towards Lake Nacogdoches	44 - 46
Lower Angelina Sub-Basin	
Junction of middle and lower sub-basin	46 - 48
Pinkston Reservoir and middle area	48 - 50
Sam Rayburn towards lower area	50 - 52
Lowermost portion of sub-basin	52 - 54

Aquifers

The Upper Neches River Basin is supported by two major aquifers (the Carrizo-Wilcox and Gulf Coast Aquifers). The basin is also supported by minor aquifers including Sparta, Yegua Jackson, and Queen City Aquifers.

Ecoregions

The watersheds are primarily located within the South Central Plains Ecoregion, with the northwest portion of the jurisdiction located within the East Central Texas Plains Ecoregion. This northwestern tip is within the East Central Texas Plains Ecoregion and is dominated by oak woods and prairie. The South Central Plains Ecoregion is locally termed "piney woods." This region is comprised mostly of irregular plains that were once blanketed by oak-hickory-pine forests. Presently, the area is predominantly loblolly and shortleaf pine. Lumber, pulpwood production, creosoting, silviculture, oil and gas activities, agriculture, and poultry are major economic activities.

Ecosystem

East Texas is home to four National Forests (the Sabine, Angelina, Davy Crockett and Sam Houston National Forests) and the Big Thicket National Preserve. The East Texas Ecosystem includes forested, scrub-shrub, emergent, aquatic bed, and wetlands. Wetland and deep water areas like reservoirs provide habitat for a large number of migratory waterfowl, wading birds, and resident species of amphibians, reptiles, birds, and mammals. The reservoirs included within the East Texas pineywoods provide outdoor recreational activities such as camping, and hiking. In addition, they provide significant sport fisheries and commercial operations within the area. Both bottomland and upland woodlands, savannah, and grasslands provide breeding and migratory habitat for neotropical migrants. This ecosystem is the major bald eagle nesting and wintering area of Texas and contains all of the state's extant habitat for red-cockaded woodpeckers.

Major threats to the East Texas ecosystem are continual loss and fragmentation of habitat from urban sprawl, forest land conversion to improved pasture, mineral extraction, highway construction, pipeline and transmission line installation, soil and water contamination, short-rotation management of commercial forests, and introduction of exotic species.

Descriptive Overview of the Neches Basin

Soil Properties

The soil properties for each of the major watersheds of the Upper Neches Basin were summarized using soil surveys and general soil maps for individual counties.

Soil Properties in the Upper Neches Basin

Segment ID	Segment Name	Soil Properties
0604	Neches River Below Lake Palestine	The soil is generally loamy with sandy and clayey portions that are nearly level to gently sloping. The natural drainage ranges from moderately well to somewhat poorly drained soils. The permeability ranges from very slow to moderate. This watershed segment is dominated by strongly acidic to moderately acidic soils.
0605	Lake Palestine	The soil is generally loamy with small portions of sandy areas. The slope of this segment ranges from gently sloping to moderately steep. This watershed segment is dominated by well to moderately drained soils, with moderate to moderately slow permeability. This segment contains slightly to moderately acidic soils.
0606	Neches River Above Lake Palestine	The soil is characterized by mostly loamy and sandy soils that are gently sloping to moderately steep. This segment's natural drainage is characterized mainly by well and moderately well drained soils. The permeability is moderately slow to moderate. This segment contains moderately to slightly acidic soils.
0610	Sam Rayburn Reservoir	This soil is characterized by loamy and sandy soils with some clayey areas that are nearly level to gently sloping. The soils are moderately well drained. This segment contains mostly moderate and very slowly permeable soils that are dominated by neutral and strongly acidic regions.
0611	Angelina River Above Sam Rayburn Reservoir	This soil is dominated by loamy and sandy soils with portions of clay soils that are gently sloping to moderately steep. This segment is characterized by well and moderately well drained soils that display moderate permeability. This soil ranges from moderate to strongly acidic.
0612	Attoyac Bayou	This segment is characterized by loamy soils with sandy and clayey portions that are gently sloping to moderately steep. These soils are well to moderately well drained, with moderately slow permeability. This segment displays moderate to strongly acidic soils.
0613	Lake Tyler/Tyler East	This soil is dominated by loamy and sandy soils with portions of clay soils that are gently sloping to moderately steep. This segment is characterized by well and moderately well drained soils that display moderate permeability. This soil ranges from moderate to strongly acidic.

Soil at Sam Rayburn Reservoir, near Shirley Creek

Descriptive Overview of the Neches Basin

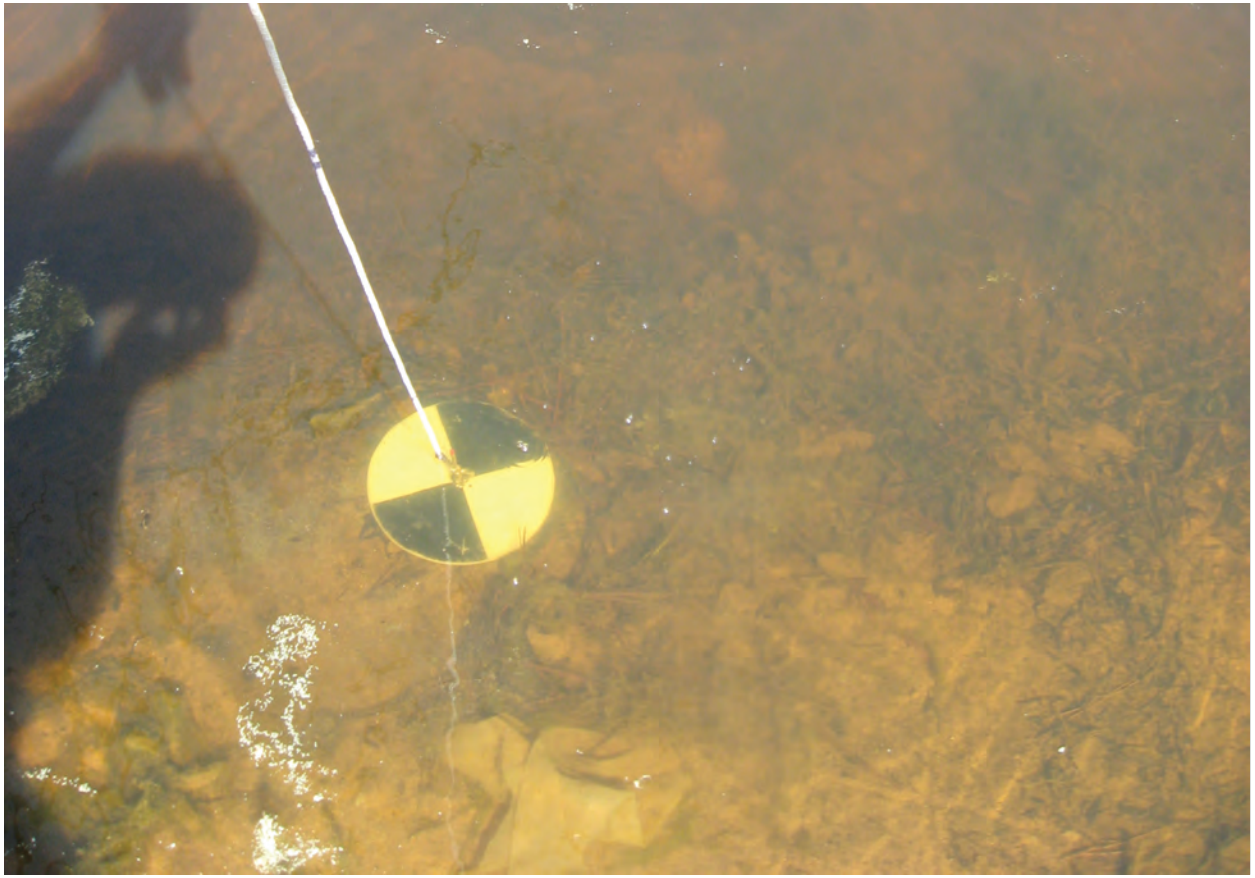
Carlson's Trophic State Index

Evaluation and Ranking of Reservoirs

Major Texas reservoirs have been evaluated and ranked by the TCEQ using Carlson's Trophic State Index (TSI). It was developed to compare among reservoirs Secchi disk depths, chlorophyll-*a* concentrations, and total phosphorus concentrations. These three variables are highly correlated and are considered estimators of algal biomass. The TSI is determined from three computational equations used with surface water quality monitoring (SWQM) data. Thus, TSI calculations can classify reservoirs or lakes into different trophic states. The trophic states below are based on the TSI calculation for chlorophyll-*a*.

Trophic Classification of Neches Basin Reservoirs (2010)

Segment ID	Reservoir	TSI (Chl-*a*)	Trophic State
0611Q	Lake Nacogdoches	43.28	Mesotrophic
0611R	Lake Striker	45.18	Eutrophic
0614	Lake Jacksonville	45.52	Eutrophic
0610	Sam Rayburn Reservoir	48.06	Eutrophic
0605F	Lake Athens	49.54	Eutrophic
0603	B.A. Steinhagen	50.74	Eutrophic
0613	Lake Tyler	50.98	Eutrophic
0605	Lake Palestine	61.46	Hypereutrophic



Measurement of Secchi disk transparency

Water Quality Characteristics of Trophic States

Trophic State	TSI (Chl-*a*) Index Range	Water Quality Characteristics
Oligotrophic	0 - 35	Clear waters with extreme clarity, low nutrient concentrations, little organic matter or sediment, and minimal biological activity.
Mesotrophic	> 35 - 45	Waters with moderate nutrient concentrations and, therefore, more biological productivity. Waters may be lightly clouded by organic matter, sediment, suspended solids or algae.
Eutrophic	> 45 - 55	Waters extremely rich in nutrient concentrations, with high biological productivity. Waters clouded by organic matter, sediment, suspended solids, and algae. Some species may be eliminated.
Hypereutrophic	> 55	Very murky, highly productive waters due to excessive nutrient loading. Many clearwater species cannot survive.

The Texas Drought

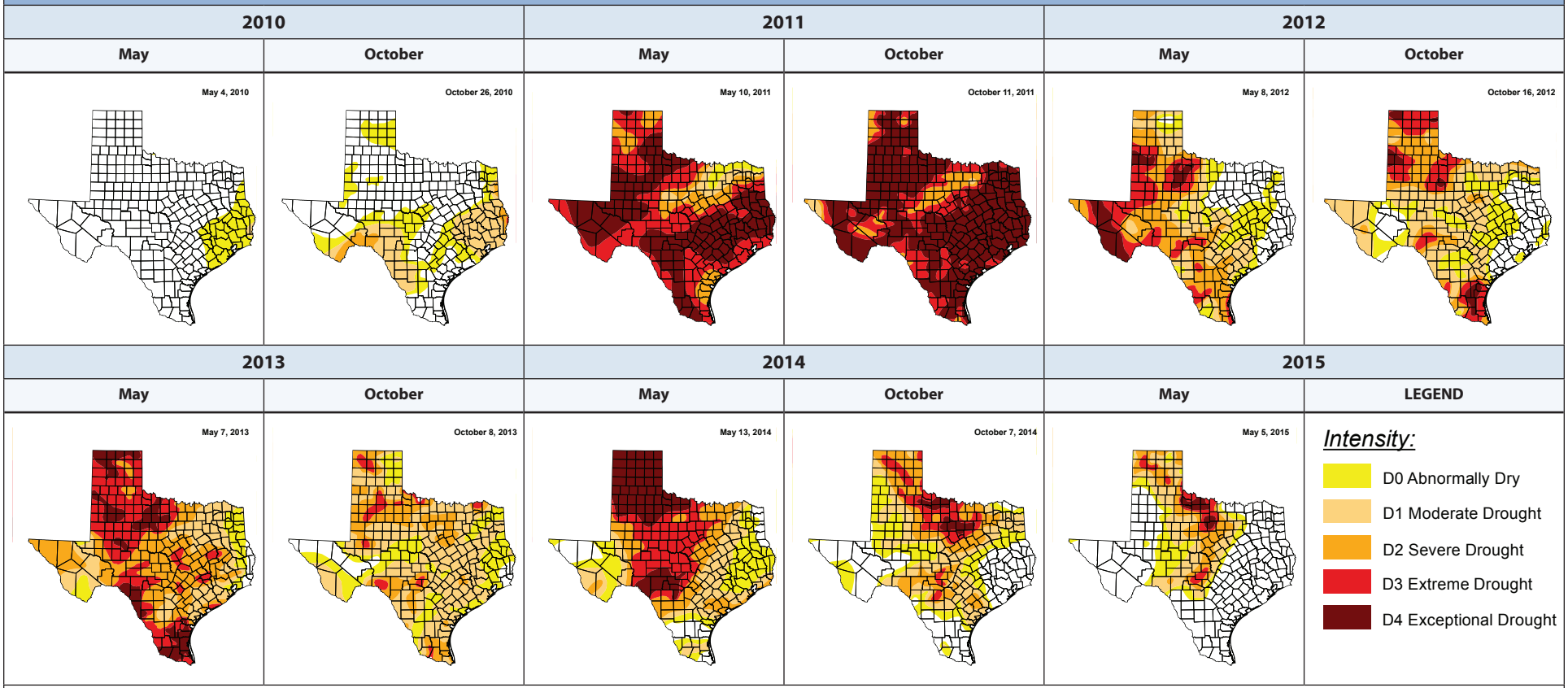
Progression of the Texas Drought Over Time

Data from the US Drought Monitor

In 2011, the drought that began in March of 2010 intensified and spread, reaching a peak in October 2011. At that time, the entire state of Texas was considered to be experiencing some level of drought, and nearly ninety percent of the state suffering "exceptional" drought, the highest intensity level that the U.S. Drought Monitor assigns. The one-year period from November 2010 through October 2011 was the driest in the state's history, according to State Climatologist John Nielsen-Gammon.

Significant relief came to East Texas in 2014. By 2015, no portion of the Neches River Basin was experiencing drought conditions.

Texas Drought Conditions (2010 - 2015)



US Drought Monitor data is available online at http://droughtmonitor.unl.edu/Home.aspx

The Texas Drought

Effects of the Drought

Reservoir Levels and Stream Flow

As the drought progressed, many streams and creeks went dry and receiving waters became more effluent-dominated. Several reservoirs in the basin reached record or near record low levels. This impacted not only recreational uses of the water, but also jeopardized drinking water supplies for municipalities that depend upon surface water.

On November 19, 2011, Lake Sam Rayburn reached a low of 150.80 ft elevation, nearly matching the record of 150.75 feet set August 10, 1996. According to Floyd Boyett of the US Army Corps of Engineers, the primary reason Sam Rayburn levels did not break the record was the saltwater barrier in Beaumont. Prior to the completion of the barrier in 2003, releases from Sam Rayburn were required to keep saltwater from intruding upstream into the Neches River. With the barrier in place, the Corps was able to retain much more water in the reservoir during Spring and Summer 2011, and even completely halt releases from November 2011 to May 2012. Above average rainfall has significantly improved pool levels of the Neches basin reservoirs since that time. In fact, in May 2015, Sam Rayburn Reservoir's flood gates had to be opened to deal with excessive rainfall in the basin.

Water Rights and Water Availability

Due to the drought, the TCEQ curtailed junior water rights throughout a large portion of the basin in November 2011. At the end of January 2012, the situation had improved enough that the TCEQ released the suspension on most, but not all, of the previously suspended junior water rights. By April 4th of that year, the reservoir and river levels improved to the point that the TCEQ were able to remove all of the remaining restrictions.

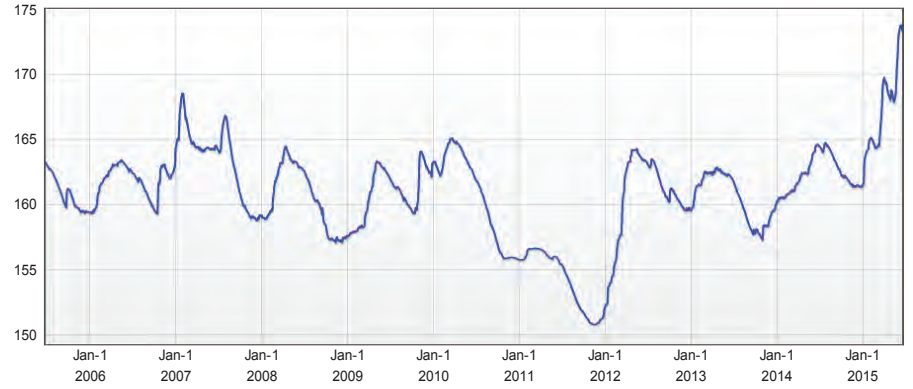
Throughout the basin, numerous municipalities and water supply corporations had to implement drought contingency measures due to diminishing water supplies. Some entities that normally depend upon surface water to meet their population's water needs turned to drilling groundwater wells in order to supply a consistent and reliable source of water.

Water Quality

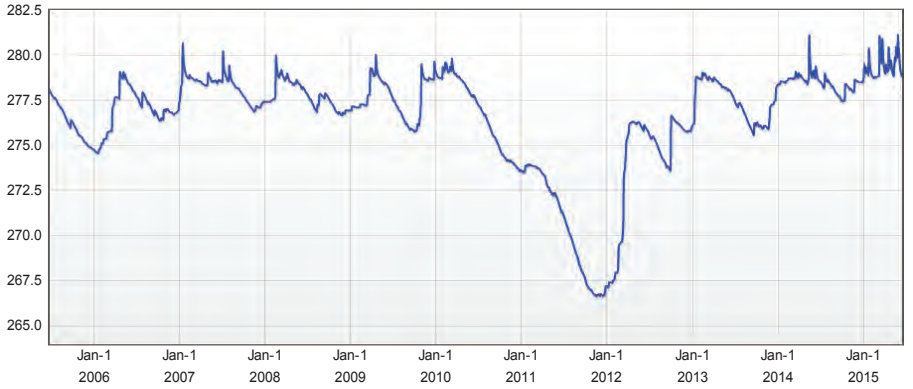
Not surprisingly, increases in the values for certain parameters, such as Specific Conductance, Total Suspended Solids, and Chloride, were observed at several monitoring stations. On several occasions, it was necessary to conduct routine monitoring from isolated pools. In other instances, it was necessary to relocate monitoring stations in order to continue monitoring.

In order to better understand these issues, the TCEQ issued an interim guidance document addressing routine surface water quality monitoring activities during periods of extended droughts. This guidance includes additional parameters that could help to determine the extent of the drought effects.

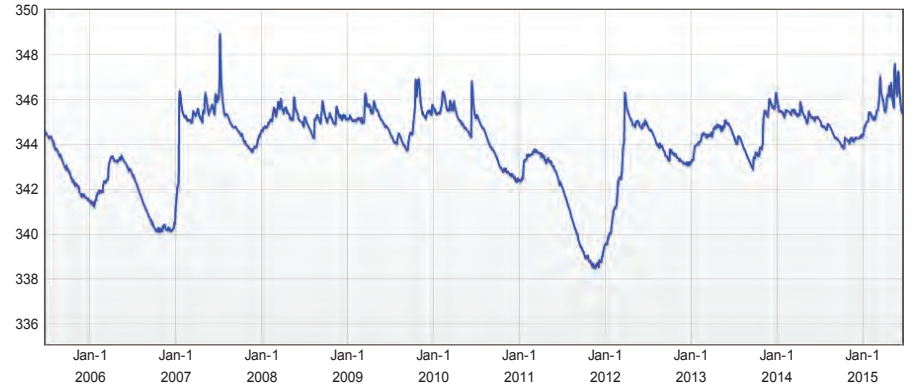
Lake Sam Rayburn - Elevation of Reservoir surface above datum in feet



Lake Nacogdoches - Elevation of Reservoir surface above datum in feet



Lake Palestine - Elevation of Reservoir surface above datum in feet



The Texas Drought

Water Quality Monitoring During the Drought

TCEQ Interim Guidance

In response to the extended drought conditions, the Texas Commission on Environmental Quality released an interim guidance document in November 2011. This document details additional parameters to monitor in order to better evaluate water quality data collected during drought periods.

According to the guidance, monitoring entities should collect and report data according to the following guidelines:

- Schedule and travel to monitoring sites as you would normally do to meet routine commitments.
- Photo document flow conditions, even if the monitoring station is dry.
- If the monitoring site is on a lake or reservoir where it is possible to safely launch a boat, and navigate to within 400 meters of the established monitoring station, go ahead and collect routine water monitoring data (field, conventional water samples, etc.).
- If the monitoring site is a stream/river, and there is water present at the site within 400 meters of the established monitoring station, and minimum size meets dimensions as described below, go ahead and collect routine water monitoring data (field, conventional water samples, etc.). If possible, report total depth at the site where the sample is collected.
- Determine pool characteristics according to the following guidance:
  - A pool is defined as anything greater than or equal to 10 meters in length and greater than or equal to 0.4 meters in depth.
  - The total length of the reach upstream/downstream of a sample station to determine pool coverage should be between 500 and 800 meters.
  - A physical measurement is the preferred method for determining percent pool coverage, but a visual estimate can also be made.
  - Report the following pool characteristics:
    - Maximum Pool Width (meters)
    - Maximum Pool Depth (meters)
    - Pool Length (in meters)
    - Percent Pool Coverage in 500 meter reach
  - Report description of where the main pool is located in relation to the bridge crossing, as well as other pertinent details such as the presence of fish, mussels, or other wildlife.
- Record field data in the Surface Water Quality Monitoring Information System (SWQMIS), even if the station is dry.
- Note comments indicating drought conditions.

Sam Rayburn Reservoir at Marion's Ferry
March 2011

Lake Nacogdoches Main Pool
November 2011

Lake Palestine
September 2011

(Photo by Upper Neches River Municipal Water Authority)

Summary of the Upper Neches Basin Water Quality Characteristics

To determine whether designated uses are supported, water quality parameters were examined and compared to criteria and screening levels as listed in the Texas Surface Water Quality Standards. Assessment data from the Draft 2014 Texas Integrated Report for Clean Water Act Section 305(b) and 303(d) was used in this report.

In general, historical and current water quality data of the Neches River basin included elevated bacteria levels, depressed dissolved oxygen, and dioxin and mercury in edible fish tissue. Data analysis displayed several concerns in regards to nutrients. However, there are several segments, tributaries, and reservoirs within the basin that are fully supporting their designated uses.

Neches River

Public Participation

Lake Nacogdoches East Park

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ANRA Outreach

ANRA Operations

The Angelina & Neches River Authority promotes public involvement in the Upper Neches Basin through numerous operations and departments. In addition to monitoring water quality through the Clean Rivers Program, ANRA operates and maintains numerous public drinking water and municipal wastewater facilities, maintains the on-site septic system program for Sam Rayburn Reservoir and the unincorporated portion of San Augustine County, and operates an Environmental Laboratory offering services to the public. Additionally, ANRA produces and sells biosolids compost through our Neches Compost Facility.

Informational Literature

Numerous pamphlets, brochures, and other educational and informational literature on such topics as water quality, conservation, and on-site septic facilities are available to the public at ANRA's offices. ANRA supports the TPWD invasive species awareness campaign "Hello Giant Salvinia, Goodbye Texas Lakes" by making informational pamphlets available to the public.

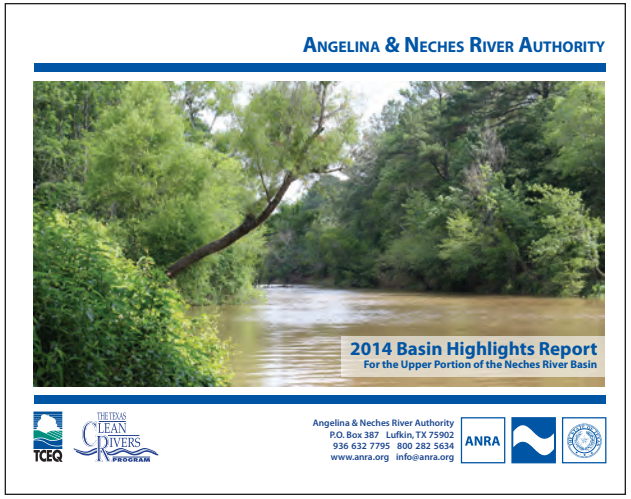
ANRA Publications

Every year, ANRA's Clean Rivers Program produces either a Basin Highlights Report or Basin Summary Report (every five years) that discusses water quality in the Neches River Basin. These reports are distributed to our Steering Committee members, interested stakeholders, and other interested parties.

ANRA Website

The Angelina & Neches River Authority provides the public with information concerning water quality issues on our website, which is updated frequently. The ANRA website provides public access to information on the Clean Rivers Program, current and historical Basin Summary and Basin Highlights reports, meeting agendas and minutes, maps, and water quality data.

Please visit us online at http://www.anra.org.

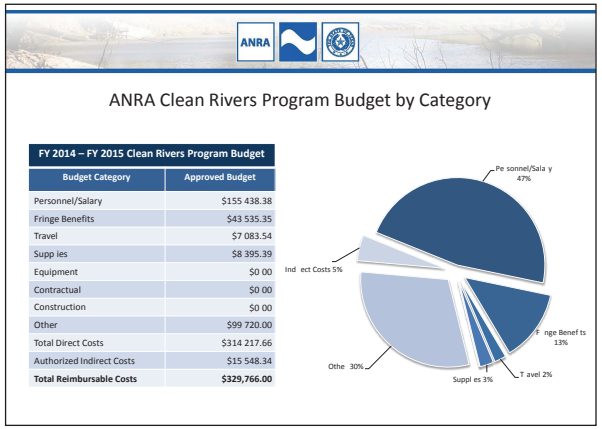


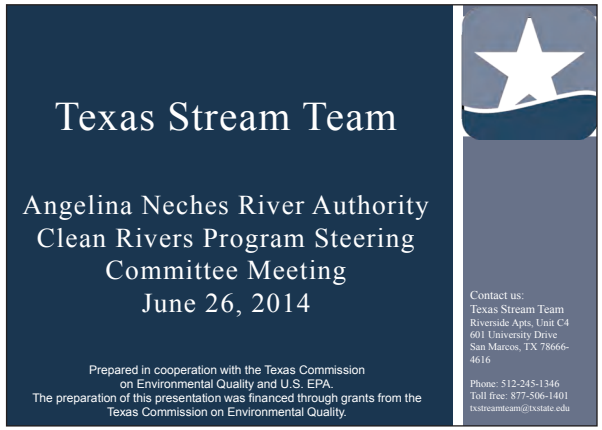
Basin Steering Committee

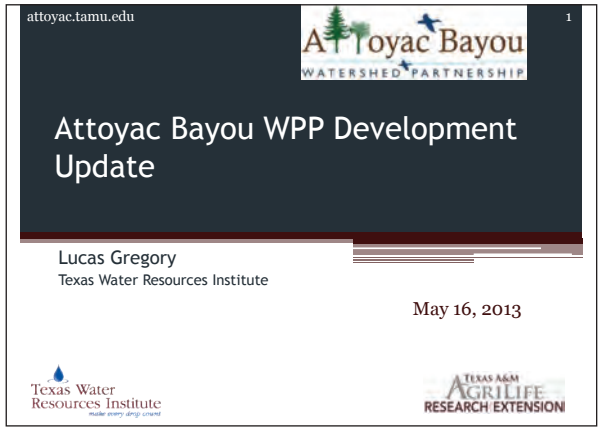
The Steering Committee's role is advisory in nature and involves assistance with the review of local issues and creation of priorities for the Upper Neches river basin. Committee members assist with the review and development of work plans, reports, basin monitoring plans, allocation of resources, and basin action plans. CRP Steering Committee meetings are held annually, typically in the spring. The committee is made up from a diverse group of stakeholders, including:

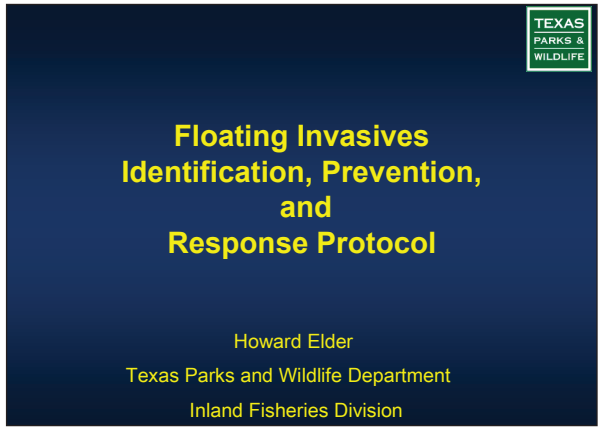
- Private citizens
- Fee-payers (identified in Texas Water Code TWC 26.0135(h))
- Political subdivisions (including local, regional, and state officials)
- Texas State Soil and Water Conservation Board
- Other appropriate state agencies including: Texas Parks and Wildlife Department, Texas Water Development Board, Texas General Land Office, Texas Department of State Health Services, Texas Department of Agriculture, Texas Railroad Commission, and Texas Department of Transportation.
- Other entities interested in water quality matters including: Texas Commission on Environmental Quality regional staff, business and industry, agriculture, environmental and other public interest groups.

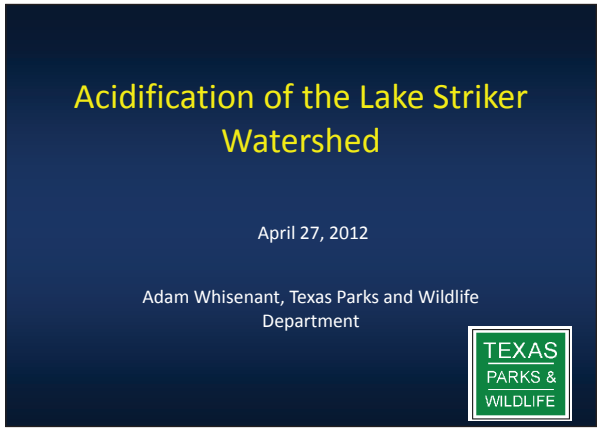
One of the objectives of the CRP Long-Term Plan is to engage and inform stakeholders. The Steering Committee process gives stakeholders an opportunity to contribute their ideas and concerns through Steering Committee meetings, public meetings, and other forums. The process also allows for the communication of issues related to water quality so that priorities may be set which consider local, regional, state, and federal needs. The Steering Committee aids in increasing opportunities for citizens to identify pressing issues and concerns, contribute ideas to the CRP process, and functions to expand the public's role in water quality management issues.











Texas Stream Team

ANRA serves as the Texas Stream Team (formerly known as Texas Watch) regional partner for the Upper Neches Basin and provides training, monitoring kits, and replacement reagents to the volunteer monitors in the basin. ANRA supports a number of water quality monitors in the basin. The largest and most active group is comprised of members of the Greater Lake Palestine Council (GLPC). GLPC consists of a group of representatives from each Property Owner's Association surrounding Lake Palestine. The GLPC is concerned about protecting water quality in Lake Palestine and making other improvements in the area.

For more information on Texas Stream Team, please visit their website at http://txstreamteam.rivers.txstate.edu

Greater Lake Palestine Council Volunteer Monitor Training

June 27, 2014

Texas StreamTeam
Caring for Our Waters

Incorporating Panoramic Photography into ANRA's Water Quality Monitoring Program

Beginning in FY 2011, ANRA Clean Rivers Program personnel began taking panoramic photographs of our monitoring stations. These images offer the viewer a full 360° view of the monitoring stations, allowing for an enhanced viewing experience as compared to traditional photographs.

Benefits and Potential Uses

There are numerous reasons for incorporating panoramic photographs into water quality monitoring programs. Some of the reasons are as follows:

- Panoramic photography allows for a 360° interactive presentation of environmental conditions associated with monitoring events.
- The photographs allow for the capture of upstream, downstream, left bank, right bank, canopy, and substrate views in one panoramic image.
- The interactive nature of the panoramas allows for rotating and zooming in order to better observe such things as weather/cloud coverage, pool reach, drought effects, pollution sources or illegal dumping, signs of contact recreation, etc.
- If each panorama is created in conjunction with a monitoring event, the panoramas can be used to demonstrate representativeness of monitoring conditions.
- If panoramas are captured from the same location, monitoring site conditions are easily compared over time.
- Integrated maps that indicate viewing direction and location can provide improved spatial awareness.

Where to View the Panoramas

All panoramas are available on ANRA's website at the following address:

http://www.anra.org/divisions/water_quality/crp/monitoring_sites/

Panoramas for different monitoring stations can be selected from either a list or a map. At stations where several panoramas have been created, the panoramas can be selected by date from a pull-down menu in the image viewer. This allows the user to compare site conditions on various dates to see seasonal variations.

Panoramic photograph at 10630 - Angelina River at SH 21

Special Projects in the Basin

Development of a Watershed Protection Plan for Attoyac Bayou

The Development of a Watershed Protection Plan for Attoyac Bayou project collected additional water quality and stream flow data to help develop a better understanding of *E. coli* loadings in the Attoyac Bayou, which is listed as impaired for bacteria. Local stakeholder input, through the Attoyac Bayou Watershed Partnership, helped facilitate the accurate identification of *E. coli* sources and was critical in the development of a Watershed Protection Plan (WPP) to protect and restore water quality in the watershed.

In July 2010, Stephen F. Austin State University (SFASU) field personnel began collecting surface water samples and submitted them to the ANRA Environmental Laboratory for analysis of nutrients, solids, and bacteria.

A subset of samples was sent to Texas A&M University for bacterial source tracking analysis. Sampling was performed biweekly at 10 routine stations and quarterly at 4 wastewater treatment facilities, with stormwater sampling being conducted at 2 additional stations in response to rain events. Sampling was occasionally sporadic due to prolonged drought conditions. Laboratory and field data from the study was submitted for inclusion in the TCEQ's Surface Water Quality Monitoring Information System (SWQMIS).

As part of this project, a Recreational Use Attainability Analysis (RUAA) was conducted in 2012 and submitted to TCEQ.

The Attoyac Bayou Watershed Protection Plan was approved by the Environmental Protection Agency in 2015.

Project Goals and Objectives

- To assess the current water quality conditions and impairments in the Attoyac Bayou watershed through targeted water quality sampling and analysis
- To conduct a watershed source survey and develop a comprehensive GIS inventory
- To analyze water quality data using Load Duration Curves and spatially explicit modeling
- To conduct bacterial source tracking and evaluate the sources of *E. coli* present in the watershed that are actually contributing to the Bayou's bacteria load
- To conduct a Recreational Use Attainability Analysis to determine the most appropriate water quality standard for the Attoyac Bayou
- To establish and provide direction for a stakeholder group that will serve as a decision making body in the assessment of the Attoyac Bayou and facilitate the development of a Watershed Protection Plan (WPP).

The project website includes links to download project documents, including the RUAA document and Watershed Protection Plan. For more information on the project, please visit the project website at http://attoyac.tamu.edu or contact:

Anthony Castilaw
Watershed Coordinator
Castilaw Environmental Services, LLC
936-559-9991
acastilaw@castilawenvironmental.com

Lucas Gregory
Project Specialist
Texas Water Resources Institute
979-845-7869
lfgregory@ag.tamu.edu

Project Partners

The Development of a Watershed Protection Plan for Attoyac Bayou project is a collaborative effort by several partner agencies. Funding for the project was provided by the Texas State Soil and Water Conservation Board (TSSWCB) through a Clean Water Act, Section 319(h) grant from the U.S. Environmental Protection Agency (EPA).

Partner agencies for the project include the Texas Water Resources Institute (TWRI), AgriLife Research & Extension, Stephen F. Austin State University (SFASU), the Angelina & Neches River Authority, and Castilaw Environmental Services, LLC.

Special Projects in the Basin

Recreational Use Attainability Analysis of Prairie Creek, Mud Creek, West Mud Creek, and Neches River Above Lake Palestine

Prairie Creek, Mud Creek, West Mud Creek, and the Neches River Above Lake Palestine are currently listed on the *Texas 303(d) List* due to elevated levels of *E. coli* bacteria. These segments have a presumed designated use of primary contact recreation. Based upon revisions to the Texas Surface Water Quality Standards (TSWQS) adopted by TCEQ in 2010, water bodies listed as impaired for bacteria are eligible for a standards review to determine if primary contact recreation is appropriate, or if a revision to the recreation use category is warranted.

Primary contact recreation is presumed for unclassified segments, and it is not known with certainty that recreational use is occurring in these waterbodies. The findings from an RUAA will provide informati n regarding the level of recreat onal use actually occurring in the waterbodies.

Through this project, which is funded by a Clean Water Act Section 319(h) Grant, the Texas State Soil and Water Conservation Board (TSSWCB) and the Texas Institute for Applied Environmental Research (TIAER) will work with local stakeholders for the data collection components of an RUAA, such as site selection and historical use surveys. At the end of this project, they will have adequate data that either supports the existing designated use (primary contact recreation) or supports a change in designated use (e.g., secondary contact recreation) for these segments.

The RUAAs were conducted during the summer of 2014, with preliminary findings presented to stakeholders in September 2014.

The website for this project is http://tiaer.tarleton.edu/ruaa/index.html.

For more information on this project, please contact:

Leah Taylor
Senior Project Director
Texas Institute for Applied Environmental Research
254-968-0513
ltaylor@tiaer.tarlton.edu

Project Partners

Funding for the project is provided by the Texas State Soil and Water Conservation Board (TSSWCB) through a Clean Water Act, Section 319(h) grant from the U.S. Environmental Protection Agency (EPA).

Recreational Use Attainability Analysis of Ayish Bayou, Biloxi Creek, East Fork Angelina River, Jack Creek, and Paper Mill Creek

The Texas Commission on Environmental Quality is the lead agency for a project to conduct Recreational Use Attainability Analyses on Ayish Bayou, Biloxi Creek, East Fork Angelina River, Jack Creek, and Paper Mill Creek. These segments have been listed as impaired for *E. coli* bacteria levels which exceed their presumed designated use of primary contact recreation.

The RUAAs will be used to determine if primary contact recreation is the most appropriate recreation use category for these water bodies, or if a more appropriate use, such as secondary contact recreation, is more appropriate.

A series of three public meetings were held to inform stakeholders and engage them in the RUAA process:

- June 24, 2014, in Lufkin to discuss the proposed RUAAs on Jack, Biloxi, and Paper Mill Creeks
- June 25, 2014, in San Augustine to discuss the Ayish Bayou RUAA
- June 26, 2014, in Mount Enterprise to discuss the East Fork Angelina RUAA

RUAAs for this project were conducted by Texas AgriLife Research & Extension.

For more information on this project, please contact:

Joe Martin
Water Bacteria Coordinator
Water Quality Standards Group
Water Quality Planning Division
Texas Commission on Environmental Quality
512-239-3163
joe.martin@tceq.texas.gov

Project Partners

Special Projects in the Basin

Lake Sam Rayburn On-Site Sewage Facility (OSSF) Program Support and Attoyac Bayou OSSF Remediation

Water Body	Attoyac Bayou (Segment 0612)
Location	Nacogdoches, San Augustine, Shelby, and Rusk Counties
River Basin	Neches River Basin (6)
Contractor	Angelina & Neches River Authority (ANRA)
Project Period	September 1, 2013 to August 31, 2016

Through this project, ANRA will develop a database of On-Site Sewage Facilities (OSSFs) in the Control Zone Rayburn (CZR), the 2000-ft buffer zone around Sam Rayburn Reservoir, as well as the unincorporated portion of San Augustine County. The database will be used to track and map all permitted systems in the area immediately surrounding Sam Rayburn Reservoir, as well as the unincorporated portion of San Augustine County. This portion of the county includes a portion of the Attoyac Bayou watershed, a 303(d) listed waterbody impaired for bacteria.

Failing or non-existent OSSFs in the area will be identified through a combination of database tracking of complaints and violations, field reconnaissance and inspections, and consultations with local officials. Funds from the project will be used to replace (in the case of failing systems) or install (in the case of non-existent systems) OSSFs in the Attoyac Bayou watershed located in Nacogdoches, San Augustine, Shelby, and Rusk Counties. Replacement or installation of OSSFs will reduce potential sources of nonpoint source (NPS) pollution that may be contributing to the bacteria impairments in the watershed.

The database tracking and GIS mapping of permitted OSSFs in the watershed will provide a framework that ANRA can use in identifying candidates for future OSSF replacement or installation in additional or subsequent projects.

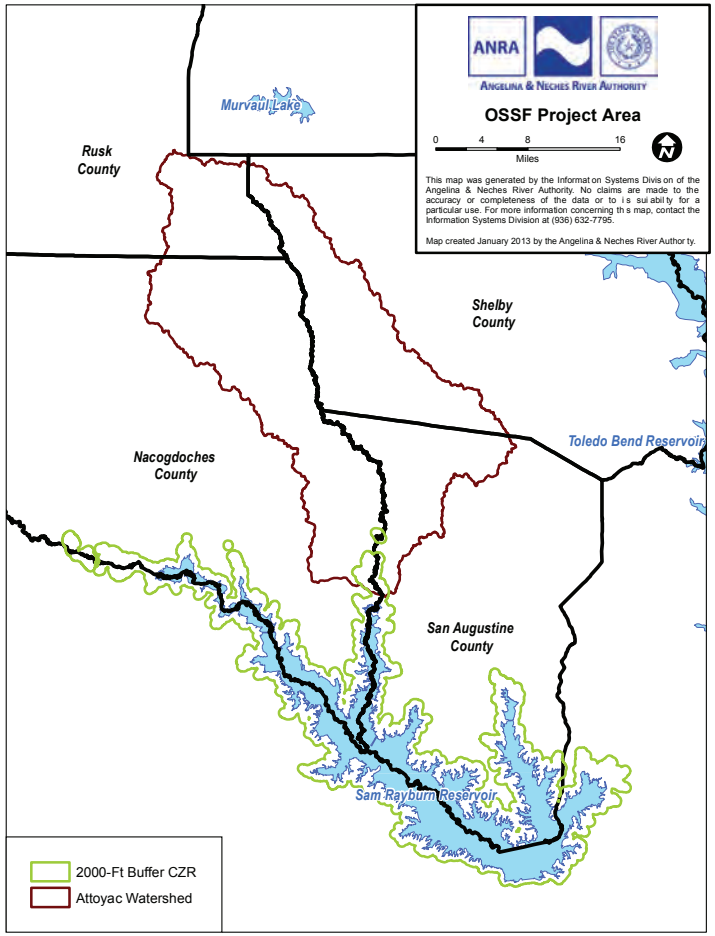
Surface water quality monitoring in the Attoyac Bayou watershed will be used to identify improvements in water quality following the replacement of failed or non-existent OSSFs, as well as monitoring effectiveness of Best Management Practices (BMPs) established by the Attoyac Bayou WPP. Water quality monitoring conducted under this project will test not only for bacteria but for nutrients as well, including parameters for which Attoyac Bayou and Sam Rayburn Reservoir have nutrient concerns

Water quality data collected under this project will be routinely shared with the Attoyac Bayou Watershed Partnership the group of stakeholders guiding the development of the Attoyac Bayou WPP. The data will also be collected under a TCEQ-approved Quality Assurance Project Plan (QAPP), allowing the data to be uploaded to the TCEQ's Surface Water Quality Monitoring Information System (SWQMIS), and thus making the data available to TCEQ for consideration in future water quality assessments.

The mapping and database components of this project began in FY 2014 OSSF replacement and surface water quality monitoring will be performed during FY 2015 and FY 2016.

For more information, please contact:

Brian Sims
Environmental Division Manager
Angelina and Neches River Authority
936-633-7527
bsims@anra.org



Project Partners

Funding for the project is provided by the Texas Commission on Environmental Quality (TCEQ) through a Clean Water Act Section 319(h) grant from the U.S. Environmental Protection Agency (EPA).

TCEQ

ANRA
Angelina & Neches River Authority

Additional Information and Resources

Online Resources

The Texas Commission on Environmental Quality
www.tceq.texas.gov

The Texas Clean Rivers Program
www.texascleanrivers.org

Clean Rivers Program Guidance
www.tceq.texas.gov/waterquality/clean-rivers/guidance/index.html

Coordinated Monitoring Schedule
cms.lcra.org

Draft 2014 Texas Integrated Report for the Clean Water Act Sections 305(b) and 303(d)
www.tceq.texas.gov/waterquality/assessment/14twqi/14txir

Texas Surface Water Quality Standards
www.tceq.texas.gov/waterquality/standards/eq_swqs.html

Clean Rivers Program Map Tool
www80.tceq.texas.gov/SwqmisWeb/public/crpmap.html

Clean Rivers Program Data Tool
www80.tceq.texas.gov/SwqmisWeb/public/crpweb.faces

Surface Water Quality Monitoring Procedures
www.tceq.texas.gov/waterquality/monitoring/swqm_guides.html

Attoyac Bayou Watershed Protection Plan (WPP) Project
attoyac.tamu.edu

TIAER RUAA for Ten Creeks in the Red River and Neches River Basins
tiaer.tarleton.edu/ruaa/

Texas Stream Team
txstreamteam.rivers.txstate.edu

Texas Invasives
www.texasinvasives.org

Texas Department of State Health Services Fish Consumption Advisories
www.dshs.state.tx.us/seafood/survey shtm

The Surface Water Quality Monitor Newsletter
www.tceq.texas.gov/compliance/monitoring/water/newsletter.html

EPA's Surf Your Watershed
cfpub.epa.gov/surf/locate/index.cfm

USGS The National Map Streamer

nationalmap.gov/streamer

US Drought Monitor
droughtmonitor.unl.edu/

Texas Drought Information
www.tceq.texas.gov/response/drought

THE TEXAS CLEAN RIVERS PROGRAM

Contact Information

For more information on ANRA's Clean Rivers Program, please contact:

Brian Sims
Environmental Division Manager
Angelina & Neches River Authority
210 E. Lufkin Ave
Lufkin, TX 75901
Phone: 936-633-7527
Fax: 936-632-2564
Email: bsims@anra.org

Jeremiah Poling
Information Systems Coordinator
Angelina & Neches River Authority
210 E. Lufkin Ave
Lufkin, TX 75901
Phone: 936-633-7551
Fax: 936-632-2564
Email: jpoling@anra.org

Water Quality Review

Fall Foliage above Hurricane Creek downstream of Kiwanis Park

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Water Quality Terminology

In order to understand the issues involved in surface water quality monitoring and the assessment of the water quality data, it is first necessary to have an understanding of terminology, water quality parameters, and the TCEQ assessment process.

This review of water quality terminology is designed to provide a description of technical terms used in the Basin Summary Report. While this review can be used as a glossary, it is intended to provide more than just definitions, as it includes background information on not only technical terms, but also legislation, water quality standards, monitoring, and the evaluation of water bodies.

The Federal Clean Water Act (CWA)

The forefront of the first law to address water pollution in the United States was the Federal Water Pollution Control Act of 1948. After heightened concern for water pollution, this act was reorganized, revised, and expanded in 1972. After amendments were added, the law became known as the Federal Clean Water Act (CWA) in 1977. The CWA encompassed the origin of permitted discharges, water quality standards, and holding liable parties responsible. The goal of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (33 U.S.C §1251(a)).

According to the Environmental Protection Agency (EPA), the 1977 amendments to the Clean Water Act:

- Established the basic structure for regulating pollutant discharges into the waters of the United States;
- Gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry;
- Maintained existing requirements to set water quality standards for all contaminants in surface waters;
- Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions;
- Funded the construction of sewage treatment plants under the construction grants program;
- Recognized the need for planning to address the critical problems posed by nonpoint source pollution.

The CWA established the basic structure for regulations of discharges, pollutant loadings in waters, and regulating water quality standards for surface waters.

Pollution

Under the Texas Administrative Code, pollution is defined as, "the alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property or to public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose."

Point Source Pollution: Any source of pollution that is subject to regulation and is permitted is defined as a "point source." An example of a point source is a wastewater treatment plant discharge.

Non-Point Source (NPS) Pollution: Any source that is not subject to regulation or permitted. Non-point source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification.

Texas Surface Water Quality Standards (TSWQS)

Texas Surface Water Quality Standards (TSWQS) are state rules adopted by the Texas Commission on Environmental Quality (TCEQ) that are designed to establish numerical and narrative goals for water quality throughout the state. TSWQS are developed to maintain the quality of surface waters in Texas so that they support public health and enjoyment, and protect aquatic life, consistent with the sustainable economic development of the state. TSWQS describe the physical, chemical, and biological conditions to be attained in waters in the state, as well as identifying uses and criteria associated with those uses. TSWQS also provide a basis on which the TCEQ regulatory programs [such as Permitting, Total Maximum Daily Load (TMDL), Non-Point Source (NPS), and Monitoring/Assessment] can establish reasonable methods to implement and attain the state's goals for water quality.

Section 304(a)(1) of the CWA requires development of criteria for water quality that accurately reflects the latest scientific knowledge. Criteria are based solely on data and scientific judgments on pollutant concentrations and environmental or human health effects. Section 304(a) also provides guidance to states and tribes in adopting water quality standards. Criteria are developed for the protection of aquatic life as well as for human health. Criteria are numerical numbers representing a specific use for the water body. For example, for high aquatic life use, the dissolved oxygen 24-hour minimum criteria is 3.0 mg/L. Impairments occur when water quality conditions do not meet assigned uses/criteria as defined in the TSWQS.

Designated Uses

As defined in the TSWQS, a body of water can be assigned designated uses including aquatic life use, contact recreation, public water supply, and general use. Other uses, such as oyster waters, do not apply in the Upper Neches Basin. For a designated use, there are criteria which usually consist of a numerical value.

Aquatic life use has criteria for dissolved oxygen, fish and macrobenthic community index, and acute and chronic substances. Aquatic Life Use (ALU) has corresponding 24-hour dissolved oxygen criteria. Water bodies have assigned/presumed ALU. ALU categories are exceptional, high, intermediate, limited, and minimal.

General use includes criteria for chloride, sulfate, total dissolved solids (TDS), pH, and temperature. General use nutrients like ammonia, nitrates, total phosphorus, and chlorophyll-*a* are used to screen concerns for

supported use of the waters. General Use criteria are used to protect overall water quality rather than a single specific use. A water body is classified as Fully Supporting for general use if it meets all of these criteria.

Public water supply use includes criteria for chlorides, sulfates, and TDS in drinking water. Criteria for these parameters are set so that public water supplies are capable of treating and delivering water of acceptable quality.

Contact recreational use is assessed using criteria for bacteria indicators such as *E. coli* (freshwater) or *Enterococcus* (tidally influenced waters or marine waters). Contact recreation use refers to the ability of the water body to support activities that involve physical contact with the water, such as swimming and wading. There are both primary and secondary contact recreation uses.

Primary contact recreation activities, such as swimming, are presumed to involve a significant risk of ingestion of water.

Secondary contact recreation activities, such as fishing, are presumed to involve a less significant risk of water ingestion than primary contact recreation due to limited body contact incidental to shoreline activity. The difference between secondary contact 1 and 2 are the frequency that the secondary contact recreation activities occur due to physical characteristics of the water body or limited public access.

Segments

For the purpose of managing Water Quality Standards, water bodies in the state are divided into classified and unclassified segments. A classified segment is a water body or portion of a water body that is individually defined 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. Classified segments may include streams, rivers, bays, estuaries, wetlands, lakes, or reservoirs. The classified segments are assigned four-digit numbers. The first two digits correspond to the major basin in which they are located. The last two digits distinguish individual segments within the particular basin.

Because of the great extent of waters of the state, not all bodies of water are classified in the standards. For example, when managing a classified segment of the Neches River, it may be necessary to examine water quality in the tributaries that flow into that segment. Some of these tributaries may not be part of the classified segment system. When that happens, for management purposes, the tributary is assigned a unique tracking number that is referred to as an unclassified segment. This unclassified tributary will be designated with the number of the classified segment in whose watershed it is located, along with a letter; for instance, tributaries of Segment 0604 would be 0604A, 0604B, and so on. The same numbering system applies to unclassified lakes.

Assessment Units

For assessment purposes, classified and unclassified segments are further subdivided into assessment units (AU). In the Integrated Report, use support is reported at the AU level for each segment.

A segment may consist of one or multiple assessment units, which are assigned unique identifying numbers based upon the segment number. For example, Segment 0612 (Attoyac Bayou) consists of three assessment units, AU 0612_01, 0612_02, and 0612_03.

Swimming area at Ebenezer Park on Sam Rayburn Reservoir

Bald eagle on Sam Rayburn Reservoir

The Texas Integrated Report

The 303(d) List is a listing of impaired water bodies. The state must identify all water bodies where required pollution controls are not sufficient to attain or maintain applicable surface water quality standards. In Texas, this list is compiled by the TCEQ and is a part of the *Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*, also known more simply as the *Texas Integrated Report*. This report is prepared by TCEQ and submitted to the US Environmental Protection Agency (EPA) every two years in even numbered years.

The *Texas Integrated Report* describes the condition of all surface water bodies that were evaluated for the assessment period. For the 2014 assessment (currently in Draft form awaiting EPA approval), the TCEQ included data collected during a seven-year period (December 1, 2005 – November 30, 2012). The timeframe was extended to ten years, if needed, to attain the minimum number of data points needed for the assessment.

If the measured values for a water body are found to be consistently exceeding the criteria for its use, then that water body must be listed as impaired, which simply means that the water body is not supporting its use. When a water body is determined to be impaired, several things must happen:

- The water body must be listed on the 303(d) List;
- An evaluation must be undertaken to discover what is preventing the water body from supporting its use(s) or if the use(s) are inappropriate for the water body;
- Steps must then be taken to either remedy the problem, collect additional data or information, or to evaluate which uses are appropriate for the water body in question. These steps can include:
  - Additional monitoring;
  - Development of a Total Maximum Daily Load;
  - Preparation of a Watershed Protection Plan (WPP);
  - A review of the water quality standards.

The most recent version of the *Texas Integrated Report*, as well as draft reports and reports from previous years, can be found at the following website:
http://www.tceq.texas.gov/waterquality/assessment/305_303.html

Categories

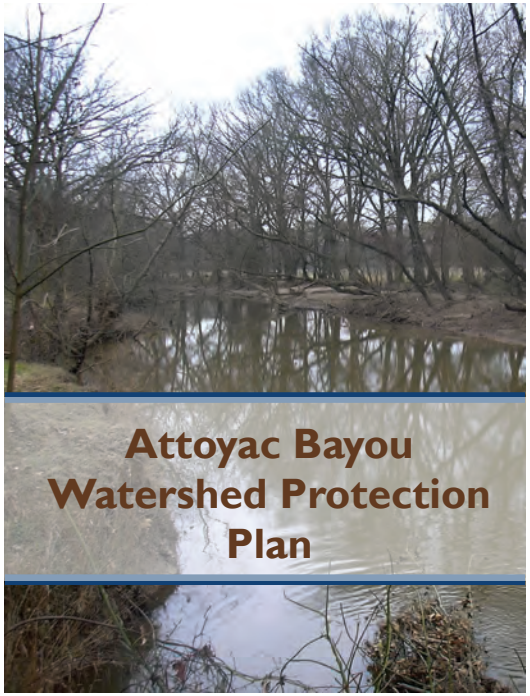
After assessment, water bodies are placed into one of five categories which indicate the water quality status of the water body. The categories are as follows:

Categories on the 303(d) List

Category	Description
1	Attaining all water quality standards and no use is threatened.
2	Attaining some water quality standards and no use is threatened; and insufficient data and information are available to determine if the remaining uses are attained or threatened.
3	Insufficient data and information are available to determine if any water quality standard is attained.
4	Water quality standard is not supported or is threatened for one or more designated uses but does not require the development of a TMDL.
4a	TMDL has been completed and approved by EPA.
4b	Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future.
4c	Nonsupport of the water quality standard is not caused by a pollutant.
5	The water body does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants.
5a	A TMDL is underway, scheduled, or will be scheduled.
5b	A review of the water quality standards for the water body will be conducted before a TMDL is scheduled.
5c	Additional data and information will be collected before a TMDL is scheduled.

Multiple tools are available to address water quality issues. Use Attainability Analysis (UAA), Best Management Practices (BMPs), Watershed Protection Plans (WPPs) and Total Maximum Daily Loads (TMDLs) are some of these tools.

- A **Use Attainability Analysis (UAA)** is a structured scientific assessment of the characteristics (physical, chemical, or biological) of a water body. If there is a general consensus among stakeholders and resource agencies that a presumed or designated use may not be appropriate, then a UAA may be conducted to evaluate the appropriate use(s) for that water body. UAAs can also be used to develop site-specific uses. In Texas, there are two types of UAAs that are available tools to assess the appropriateness of a water body's presumed or designated use. These types of UAAs are Aquatic Life Use UAAs (ALU UAA) and Recreational UAAs (RUAA).
- **Best Management Practices (BMPs)** are structural or non-structural practices which are intended to minimize the impacts of development on water bodies. Nonpoint Source BMPs are used to reduce or control impacts to water bodies from nonpoint sources, most commonly by reducing pollutant loading. There are many types of BMPs to address specific needs and site characteristics. Categories of BMPs include:
  - Preventative Practices
  - Cleanup Practices
  - Erosion Control Practices
  - Sediment Control Practices
  - Runoff Control Practices
  - Channel Protection Practices
  - Habitat Restoration Practices
  - In-Stream Remediation Practices
  - Other BMPs (such as public education)
- **Watershed Protection Plans (WPPs)** are a voluntary, proactive approach to integrating activities and prioritizing implementation of BMPs. They address complex water quality problems that cross multiple jurisdictions with the goal of improving, restoring or maintaining water quality within a particular watershed. Through the WPP process, the State of Texas encourages stakeholders and local landowners to holistically address all of the sources and causes of impairments and threats to resources within a watershed. Developed and implemented through diverse, well integrated partnerships, a WPP helps assure the long-term health of a watershed with strategies for protecting unimpaired waters and for restoring impaired waters.



- A **Total Maximum Daily Load (TMDL)** is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. It is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the water body can be used for the purposes the State has designated. The calculation must also account for seasonal variation in water quality. Once a TMDL and TMDL Implementation Plan (I-Plan) has been developed, the TMDL will be put into action and pollutant loads will be reduced through regulatory and voluntary activities. For example, discharge permits for any point sources associated with the water body may need to be modified to include more strict limitations on their output in order to reduce the amount of pollution in their discharge.

These and other tools, along with public education and the diligent work of stakeholders, resource agencies, and volunteers can and do make a difference. The quality of a water body can be improved to a point where it is capable of supporting its use(s), and the water body can then be removed from the 303(d) List of impaired water bodies.

Surface Water Quality Monitoring (SWQM) Program

TCEQ's Surface Water Quality Monitoring (SWQM) program evaluates the physical, chemical, and biological characteristics of aquatic systems as a basis for effective policy. Water quality is monitored in relation to human health concerns, ecological condition, and designated uses. SWQM data is utilized to provide a basis for effective policies that promote the protection, restoration, and wise use of surface water in Texas.

Surface water samples collected for assessment purposes are done so following the procedures outlined in TCEQ's *Surface Water Quality Monitoring Procedures Volume 1: Physical and Chemical Monitoring Methods* (TCEQ Publication RG-415). The guidelines outlined in the SWQM procedures manual document the quality assurance procedures that must be used to demonstrate that the data collected by monitoring personnel across the state are of a known and comparable quality.

SWQMIS

TCEQ's Surface Water Quality Monitoring Information System (SWQMIS) database is used to enter, manage, track, and report on water quality-related data, including data collected for the Texas Clean Rivers Program.

Coordinated Monitoring Schedule (CMS)

The Coordinated Monitoring Schedule (CMS) is the combined schedule for all surface water quality monitoring within Texas. Monitoring agencies within the basin coordinate sampling schedules to reduce duplication of effort and better utilize resources. Coordinated Monitoring Meetings are held annually with all monitoring agencies within each basin. The CMS lists monitoring stations, collecting and submitting entities, monitoring type, parameters, and monitoring frequency.

The Coordinated Monitoring Schedule is available online at cms.lcra.org.

Quality Assurance Project Plan (QAPP)

The CRP Quality Assurance Project Plan (QAPP) describes ANRA's quality assurance policies, management structure, and procedures which will be used to implement the quality assurance requirements necessary to verify and validate surface water quality data collected for the Clean Rivers Program and SWQM. This document is reviewed and approved by TCEQ to help ensure that data generated by ANRA are scientifically valid and legally defensible. This process ensures that data collected under the approved QAPP and submitted to SWQMIS have been collected and managed in such a way as to guarantee its reliability. It is crucial that only valid, quality-assured data be used in water quality assessments or other regulatory purposes.

ANRA's current and previous QAPP documents are available for viewing and/or download on ANRA's website at www.anra.org.

Angelina River immediately downstream from Sam Rayburn Reservoir dam

Monitoring Categories

Monitoring is divided into the following categories:

Routine Monitoring is a general-type monitoring to collect physical, chemical, biological, and hydrological data at classified and unclassified water bodies, including water bodies that do not support the water quality standards. Routine monitoring typically lasts for at least 5 years, with 4 seasonal monitoring events which include field measurements, conventional chemical parameter samples, bacterial measurements, and flow measurements. Routine monitoring may also include aquatic-life monitoring, toxics (metals or organics) in water, and ecoregion monitoring.

Special-Study Monitoring is a monitoring and assessment plan implemented to answer a specific question. Special study monitoring, which typically lasts 2 years, can be used to better characterize nonattainment of water quality standards, assess impacts of point and nonpoint source discharges, or to address stakeholder concerns. Examples of special studies include TMDL project-support monitoring, 24-hr Dissolved Oxygen studies, and toxics (metals or organics) in sediment or fish tissue, among others.

Permit-Support Monitoring is conducted to directly support the TCEQ wastewater discharge permitting process, and is typically used in the development or modification of effluent permit limits by determining the appropriate aquatic life use. Examples of permit-support monitoring include use-attainability analyses (UAAs), receiving-water assessments (RWAs), and wasteload evaluations (WLEs).

Systematic Monitoring is similar to routine monitoring, but with a duration of less than 5 years.

Biased season, flow, and event monitoring may also be included.

Water Quality Parameters

ANRA monitoring personnel collect both Field and Conventional parameters at monitoring stations.

Field measurements are collected on-site by direct monitoring in the water body. Field data collected by multiprobe instruments include such parameters as water temperature, pH, dissolved oxygen, and specific conductance. Other field measurements include flow and Secchi disk transparency.

Conventional parameters are also evaluated as part of the monitoring plan. During routine monitoring events, water samples are collected for laboratory analysis of conventional parameters. Conventional parameters include nutrients, minerals, and particulates. For routine monitoring stations, ANRA collects and analyzes samples for the following conventional parameters:

- Ammonia-Nitrogen
- Nitrate-Nitrogen
- Nitrite-Nitrogen
- Total Phosphorus
- Chlorophyll-*a*/Pheophytin
- Chloride
- Sulfate
- Total Suspended Solids
- Total Dissolved Solids
- *E. coli* bacteria

For the conventional parameters, all analyses, with the exception of Chlorophyll-*a,* are conducted in-house at ANRA's Environmental Laboratory. Samples for Chlorophyll-*a* are analyzed by the Lower Colorado River Authority (LCRA) Environmental Laboratory Services (ELS).

The following section summarizes the various field and conventional parameters monitored, as well as potential impacts and possible sources.

Preparation of samples for Total Phosphorus digestion

Water Quality Parameters

Field Parameters		
Parameter	**Potential Impacts**	**Possible Sources/Causes**
pH	pH is a measure of the acidity or basicity of an aqueous solution. Most aquatic organisms are adapted to live within a specific pH range. pH can also affect the toxicity of many substances, which generally increase in solubility as pH decreases. The ability of water to resist changes in pH (its buffering capacity) is essential to aquatic life.	pH can be affected by industrial and wastewater discharges, runoff, and accidental spills. Natural variation in seasons may also affect pH.
Dissolved Oxygen (DO)	DO is a measure of the amount of dissolved oxygen that is available in the water. DO is vital for aquatic organisms to live. Where DO is too low, aquatic organisms may have insufficient oxygen to live.	DO is temperature-dependent, with water being able to hold more dissolved oxygen at lower temperatures due to the solubility of gases increasing as the temperature decreases. The amount of oxygen present usually decreases with depth, rising temperatures, and with the oxidation of organic matter and pollutants. Bacteria and algal blooms may cause DO to decrease as decomposition of organic matter consumes oxygen in the water, resulting in hypoxic (low oxygen) areas.
Specific Conductance	Specific Conductance is the measure of the water's capacity to carry an electrical current and is indicative of the amounts of dissolved solids present in a water body.	Dissolved salt-forming substances such as sulfate, chloride, and sodium increase the conductivity of the water.
Temperature	Water temperature affects the oxygen content of the water (dissolved oxygen). Temperature also has an impact on cold-blooded animals.	Water temperature may be affected by alterations to the riparian zone, changes in ambient temperature, and discharges.
Flow	Flow is a measurement of the velocity of the water, measured in cubic feet per second (cfs). Flow combined with other parameters can be a good indicator of water quality.	Flow can be affected by both natural and man-made sources.

Flow measurement at La Nana Creek at East Main Street (Monitoring Station 20792)

Calibration of the multiprobe

Conventional Parameters		
Parameter	**Potential Impacts**	**Possible Sources/Causes**
Ammonia-Nitrogen	Ammonia, which is produced from the breakdown of nitrogen-containing compounds, is found naturally in waters. In excess, algal blooms may occur. Elevated ammonia levels are indicative of organic pollution. These elevated levels can cause stress on aquatic organisms, as well as damage to tissue and gills.	Ammonia enters into a body of water via excretion of nitrogenous wastes, decomposition of plants and animals, and runoff. Ammonia is an ingredient in many fertilizers. It is also present in sewage, wastewater discharges, and storm water runoff.
Chloride	Chloride is one of the major inorganic ions in water and wastewater. It is an essential element for maintaining normal physiological functions in all organisms. Elevated chloride concentrations can adversely affect survival, growth, and/or reproduction of aquatic organisms.	An elevated chloride concentration can be indicative of natural or man-made pollution. Natural sources of chloride include the weathering and leaching of sedimentary rocks, soils, and salt deposits. Other possible sources include oil exploration and storage, sewage and industrial discharges, and landfill runoff.
Chlorophyll-*a*	Chlorophyll-*a* is an indicator of algal biomass in a water body. Increased concentrations indicate potential eutrophication or nutrient loading. Diurnal shifts in DO and pH resulting from increased photosynthesis and respiration can cause stress to aquatic organisms.	Chlorophyll-*a* is a photosynthetic pigment that plays a vital role in photosynthesis. It is found in most plants, cyanobacteria, and algae. When chlorophyll-*a* levels are consistently high or variable, this may be indicative of algal blooms.
Escherichia coli (E. coli)	*E. coli* is an indicator of fecal contamination. Fecal contamination is a health concern to the general public, and its presence indicates a risk for contact recreation. The presence of *E. coli* in the water indicates that pathogenic organisms may be present.	*E. coli* is abundant in the gastrointestinal tract of warm-blooded animals. Elevated bacterial levels are indicative of a potential pollution problem. Reasons for the presence of fecal coliforms such as *E. coli* include failing septic systems, animal wastes, and inadequately treated sewage.
Nitrate-Nitrogen Nitrite-Nitrogen Nitrate+Nitrite-Nitrogen	Elevated levels of nitrite and nitrate can produce nitrite toxicity in fish ("brown blood disease") and methemoglobinemia ("blue baby syndrome") in infants by reducing the oxygen-carrying capacity of blood. In surface water, high levels of nitrates can lead to excessive growth of aquatic plants.	As part of the nitrogen cycle, nitrogenous compounds are converted from ammonia to nitrite and then to nitrate by bacterial and chemical processes. Potential sources include effluent discharges from wastewater treatment plants, fertilizers, and agricultural runoff. High levels of nitrates are often indicative of human-caused pollution.
Total Phosphorus	Phosphorus is essential to the growth of organisms, and is considered a growth-limiting nutrient. Elevated levels in water may stimulate the growth of photosynthetic aquatic macro- and microorganisms. Elevated phosphorus levels contribute to eutrophication and may cause algal blooms.	Phosphorus is commonly known as a man-made pollutant. It is present in industrial and domestic wastewater discharges, as well as agricultural and storm water runoff. It is an ingredient in soaps and detergents, and is used extensively in the treatment of boiler waters. Phosphates are also used by some water supplies during treatment.
Total Dissolved Solids (TDS)	TDS, reported in mg/L, is a measure of the total dissolved particles in water. Typically, it is comprised of chlorides, sulfates, and other salt-forming anions. TDS is an important measure of drinking water quality.	TDS can occur naturally from dissolution of carbonate and salt deposits in rocks and soils. Other sources include agricultural and storm water runoff, effluent discharges from industrial and domestic wastewater treatment plants, and oil exploration.
Total Suspended Solids (TSS)	TSS, reported in mg/L, is a measure of the total suspended particles in water. High levels of TSS increase the turbidity of the water, reducing light penetration which subsequently decreases oxygen production by plants.	Elevated TSS can result from multiple point and non-point sources. Soil erosion and runoff are two primary sources.
Sulfate	Sulfate is essential for plant growth, and low levels (under 0.5 mg/L) can be detrimental to algal growth. Excessive levels of sulfate can form strong acids and change the pH of the water. Excessively high levels may be toxic to cattle and other animals. Sulfate can also affect drinking water quality.	Sulfate occurs in almost all natural waters due to an abundance of elemental and organic sulfur in the environment. It usually enters into water bodies by water passing over rock or soil containing minerals like gypsum, as well as runoff from agricultural lands, industrial discharges, and sewage treatment plant discharges. Sulfate can also enter water bodies from atmospheric deposition from such sources as burning fossil fuels.

ANRA Environmental Laboratory

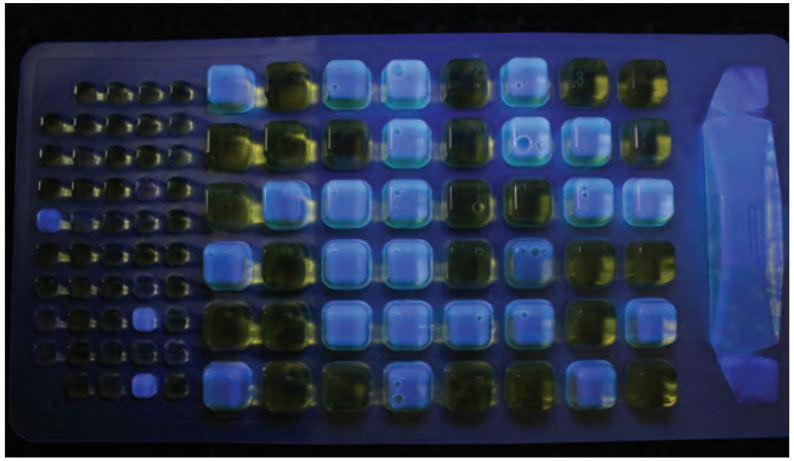
For water samples collected by ANRA, analysis of conventional parameters is performed by the ANRA Environmental Laboratory. The ANRA Environmental Laboratory is certified by the National Environmental Laboratory Accreditation Program (NELAP) for the chemical and microbiological analysis of potable and non-potable water. The laboratory performs analysis of drinking water, wastewater, and surface water samples for numerous entities and private individuals in the basin, including the Clean Rivers Program. For more information regarding analytical testing services and ANRA, please visit http://www.anra.org/divisions/water_quality/lab/

Beginning in FY 2014, The ANRA Environmental Laboratory began performing analyses for Total Phosphorus using a SEAL AutoAnalyzer 3 system. This equipment was partially funded by a grant from the TCEQ Clean Rivers Program. The autoanalyzer allows the laboratory to report data to a much lower limit of quantitation (currently 0.02 mg/L as P). Efficiencies gained by moving away from manual methods to automated equipment has allowed for a much higher throughput of samples. The addition of this equipment is one of the primary reasons that ANRA was able to increase the number of monitoring stations from 26 to 40 stations beginning in FY 2014.

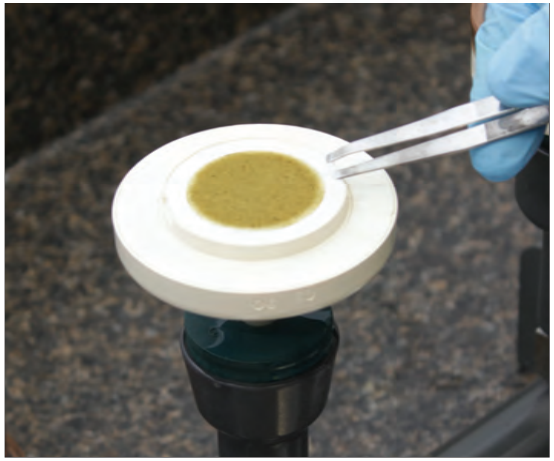
The ANRA Environmental Laboratory is currently NELAP-accredited for Total Phosphorus, Orthophoshorusm and Nitrate+Nitrite-N using this equipment. Additional methods will be added in the future as needed.

As part of a Federal Clean Water Act Section 319 grant funded by TCEQ, the ANRA Environmental Laboratory was able to purchase a Metrohm ion chromatograph for anion analysis. This equipment is utilized for analysis of water samples from an extensive monitoring program in the Attoyac Bayou watershed, as well as to analyze samples collected under the Clean Rivers Program.

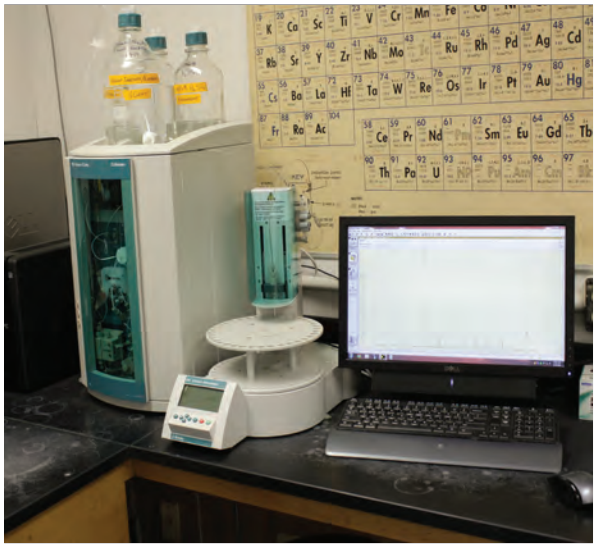
In September 2014, the ANRA Environmental Laboratory added Nitrate-N, Nitrite-N, Chloride, Sulfate, and Orthophosphorus-P by EPA Method 300.0 to our NELAP scope of accreditation.



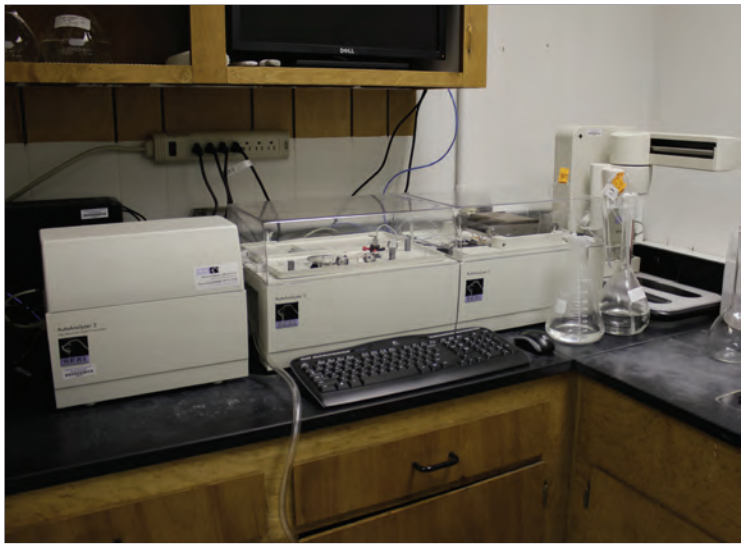
Analysis of E. coli by IDEXX Colilert-18



Analysis of Total Suspended Solids (TSS)



Metrohm Ion Chromatograph for Anion analysis



SEAL AutoAnalyzer 3 for nutrient analysis

Data Review Methodology

Trend Analysis

In order to review and evaluate water quality trends for this report, data from the period of January 1, 2000 to August 31, 2014 was queried and exported from TCEQ's Surface Water Quality Monitoring Information System (SWQMIS). The public interface for SWQMIS can be found at the following web address:

http://www80.tceq.texas.gov/SwqmisPublic/public/default.htm

Once the data from the selected range was exported from SWQMIS, the raw data files (in the form of pipe-delimited text files), were used to create a relational database. Data was loaded into SQL Server to be queried and graphed using the R statistical software package. R, which is Open Source, provides a wide variety of techniques for data manipulation, calculation, and graphing. R is available as Free Software under the terms of the Free Software Foundation's GNU General Public License in source code format.

The R statistical package can be downloaded from the following web address:

http://www.r-project.org

In R, the following parameters were graphed, with results plotted against time:

Assessed Parameters for the 2015 Basin Summary Report

Parameter Code	Parameter	Units
00094	Specific Conductance	µm/cm @ 25°C
00300	Dissolved Oxygen	mg/L
00400	pH	S.U.
00530	Total Suspended Solids (TSS)	mg/L
00610	Ammonia-Nitrogen	mg/L as N
00630	Nitrate+Nitrite-Nitrogen	mg/L as N
00665	Total Phosphorus	mg/L as P
00940	Chloride	mg/L
00945	Sulfate	mg/L
31699	*E. coli*	MPN/100 mL
32211 + 70953	Chlorophyll-*a*	µg/L
70300	Total Dissolved Solids (TDS)	mg/L

For most parameters, only one parameter code was assessed. For other parameters such as Chlorophyll-*a* where different (but comparable) parameter codes exist, the data from multiple parameter codes was combined.

Vertical profile data was excluded from analysis.

The count, minimum, maximum, and mean for each parameter was determined. In the case of *E. coli* bacteria, the geometric mean was calculated. The number of values exceeding criteria were counted.

If enough data was present for each parameter (>19 samples in the evaluation period, with continuous monitoring), a linear regression against time was performed. Trends were considered to be significant with a *t-stat* = or > |2| and a *p-value* < 0.1. In the case of non-detects (values reported as less than the method reporting limit), those values were left as-is, ignoring the less than sign. For parameters reported as a greater than (>) value, the greater than sign was dropped and the value was used as-is for calculation purposes.

To determine if water bodies met the established criteria for their designated uses, the data was compared to the uses and criteria specified in the *TSWQS*, as well as the screening levels for nutrient parameters listed in the *Draft 2014 Guidance for Assessing and Reporting Surface Water Quality in Texas*.

Significant trends were graphed and are presented in this report.

For each graph, parameter concentrations are represented by unconnected black dots (•). Each parameter's water quality standard or screening level is represented by a dashed red line (-----), with the numeric value listed as well. For some parameters such as dissolved oxygen, pH, and *E. coli*, there may be multiple criteria. The trend line for each parameter versus time is shown as a black line (——). The *t-stat*, *p-value*, and linear regression equation are listed on each graph. The *t-stat* and *p-value*, including those for parameters that are not graphed, are also included in the water quality summary tables presented with each station.

Flow values for each station are also presented on the graphs in a separate plot.

For each station, trends were evaluated to determine if they were statistically significant based upon the *t-stat* and *p-value*. Parameters with a statistically significant decreasing trend are identified with a downward arrow (↓). Parameters with a statistically significant increasing trend are identified with an upward arrow (↑). In cases where the trend was being influenced by changes in the analytical limit of quantitation (LOQ), such as was common with Chlorophyll-*a*, this was noted in the report. In those cases, the trends were not considered to be of statistical significance.

Screening Levels for Nutrient Parameters

Water Body Type	PARAMETERS			
	Ammonia (mg/L as N)	Nitrate (mg/L as N)	Total Phosphorus (mg/L as P)	Chlorophyll-*a* (µg/L)
Freshwater Stream	0.33	1.95	0.69	14.1
Reservoir	0.11	0.37	0.20	26.7

Watershed Summaries

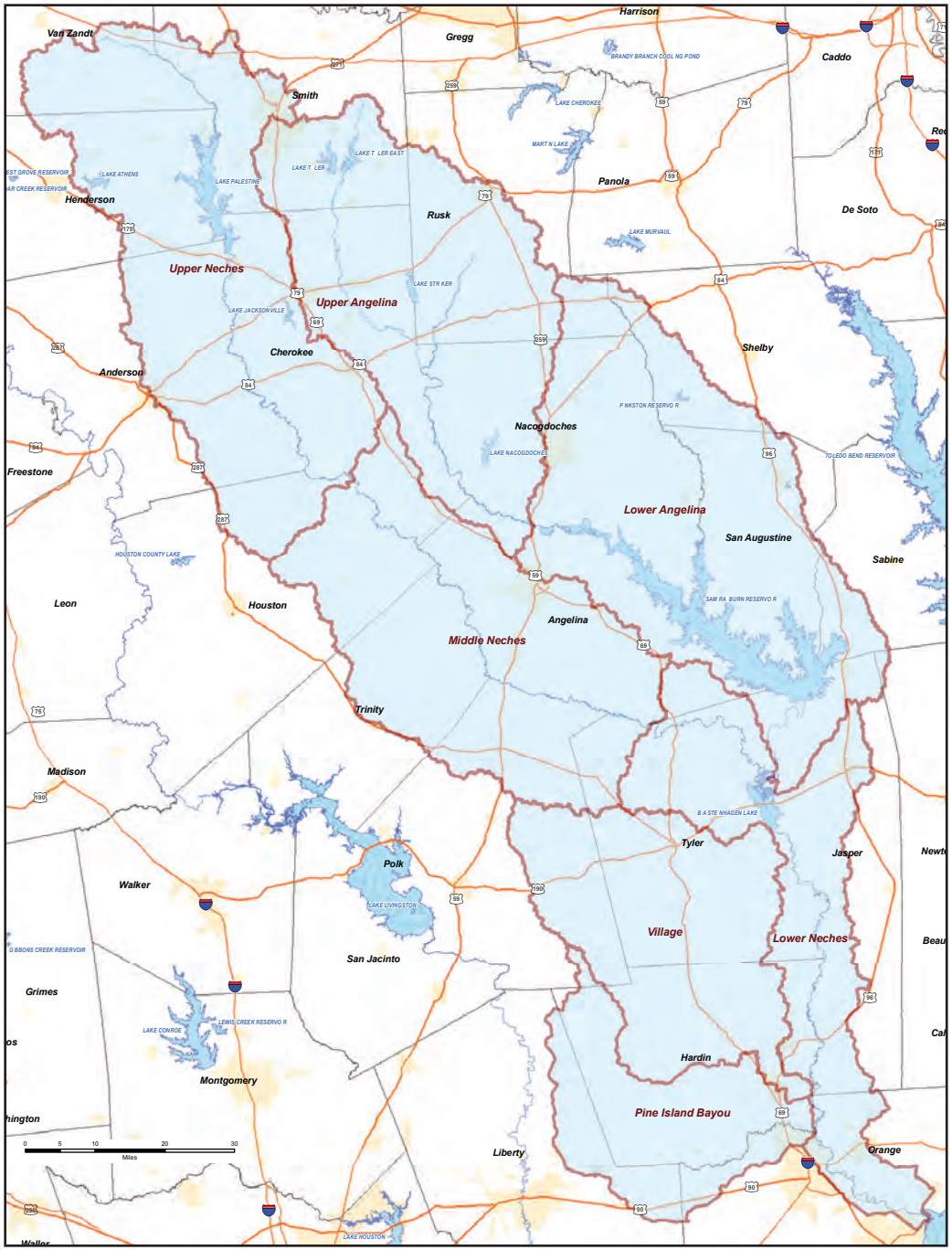
For the purpose of this report, data will be divided and presented based upon sub-basins (as defined by their 8-digit hydrologic unit code (HUC)).

The Sub-Basin Summaries provide detailed information about the water quality in each watershed in the basin. The sub-basins in the Upper Neches Basin include:

- Upper Angelina
- Lower Angelina
- Upper Neches
- Middle Neches
- Lower Neches

Each Sub-Basin Summary includes a narrative and descriptors of the sub-basin's geographic area, population centers, stream segments, and discharge permits. A map of each sub-basin is included with each summary. Each sub-basin summary includes a discussion of individual segments within the sub-basin, information from TCEQ's Draft 2014 Integrated Report, and a trend analysis of water quality parameters. Maps of each segment displaying the monitoring stations monitored by ANRA and other agencies in the basin are included. In the review of water quality, parameters which show significant trends, concerns for screening levels, and/or exceedances of standards are graphed.

For more information on the other sub-basins comprising the Neches Basin, such as Lower Neches, Village, and Pine Island Bayou sub-basins, please refer to the Basin Summary Report developed by the Lower Neches Valley Authority (LNVA).



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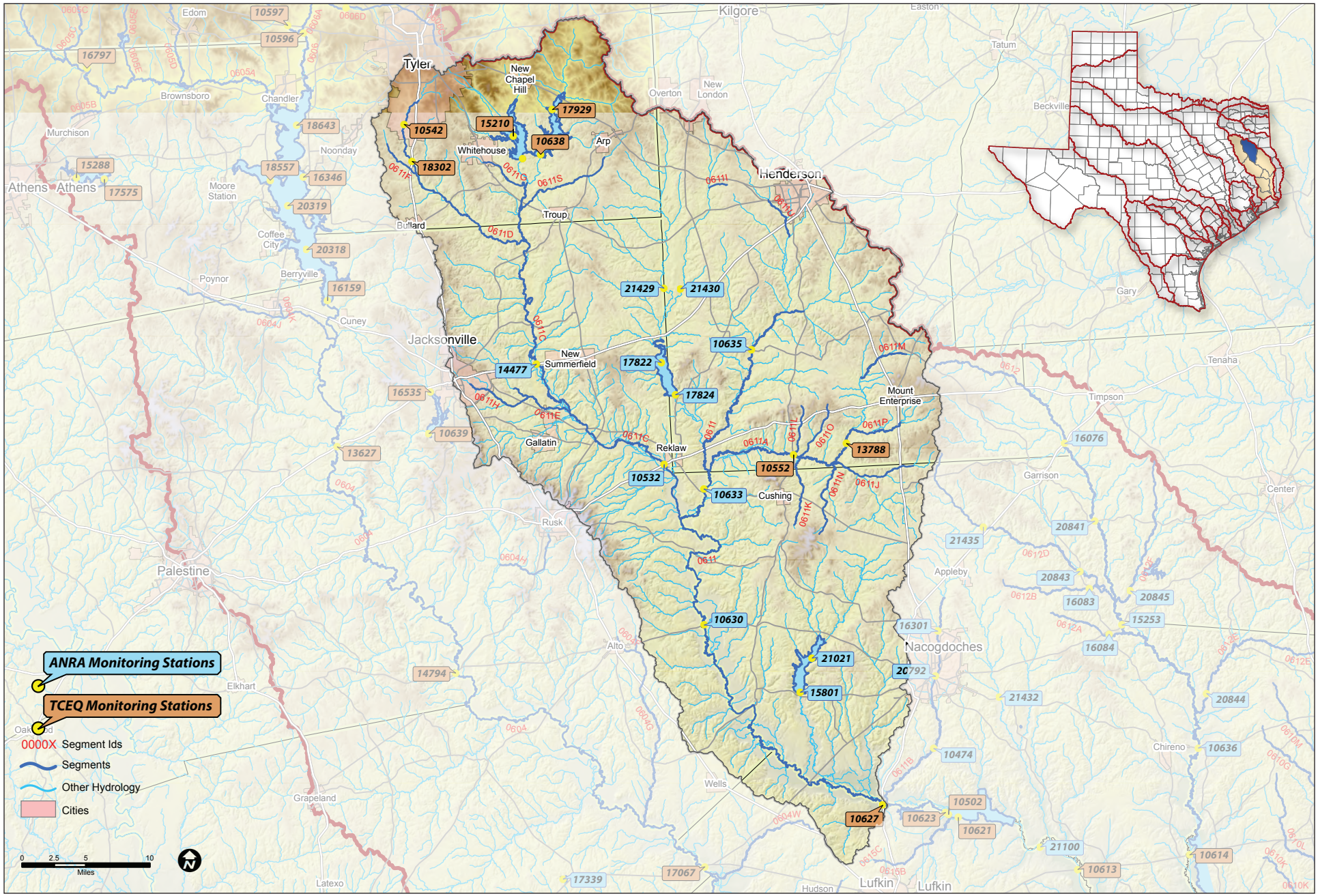
Upper Angelina Overview Map



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Profile of the Upper Angelina Sub-Basin

Population

The Upper Angelina Sub-Basin includes all or a portion of Angelina, Cherokee, Nacogdoches, Rusk, and Smith Counties. The Cities of Arp, Whitehouse, New Chapel Hill, Tyler, Jacksonville, New Summerfield, Gallatin, Henderson, Mount Enterprise, Reklaw, Cushing, and Troup are included in the sub-basin. As of the 2010 census, there are an estimated 66,356 households, including 157,794 individuals residing within the sub-basin.

Segments in the Upper Angelina Sub-Basin

Segment ID	Segment Name
0611	Angelina River Above Sam Rayburn
0611A	East Fork Angelina River
0611C	Mud Creek
0611D	West Mud Creek
0611Q	Lake Nacogdoches
0611R	Lake Striker
0613	Lake Tyler / Lake Tyler East

Land Characteristics and Use

This South-Central Plains Ecoregion includes floodplains, low terraces, southern tertiary uplands, and tertiary uplands. The upper north-western portion of the sub-basin includes the City of Tyler, which has developed open space and a high-intensity population. Included within the northern part of the Upper Angelina Sub-Basin is mixed, deciduous, and evergreen forest, woody wetlands, hay/pasture land, and shrub. Between Henderson and New Summerfield, there are several areas of cultivated cropland.

The lower southeastern portion of the sub-basin includes Lake Nacogdoches. This region is dominated by willow oak, water oak, blackgum forest, and pine hardwood. The vegetation surrounding the lower area of this sub-basin includes hay/pasture, woody wetlands, shrub, mixed, evergreen, deciduous, and young forest. There are several developed low intensity areas around Mount Enterprise, Reklaw, and Gallatin.

Cattle and poultry operations are common within the sub-basin.

14477 - Mud Creek at US 79

Texas Surface Water Quality Standards for the Upper Angelina Sub-Basin

Site-Specific Uses and Numeric Criteria for Classified Segments in the Upper Angelina Sub-Basin

Segment ID	Segment Name	DESIGNATED USES				CRITERIA*						
		Recreation	Aquatic Life	Domestic Water Supply	Other	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	Dissolved Oxygen (mg/L)	pH Range (S.U.)	*E. coli* Bacteria #/100 mL	Temp (°F)
0611	Angelina River Above Sam Rayburn	PCR	H	PS		125	50	250	5.0	6.0 - 8.5	126	90
0613	Lake Tyler / Lake Tyler East	PCR	H	PS		50	50	200	5.0	6.0 - 9.0	126	93

PCR = Primary Contact Recreation SCR1 = Secondary Contact Recreation 1 SCR2 = Secondary Contact Recreation 2 NCR = Noncontact Recreation
H = High Aquatic Life Use I = Intermediate Aquatic Life Use
PS = Public Supply

* The criteria for Chloride, Sulfate, and TDS are listed as the maximum annual averages for the segment. Dissolved Oxygen criteria are listed as minimum 24-hour means at any site within the segment. The pH criteria are listed as minimum and maximum values expressed in standard units at any site within the segment. The criteria for Temperature are listed as maximum values at any site within the segment.

Profile of the Upper Angelina Sub-Basin

Permitted Discharges in the Upper Angelina Sub-Basin

A total of twenty-one permitted discharges are within the Upper Angelina sub-basin.

Permitted Discharges in the Upper Angelina Sub-Basin

First Segment in Drainage Path	Segment ID as identified in Permit	Permit Number	Outfall Number	NPDES Number	Permittee	County	TCEQ Region	Map Locations
0611	0611	04414-000	001	124842	NACOGDOCHES POWER LLC	Nacogdoches	10 - Beaumont	Page 45
611C	0611	10304-001	001	033529	CITY OF TROUP	Cherokee	05 - Tyler	Pages 45 & 59
611C	0611	13585-001	001	107875	CITY OF NEW SUMMERFIELD	Cherokee	05 - Tyler	Pages 45 & 59
611D	0611	10653-002	001	047988	CITY OF TYLER	Smith	05 - Tyler	Pages 45 & 59
611D	0611	13000-001	001	101010	TALL TIMBERS UTILITY CO INC	Smith	05 - Tyler	Pages 45 & 59 & 68
611F	0611	13168-001	001	098795	WOODMARK UTILITIES INC	Smith	05 - Tyler	Pages 45 & 59 & 68
611G	0611	11222-001	001	072770	CITY OF WHITEHOUSE	Smith	05 - Tyler	Pages 45 & 59
611H	0611	10693-001	001	024392	CITY OF JACKSONVILLE	Cherokee	05 - Tyler	Pages 45 & 59
611H	0611	10693-003	001	100587	CITY OF JACKSONVILLE	Cherokee	05 - Tyler	Pages 45 & 59
611K	0611	10437-001	001	053937	CITY OF CUSHING	Nacogdoches	10 - Beaumont	Pages 45 & 55
611P	0611	14283-001	001	122173	CITY OF MOUNT ENTERPRISE	Rusk	05 - Tyler	Pages 45 & 55
611R	0611	00946-000	001	001066	LUMINANT GENERATION CO LLC	Cherokee	05 - Tyler	Pages 45 & 83
611R	0611	02973-000	001	104175	UNIMIN CORP	Cherokee	05 - Tyler	Pages 45 & 83
611R	0611	02973-000	002	104175	UNIMIN CORP	Cherokee	05 - Tyler	Pages 45 & 83
611R	0611	02973-000	005	104175	UNIMIN CORP	Cherokee	05 - Tyler	Pages 45 & 83
611R	0611	02973-000	006	104175	UNIMIN CORP	Cherokee	05 - Tyler	Pages 45 & 83
611R	0611	02973-000	007	104175	UNIMIN CORP	Cherokee	05 - Tyler	Pages 45 & 83
611R	0611	12376-001	001	087360	CITY OF NEW LONDON	Rusk	05 - Tyler	Pages 45 & 83
611R	0611	14292-001	001	124371	CARLISLE ISD	Rusk	05 - Tyler	Pages 45 & 83
611S	0611	10511-001	001	054194	CITY OF ARP	Smith	05 - Tyler	Pages 45 & 59
611U	0611	10187-001	001	052779	CITY OF HENDERSON	Rusk	05 - Tyler	Page 45

Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Segment Profile

This freshwater stream encompasses a length of 104 miles and extends from the Upper Angelina sub-basin to the Lower Angelina sub-basin. Segment 0611 originates from the aqueduct crossing 0.6 miles upstream of the confluence of the Paper Mill Creek in Angelina/ Nacogdoches County to the confluence of Barnhardt Creek and Mill Creek at FM 225 in Rusk County.

Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Assessment Units

Assessment Units in Segment 0611 - Angelina River Above Sam Rayburn Reservoir	
AU ID	**Description**
0611_01	From the aqueduct crossing upstream to the confluence with Old River Channel in Nacogdoches County about 2.8 km downstream of County Hwy 2625 at NHD RC 12020004000039
0611_02	From a point immediately upstream of the confluence with Old River channel about 2.8 km downstream of County Hwy 2625 upstream to the confluence with Mud Creek (0611C)
0611_03	From a point immediately upstream of the confluence with Mud Creek (0611C) upstream to the confluence with East Fork Angelina River (0611A)
0611_04	From a point immediately upstream of confluence with East Fork Angelina River (0611A) upstream to confluence with Barnhardt and Mill Creeks

Monitoring Stations

Monitoring Stations in Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Assessment Unit	Monitoring Station ID	Description	Annual Frequency						Monitoring Entity
			Field	Conv	Bacteria	Flow	Metals in Water	Metals in Sediment	
0611_01	10627	ANGELINA RIVER AT US 59	4	4	4	4			TCEQ-10
0611_02	10630	ANGELINA RIVER AT SH 21	4	4	4	4			ANRA
0611_03	10633	ANGELINA RIVER 340 METERS UPSTREAM OF SH 204	4	4	4	4			ANRA
0611_04	10635	ANGELINA RIVER AT FM 1798	4	4	4	4			ANRA

10630 - Angelina River at SH 21

10633 - Angelina River Upstream of SH 204

10635 - Angelina River at FM 1798

Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Description of Water Quality Issues

Site-Specific Uses and Criteria

The designated uses for this classified segment include contact recreation, high aquatic life use, fish consumption use, public water supply use, and general use.

Impairments and Concerns

Segment 0611 has four assessment units. One of those assessment units, AU 0611_04, is listed in the Draft 2014 Integrated Report as not supporting for Primary Contact Recreation due to bacteria impairments. This assessment unit extends from a point immediately upstream of the confluence with East Fork Angelina River (Segment 0611A) upstream to the confluence with Barnhardt and Mill Creeks. In the assessment, the geometric mean of *E. coli* bacteria results was 226.73 MPN/100 mL based on 25 samples, which exceeds the standard of 126 MPN/100 mL for Primary Contact Recreation.

There were no other impairments or concerns listed for this segment in the Draft 2014 Integrated Report.

Bridge Crossing at Station 10630 - Angelina River at SH 21

Assessment Summary for Segment 0611 - Angelina River Above Sam Rayburn Reservoir as listed in the Draft 2014 Texas Integrated Report

AU	Chloride	Sulfate	TDS	DO Grab Screening Level	DO Grab Minimum	24 Hour DO Average	24 Hour DO Minimum	pH	Temp (C)	*E. coli* geomean	Ammonia Nitrogen	Nitrate Nitrogen	Total Phosphorus	Chl-*a*
	125 mg/L	50 mg/L	250 mg/L	5.00 mg/L	3.00 mg/L			6.0 - 8.5 SU	32.2	126 MPN /100 mL	0.33 mg/L	1.95 mg/L	0.69 mg/L	14.1 µg/L
0611_01	FS	FS	FS	NC	FS			FS	FS	FS	NC	NC	NC	NC
0611_02	FS	FS	FS	NC	FS			FS	FS	FS	NC	NC	NC	NC
0611_03	FS	FS	FS	NC	FS			FS	FS	FS	NC	NC	NC	NC
0611_04	FS	FS	FS	NC	FS			FS	FS	**NS**	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Monitoring Station 10627 - Angelina River at US 59

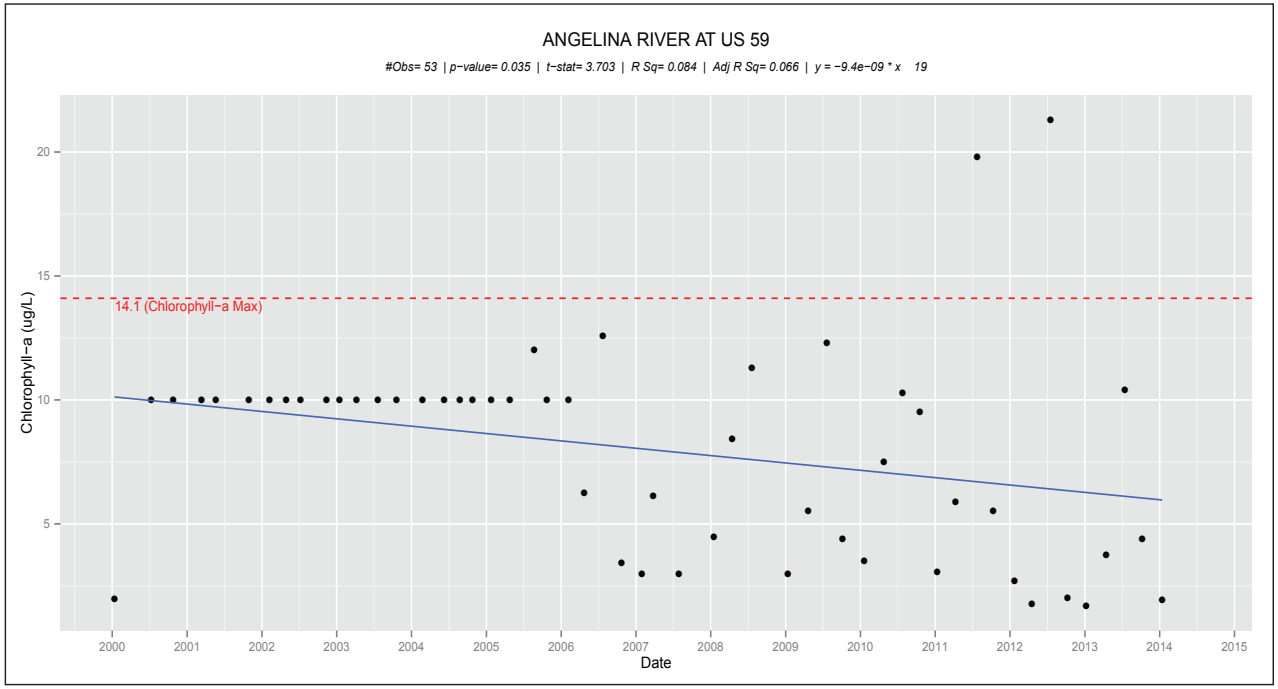
Located in AU 0611_01, Monitoring Station 10627 is monitored quarterly by TCEQ Region 10 (Beaumont) personnel for field parameters, conventional parameters, *E. coli* bacteria, and flow.

No concerns for nutrients are listed for this assessment unit in the Draft 2014 Integrated Report, and the water body is fully supporting for all designated uses.

Statistical analysis of the water quality data does show an increasing trend for Specific Conductance, but this trend is not statistically significant. Values for Specific Conductance ranged from 101 to 439 µS/cm, with the bulk of the results between 150 to 250 µS/cm.

A decreasing trend is observed for *E. coli* bacteria. Results for *E. coli* analysis ranged from 6 to 1840 MPN/100 mL, with a geometric mean of 27.4 MPN/100 mL.

A decreasing trend is observed for Chlorophyll-*a*. This trend is not considered to be statistically significant because it is being influenced by a change in the limit of quantitation.



Water Quality Monitoring Results for Station 10627 - Angelina River at US 59

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	58	0	101	439	199		0.6816	0.0161	
00300	Dissolved Oxygen (mg/L)	57	0	4.6	12.2	7.57		3.0167	0.4128	
00400	pH (S.U.)	58	0	6.2	8.4	7.19		13.1977	0.435	
00530	Total Suspended Solids (mg/L)	54	0	5	64	26.78		0.9395	0.6826	
00610	Ammonia-Nitrogen (mg/L as N)	54	0	0.05	0.14	0.06		2.3201	0.9183	
00630	Nitrate + Nitrite (mg/L as N)	36	0	0.04	0.53	0.19		0.7734	0.9626	
00665	Total Phosphorus (mg/L as P)	51	0	0.06	0.18	0.12		3.8353	0.2434	
00940	Chloride (mg/L)	53	0	7	63	20.06		-0.278	0.028	
00945	Sulfate (mg/L)	53	1	5	63	25.19		1.2891	0.3451	
31699	*E. coli* (MPN/100 mL)	47	21	6	1842		27.41	3.3103	0.006	↓
32211+70953	Chlorophyll-*a* (µg/L)	53	2	1.68	21.3	7.98		3.703	0.0352	
70300	Total Dissolved Solids (mg/L)	41	1	93	256	147.05		2.4986	0.6395	

Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Monitoring Station 10630 - Angelina River at SH 21

Monitoring Station 10630 (Angelina River at SH 21) is located in assessment unit 0611_02. This station is monitored quarterly by ANRA for field parameters, conventional parameters, flow, and *E. coli* bacteria.

No concerns for nutrients are listed for this assessment unit in the Draft 2014 Integrated Report, and the water body is fully supporting for all designated uses.

Statistical analysis of the water quality data does show an increasing trend for Specific Conductance, but this trend is not statistically significant. An increasing trend is also observed with Chloride and Sulfate. The Chloride trend is statistically significant, but all values are too low to be of concern. For these parameters, the trends are influenced by higher values recorded during a period of drought.

10630 - Angelina River at SH 21

Water Quality Monitoring Results for Station 10630 - Angelina River at SH 21

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	58	0	106	406	209.19		-0.9523	0.0001	
00300	Dissolved Oxygen (mg/L)	56	0	4.5	11.8	7.66		3.6724	0.8313	
00400	pH (S.U.)	56	2	5.6	7.6	6.93		12.4599	0.2829	
00530	Total Suspended Solids (mg/L)	56	0	4	64	22.01		0.4323	0.2598	
00610	Ammonia-Nitrogen (mg/L as N)	57	0	0.05	0.24	0.08		-1.3141	0.0011	
00630	Nitrate + Nitrite (mg/L as N)	36	0	0.04	0.56	0.24		1.0074	0.7957	
00665	Total Phosphorus (mg/L as P)	57	0	0.04	0.47	0.14		0.4813	0.2143	
00940	Chloride (mg/L)	56	0	8	46.2	22.06		-2.0893	0.0000	↑
00945	Sulfate (mg/L)	56	4	8	80	29.74		-1.8130	0.0001	
31699	*E. coli* (MPN/100 mL)	47	16	7	2400		35.56	-0.1465	0.6295	
32211+70953	Chlorophyll-*a* (µg/L)	56	5	1	43.3	8.25		1.9784	0.3828	
70300	Total Dissolved Solids (mg/L)	56	3	73	374	159.93		1.9215	0.5420	

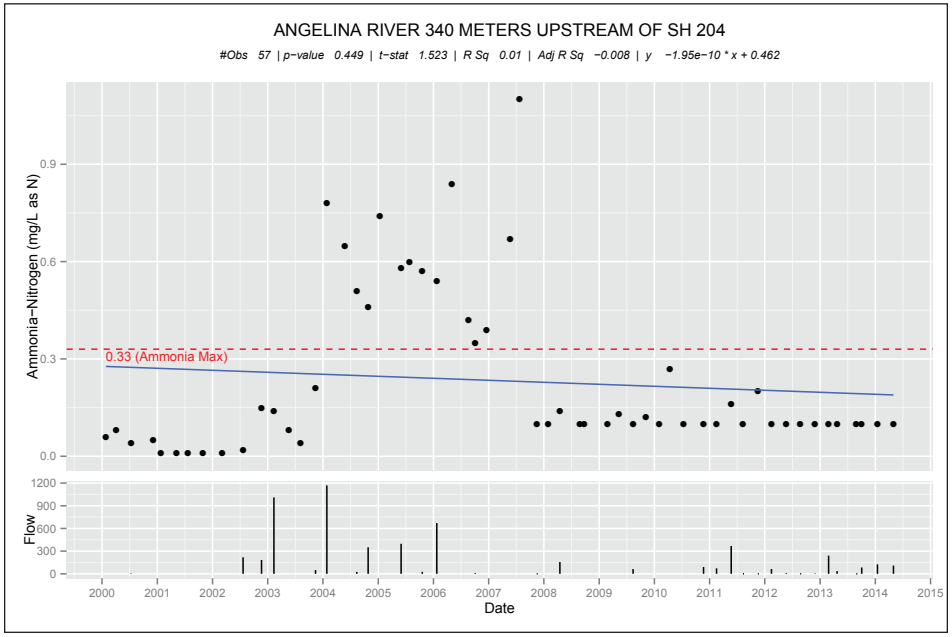
Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Monitoring Station 10633 - Angelina River Upstream of SH 204

Located in AU 0611_03, Monitoring Station 10633 is monitored quarterly by ANRA for field parameters, conventional parameters, flow, and *E. coli* bacteria. In 2012, it was necessary to relocate the monitoring station due to the installation of a wastewater outfall for Nacogdoches Power. The monitoring station, originally located at the SH 204 bridge, is currently located approximately 340 meters upstream of the bridge crossing.

There are no concerns for nutrient criteria for this assessment unit. However, there are numerous values for Ammonia-Nitrogen that exceeded the criteria during the period of 2004 – 2008. The range for Ammonia-Nitrogen results was <0.01 to 1.1 mg/L as N, with a mean of 0.23 mg/L as N. Since 2008, the majority of results have been reported as <0.10 mg/L as N. Statistically significant decreasing trends were observed for both Nitrate+Nitrite and Total Phosphorus.

For Aquatic Life Use, this assessment unit is listed in the Draft 2014 Integrated Report as Not Supporting for Aluminum in Water. The AU also has a concern for Lead in Water.

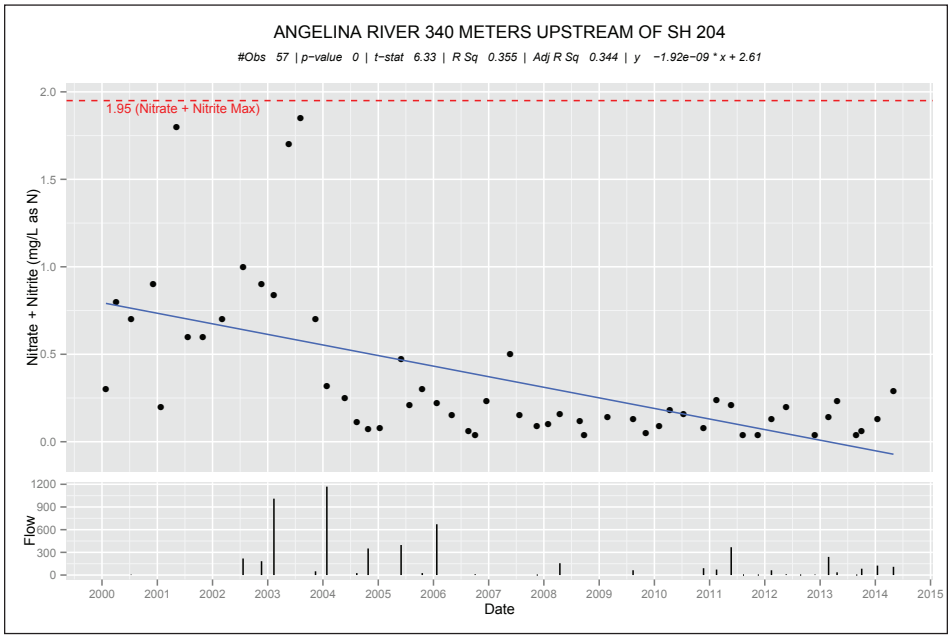


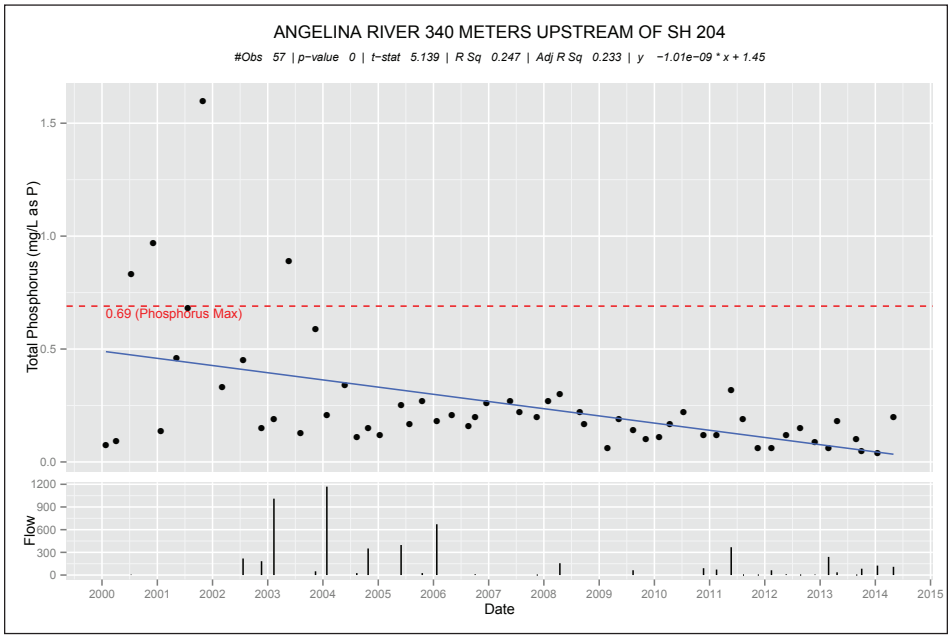
Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Monitoring Station 10633 - Angelina River Upstream of SH 204

Water Quality Monitoring Results for Station 10633 - Angelina River Upstream of SH 204

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	57	0	15	1470	179.30		-1.0995	0.0632	
00300	Dissolved Oxygen (mg/L)	56	1	2.1	11.9	7.32		3.6133	0.3788	
00400	pH (S.U.)	54	2	5.6	8.4	6.99		10.7911	0.1278	
00530	Total Suspended Solids (mg/L)	57	0	1.33	56	13.01		-0.6592	0.1042	
00610	Ammonia-Nitrogen (mg/L as N)	57	15	0.01	1.1	0.23		1.5235	0.4489	
00630	Nitrate + Nitrite (mg/L as N)	57	0	0.04	1.85	0.35		6.3300	0.0000	↓
00665	Total Phosphorus (mg/L as P)	57	4	0.04	1.6	0.26		5.1394	0.0001	↓
00940	Chloride (mg/L)	57	0	8.3	110	20.37		1.3295	0.9030	
00945	Sulfate (mg/L)	57	2	10	550	36.04		-0.6163	0.2963	
31699	*E. coli* (MPN/100 mL)	54	25	18	4840		141.95	1.4024	0.3088	
32211+70953	Chlorophyll-*a* (µg/L)	42	1	2	52.1	5.08		0.1137	0.8264	
70300	Total Dissolved Solids (mg/L)	56	3	56	1100	148.71		-0.8151	0.0901	





Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Monitoring Station 10635 - Angelina River at FM 1798

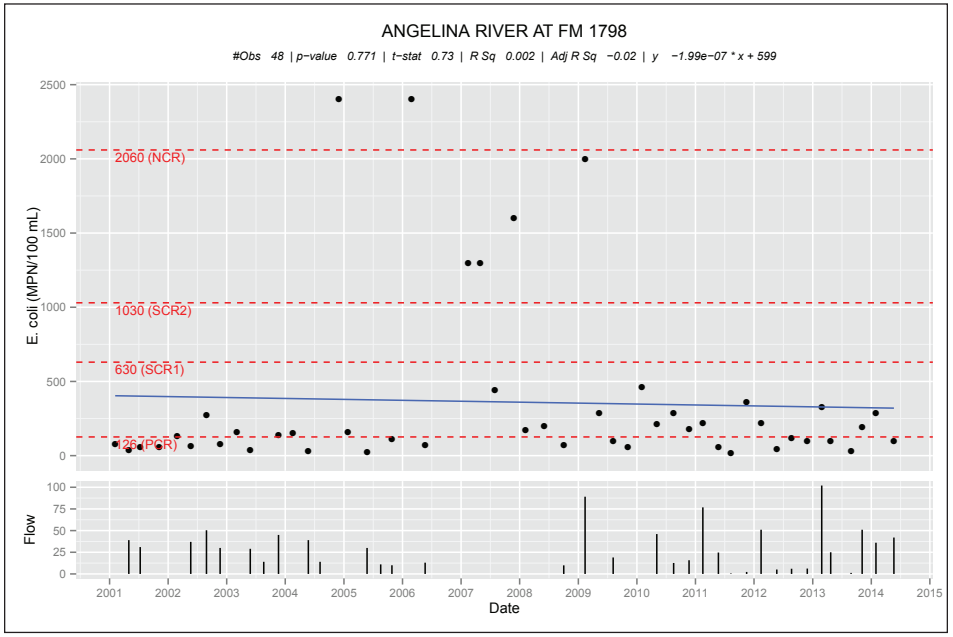
Monitoring Station 10635 (Angelina River at FM 1798) is located in AU 0611_04. This station is monitored quarterly by ANRA for field parameters, conventional parameters, flow, and *E. coli* bacteria.

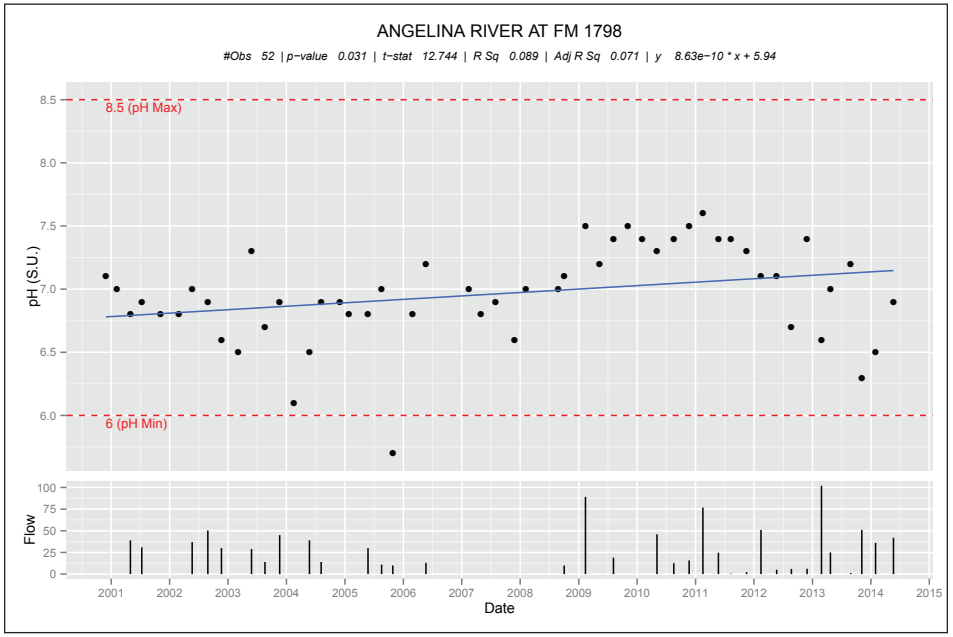
As listed in the Draft 2014 Integrated Report, this assessment unit is not supporting for Primary Contact Recreation Use, with an *E. coli* bacteria geometric mean of 226.73 MPN/100 mL (based on 25 samples assessed). No other impairments or concerns were listed for this assessment unit.

A statistically significant increasing trend is observed for pH. However, the majority of values are between 6.5 – 7.5 S.U.

Statistically significant increasing trends were observed for Specific Conductance, Chloride, and Sulfate. During the period of record, no values for Chloride exceeded the standard, and for Sulfate, only two values exceeded the standard, with the exceedances occurring in 2011 and 2012 during a period of drought.

10635 - Angelina River at FM 1798

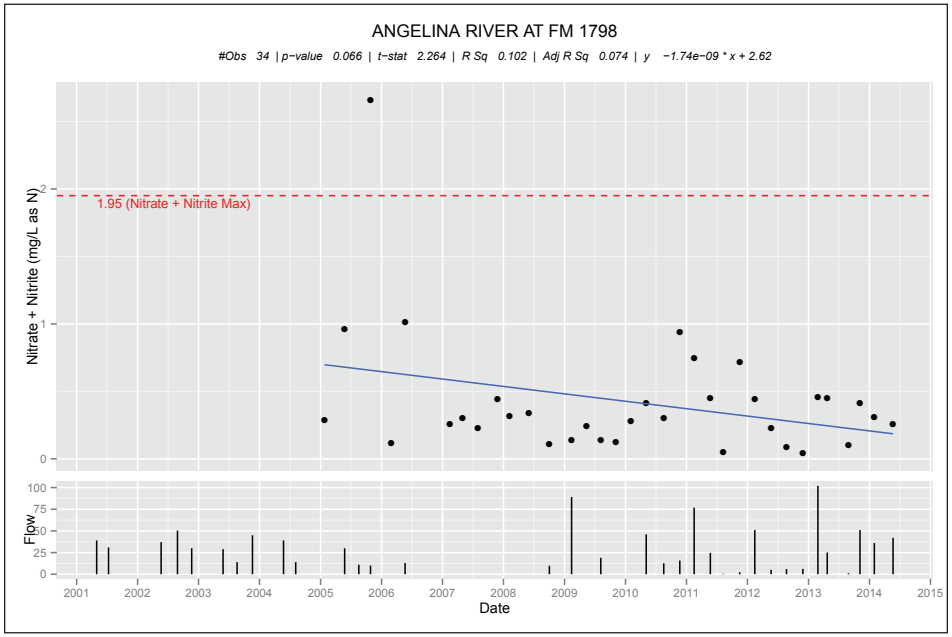


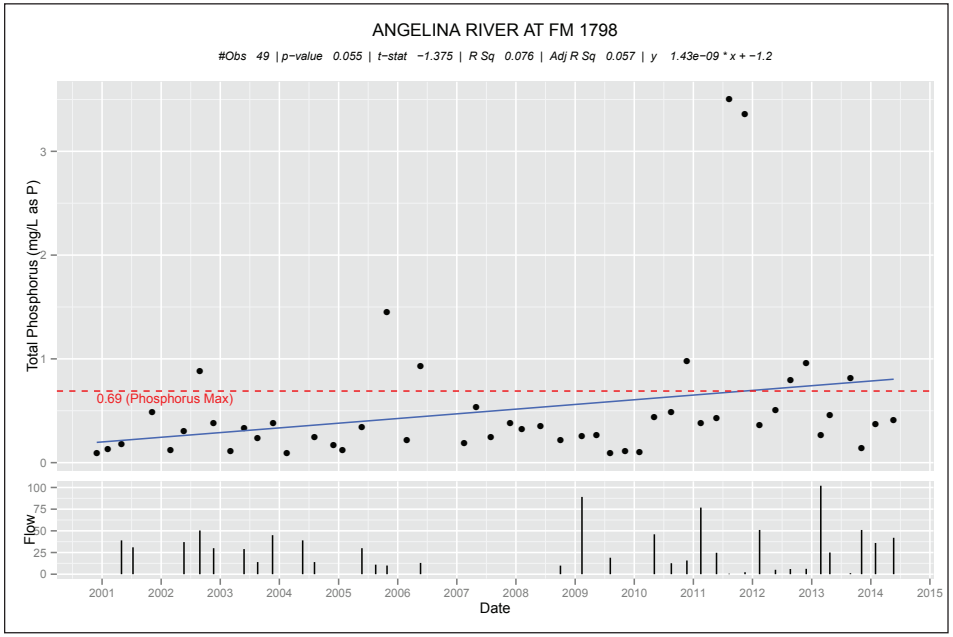


Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Monitoring Station 10635 - Angelina River at FM 1798

For nutrient analyses, a statistically significant decreasing trend was observed for Nitrate+Nitrite. Results for this parameter ranged from <0.04 to 2.66 mg/L as N, with a mean of 0.42 mg/L as N. An increasing trend was observed for Total Phosphorus, but this trend was not statistically significant. For the period assessed by ANRA, Total Phosphorus results ranged from 0.09 to 3.5 mg/L as P, with 9 of 49 samples exceeding the screening level of 0.69 mg/L as P. An increasing trend for Ammonia-Nitrogen and a decreasing trend for Chlorophyll-*a* are both due to changes in the analytical limit of quantitation.





Water Quality Monitoring Results for Station 10635 - Angelina River at FM 1798

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	52	0	96	746	208.06		-2.5057	0.0002	↑
00300	Dissolved Oxygen (mg/L)	51	0	3.4	12.7	8.13		3.4359	0.5548	
00400	pH (S.U.)	52	1	5.7	7.6	6.96		12.7438	0.0315	↑
00530	Total Suspended Solids (mg/L)	51	0	2.5	74	19.63		1.2306	0.7462	
00610	Ammonia-Nitrogen (mg/L as N)	49	0	0.05	0.23	0.08		-3.7120	0.0000	
00630	Nitrate + Nitrite (mg/L as N)	34	1	0.04	2.66	0.42		2.2643	0.0660	↓
00665	Total Phosphorus (mg/L as P)	49	9	0.09	3.5	0.51		-1.3752	0.0548	
00940	Chloride (mg/L)	51	0	8	100	24.91		-2.4067	0.0007	↑
00945	Sulfate (mg/L)	51	2	8	161	23.95		-2.3419	0.0021	↑
31699	*E. coli* (MPN/100 mL)	48	26	17	2400		116.87	0.7297	0.7714	
32211+70953	Chlorophyll-*a* (µg/L)	50	0	2	10	5.69		14.8117	0.0000	
70300	Total Dissolved Solids (mg/L)	50	3	97	431	150.38		-1.6136	0.0010	

Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Summary of Water Quality Trends

In AU 0611_02, there is a statistically significant increasing trend for Chloride.

In AU 0611_03, there are statistically significant decreasing trends for Total Phosphorus and Nitrate+Nitrite.

In AU 0611_04, there is a statistically significant increasing trend for Nitrate+Nitrite.
Significant increasing trends are observed for pH, Chloride, Sulfate, and Specific Conductance.

Trend Analysis Summary for Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/NO2	Total P
Angelina River Above Sam Rayburn Reservoir	0611_01	10627	Angelina River at US 59												
	0611_02	10630	Angelina River at SH 21				↑								
	0611_03	10633	Angelina River Upstream of SH 204											↓	↓
	0611_04	10635	Angelina River at FM 1798		↑		↑	↑	↑					↓	

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

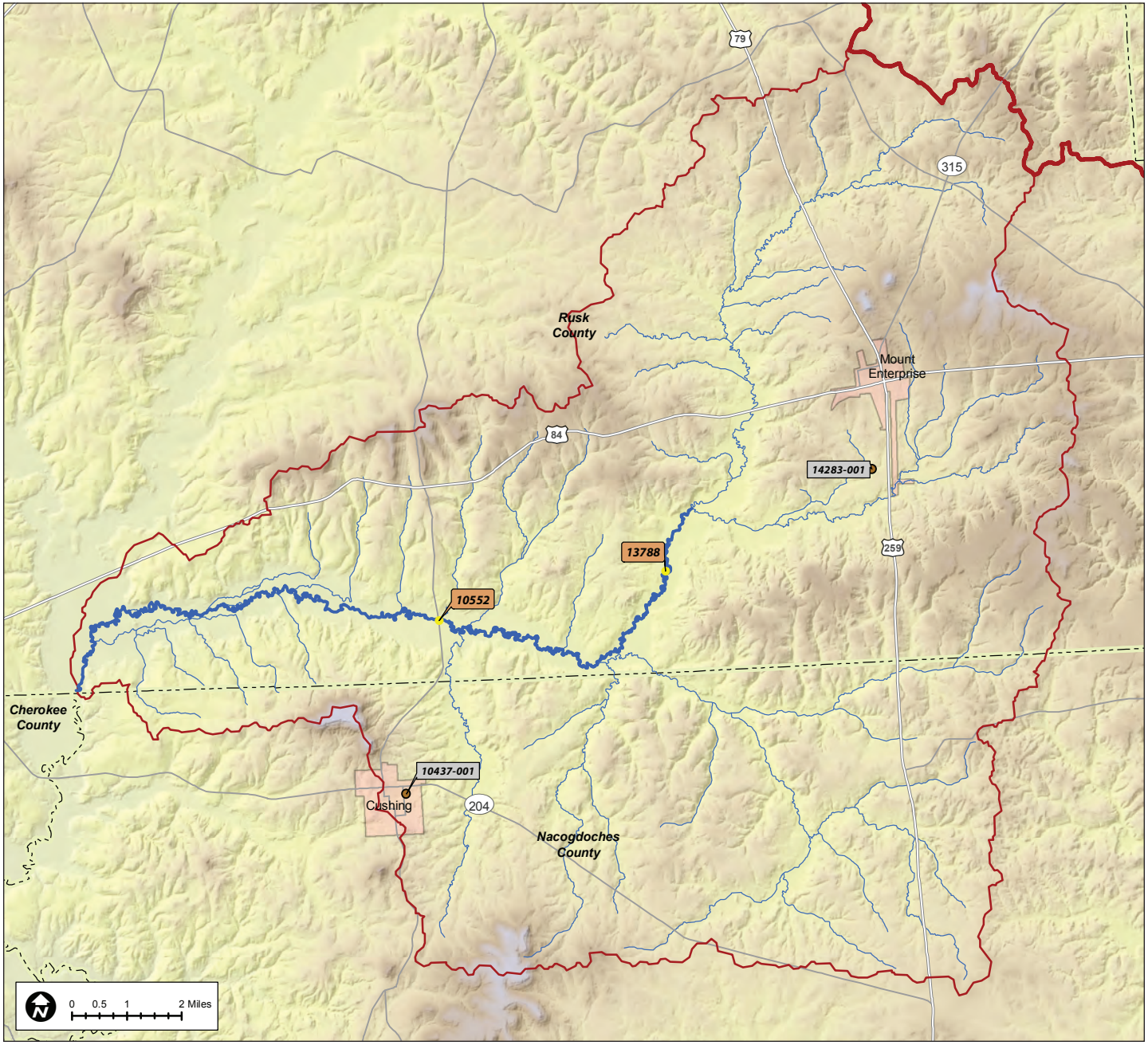
Water Quality Issues Summary for Segment 0611 - Angelina River Above Sam Rayburn Reservoir

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment for *E. coli* bacteria	AU 0611_04 (upstream of confluence with East Fork Angelina River)	• Municipal wastewater discharges • Failing (and non-existent) septic systems • Wildlife (deer and feral hogs) • Livestock and agricultural operations, including cattle and poultry operations	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring
Toxic substances in water (Aluminum and Lead)	AU 0611_03 (from the confluence of Mud Creek upstream to the confluence with East Fork Angelina River)	• This concern was based upon carry-forward data	• Metals in water can be toxic to the aquatic biological community	• Collect additional data and re-evaluate

Segment 0611A - East Fork Angelina River

Segment Profile

Segment 0611A extends from the confluence of the Angelina River at the Rusk/Nacogdoches County line to the upstream perennial portion of the stream west of Mount Enterprise in Rusk County. This unclassified water body extends 29.1 miles in length. The segment is designated for aquatic life, general, and recreation use.



Segment 0611A - East Fork Angelina River

Assessment Units

Assessment Units in Segment 0611A - East Fork Angelina River	
AU ID	**Description**
0611A_01	From the confluence with Angelina River (0611) at Rusk/Nacogdoches county line upstream to confluence with Beech Creek (0611J) in Rusk County
0611A_02	From a point immediately upstream of confluence with Beech Creek (0611J) upstream to confluence with Wooten Creek (0611P)

Monitoring Stations

Monitoring Stations in Segment 0611A - East Fork Angelina River									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0611A_01	13788	EAST FORK ANGELINA RIVER AT RUSK CR 3218	4	4	4	5			TCEQ-5
0611A_02	10552	EAST FORK ANGELINA RIVER AT FM 225	4	4	4	4			TCEQ-5

Description of Water Quality Issues

Impairments and Concerns

Segment 0611A has two assessment units. One of those assessment units, AU 0611A_01, is listed in the Draft 2014 Integrated Report as not supporting for Primary Contact Recreation due to bacteria impairments. In the assessment, the geometric mean of *E. coli* bacteria for this AU was 173.14 MPN/100 mL based on 41 samples, which exceeds the standard of 126 MPN/100 mL for Primary Contact Recreation. In AU 0611A_02, there is a concern for *E. coli* bacteria, with a geometric mean of 129.49 MPN/100 mL based on 7 samples assessed. The TCEQ is currently in the process of conducting a Recreational Use Attainability Analysis on Segment 0611A to determine if Primary Contact Recreation is the appropriate use designation for this water body.

There were no other impairments or concerns listed for this segment in the Draft 2014 Integrated Report.

Assessment Summary for Segment 0611A - East Fork Angelina River as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	125 mg/L	**50 mg/L**	**250 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.2**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0611A_01				NC	FS					**NS**				
0611A_02				NC	FS					CN	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0611A - East Fork Angelina River

Monitoring Station 13788 – East Fork Angelina River at Rusk CR 3218

This station is monitored quarterly by TCEQ Region 5 (Tyler) for field parameters, conventional parameters, flow, and *E. coli* bacteria.

Water Quality Monitoring Results for Station 13788 - East Fork Angelina River at Rusk CR 3218

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	25	0	113	180	147.76		-1.3373	0.0047	
00300	Dissolved Oxygen (mg/L)	25	1	0.5	11.7	8.10		0.9685	0.7602	
00400	pH (S.U.)	24	0	6.5	7.2	6.94		7.3874	0.5539	
00530	Total Suspended Solids (mg/L)	19	0	4	49	11.47		-0.7366	0.3738	
00610	Ammonia-Nitrogen (mg/L as N)	19	0	0.05	0.16	0.06		1.9722	0.1364	
00630	Nitrate + Nitrite (mg/L as N)	19	0	0.04	0.36	0.13		0.4751	0.7969	
00665	Total Phosphorus (mg/L as P)	14	0	0.04	0.25	0.08		-0.0346	0.8191	
00940	Chloride (mg/L)	19	0	10	25	13.53		0.4540	0.8094	
00945	Sulfate (mg/L)	19	1	5	66	21.84		-0.5629	0.4358	
31699	*E. coli* (MPN/100 mL)	13	8	31	870		10.75	-0.8753	0.3333	
32211+70953	Chlorophyll-*a* (µg/L)	17	1	0.3	109	9.00		-0.4194	0.6406	
70300	Total Dissolved Solids (mg/L)	8	0	69	138	111.38		1.5273	0.2530	

Monitoring Station 10552 – East Fork Angelina River at FM 225

This station is monitored quarterly by TCEQ Region 5 (Tyler) for field parameters, conventional parameters, flow, and *E. coli* bacteria.

Water Quality Monitoring Results for Station 10552 - East Fork Angelina River at FM 225

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	53	0	60	162	102.26		-0.3598	0.0001	
00300	Dissolved Oxygen (mg/L)	52	0	3.6	12	8.10		4.5223	0.1698	
00400	pH (S.U.)	51	0	6.1	7.3	6.79		24.0150	0.3702	
00530	Total Suspended Solids (mg/L)	49	0	3	292	19.31		0.5191	0.8671	
00610	Ammonia-Nitrogen (mg/L as N)	50	0	0.05	0.18	0.06		0.4369	0.1155	
00630	Nitrate + Nitrite (mg/L as N)	34	0	0.04	0.3	0.15		3.2499	0.0207	↓
00665	Total Phosphorus (mg/L as P)	45	0	0.03	0.46	0.09		0.4280	0.6221	
00940	Chloride (mg/L)	49	0	6	24	10.76		0.2260	0.0173	
00945	Sulfate (mg/L)	50	1	4	60	13.44		-0.5484	0.1347	
31699	*E. coli* (MPN/100 mL)	40	22	31	2400		37.46	0.5380	0.8904	
32211+70953	Chlorophyll-*a* (µg/L)	47	0	0.42	10	6.08		10.8850	0.0000	
70300	Total Dissolved Solids (mg/L)	37	0	49	126	91.11		1.4617	0.1542	

A decreasing trend for Chlorophyll-*a* is due to a change in the limit of quantitation. There is a statistically significant decreasing trend for Nitrate+Nitrite. All values for this parameter are low, with results ranging from <0.04 to 0.3 mg/L as N.

Segment 0611A - East Fork Angelina River

Summary of Water Quality Trends

In AU 0611A_02, there is a statistically significant decreasing trend for Nitrate+Nitrite. There were no statistically significant trends in AU 0611A_01.

Trend Analysis Summary for Segment 0611A - East Fork Angelina River

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
East Fork Angelina River	0611A_01	13788	East Fork Angelina River at Rusk CR 3218	No statistically significant trends at this station.											
	0611A_02	10552	East Fork Angelina River at FM 225											↓	

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 061A - East Fork Angelina River

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment/Concern for *E. coli* bacteria	Entire segment AU 0611A_01 - Non-Support AU 0611A_02 - Concern for Near Non-Attainment	• Failing (and non-existent) septic systems • Wildlife (deer and feral hogs) • Livestock and agricultural operations, including cattle and poultry operations	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A RUAA is being conducted by TCEQ on this water body to determine if the most appropriate contact recreation standard is being applied

Segment 0611C - Mud Creek

Segment Profile

Segment 0611C is a 45-mile length freshwater stream extending from the confluence of the Angelina River east of Rusk in Cherokee County to the upstream perennial portion of the stream west of Troup in Smith County. It is designated for aquatic life, general, and recreational use.

Segment 0611C - Mud Creek

Assessment Units

Assessment Units in Segment 0611C - Mud Creek

AU ID	Description
0611C_01	From the confluence with Angelina River (0611), per WQS App. D, at the Cherokee and Nacogdoches county line south of City of Reklaw upstream to top of channelized/dredged portion about 2.3 km south of US Hwy 79 at -95.150452N/31.956933W
0611C_02	From a point immediately upstream of channelized/dredged portion about 2.3 km south of US Hwy 79 at -95.150452N/31.956933W upstream to confluence with Prairie Creek in Smith County, per WQS App. D

Monitoring Stations

Monitoring Stations in Segment 0611C - Mud Creek

Assessment Unit	Monitoring Station ID	Description	Annual Frequency						Monitoring Entity
			Field	Conv	Bacteria	Flow	Metals in Water	Metals in Sediment	
0611C_01	14477	MUD CREEK AT US 79	4	4	4	4			ANRA
0611C_01	10532	MUD CREEK AT US 84	4	4	4	4			ANRA

14477 - Mud Creek at US 79

10532 - Mud Creek at US 84

Segment 0611C - Mud Creek

Description of Water Quality Issues

Impairments and Concerns

Mud Creek has two assessment units. AU 0611C_01, which reaches from the confluence with the Angelina River (Segment 0611) at the Cherokee and Nacogdoches county line south of the City of Reklaw upstream to the top of the channelized/dredged portion south of US 79, is listed in the Draft 2014 Integrated Report as impaired for *E. coli* bacteria. Based on 52 samples assessed, the geometric mean is 148.29 MPN/100 mL, which exceeds the criteria for Primary Contact Recreation.

In AU 0611C_02, a concern for *E. coli* bacteria has been identified, with a geometric mean of 133.31 MPN/100 mL based on 28 samples assessed. The Texas Institute for Applied Environmental Research (TIAER), with funding by the Texas State Soil and Water Conservation Board (TSSWCB), is currently conducting a Recreational Use Attainability Analysis on Mud Creek to determine if Primary Contact Recreation is the most appropriate recreational use for this waterbody

In AU 0611C_01, there is a concern for depressed Dissolved Oxygen, with 5 of 27 results below the grab screening level of 5.0 mg/L.

Also in AU 0611C_01, there is a listing for Aluminum in water.

14477- Mud Creek at US 79

Assessment Summary for Segment 0611C - Mud Creek as listed in the Draft 2014 Texas Integrated Report

AU	Chloride	Sulfate	TDS	DO Grab Screening Level	DO Grab Minimum	24 Hour DO Average	24 Hour DO Minimum	pH	Temp (C)	*E. coli* geomean	Ammonia Nitrogen	Nitrate Nitrogen	Total Phosphorus	Chl-*a*
	125 mg/L	50 mg/L	250 mg/L	5.00 mg/L	3.00 mg/L	5.00 mg/L	3.00 mg/L	6.0 - 8.5 SU	32.2	126 MPN /100 mL	0.33 mg/L	1.95 mg/L	0.69 mg/L	14.1 µg/L
0611C_01				CS	FS					**NS**	NC	NC	NC	NC
0611C_02				NC	FS	NA	NA			CN	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0611C - Mud Creek

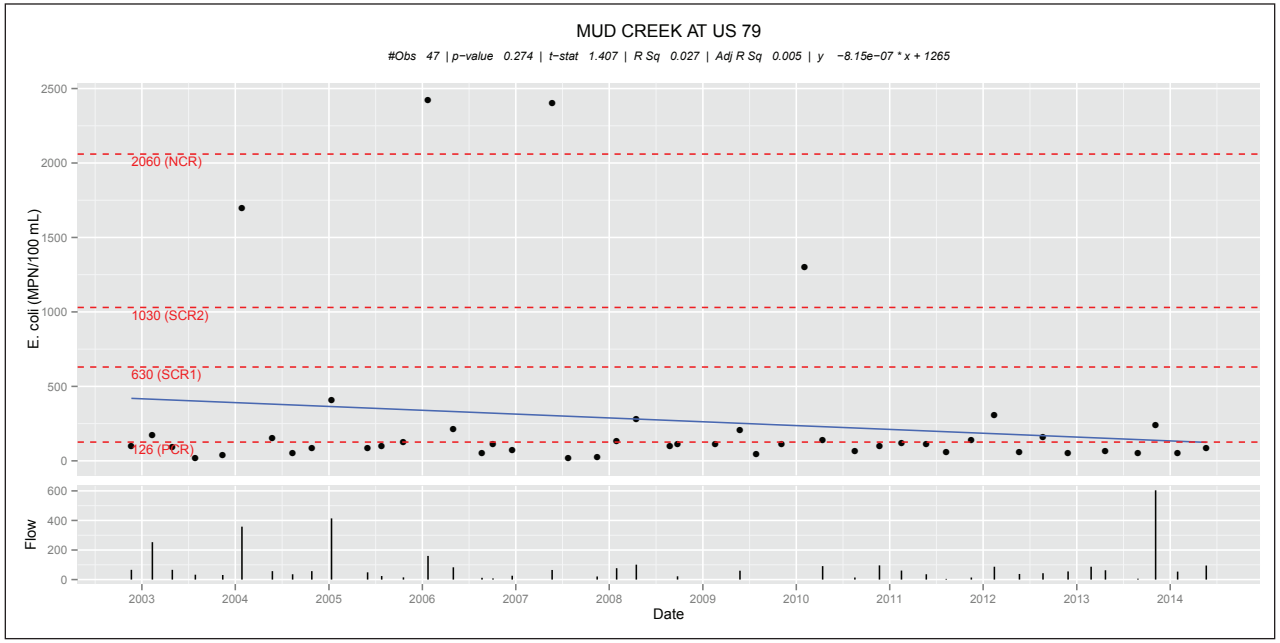
Monitoring Station 14477 - Mud Creek at US 79

Monitoring Station 14477 is sampled by ANRA on a quarterly basis for field parameters, conventional parameters, flow, and *E. coli* bacteria.

For *E. coli* bacteria at station 14477, most values are below the Secondary Contact Recreation 1 (SCR1) standard. Results ranged from 22 to >2400 MPN/100 mL, with a geometric mean of 122.27 MPN/100 mL.

At this station, increasing trends are observed for Specific Conductance, Total Dissolved Solids, and Sulfate, although none of these trends are statistically significant.

For nutrient parameters, there is a statistically significant decreasing trend for Ammonia-Nitrogen, although this data set does contain censored data (values reported as <LOQ). Ammonia-Nitrogen results range from 0.07 to 1.16 mg/L as N, with 14 of 47 results exceeding the 0.33 mg/L as N screening level. Since 2008, the vast majority of results were reported at or below the LOQ of 0.10 mg/L as N. Significant decreasing trends are also observed for both Nitrate+Nitrite and Total Phosphorus. The trend for Chlorophyll-*a* is due to a change in the limit of quantitation.

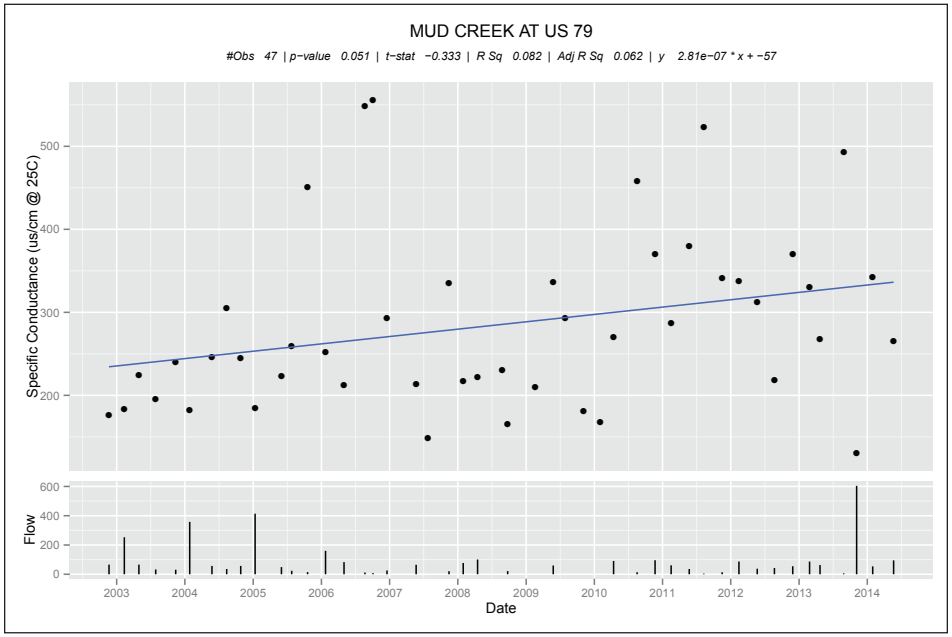


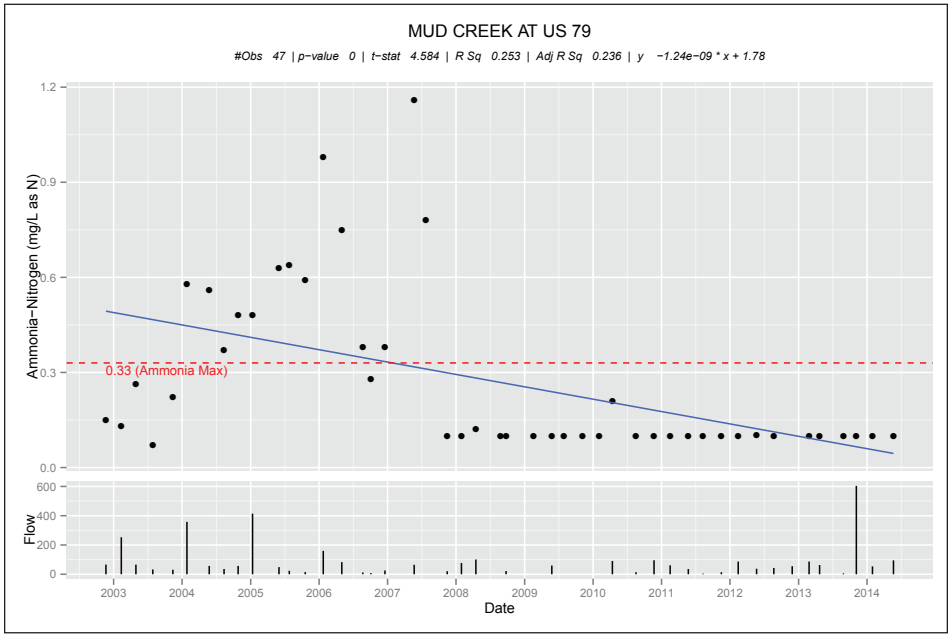
Water Quality Monitoring Results for Station 14477 - Mud Creek at US 79

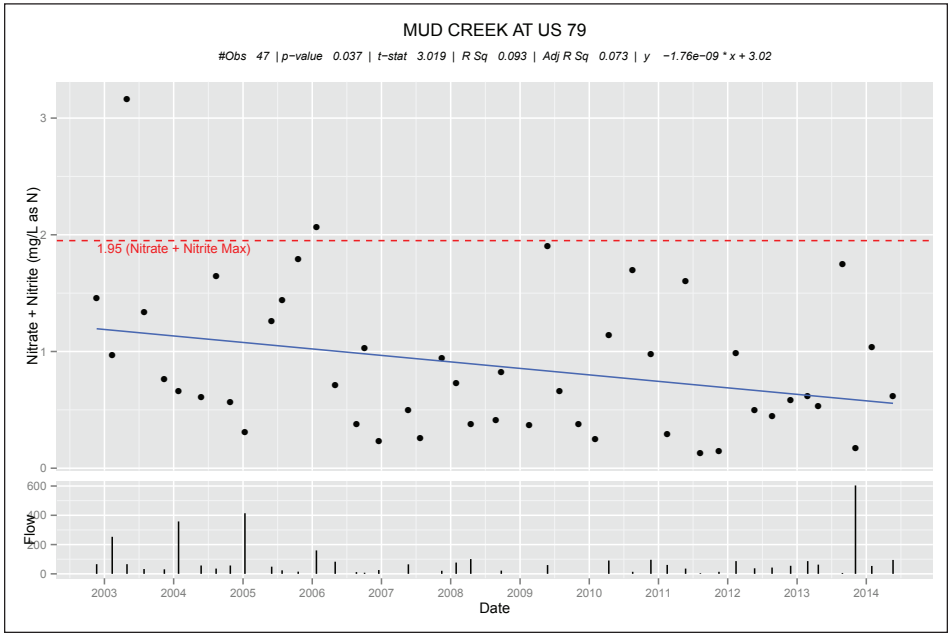
Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	47	0	130	556	285.02		-0.3334	0.0508	
00300	Dissolved Oxygen (mg/L)	47	0	4	13.6	7.81		1.2979	0.5063	
00400	pH (S.U.)	44	0	6.1	8	7.25		10.0132	0.7281	
00530	Total Suspended Solids (mg/L)	47	0	1.33	77	17.79		-1.4736	0.0386	
00610	Ammonia-Nitrogen (mg/L as N)	47	14	0.07	1.16	0.27		4.5839	0.0003	↓
00630	Nitrate + Nitrite (mg/L as N)	47	2	0.13	3.16	0.88		3.0191	0.0369	↓
00665	Total Phosphorus (mg/L as P)	47	0	0.02	0.43	0.16		2.7177	0.0996	↓
00940	Chloride (mg/L)	46	0	10	75.5	31.49		1.1132	0.9616	
00945	Sulfate (mg/L)	46	5	21.1	72.2	39.70		-0.0001	0.0287	
31699	*E. coli* (MPN/100 mL)	47	18	22	2420		122.27	1.4070	0.2738	
32211+70953	Chlorophyll-*a* (µg/L)	42	0	2	5.2	3.41		6.9760	0.0000	
70300	Total Dissolved Solids (mg/L)	46	5	115	299	185.87		-0.1817	0.0083	

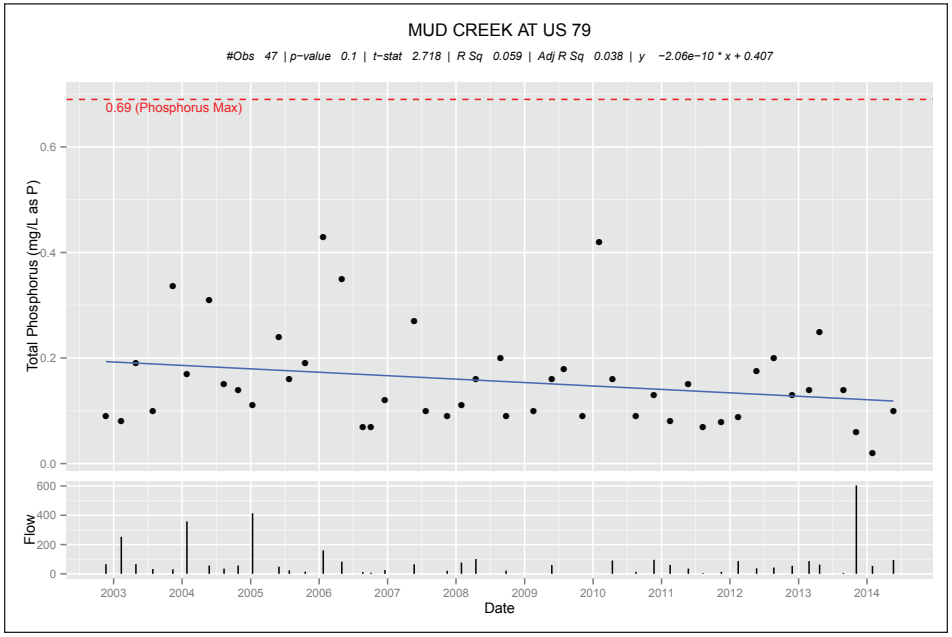
Segment 0611C - Mud Creek

Monitoring Station 14477 - Mud Creek at US 79









Segment 0611C - Mud Creek

Monitoring Station 10532 - Mud Creek at US 84

Monitoring Station 10532 is located on US 84 just southwest of Reklaw. This station is monitored quarterly by ANRA for field parameters, conventional parameters, flow, and *E. coli* bacteria.

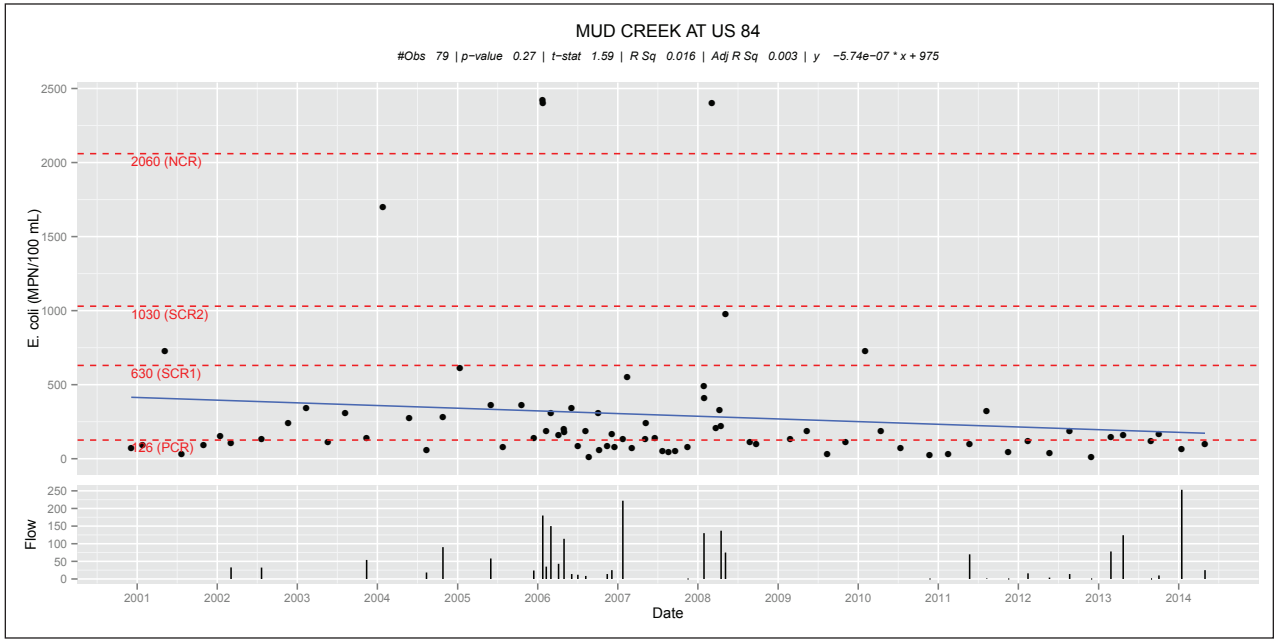
For *E. coli* bacteria at station 10532, numerous values are above the standard for Primary Contact Recreation. Results ranged from 11 to >2400 MPN/100 mL, with a geometric mean of 155.94 MPN/100 mL based on 79 samples collected.

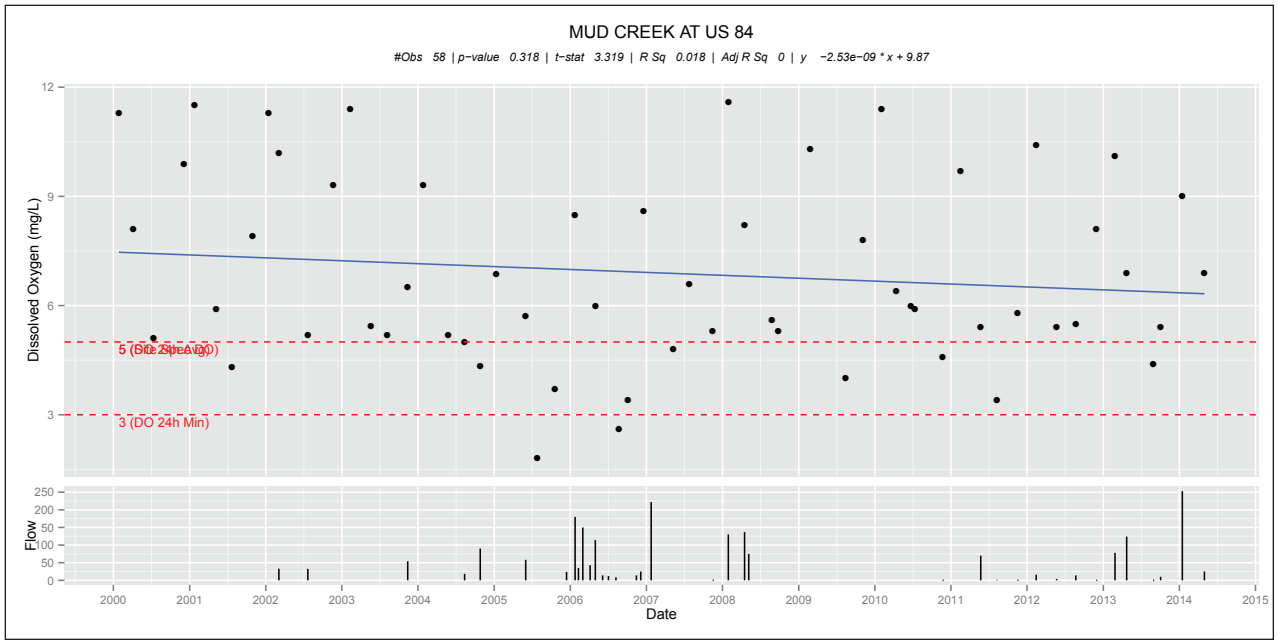
At this station, numerous Dissolved Oxygen measurements were below the 5.00 mg/L grab screening level, with results ranging from 1.8 – 11.6 mg/L. There was a concern for depressed Dissolved Oxygen listed in the Draft 2014 Integrated Report.

Increasing trends were seen for both Specific Conductance and Chloride, but neither trend was statistically significant.

For nutrient parameters, a decreasing trend was observed for Ammonia-Nitrogen, but the trend was not statistically significant. Ammonia-Nitrogen results ranged from <0.01 – 1.11 mg/L as N, with a mean value of 0.24 mg/L as N. In the period assessed by ANRA, 15 of 58 values exceeded the 0.33 mg/L as N screening level. Numerous elevated values were observed during the period of 2004 – 2008, but most recent values were reported at or below the laboratory's limit of quantitation (0.10 mg/L as N).

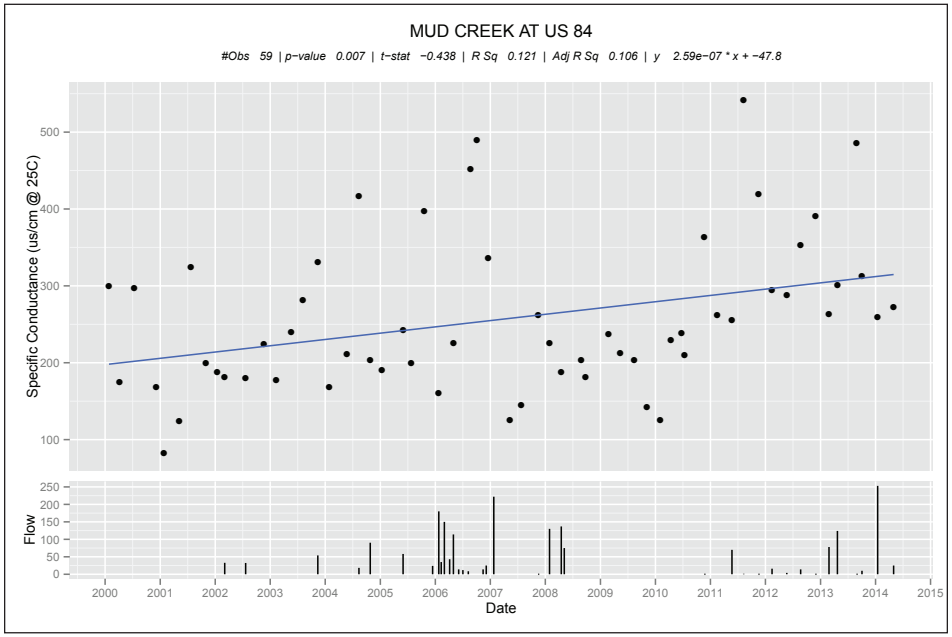
Nitrate+Nitrite and Total Phosphorus both had statistically significant decreasing trends over the period analyzed. Both parameters had results which exceeded the screening level, but these elevated values all occurred prior to 2005.

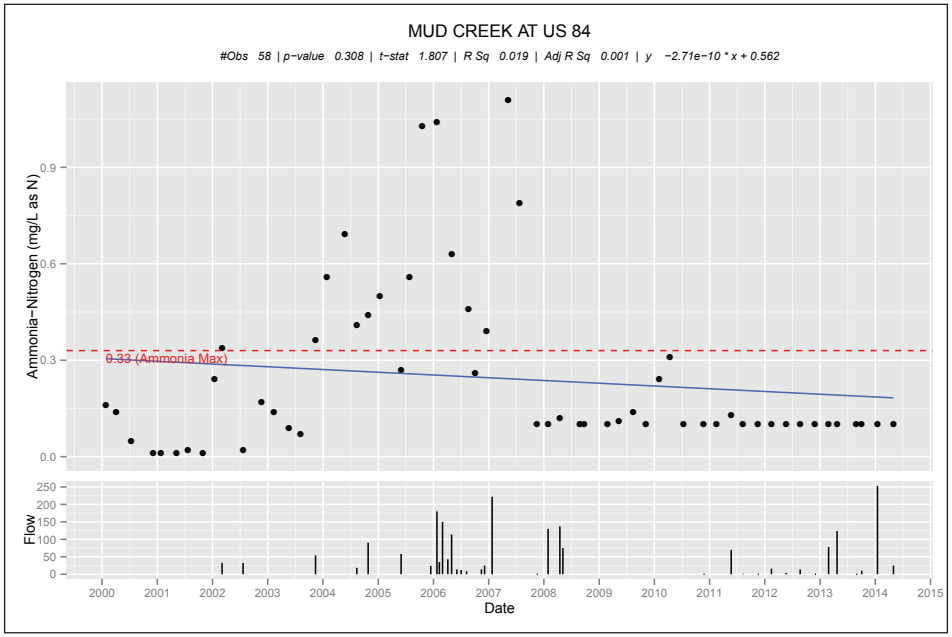


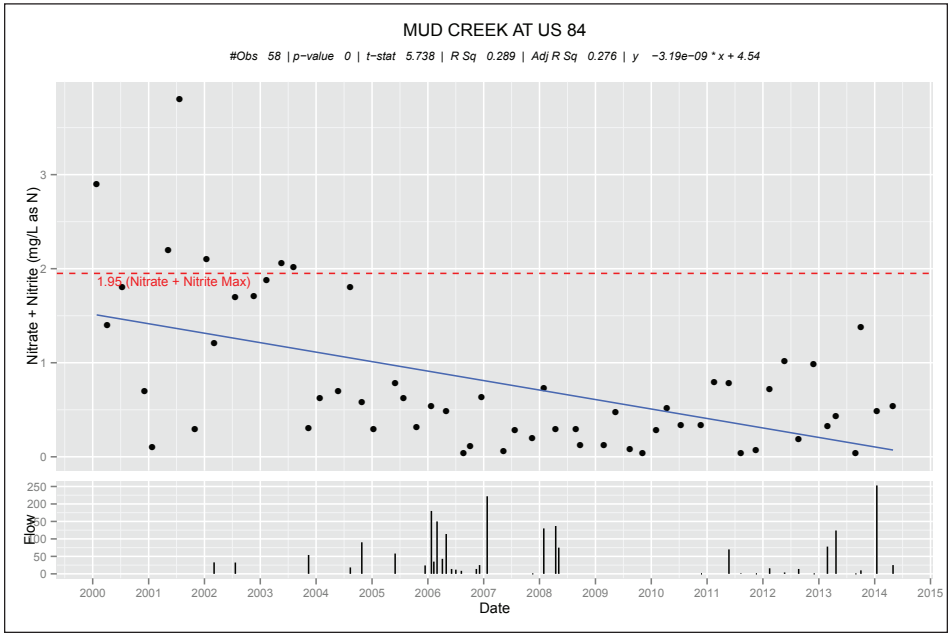


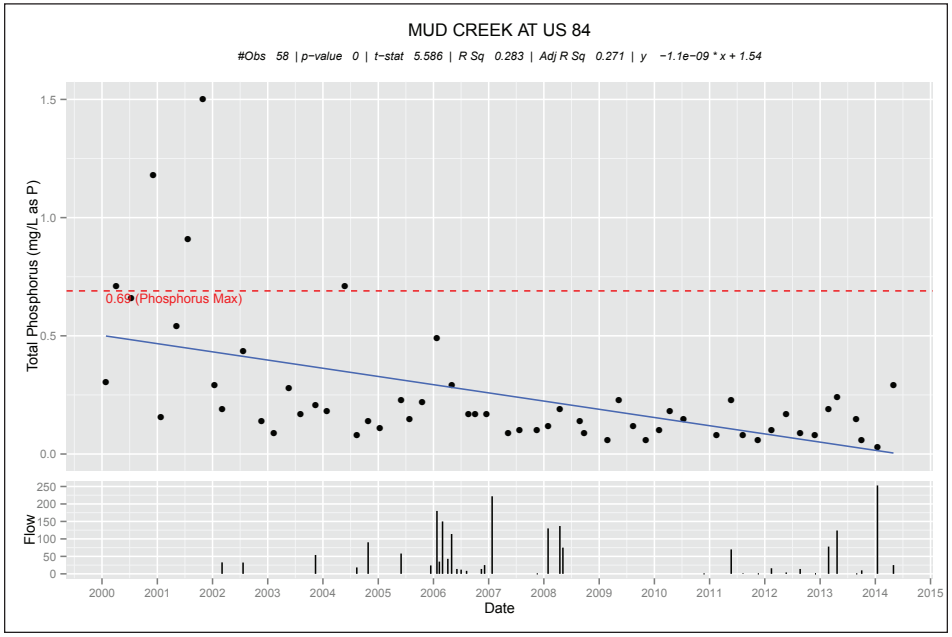
Segment 0611C - Mud Creek

Monitoring Station 10532 - Mud Creek at US 84









Segment 0611C - Mud Creek

Monitoring Station 10532 - Mud Creek at US 84

Water Quality Monitoring Results for Station 10532 - Mud Creek at US 84										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	59	0	82	542	257.00		-0.4378	0.0068	
00300	Dissolved Oxygen (mg/L)	58	2	1.8	11.6	6.89		3.3193	0.3180	
00400	pH (S.U.)	56	0	6.1	7.9	7.14		15.8516	0.7666	
00530	Total Suspended Solids (mg/L)	58	0	1.67	48	12.71		-1.7106	0.0071	
00610	Ammonia-Nitrogen (mg/L as N)	58	15	0.01	1.11	0.24		1.8067	0.3078	
00630	Nitrate + Nitrite (mg/L as N)	58	6	0.04	3.8	0.79		5.7382	0.0000	↓
00665	Total Phosphorus (mg/L as P)	58	5	0.03	1.5	0.25		5.5863	0.0000	↓
00940	Chloride (mg/L)	58	0	10	67.5	26.19		-0.9744	0.0083	
00945	Sulfate (mg/L)	58	11	10.7	87	41.13		3.5469	0.3336	
31699	*E. coli* (MPN/100 mL)	79	46	11	2420		155.94	1.5902	0.2704	
32211+70953	Chlorophyll-*a* (µg/L)	42	3	2	22.3	6.24		0.1019	0.5842	
70300	Total Dissolved Solids (mg/L)	57	5	82	301	175.86		0.9712	0.0416	

10532 - Mud Creek at US 84

Segment 0611C - Mud Creek

Summary of Water Quality Trends

For Mud Creek, there were statistically significant decreasing trends for nutrient parameters. In assessment unit 0611C_01, there were decreasing trends for Ammonia-Nitrogen, Nitrate+Nitrite, and Total Phosphorus. In assessment unit 0611C_02, there were decreasing trends for Nitrate+Nitrite and Total Phosphorus.

Trend Analysis Summary for Segment 0611C - Mud Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Mud Creek	0611C_01	14477	Mud Creek at US 79										↓	↓	↓
	0611C_01	10532	Mud Creek at US 84											↓	↓

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

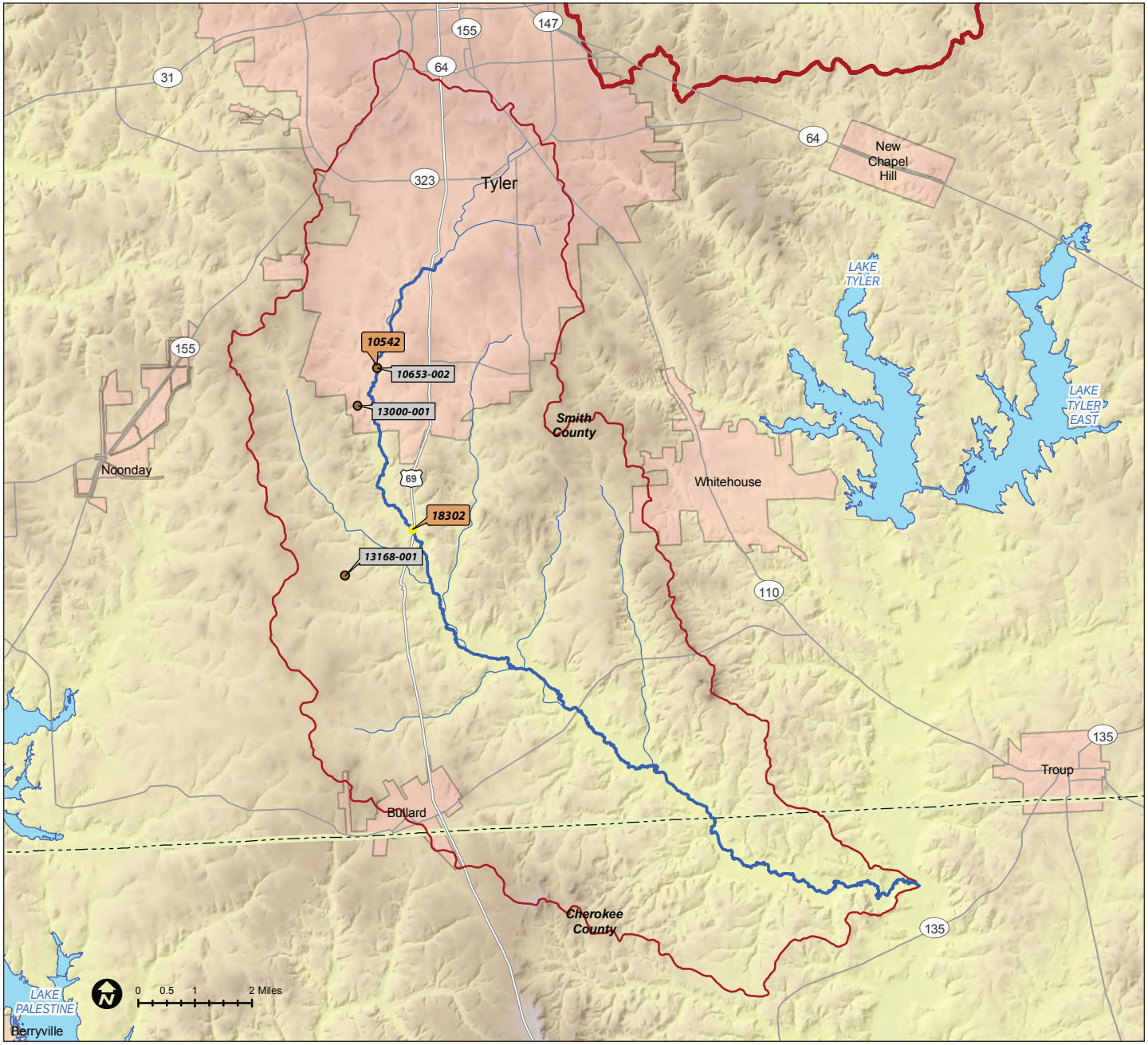
Water Quality Issues Summary for Segment 0611C - Mud Creek

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment for *E. coli* bacteria	Entire segment	• Failing (and non-existent) septic systems • Stormwater runoff • Wildlife (deer and feral hogs) • Livestock and agricultural operations, including cattle and poultry operations	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A RUAA is being conducted on this water body to determine if the most appropriate contact recreation standard is being applied
Depressed Dissolved Oxygen	Lower assessment unit (AU 0611C_01)	• Organic matter and nutrients in the water body	• Low dissolved oxygen is detrimental to the aquatic biological community	• Continue monitoring • Conduct 24-hour dissolved oxygen measurements
Toxic substances in water (Aluminum)	Lower assessment unit (AU 0611C_01)	• This concern was based upon carry-forward data	• Metals in water can be toxic to the aquatic biological community	• Collect additional data and re-evaluate

Segment 0611D - West Mud Creek

Segment Profile

This segment is twenty-three miles in length from the confluence of Mud Creek southwest of Troup in Cherokee County to the upstream perennial portion of the stream south of Tyler in Smith County. The designated uses are aquatic life, general, and recreation use.



Segment 0611D - West Mud Creek

Assessment Units

Assessment Units in Segment 0611D - West Mud Creek	
AU ID	**Description**
0611D_01	From the confluence with Mud Creek (0611C), per WQS App. D, upstream to confluence with unnamed tributary about 75 m north of WWTP in City of Tyler at NHD RC 12020004000212
0611D_02	From the confluence with unnamed tributary about 75 m north of WWTP in City of Tyler upstream to confluence of unnamed tributary about 300 meters upstream of the most northern crossing of US 69 in City of Tyler, per WQS App. D, at NHD RC 12020004000212

Monitoring Stations

Monitoring Stations in Segment 0611D - West Mud Creek

Assessment Unit	Monitoring Station ID	Description	Annual Frequency						Monitoring Entity
			Field	Conv	Bacteria	Flow	Metals in Water	Metals in Sediment	
0611D_01	18302	WEST MUD CREEK AT US 69	4	4	4	4			TCEQ-5
0611D_01	10542	WEST MUD CREEK ABOVE CITY OF TYLER SOUTHSIDE WWTP	4	4	4	4			TCEQ-5

In the past, monitoring on West Mud Creek was conducted by City of Tyler personnel in support of ANRA's Clean Rivers Program. Due to budgetary and staffing issues, the City of Tyler had to cease monitoring of the creek. TCEQ Region 5 assumed the monitoring activities formerly performed by City of Tyler personnel.

Flow Measurements being conducted on West Mud Creek by City of Tyler personnel (7/19/2011)

Segment 0611D - West Mud Creek

Description of Water Quality Issues

Impairments and Concerns

West Mud Creek has two assessment units. Both AUs are listed in the Draft 2014 Integrated Report as impaired for *E. coli* bacteria. In AU 0611D_01 the geometric mean is 246.84 MPN/100 mL (based on 62 samples assessed), which exceeds the criteria for Primary Contact Recreation. The Texas Institute for Applied Environmental Research (TIAER), with funding by the Texas State Soil and Water Conservation Board (TSSWCB), is currently conducting a Recreational Use Attainability Analysis on West Mud Creek to determine if Primary Contact Recreation is the most appropriate recreational use for this water body.

In AU 0611D_01, there is a concern for Ammonia-Nitrogen, with 27 of 55 samples exceeding the nutrient screening level of 0.33 mg/L as N. There is also a concern for Nitrate+Nitrite in this assessment unit, with 27 of 55 samples exceeding the nutrient screening level of 1.95 mg/L as N.

Water Moccasin in West Mud Creek

Assessment Summary for Segment 0611D - West Mud Creek as listed in the Draft 2014 Texas Integrated Report

AU	Chloride	Sulfate	TDS	DO Grab Screening Level	DO Grab Minimum	24 Hour DO Average	24 Hour DO Minimum	pH	Temp (C)	*E. coli* geomean	Ammonia Nitrogen	Nitrate Nitrogen	Total Phosphorus	Chl-*a*
	125 mg/L	50 mg/L	250 mg/L	3.00 mg/L	2.00 mg/L			6.0 - 8.5 SU	32.2	126 MPN /100 mL	0.33 mg/L	1.95 mg/L	0.69 mg/L	14.1 µg/L
0611D_01				NC	FS					**NS**	CS	CS	NC	NC
0611D_02										**NS**	CS			

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Data for the assessment also included monitoring station 10540 – West Mud Creek at FM 346. This station is no longer monitored.

Segment 0611D - West Mud Creek

Monitoring Station 18302 - West Mud Creek at US 69

Monitoring Station 18302 is monitored quarterly by TCEQ Region 5 (Tyler) for field parameters, conventional parameters, flow, and *E. coli* bacteria.

All AUs in West Mud Creek are listed as Not Supporting based upon the Primary Contract Recreation Use. At this station, there are numerous *E. coli* bacteria results that exceed the Primary Contact Recreation standard. However, the vast majority of results are below the Secondary Contact Recreation 1 standard. *E. coli* bacteria results ranged from 44 – 1600 MPN/100 mL. The geometric mean of the results, based on 32 samples, is 168.44 MPN/100 mL.

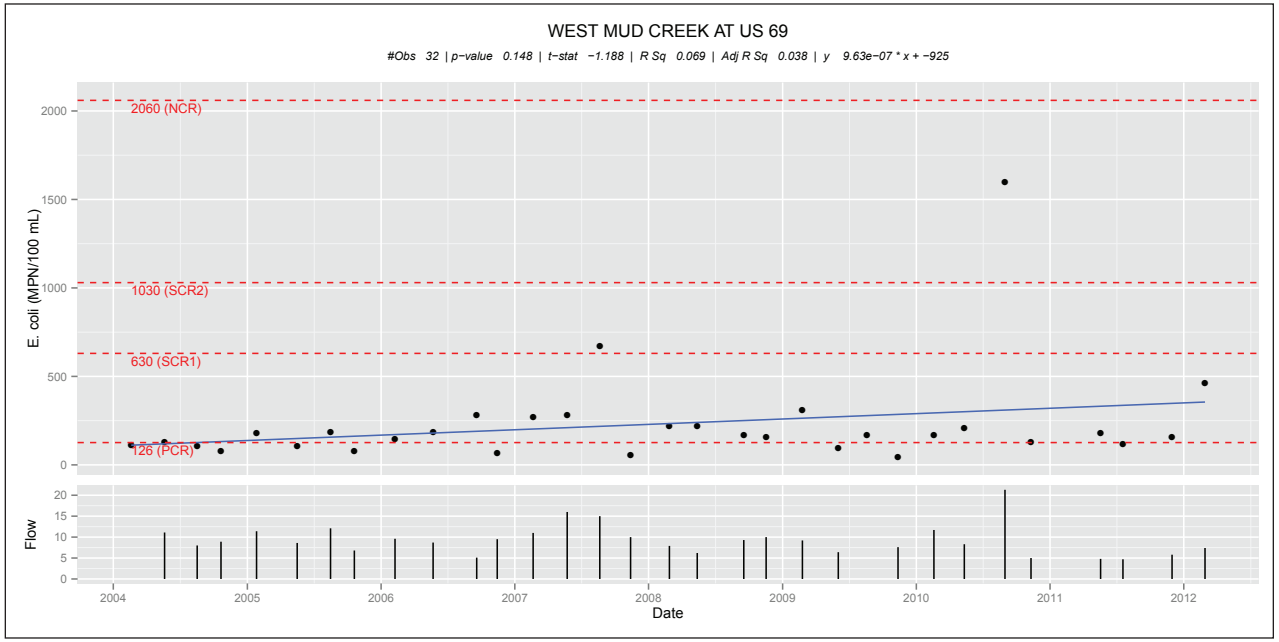
There is a statistically significant decreasing trend for Dissolved Oxygen at this station, with results ranging from 4.0 – 10.4 mg/L.

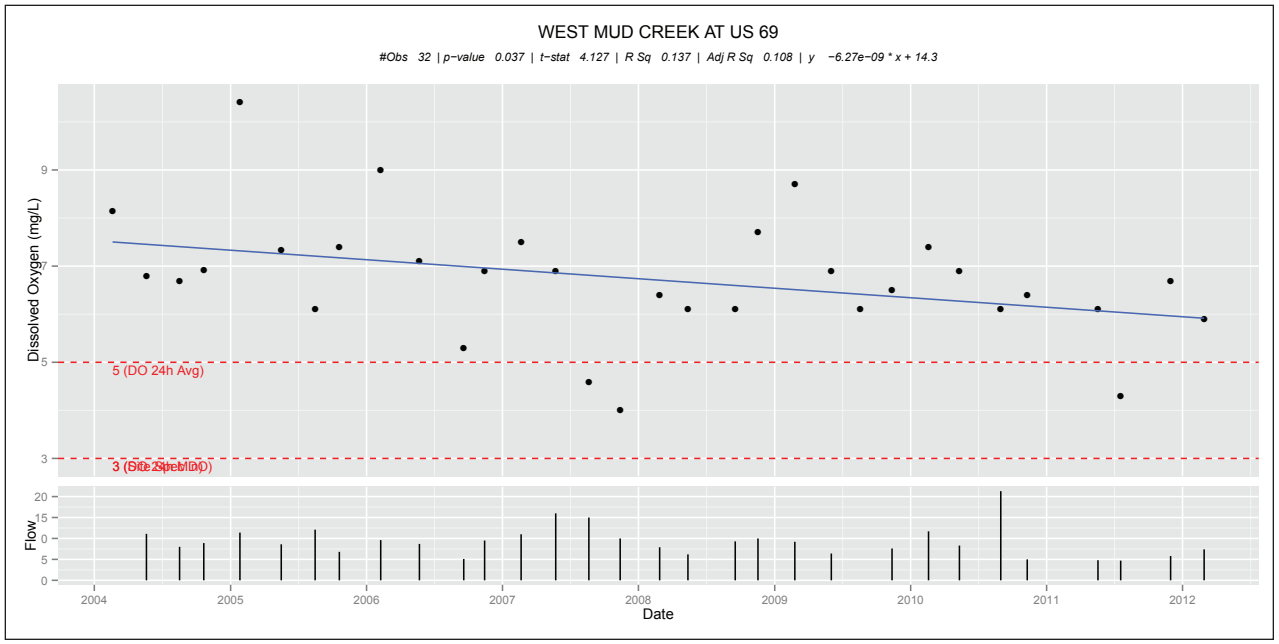
For nutrient parameters, there is a concern for Ammonia-Nitrogen. This parameter shows a decreasing trend, but it is not statistically significant. The nutrient screening level of 0.33 mg/L as N was exceeded for 18 of the 32 samples during the period assessed by ANRA, with values that ranged from <0.1 – 1.4 mg/L as N.

An increasing trend (not statistically significant) is also observed for Nitrate+Nitrite. For Nitrate+Nitrite, the majority of values (28 of 32 results) are greater than the nutrient screening level of 1.95 mg/L. Results ranged from 0.24 – 7.9 mg/L as N.

Total Phosphorus shows a statistically significant decreasing trend.

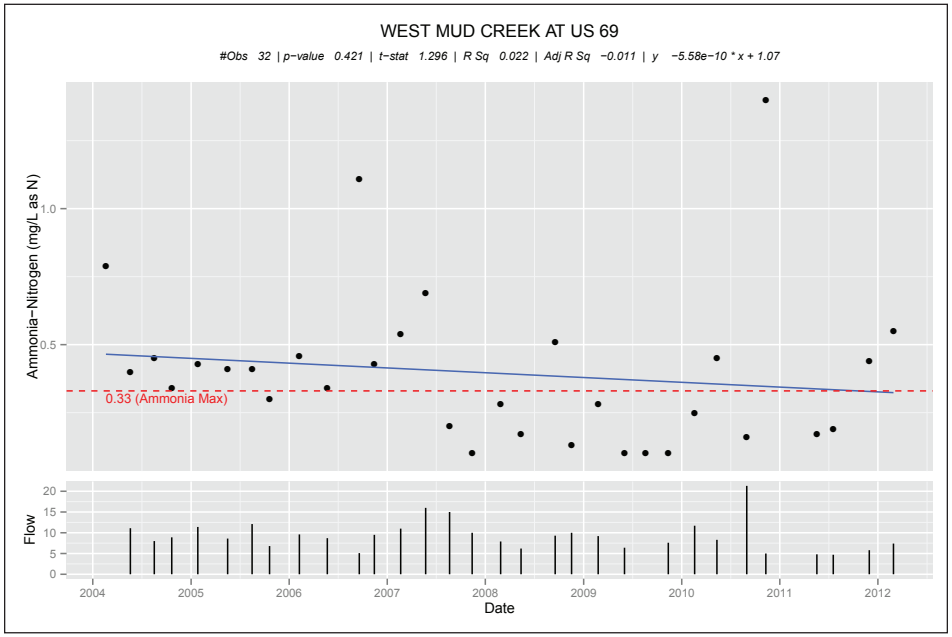
A trend for Chlorophyll-*a* is due to a change in the limit of quantitation.

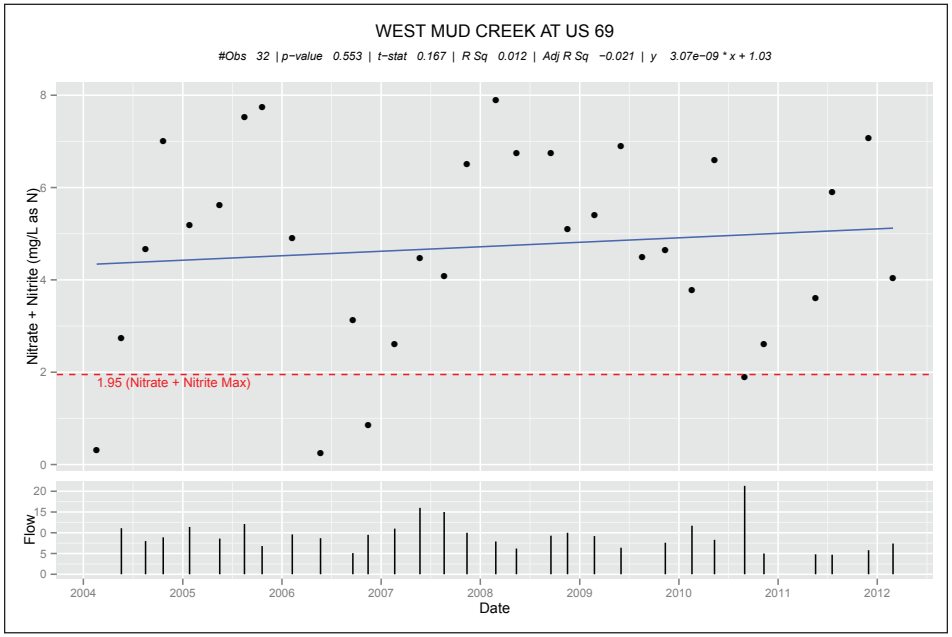




Segment 0611D - West Mud Creek

Monitoring Station 18302 - West Mud Creek at US 69





Water Quality Monitoring Results for Station 18302 - West Mud Creek at US 69

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	32	0	317	636	452.47		2.9384	0.3860	
00300	Dissolved Oxygen (mg/L)	32	0	4	10.42	6.73		4.1270	0.0371	↓
00400	pH (S.U.)	31	0	6.7	8.2	7.29		8.0934	0.2405	
00530	Total Suspended Solids (mg/L)	32	0	1	24	6.36		1.2896	0.4219	
00610	Ammonia-Nitrogen (mg/L as N)	32	18	0.1	1.4	0.40		1.2955	0.4212	
00630	Nitrate + Nitrite (mg/L as N)	32	28	0.24	7.9	4.72		0.1672	0.5528	
00665	Total Phosphorus (mg/L as P)	32	3	0.074	0.96	0.29		3.6692	0.0031	↓
00940	Chloride (mg/L)	32	0	27	69	49.54		1.7800	0.8571	
00945	Sulfate (mg/L)	32	12	29	813	74.80		1.8033	0.1185	
31699	*E. coli* (MPN/100 mL)	32	22	44	1600		168.44	-1.1885	0.1476	
32211+70953	Chlorophyll-*a* (µg/L)	30	0	2	10.9	3.97		3.4875	0.0102	
70300	Total Dissolved Solids (mg/L)	32	29	192	376	298.03		1.6151	0.4756	

Segment 0611D - West Mud Creek

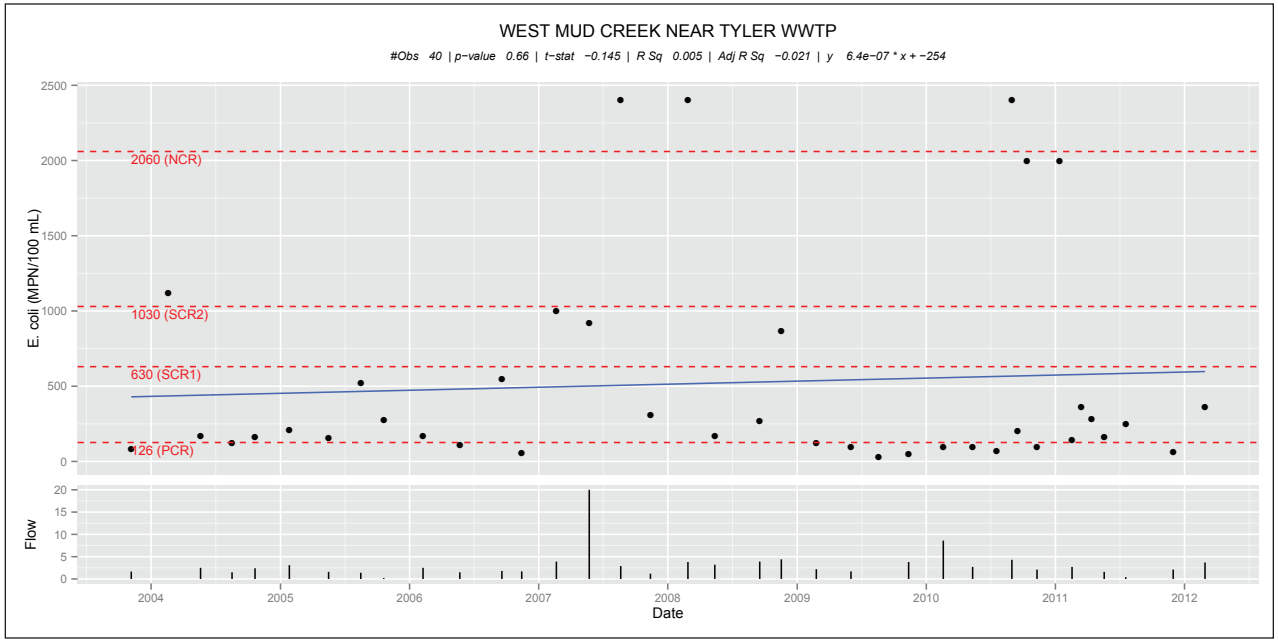
Monitoring Station 10542 - West Mud Creek Above City of Tyler's Southside Wastewater Treatment Plant

Monitoring Station 10542 is located on West Mud Creek immediately upstream of the City of Tyler's Southside wastewater treatment plant. This station is monitored quarterly by TCEQ Region 5 (Tyler) for field parameters, conventional parameters, flow, and *E. coli* bacteria.

At this station, there are numerous *E. coli* bacteria results that exceed the Primary Contact Recreation level, including three results reported as >2400 MPN/100 mL. However, the majority of results are below the level for Secondary Contact Recreation 1.

For nutrient parameters, there are statistically significant decreasing trends for both Ammonia-Nitrogen and Nitrate+Nitrite. For Ammonia-Nitrogen, 8 of 34 values exceeded the nutrient screening criteria of 0.33 mg/L, but these results typically occurred prior to 2008. The values for Ammonia-Nitrogen ranged from 0.03 to 0.9 mg/L as N, with a mean of 0.25 mg/L as N.

A trend for Chlorophyll-*a* is due to a change in the limit of quantitation.



Water Quality Monitoring Results for Station 10542 - West Mud Creek Above City of Tyler's Southside Wastewater Treatment Plant

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	33	0	183	390	298.55		1.1036	0.2216	
00300	Dissolved Oxygen (mg/L)	34	0	3	10.18	6.05		2.1563	0.5147	
00400	pH (S.U.)	33	0	6.5	7.9	7.14		8.4674	0.9154	
00530	Total Suspended Solids (mg/L)	34	0	1	76	7.23		-0.6051	0.4242	
00610	Ammonia-Nitrogen (mg/L as N)	34	8	0.03	0.9	0.25		3.9931	0.0016	↓
00630	Nitrate + Nitrite (mg/L as N)	34	1	0.1	3.14	0.50		2.1042	0.0952	↓
00665	Total Phosphorus (mg/L as P)	33	0	0.06	0.2	0.09		1.8887	0.2421	
00940	Chloride (mg/L)	34	0	17	44.8	29.21		0.0121	0.0624	
00945	Sulfate (mg/L)	34	5	17.4	75.4	38.31		0.7414	0.5801	
31699	*E. coli (MPN/100 mL)*	40	27	29	2400		252.38	-0.1450	0.6598	
32211+70953	Chlorophyll-a (µg/L)	32	1	2	21	4.03		4.9295	0.0001	
70300	Total Dissolved Solids (mg/L)	33	2	2.31	284	190.24		0.1994	0.1832	

Segment 0611D - West Mud Creek

Summary of Water Quality Trends

At station 18302 (West Mud Creek at US 69), there were statistically significant decreasing trends for Dissolved Oxygen and Total Phosphorus. At station 10542 (West Mud Creek Above City of Tyler Southside Wastewater Treatment Plant), there were statistically significant decreasing trends for Ammonia-Nitrogen and Nitrate+Nitrite. Both of these stations are located in AU 0611D_01.

Trend Analysis Summary for Segment 0611D - West Mud Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-a	NH3	NO3/ NO2	Total P
West Mud Creek	0611D_01	18302	West Mud Creek at US 69			↓									↓
	0611D_01	10542	West Mud Creek Above City of Tyler Southside WWTP										↓	↓	

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0611D - West Mud Creek

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment for *E. coli* bacteria	Entire segment	• Rapid urbanization in the upper portion of the watershed • Stormwater runoff • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Failing (and non-existent) septic systems • Domestic animals and wildlife	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A RUAA is being conducted on this water body to determine if the most appropriate contact recreation standard is being applied
Concern for Ammonia-Nitrogen	Entire segment	• Stormwater runoff • Municipal wastewater discharge • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Improper fertilizer use	• Detrimental effect on aquatic biological community	• Continue monitoring • Determination of source of nutrient loading • Evaluation of discharge permit limits
Concern for Nitrate-Nitrogen	Upper assessment unit (AU 0611D_02)	• Stormwater runoff • Municipal wastewater discharge • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Improper fertilizer use	• Detrimental effect on aquatic biological community	• Continue monitoring • Determination of source of nutrient loading • Evaluation of discharge permit limits

Segment 0611Q - Lake Nacogdoches

Segment Profile

Lake Nacogdoches is a reservoir encompassing 2,210 acres located approximately ten miles west of Nacogdoches in Nacogdoches County. The designated uses are aquatic life, general, and contact recreation use. It has a maximum depth of forty feet and was impounded in 1976. Aquatic hydrillas are the primary vegetation on this reservoir. Largemouth bass, crappie, and sunfish are the predominant fish species inhabiting the reservoir.

Segment 0611Q - Lake Nacogdoches

Assessment Units

Assessment Units in Segment 0611Q - Lake Nacogdoches	
AU ID	**Description**
0611Q_01	Entire water body

Monitoring Stations

Monitoring Stations in Segment 061Q - Lake Nacodoches									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0611Q_01	15801	LAKE NACOGDOCHES AT DAM	4	4	4				ANRA
0611Q_01	21021	LAKE NACOGDOCHES NEAR ISLAND IN UPPER LAKE	4	4	4				ANRA

Boat Ramp near Station 15801 - Lake Nacogdoches At Dam

Segment 0611Q - Lake Nacogdoches

Description of Water Quality Issues

Impairments and Concerns

Lake Nacogdoches has one assessment unit. It is listed in the Draft 2014 Integrated Report for a concern for Ammonia-Nitrogen. Of the 56 samples assessed, 20 samples exceeded the nutrient screening level of 0.11 mg/L as N.

Assessment Summary for Segment 0611Q - Lake Nacogdoches as listed in the Draft 2014 Texas Integrated Report

AU	Chloride	Sulfate	TDS	DO Grab Screening Level	DO Grab Minimum	24 Hour DO Average	24 Hour DO Minimum	pH	Temp (C)	*E. coli* geomean	Ammonia Nitrogen	Nitrate Nitrogen	Total Phosphorus	Chl-*a*
	125 mg/L	**50 mg/L**	**250 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.2**	**126 MPN /100 mL**	**0.11 mg/L**	**0.37 mg/L**	**0.20 mg/L**	**26.7 µg/L**
0611Q_01				NC	FS					FS	CS	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

15801 - Lake Nacogdoches At Dam

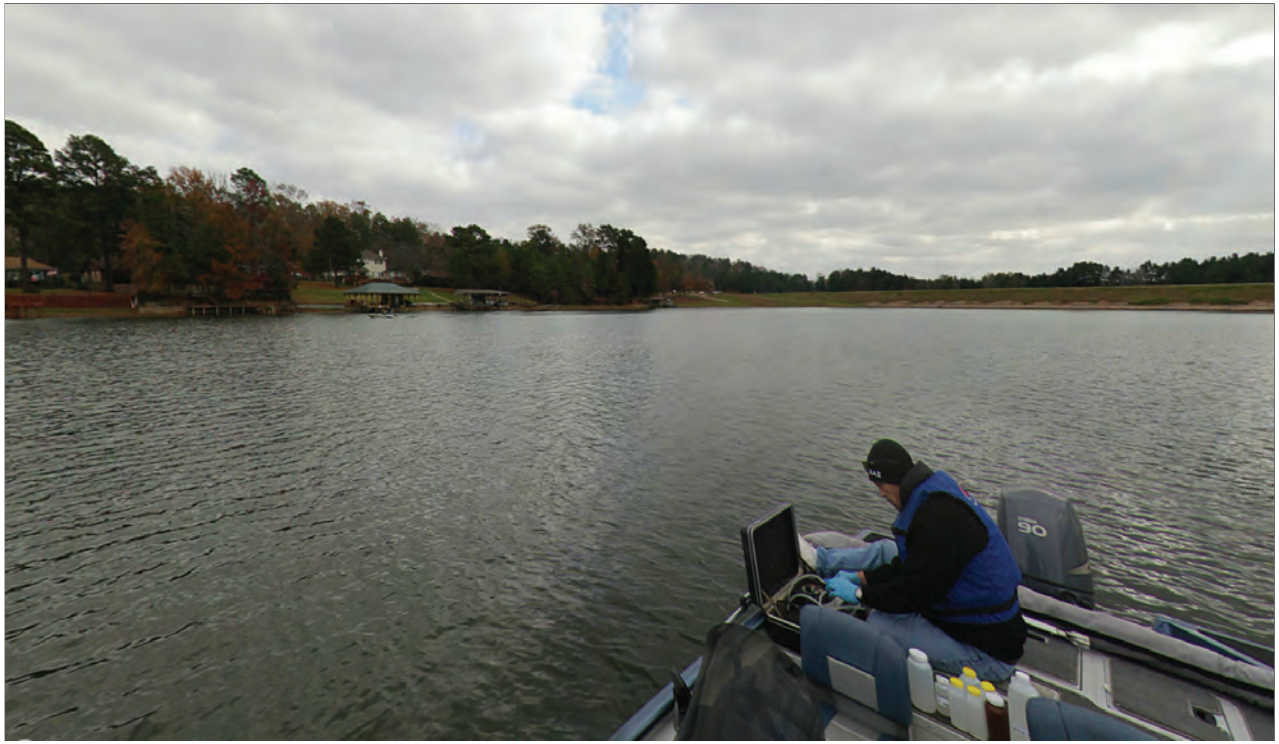
Segment 0611Q - Lake Nacogdoches

Monitoring Station 15801 - Lake Nacogdoches At Dam

Monitoring Station 15801 is monitored quarterly by ANRA for field parameters, conventional parameters, and *E. coli* bacteria. This monitoring station is located in the main pool of the lake near the dam.

Significant increasing trends are observed for Specific Conductance, Total Dissolved Solids, and Sulfate.

There is a concern for nutrient screening levels for Ammonia-Nitrogen on Lake Nacogdoches. At station 15801, there is a decreasing trend for Ammonia-Nitrogen. This trend is statistically significant, although the data set does include numerous values reported as <LOQ. There were numerous elevated values prior to 2008. Results for this parameter ranged from 0.08 – 0.58 mg/L as N, with a mean of 0.15 mg/L as N.



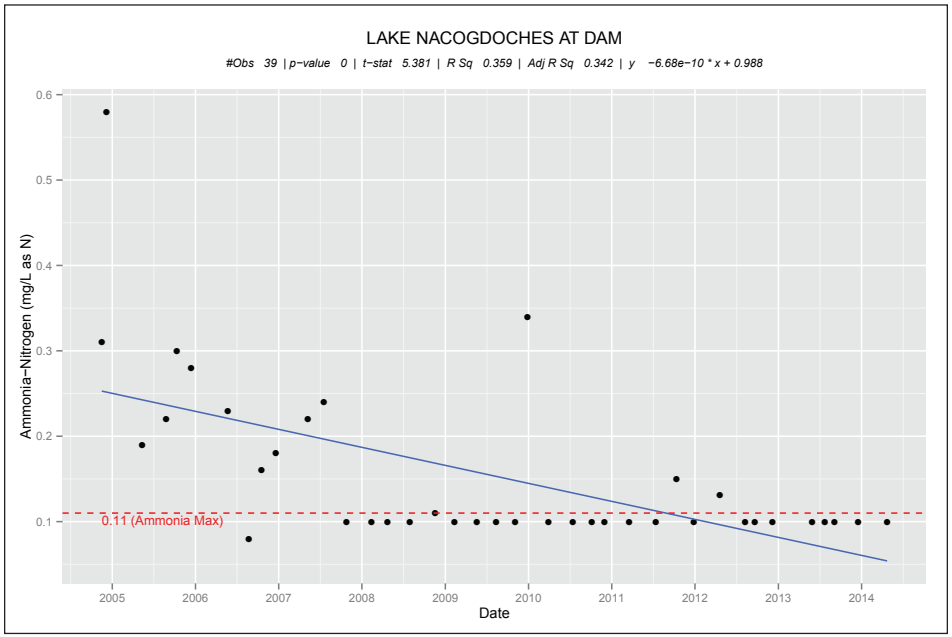
15801 - Lake Nacogdoches At Dam

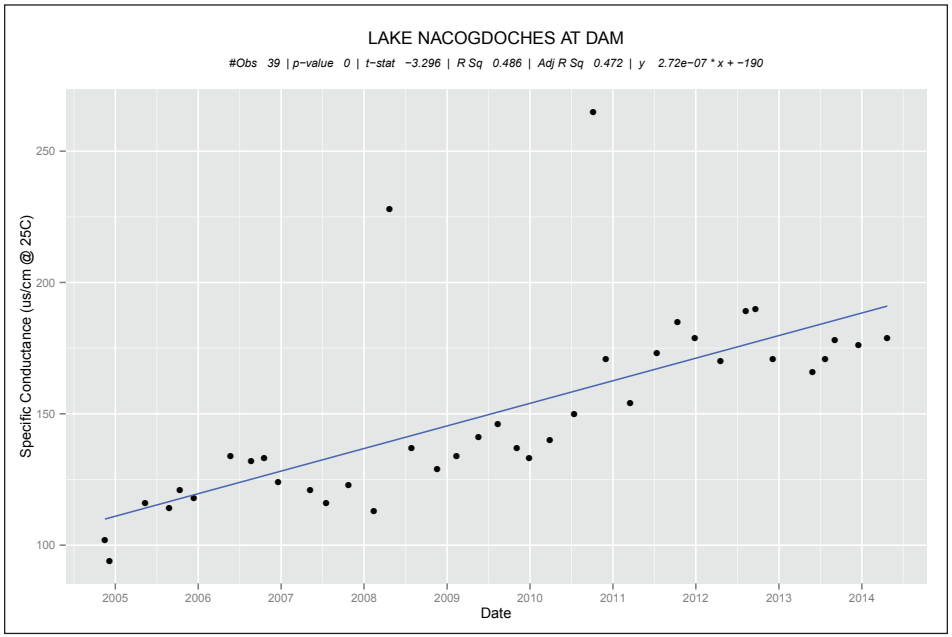
Water Quality Monitoring Results for Station 15801 - Lake Nacogdoches At Dam

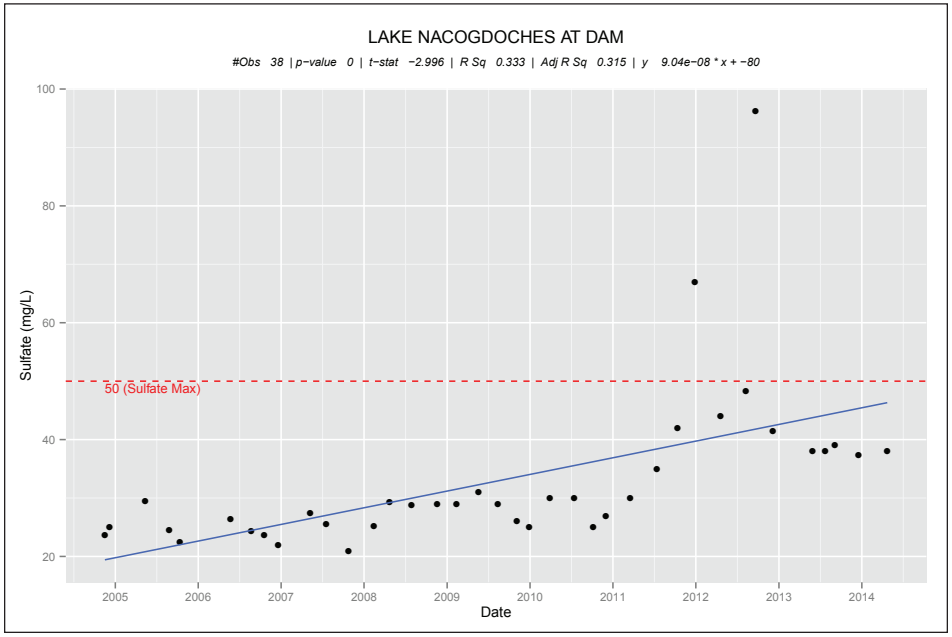
Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	39	0	94	265	150.08		-3.2961	0.0000	↑
00300	Dissolved Oxygen (mg/L)	39	0	6.96	11.6	8.75		1.2978	0.1352	
00400	pH (S.U.)	37	0	6.4	8.3	7.40		8.3142	0.2845	
00530	Total Suspended Solids (mg/L)	39	0	1	15	2.99		0.1426	0.6697	
00610	Ammonia-Nitrogen (mg/L as N)	39	14	0.08	0.58	0.15		5.3813	0.0001	↓
00630	Nitrate + Nitrite (mg/L as N)	39	0	0.04	0.282	0.07		1.5742	0.3196	
00665	Total Phosphorus (mg/L as P)	39	2	0.02	0.69	0.09		1.2947	0.3409	
00940	Chloride (mg/L)	38	0	7.1	44	13.33		0.0625	0.3837	
00945	Sulfate (mg/L)	38	2	20.9	96.3	33.01		-2.9960	0.0001	↑
31699	*E. coli* (MPN/100 mL)	39	0	1	27		1.42	0.3004	0.9418	
32211+70953	Chlorophyll-*a* (µg/L)	37	1	2	37.4	5.77		0.3721	0.9576	
70300	Total Dissolved Solids (mg/L)	39	0	38.7	214	96.11		-2.5881	0.0001	↑

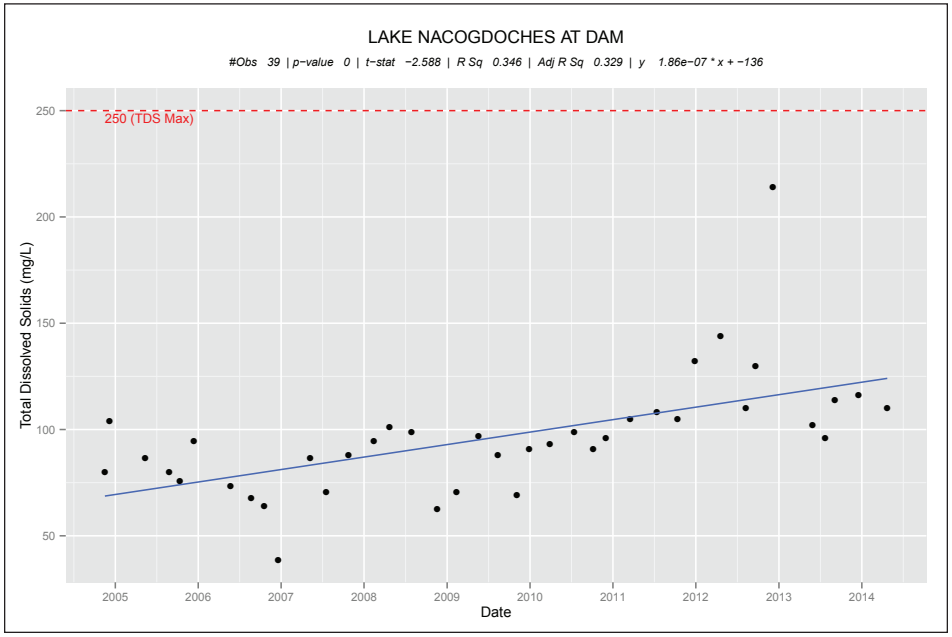
Segment 0611Q - Lake Nacogdoches

Monitoring Station 15801 - Lake Nacogdoches At Dam









Segment 0611Q - Lake Nacogdoches

Monitoring Station 21021 - Lake Nacogdoches Near Island in Upper Lake

Monitoring Station 21021 is monitored quarterly by ANRA for field parameters, conventional parameters, and *E. coli* bacteria. This monitoring station is located in the upper portion of the lake. Water quality results and trends at this station are very similar to those seen at station 15801. A decreasing trend for Total Phosphorus is influenced by a recent change in the limit of quantitation from 0.06 mg/L as P to 0.02 mg/L as P. A statistically significant decreasing trend is observed for Chlorophyll-*a*.

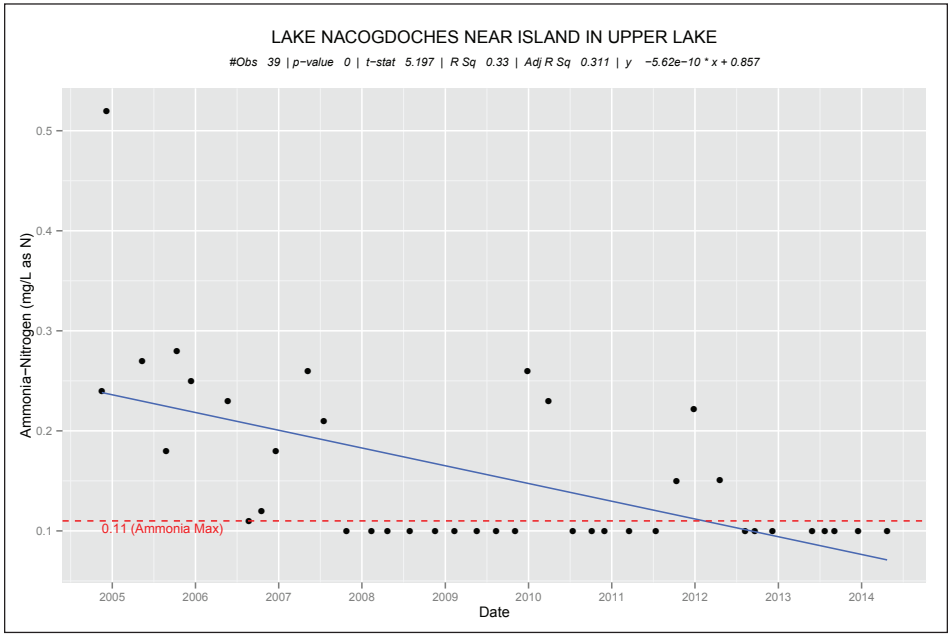
Water Quality Monitoring Results for Station 21021 - Lake Nacogdoches Near Island in Upper Lake

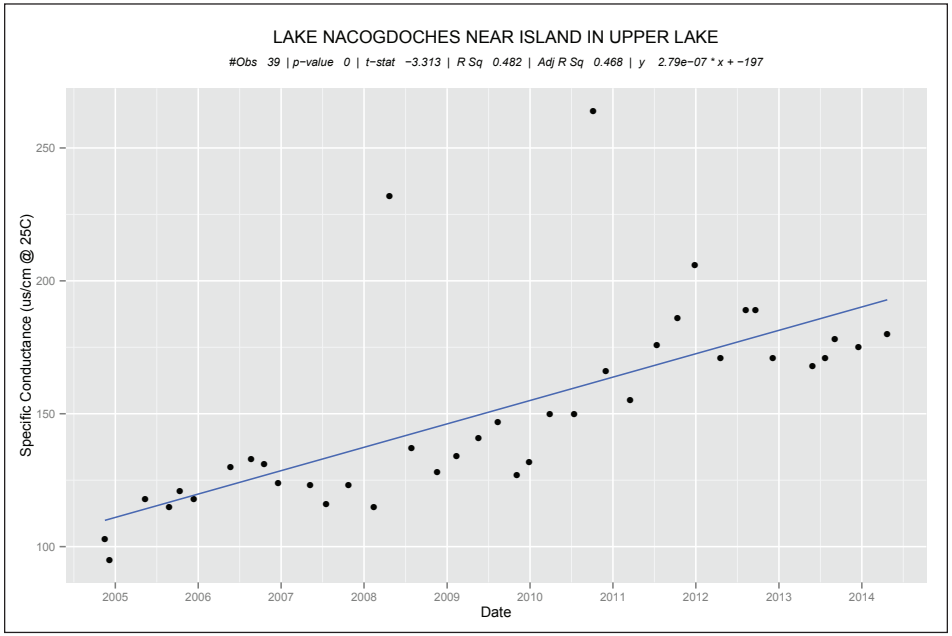
Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	39	0	95	264	150.97		-3.3134	0.0000	↑
00300	Dissolved Oxygen (mg/L)	39	0	6.8	11.9	8.89		2.0358	0.4224	
00400	pH (S.U.)	37	0	6.4	8.2	7.38		9.0556	0.1583	
00530	Total Suspended Solids (mg/L)	39	0	1	18.4	3.54		-0.3028	0.4146	
00610	Ammonia-Nitrogen (mg/L as N)	39	16	0.1	0.52	0.16		5.1971	0.0001	↓
00630	Nitrate + Nitrite (mg/L as N)	39	0	0.04	0.35	0.08		1.2576	0.4534	
00665	Total Phosphorus (mg/L as P)	39	0	0.02	0.16	0.06		4.9140	0.0008	
00940	Chloride (mg/L)	38	0	6	31	13.00		-0.1396	0.1693	
00945	Sulfate (mg/L)	38	1	20.8	70.4	31.83		-3.6088	0.0000	↑
31699	*E. coli* (MPN/100 mL)	39	1	1	980		1.72	-0.7266	0.4219	
32211+70953	Chlorophyll-*a* (µg/L)	37	0	2.1	17	5.87		2.6435	0.0701	↓
70300	Total Dissolved Solids (mg/L)	39	0	25.3	174.7	94.84		-0.4214	0.0337	

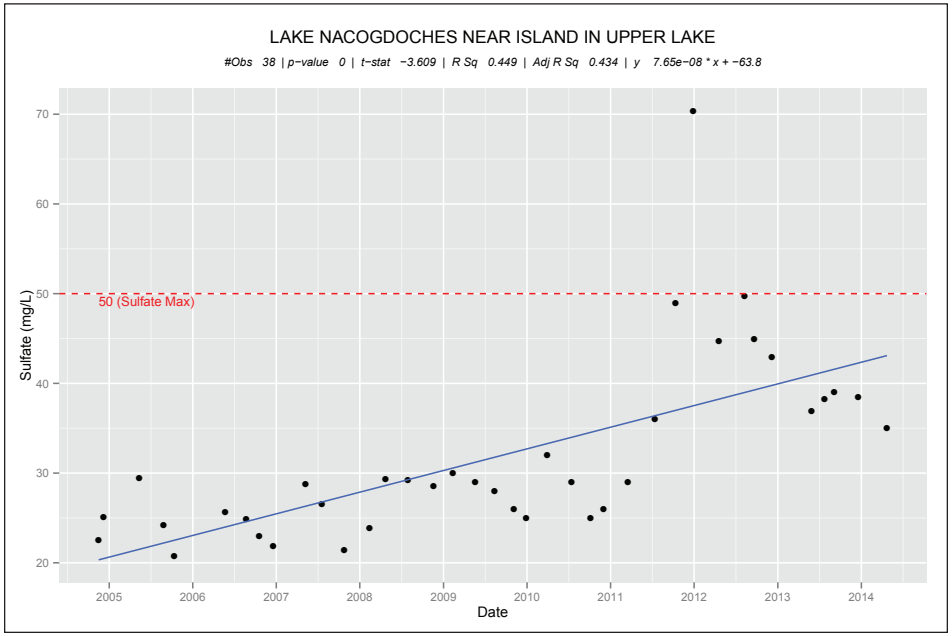
Cattle grazing near the shore on Lake Nacogdoches

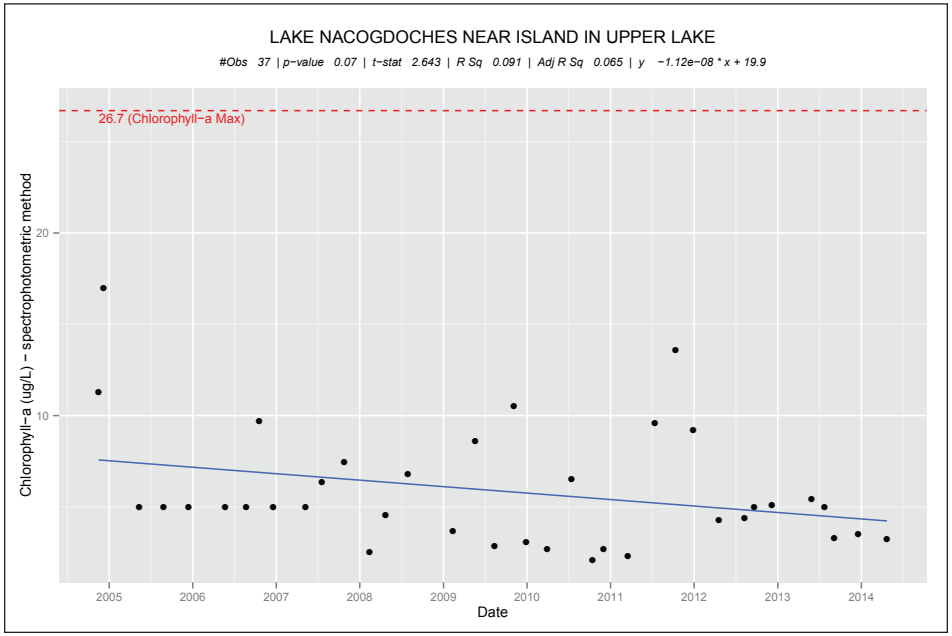
Segment 0611Q - Lake Nacogdoches

Monitoring Station 21021 - Lake Nacogdoches Near Island in Upper Lake









Segment 0611Q - Lake Nacogdoches

Summary of Water Quality Trends

Water quality trends were very similar for both monitoring stations within the lake. Statistically significant increasing trends for Sulfate and Specific Conductance were seen at both stations, with an increasing trend for Total Dissolved Solids also present at station 15801 (Lake Nacogdoches at Dam).

For nutrient parameters, a statistically significant decreasing trend was identified for Ammonia-Nitrogen at station 15801. A statistically significant decreasing trend for Chlorophyll-*a* was identified at both monitoring stations.

Trend Analysis Summary for Segment 0611Q - Lake Nacogdoches

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Lake Nacogdoches	0611Q_01	15801	Lake Nacogdoches At Dam					↑	↑	↑			↓		
	0611Q_01	21021	Lake Nacogdoches Near Island in Upper Lake					↑	↑			↓	↓		

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

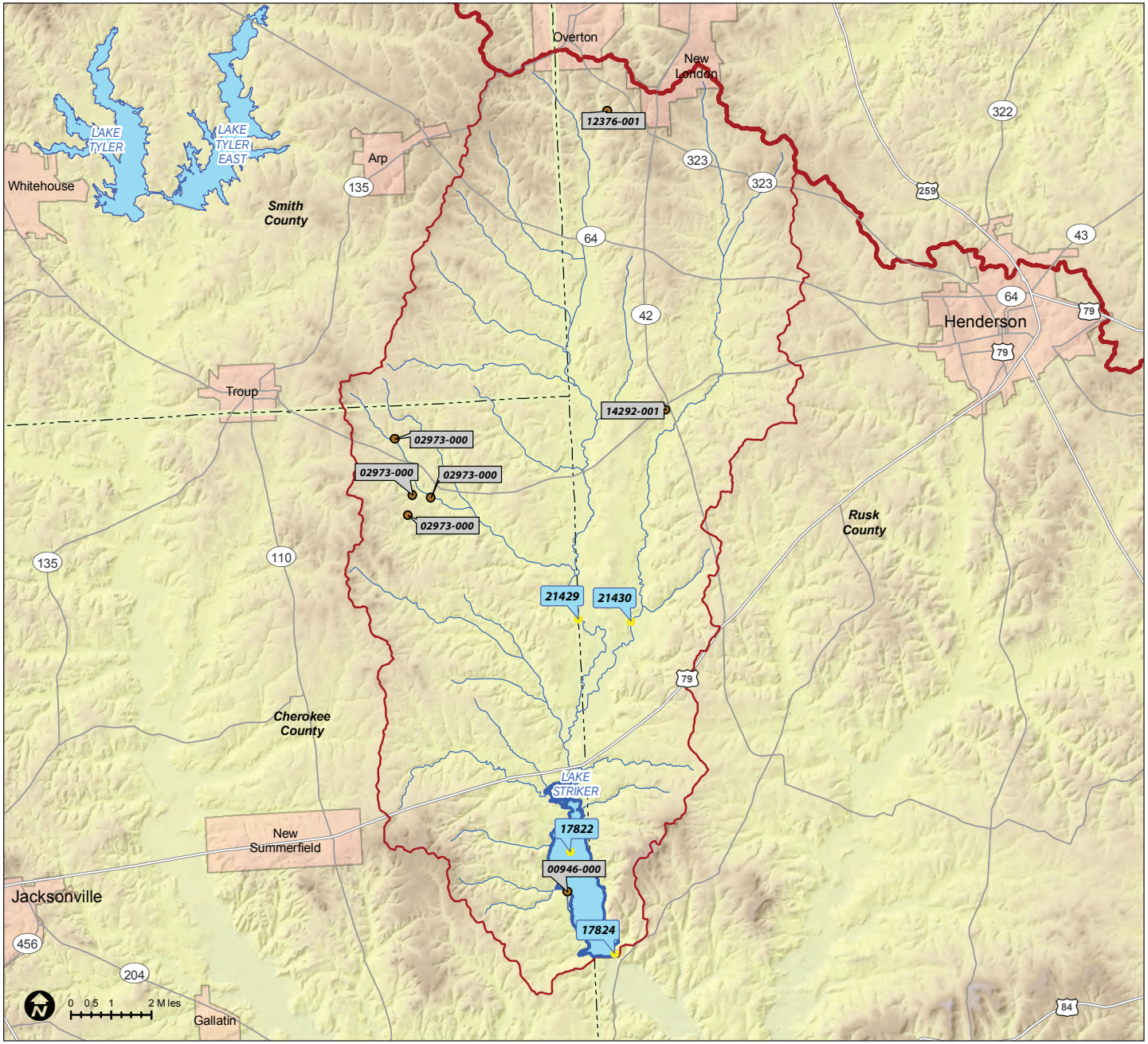
Water Quality Issues Summary for Segment 0611Q - Lake Nacogdoches

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Concern for Ammonia-Nitrogen	Entire water body	• Nonpoint source pollution • Domestic animals and wildlife • Improper fertilizer use	• Detrimental effect on aquatic biological community	• Continue monitoring • Determination of source of nutrient loading

Segment 0611R - Lake Striker

Segment Profile

Lake Striker is a 1,863 acre reservoir extending from the dam approximately half a mile west of CR 2430 to the north end of the lake close to US HWY 79 in Rusk County north of Reklaw. The designated uses are aquatic life, general, and recreation use. Impounded in 1957, the reservoir has a maximum depth of 35 feet. Primary vegetation on this reservoir includes emergent and floating native vegetation. The largemouth bass, spotted bass, catfish, and crappie are among the predominant fish species.



Segment 0611R - Lake Striker

Assessment Units

Assessment Units in Segment 0611R - Lake Striker	
AU ID	**Description**
0611R_01	Entire water body

Monitoring Stations

Monitoring Stations in Segment 0611R - Lake Striker									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0611R_01	17822	LAKE STRIKER UPPER LAKE	4	4	4				ANRA
0611R_01	17824	LAKE STRIKER SE OF POWERPLANT	4	4	4				ANRA
0611R_01	21429	BOWLES CREEK AT CHEROKEE CR 4608/RUSK CR 4194	4	4	4	4			ANRA
0611R_01	21430	JOHNSON CREEK AT RUSK CR 476	4	4	4	4			ANRA

Description of Water Quality Issues

Impairments and Concerns

Lake Striker has one assessment unit. It is listed in the Draft 2014 Integrated Report for a concern for Ammonia-N. Of the 50 samples assessed, 15 samples exceeded the nutrient screening level of 0.11 mg/L as N.

Although Lake Striker is not assessed for pH, there are historical issues with low pH for this waterbody. For both monitoring stations on Lake Striker, there is a statistically significant decreasing trend for pH, with numerous values below 6.0 S.U. Recently, two additional monitoring stations on Johnson and Bowles Creek, which drain to Lake Striker, have been added to help determine a possible source of the low pH values reported in the reservoir.

Assessment Summary for Segment 0611R - Lake Striker as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	125 mg/L	**50 mg/L**	**250 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.2**	**126 MPN /100 mL**	**0.11 mg/L**	**0.37 mg/L**	**0.20 mg/L**	**26.7 µg/L**
0611R_01				NC	FS					FS	CS	NC	NC	NC
FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed														

Segment 0611R - Lake Striker

Monitoring Station 17824 - Lake Striker SE of Powerplant

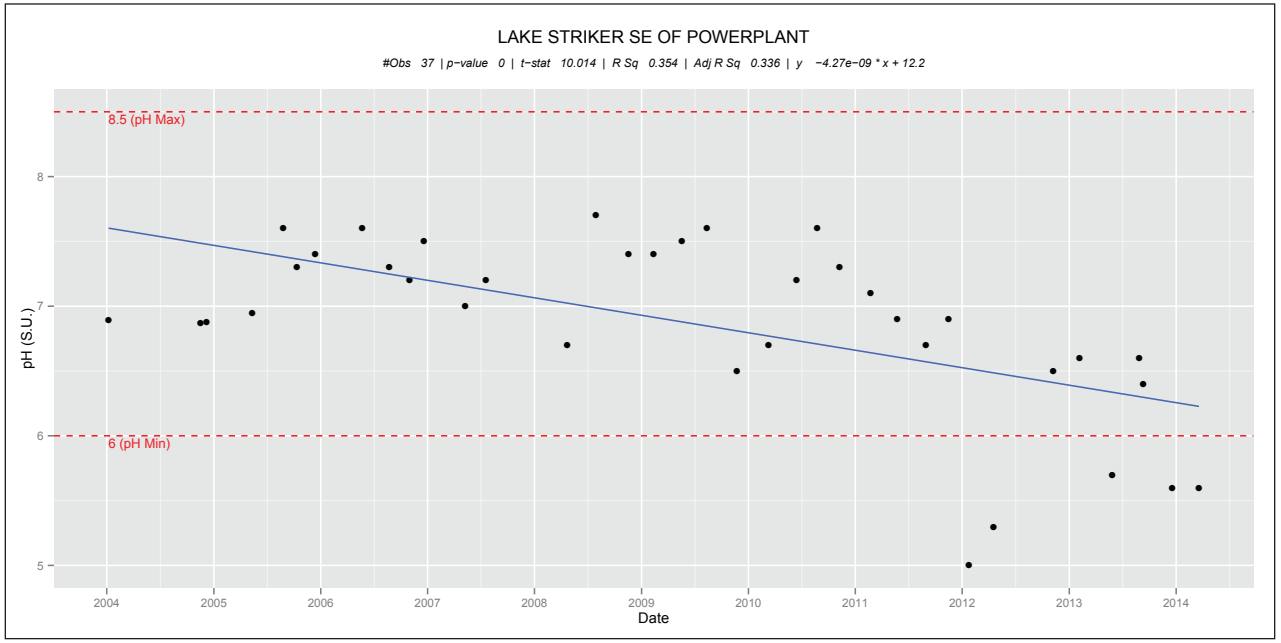
Monitoring Station 17824 is located near the dam in the main pool of Lake Striker. This station is located southeast of the Luminant Energy power plant. Station 17824 is monitored quarterly by ANRA for field parameters, conventional parameters, and *E. coli* bacteria.

At this station, there is a significant decreasing trend for pH. The data set includes 5 values that are <6.0 S.U., with measurements ranging from 5.0 – 7.7 S.U. Historically, Lake Striker has had issues with pH. In recent years, ANRA has added monitoring stations to Bowles Creek and Johnson Creek, which are tributaries that flow into Lake Striker, in an attempt to better characterize potential causes of the low pH.

Significant increasing trends are observed for both Specific Conductance and Sulfate. For Sulfate, recent values exceed the 50 mg/L standard. Results range from 7.78 – 87 mg/L. There is a statistically significant increasing trend for Total Suspended Solids, but all values remain low.

For nutrient parameters, there are statistically significant decreasing trends for Ammonia-Nitrogen, Nitrate, and Total Phosphorus. For Ammonia-Nitrogen, there was greater than 50% censored data (values reported as <LOQ). Results ranged from <0.05 to 0.94 mg/L as N, with 13 of 28 samples exceeding the nutrient screening criteria of 0.11 mg/L as N. All samples that exceeded the screening level were reported prior to 2008. There is a concern for screening level for Ammonia-Nitrogen for Lake Striker. There is also a significant decreasing trend for Chlorophyll-*a*.

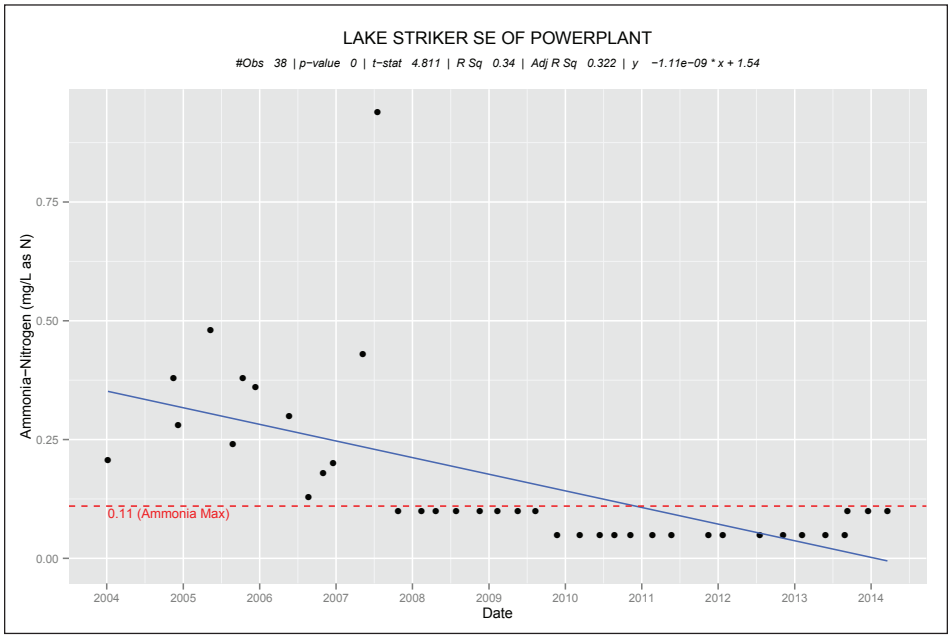
Water quality trends at Station 17822 (Lake Striker Upper Lake) are essentially the same as the ones observed at this station.

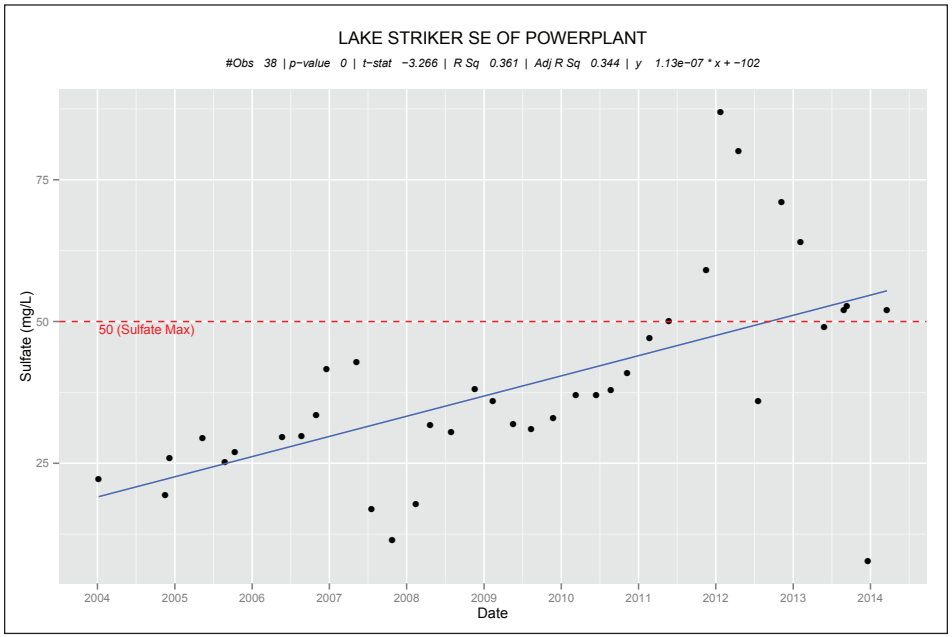


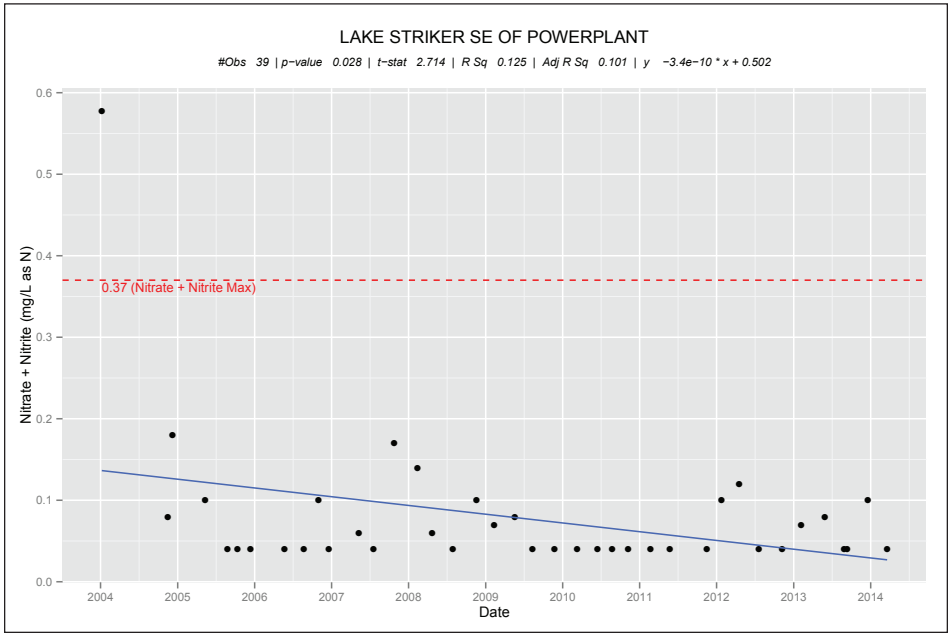
17824 - Lake Striker Near Dam

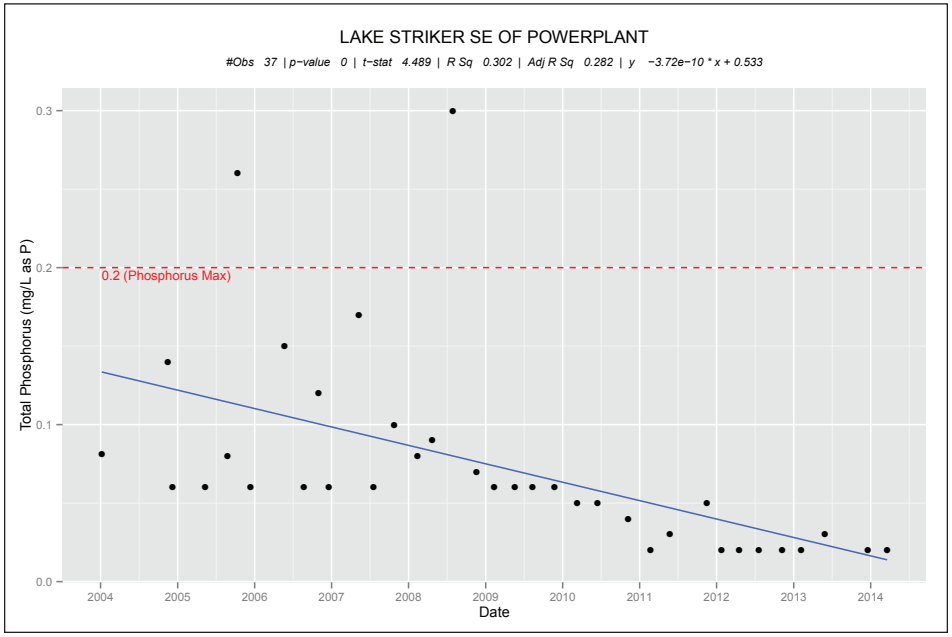
Segment 0611R - Lake Striker

Monitoring Station 17824- Lake Striker SE of Powerplant









Segment 0611R - Lake Striker

Monitoring Station 17824- Lake Striker Near Dam

Water Quality Monitoring Results for Station 17824 - Lake Striker SE of Powerplant										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	39	0	78	475	295.41		-2.1392	0.0002	↑
00300	Dissolved Oxygen (mg/L)	39	0	5.2	12.6	8.65		1.6204	0.4924	
00400	pH (S.U.)	37	5	5	7.7	6.87		10.0139	0.0001	↓
00530	Total Suspended Solids (mg/L)	37	0	1	8	2.99		-3.7735	0.0000	↑
00610	Ammonia-Nitrogen (mg/L as N)	38	13	0.05	0.94	0.17		4.8111	0.0001	↓
00630	Nitrate + Nitrite (mg/L as N)	39	1	0.04	0.578	0.08		2.7136	0.0275	↓
00665	Total Phosphorus (mg/L as P)	37	2	0.02	0.3	0.07		4.4892	0.0004	↓
00940	Chloride (mg/L)	37	0	10	85	52.53		-0.8717	0.0183	
00945	Sulfate (mg/L)	38	8	7.78	87	38.58		-3.2663	0.0001	↑
31699	*E. coli* (MPN/100 mL)	34	0	1	13.5		3.02	1.8355	0.1939	
32211+70953	Chlorophyll-*a* (µg/L)	36	0	1.1	13.3	4.20		5.3813	0.0001	↓
70300	Total Dissolved Solids (mg/L)	30	0	93.3	234	176.93		0.2895	0.0562	

Monitoring Station 17822- Lake Striker Upper Lake

Water Quality Monitoring Results for Station 17822 - Lake Striker Upper Lake										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	39	0	86	478	296.87		-2.1605	0.0002	↑
00300	Dissolved Oxygen (mg/L)	39	0	4.6	12.5	8.51		1.3382	0.3437	
00400	pH (S.U.)	37	4	5.1	7.6	6.77		10.4527	0.0001	↓
00530	Total Suspended Solids (mg/L)	37	0	1	10	3.32		-3.3089	0.0002	↑
00610	Ammonia-Nitrogen (mg/L as N)	38	14	0.05	1.2	0.19		4.6735	0.0002	↓
00630	Nitrate + Nitrite (mg/L as N)	39	1	0.04	0.558	0.08		2.3439	0.0606	↓
00665	Total Phosphorus (mg/L as P)	37	1	0.02	0.56	0.07		1.9042	0.1340	
00940	Chloride (mg/L)	37	0	12	113.3	56.30		0.4471	0.3626	
00945	Sulfate (mg/L)	38	9	15.5	88	40.60		-5.2497	0.0000	↑
31699	*E. coli* (MPN/100 mL)	34	0	1	15		2.40	0.5675	0.8981	
32211+70953	Chlorophyll-*a* (µg/L)	36	0	0.95	10.7	3.91		3.4703	0.0185	↓
70300	Total Dissolved Solids (mg/L)	30	2	92	328	184.77		0.4613	0.2018	

Segment 0611R - Lake Striker

Monitoring Station 21429 - Bowles Creek at Cherokee CR 4608/Rusk CR 4194 and Monitoring Station 21430 - Johnson Creek at Rusk CR 476

Based upon Steering Committee concerns regarding pH issues in Lake Striker, two additional monitoring stations were added above the lake on creeks which drain to the reservoir. These stations, located on Bowles Creek and Johnson Creek, have been monitored since 2014. Although enough data does not exist to perform statistical analysis, results so far indicate issues with pH in these streams. Only three monitoring events have occurred at these stations as of the time of this report, and of those, no pH value at Bowles Creek was above 6.0 S.U. For Johnson Creek, the issue is even more severe, with no pH value higher than 4.0 S.U. The cause of these low pH conditions is unknown.

21429 - Bowles Creek at Cherokee CR 4608/Rusk CR 4194

21430 - Johnson Creek at Rusk CR 476

Segment 0611R - Lake Striker

Monitoring Station 21429 - Bowles Creek at Cherokee CR 4608/Rusk CR 4194

Water Quality Monitoring Results for Station 21429 - Bowles Creek at Cherokee CR 4608/Rusk CR 4194										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	3	0	229	516	355.67				
00300	Dissolved Oxygen (mg/L)	3	1	2.1	10.9	5.77				
00400	pH (S.U.)	3	3	3.7	5.3	4.57				
00530	Total Suspended Solids (mg/L)	3	0	2.5	12	6.78				
00610	Ammonia-Nitrogen (mg/L as N)	3	0	0.1	0.23	0.14				
00630	Nitrate + Nitrite (mg/L as N)	3	0	0.04	0.09	0.06				
00665	Total Phosphorus (mg/L as P)	3	0	0.02	0.03	0.02				
00940	Chloride (mg/L)	3	0	33.9	95.6	63.50				
00945	Sulfate (mg/L)	3	2	48.3	96	71.30				
31699	*E. coli* (MPN/100 mL)	3	0	4	86		24.74			
70300	Total Dissolved Solids (mg/L)	3	0	162	250	212.67				

Monitoring Station 21430 - Johnson Creek at Rusk CR 476

Water Quality Monitoring Results for Station 21430 - Johnson Creek at Rusk CR 476										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	3	0	311	431	368.67				
00300	Dissolved Oxygen (mg/L)	3	0	5.5	12.7	8.63				
00400	pH (S.U.)	3	3	3.5	3.9	3.67				
00530	Total Suspended Solids (mg/L)	3	0	2.5	11	7.38				
00610	Ammonia-Nitrogen (mg/L as N)	3	0	0.1	0.22	0.14				
00630	Nitrate + Nitrite (mg/L as N)	3	0	0.05	0.09	0.06				
00940	Chloride (mg/L)	3	0	47.4	81.9	62.10				
00945	Sulfate (mg/L)	3	2	45	69.4	56.10				
31699	*E. coli* (MPN/100 mL)	3	1	9	230		28.34			
70300	Total Dissolved Solids (mg/L)	3	0	190	214	201.33				

Segment 0611R - Lake Striker

Summary of Water Quality Trends

Water quality trends were nearly identical for both monitoring stations in Lake Striker. At both stations, there was a statistically significant decreasing trend for pH.

At both stations, there are statistically significant increasing trends for Sulfate, Specific Conductance, and Total Suspended Solids.

For nutrient parameters, there are statistically significant decreasing trends at both monitoring stations for Ammonia-Nitrogen, Nitrate+Nitrite, and Chlorophyll-*a*. At station 17822 (Lake Striker Upper Lake), there is also a statistically significant decreasing trend for Total Phosphorus.

There is insufficient data to perform trend analysis for either Bowles Creek or Johnson Creek.

Trend Analysis Summary for Segment 0611R- Lake Striker

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Lake Striker	0611R_01	17822	Lake Striker Upper Lake		↓			↑	↑		↑	↓	↓	↓	↓
	0611R_01	17824	Lake Striker Near Dam		↓			↑	↑		↑	↓	↓	↓	
	0611R_01	21429	Bowles Creek at Cherokee CR 4608 / Rusk CR 4194	Insufficient data for trend analysis.											
	0611R_01	21430	Johnson Creek at Rusk CR 476	Insufficient data for trend analysis.											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0611R- Lake Striker

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Low pH	Entire water body Bowles Creek Johnson Creek	• The cause of the low pH values observed in Lake Striker is unknown, but it is believed to be naturally occurring	• Detrimental effect on aquatic biological community • Aquatic organisms are only capable of living within certain pH ranges • Changes in pH can result in fish kills	• Continue monitoring of lake as well as tributaries • Attempt to determine cause of low pH
Concern for Ammonia-Nitrogen	Entire water body	• Nonpoint source pollution • Point source pollution • Domestic animals and wildlife • Improper fertilizer use	• Detrimental effect on aquatic biological community	• Continue monitoring

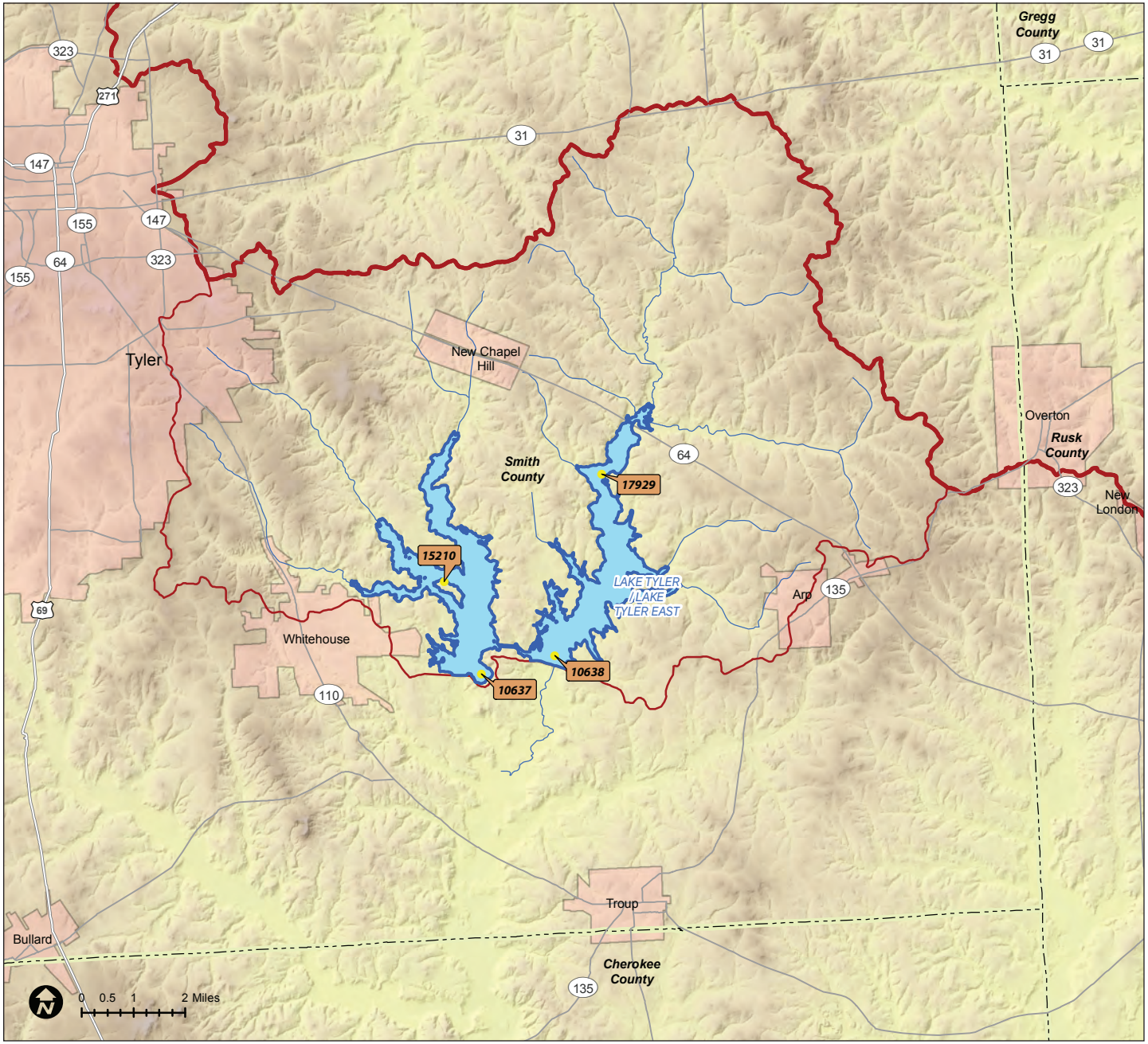
Segment 0613 - Lake Tyler/Tyler East

Segment Profile

Segment 0613 extends from Whitehouse Dam and Mud Creek Dam in Smith County up to the normal pool elevation of 375.38 feet. The reservoir impounds both Prairie Creek and Mud Creek. Lake Tyler West and East include a total of 4,880 acres. Lake Tyler West and East were impounded in 1949 and 1966, respectively.

The reservoir serves as a major source for water supply and recreational use. There are several park areas adjacent to the lakes. The lakes have a storage capacity of 15 billion gallons of water within the watershed. The maximum depth is forty feet. Predominant fish species include: largemouth bass, spotted bass, crappie, catfish, sunfish, white bass, and chain pickerel. There is moderate native vegetation including submergent and emergent aquatic life found on the upper ends of both lakes. Native vegetation and abundant hydrilla can be found on Lake Tyler East.

This segment is designated for high aquatic life use, general use, fish consumption use, public water supply use, and recreation use.



Segment 0613 - Lake Tyler/Tyler East

Assessment Units

Assessment Units in Segment 0613 - Lake Tyler/Tyler East	
AU ID	**Description**
0613_01	Lake Tyler lower reservoir
0613_02	Lake Tyler upper reservoir
0613_03	Lake Tyler East lower reservoir
0613_04	Lake Tyler East upper reservoir

Monitoring Stations

Monitoring Stations in Segment 0613 - Lake Tyler/Tyler East										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0613_01	10637	LAKE TYLER MIDLAKE AT DAM	4	4	4			1	TCEQ-5
0613_02	15210	LAKE TYLER AT LANGLEY ISLAND	4	4	4			1	TCEQ-5
0613_03	10638	LAKE TYLER EAST NEAR DAM	4	4	4			1	TCEQ-5
0613_04	17929	LAKE TYLER EAST UPPER MID LAKE	4	4	4			1	TCEQ-5

Description of Water Quality Issues

Impairments and Concerns

There were no impairments or concerns listed for this segment in the Draft 2014 Integrated Report.

Assessment Summary for Segment 0613 - Lake Tyler/Tyler East														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 -9.0 SU**	**33.9**	**126 MPN /100 mL**	**0.11 mg/L**	**0.37 mg/L**	**0.20 mg/L**	**26.7 µg/L**
0613_01	FS	FS	FS	NC	FS			FS	FS	NC	NC	NC	NC	NC
0613_02	FS	FS	FS	NC	FS			FS	FS	NC	NC	NC	NC	NC
0613_03	FS	FS	FS	NC	FS			FS	FS	NC	NC	NC	NC	NC
0613_04	FS	FS	FS	NC	FS			FS	FS	NC	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0613 - Lake Tyler/Tyler East

Monitoring Station 10637 - Lake Tyler Mid-Lake at Dam

Monitoring Station 10637 is located near the dam on Lake Tyler. This station is monitored quarterly by TCEQ Region 5 for field parameters, conventional parameters, and *E. coli* , and annually for Metals in Sediment.

An increasing trend is observed for Specific Conductance, but it is not statistically significant. A statistically significant increasing trend is found for Alkalinity.

A trend for Total Phosphorus is due to data reported at or below the LOQ.

Monitoring Station 15210 - Lake Tyler at Langley Island

Station 15210 is located approximately 100 meters west of the City of Tyler's water intake structure. This station is monitored quarterly by TCEQ Region 5 for field parameters, conventional parameters, and *E. coli* , and annually for Metals in Sediment.

A statistically significant increasing trend for pH is observed at this station.

A trend for Total Phosphorus is due to data reported at or below the LOQ.

Monitoring Station 10638 - Lake Tyler East at Dam

Monitoring Station 10638 is located near the dam on Lake Tyler East. This station is monitored quarterly by TCEQ Region 5 for field parameters, conventional parameters, and *E. coli* , and annually for Metals in Sediment.

An increasing trend for Specific Conductance is present at this station, but the trend is not statistically significant. Statistically significant increasing trends are present for both Chloride and Total Dissolved Solids. For both parameters, the values reported are all well below the water quality standard.

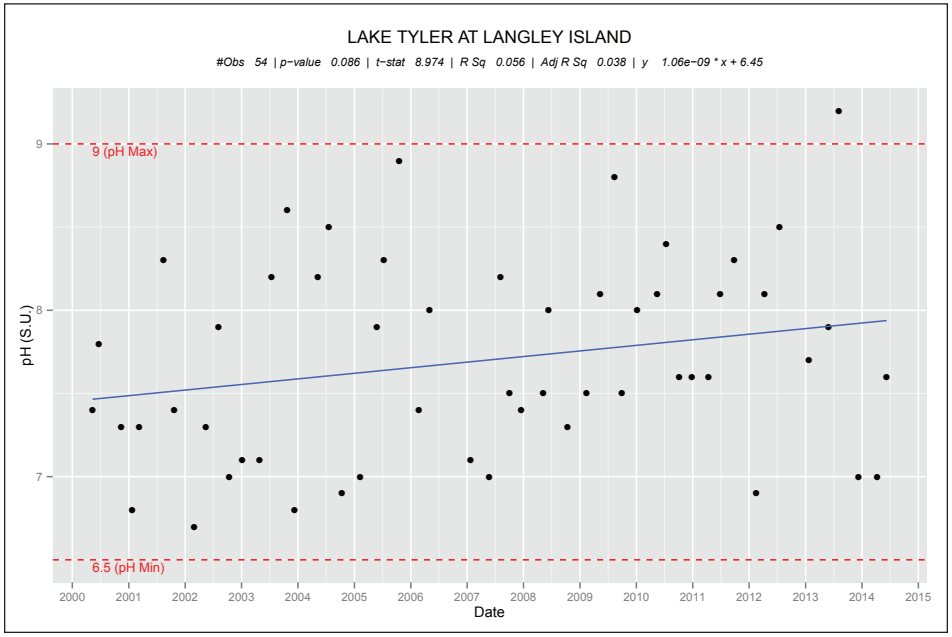
A trend for Total Phosphorus is due to data reported at or below the LOQ.

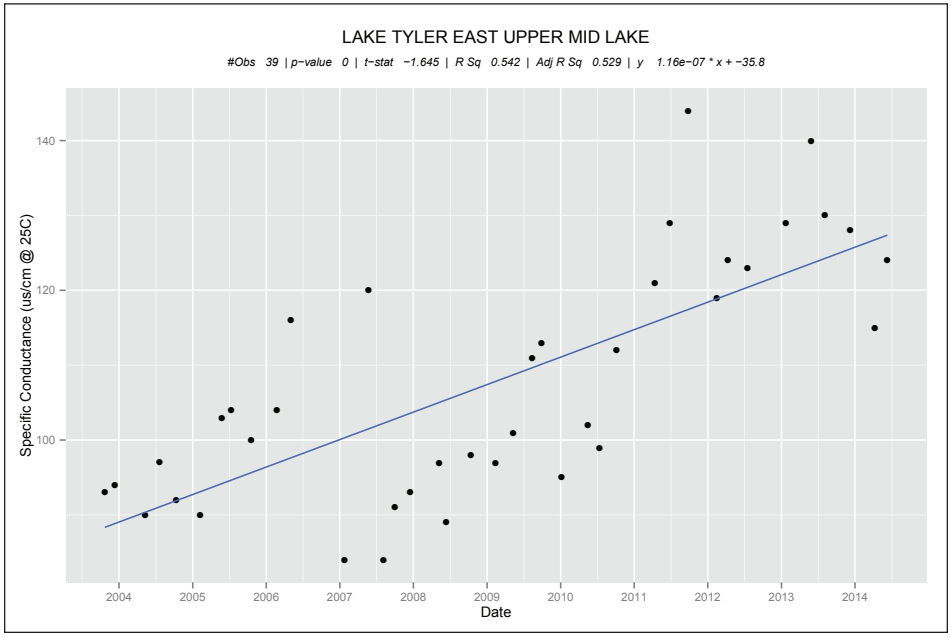
Monitoring Station 17929 - Lake Tyler East Upper Lake

Monitoring Station 17929 is located near the east shore on Lake Tyler East in the upper portion of the lake, southwest of SH 64. This station is monitored quarterly by TCEQ Region 5 for field parameters, conventional parameters, and *E. coli* , and annually for Metals in Sediment.

An increasing trend is observed for Specific Conductance, but it is not statistically significant. A statistically significant increasing trend is found for Sulfate, although all values reported are well below the water quality standard.

A trend for Total Phosphorus is due to data reported at or below the LOQ.





Segment 0613 - Lake Tyler/Tyler East

Monitoring Station 10637 - Lake Tyler Mid-Lake at Dam

Water Quality Monitoring Results for Station 10637 - Lake Tyler Mid-Lake at Dam

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	53	0	86	154	113.62		1.2869	0.0000	
00300	Dissolved Oxygen (mg/L)	54	0	4.1	11.9	8.29		4.3598	0.7791	
00400	pH (S.U.)	54	0	6.8	8.8	7.56		11.2580	0.6210	
00530	Total Suspended Solids (mg/L)	51	0	2	7	4.29		1.6696	0.1810	
00610	Ammonia-Nitrogen (mg/L as N)	52	6	0.05	0.18	0.07		0.9561	0.6012	
00630	Nitrate + Nitrite (mg/L as N)	34	0	0.04	0.24	0.06		0.7889	0.7943	
00665	Total Phosphorus (mg/L as P)	45	0	0.02	0.06	0.05		6.7657	0.0003	
00940	Chloride (mg/L)	52	0	8	16	11.08		-1.4468	0.0000	
00945	Sulfate (mg/L)	52	0	6	16	10.17		0.1768	0.0027	
31699	*E. coli* (MPN/100 mL)	42	1	0	280		2.64	0.5081	0.7376	
32211+70953	Chlorophyll-*a* (µg/L)	49	3	1.6	40.7	12.54		1.2202	0.9031	
70300	Total Dissolved Solids (mg/L)	40	0	10	105	73.30		1.0209	0.0283	

Monitoring Station 15210 - Lake Tyler at Langley Island

Water Quality Monitoring Results for Station 15210 - Lake Tyler at Langley Island

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	53	0	86	151	113.64		1.2807	0.0000	
00300	Dissolved Oxygen (mg/L)	54	0	4.8	12.2	8.78		5.3180	0.8432	
00400	pH (S.U.)	54	1	6.7	9.2	7.70		8.9735	0.0856	↑
00530	Total Suspended Solids (mg/L)	51	0	3	10	4.73		2.0785	0.6472	
00610	Ammonia-Nitrogen (mg/L as N)	52	3	0.05	0.21	0.06		1.4257	0.9959	
00630	Nitrate + Nitrite (mg/L as N)	33	0	0.04	0.21	0.06		1.4109	0.3959	
00665	Total Phosphorus (mg/L as P)	46	0	0.02	0.08	0.05		7.1656	0.0001	
00940	Chloride (mg/L)	52	0	8	18	10.98		-1.2676	0.0000	
00945	Sulfate (mg/L)	52	0	6	18	10.08		0.1562	0.0023	
31699	*E. coli* (MPN/100 mL)	42	2	1	290		3.98	0.2477	0.9825	
32211+70953	Chlorophyll-*a* (µg/L)	49	5	2.39	35.7	13.65		0.9774	0.7038	
70300	Total Dissolved Solids (mg/L)	42	0	44	94	74.33		3.0666	0.1299	

Segment 0613 - Lake Tyler/Tyler East

Monitoring Station 10638 - Lake Tyler East at Dam

Water Quality Monitoring Results for Station 10638 - Lake Tyler East at Dam

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	52	0	75	148	104.19		-0.3847	0.0000	
00300	Dissolved Oxygen (mg/L)	53	0	4.2	12.1	8.19		3.7763	0.9415	
00400	pH (S.U.)	53	0	6.7	8.7	7.44		10.7516	0.5763	
00530	Total Suspended Solids (mg/L)	52	0	2	9	4.21		1.1643	0.0703	
00610	Ammonia-Nitrogen (mg/L as N)	50	7	0.05	0.22	0.07		1.0783	0.8284	
00630	Nitrate + Nitrite (mg/L as N)	33	0	0.04	0.29	0.06		0.3037	0.8792	
00665	Total Phosphorus (mg/L as P)	45	0	0.02	0.06	0.05		6.8913	0.0002	
00940	Chloride (mg/L)	52	0	9	19	13.21		-2.3870	0.0000	↑
00945	Sulfate (mg/L)	52	0	4	17	8.77		-1.8536	0.0001	
31699	*E. coli* (MPN/100 mL)	41	1	1	160		2.97	0.3999	0.8887	
32211+70953	Chlorophyll-*a* (µg/L)	49	2	3.03	41.6	12.28		1.0111	0.6623	
70300	Total Dissolved Solids (mg/L)	40	0	56	95	72.05		2.9450	0.0024	↑

Monitoring Station 17929 - Lake Tyler East Upper Lake

Water Quality Monitoring Results for Station 17929 - Lake Tyler East Upper Lake

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	39	0	84	144	107.56		-1.6445	0.0000	
00300	Dissolved Oxygen (mg/L)	40	0	6.4	12.6	8.39		1.7846	0.1231	
00400	pH (S.U.)	40	2	5.9	9.2	7.56		6.0233	0.8638	
00530	Total Suspended Solids (mg/L)	37	0	4	20	6.27		0.6779	0.7689	
00610	Ammonia-Nitrogen (mg/L as N)	37	2	0.05	0.13	0.06		-0.3715	0.0788	
00630	Nitrate + Nitrite (mg/L as N)	32	0	0.04	0.26	0.06		0.6731	0.7924	
00665	Total Phosphorus (mg/L as P)	32	0	0.02	0.08	0.05		7.8111	0.0000	
00940	Chloride (mg/L)	37	0	10	29	14.81		-0.6994	0.0069	
00945	Sulfate (mg/L)	37	0	5	18	9.43		-3.8772	0.0000	↑
31699	*E. coli* (MPN/100 mL)	32	3	1	1400		6.09	0.4279	0.7710	
32211+70953	Chlorophyll-*a* (µg/L)	34	4	3	47	15.57		0.8616	0.8991	
70300	Total Dissolved Solids (mg/L)	26	0	65	109	76.92		1.1136	0.0836	

Segment 0613 - Lake Tyler/Tyler East

Summary of Water Quality Trends

For Lake Tyler, there is a statistically significant increasing trend in the upper portion of the lake (AU 0613_02) for pH.

In Lake Tyler East, there are statistically significant increasing trends for Chloride and Total Dissolved Solids in AU 0613_03 near the dam. In the upper portion of Lake Tyler East (AU 0613_04), there is a statistically significant increasing trend for Sulfate.

Trend Analysis Summary for Segment 0613 - Lake Tyler/Tyler East

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Lake Tyler/Tyler East	0613_01	10637	Lake Tyler Mid-Lake at Dam	No statistically significant trends at this station.											
	0613_02	15210	Lake Tyler at Langley Island		↑										
	0613_03	10638	Lake Tyler East at Dam				↑			↑					
	0613_04	17929	Lake Tyler Upper Lake					↑							

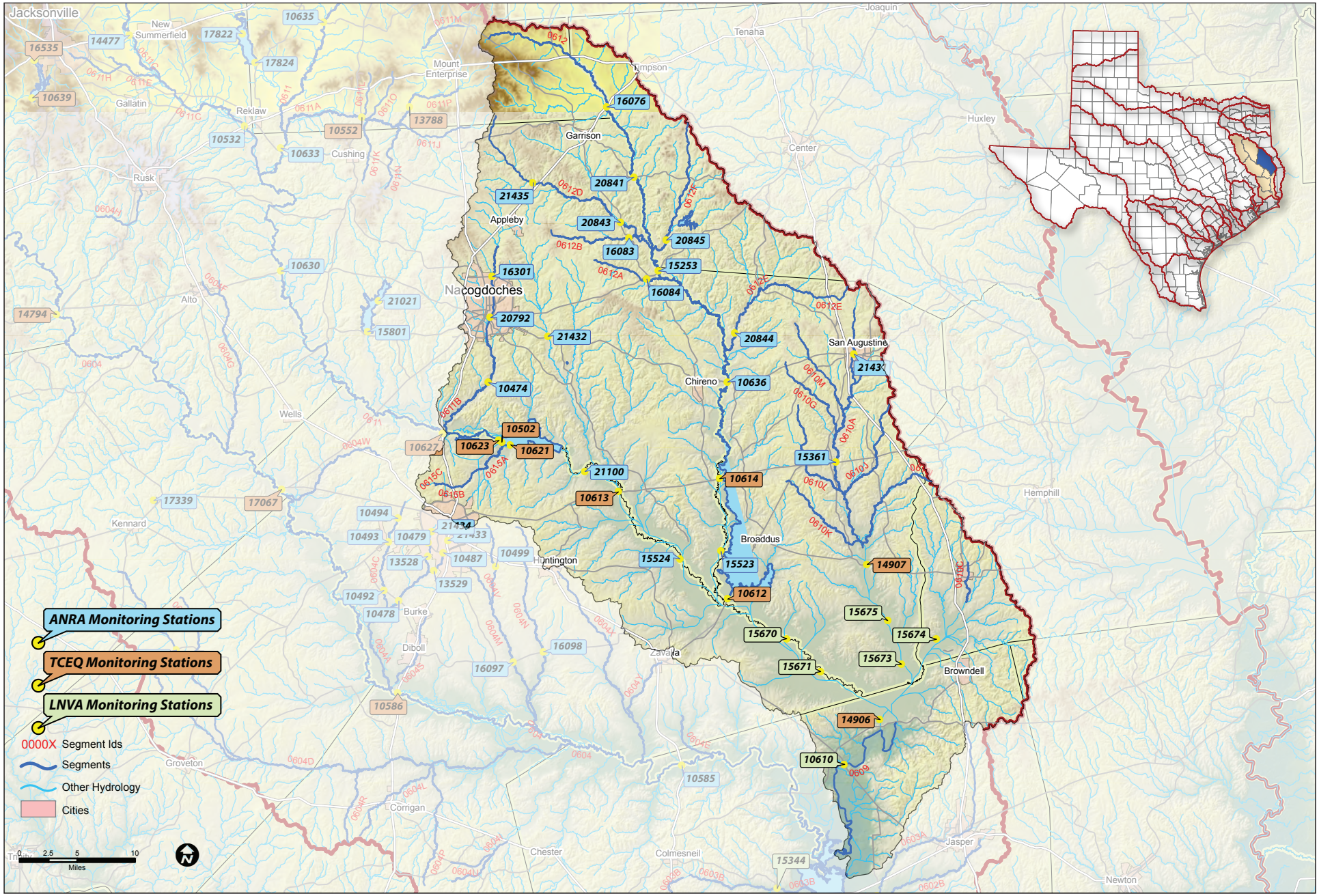
↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0613 - Lake Tyler/Tyler East

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
No impairments or concerns identified				

Lower Angelina Overview Map



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Profile of the Lower Angelina Sub-Basin

Population

The Lower Angelina sub-basin includes, partially or wholly, Angelina, Jasper, Nacogdoches, Newton, Rusk, Sabine, Shelby and San Augustine counties. The sub-basin includes the following cities: Chireno, Garrison, Nacogdoches, Lufkin, Huntington, Broaddus, Pineland, Browndell, San Augustine, and Appleby.

As of the 2010 census, there are an estimated 41,852 households, including 90,064 individuals residing within the sub-basin. The City of Nacogdoches, with a population of 32,996, is located almost entirely within the Lower Angelina sub-basin.

Land Characteristics and Use

In the Lower Angelina sub-basin, evergreen forest, shrub, woody wetlands, young forest, grassland, and piney hardwood are emergent. Land coverage in the northern part of the sub-basin includes hay, pasture, shrub, developed open space, and developed low intensity regions located around Lufkin and Nacogdoches. Within the southern portion of the sub-basin, land use includes emergent herbaceous and mixed forest. There are areas of willow oak, water oak, and blackgum located at the upper reaches of Sam Rayburn reservoir. Carrizo-Wilcox, Sparta, Yegua Jackson, and Gulf Coast are the aquifers which supply the region. This South-Central Plains Ecoregion includes floodplains, low terraces, southern tertiary uplands, and tertiary uplands.

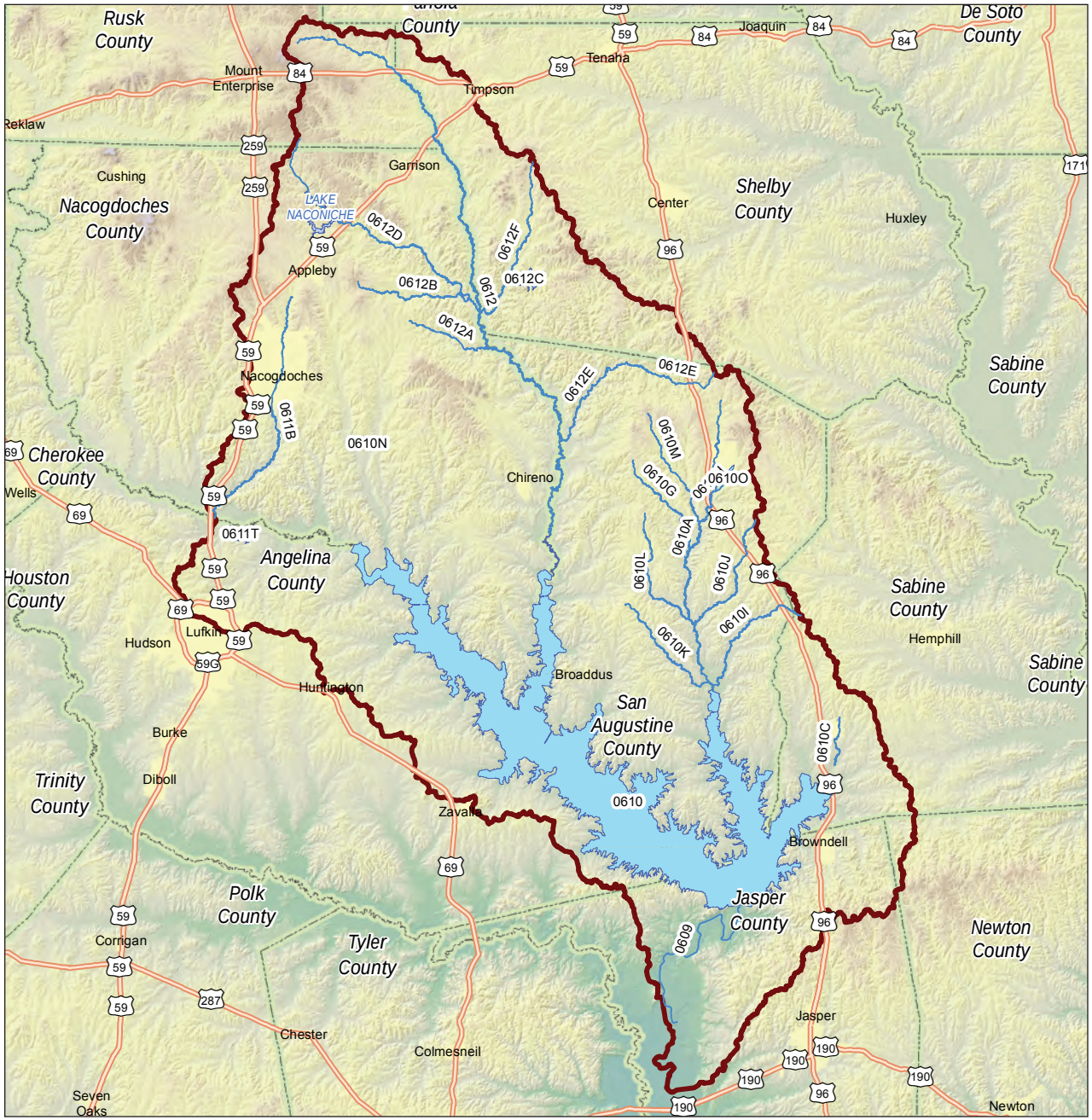
The area is very rural and heavily agricultural. Poultry and cattle operations are common within the Lower Angelina sub-basin, particularly in the Attoyac Bayou (Segment 0612) watershed.

Shoreline of Sam Rayburn Reservoir near the Shirley Creek boat ramp

Profile of the Lower Angelina Sub-Basin

Segments in the Lower Angelina Sub-Basin

Segments in the Lower Angelina Sub-Basin	
Segment ID	**Segment Name**
0609	Angelina River Below Sam Rayburn Reservoir
0610	Sam Rayburn Reservoir
0610A	Ayish Bayou (unclassified water body)
0611B	La Nana Bayou
0612	Attoyac Bayou
0612A	Terrapin Creek (unclassified water body)
0612B	Waffelow Creek (unclassified water body)
0612C	Pinkston Reservoir
0612D	Naconiche Creek (unclassified water body)
0612E	Big Iron Ore Creek (unclassified water body)
0612F	West Creek (unclassified water body)
0615	Angelina River/Sam Rayburn Reservoir
0615A	Paper Mill Creek (unclassified water body)



Profile of the Lower Angelina Sub-Basin

Permitted Discharges in the Lower Angelina Sub-Basin

A total of thirty-three permitted discharges are within the Lower Angelina sub-basin.

Permitted Discharges in the Lower Angelina Sub-Basin

First Segment in Drainage Path	Segment ID as identified in Permit	Permit Number	Outfall Number	NPDES Number	Permittee	County	TCEQ Region	Map Locations
0609	0609	10998-001	001	031283	BROOKELAND FWSD	Jasper	10 - Beaumont	Page 103
0610	0610	10788-001	001	023701	RAYBURN COUNTRY MUD	Jasper	10 - Beaumont	Page 104
0610	0610	10947-001	001	054224	SHIRLEY CREEK MARINA INC	Nacogdoches	10 - Beaumont	Page 104
0610	0610	11337-001	001	031275	WESTWOOD WSC	Jasper	10 - Beaumont	Page 104
0610	0610	11772-001	001	057673	CITY OF BROADDUS	San Augustine	10 - Beaumont	Page 104
0610	0610	11895-001	001	068039	TEXAS AIRSTREAM HARBOR INC	Angelina	10 - Beaumont	Page 104
0610	0610	13092-001	001	099082	BROOKELAND ISD	Sabine	10 - Beaumont	Page 104
0610	0610	13161-001	001	098744	STEPHEN F AUSTIN STATE UNIVERSITY	San Augustine	10 - Beaumont	Page 104
0610	0610	14345-001	001	134449	WODEN ISD	Nacogdoches	10 - Beaumont	Page 104
0610	0610	15207-001	001	135089	SHERRY SMITH MILNER	Angelina	10 - Beaumont	Page 104
0611	0611	14729-001	001	128937	REDLAND WATER SUPPLY CORP	Angelina	10 - Beaumont	Pages 45 & 161
0612	0612	11304-001	001	076503	CITY OF GARRISON	Nacogdoches	10 - Beaumont	Page 143
0612	0612	13917-001	001	118915	CHIRENO ISD	Nacogdoches	10 - Beaumont	Page 143
0615	0611	14201-001	001	123021	ANGELINA COUNTY WCID NO 3	Angelina	10 - Beaumont	Pages 45 & 161
0610A	0610	10268-001	001	022349	CITY OF SAN AUGUSTINE	San Augustine	10 - Beaumont	Pages 104 & 130
0610C	0610	01820-000	001	046892	TIN INC	Sabine	10 - Beaumont	Page 104
0610C	0610	01820-000	002	046892	TIN INC	Sabine	10 - Beaumont	Page 104
0610C	0610	01820-000	003	046892	TIN INC	Sabine	10 - Beaumont	Page 104
0610C	0610	01820-000	006	113689	TIN INC	Sabine	10 - Beaumont	Page 104
0610C	0610	10249-001	001	027154	CITY OF PINELAND	Sabine	10 - Beaumont	Page 104
0610O	0610	10268-002	001	122351	CITY OF SAN AUGUSTINE	San Augustine	10 - Beaumont	Pages 104 & 130
0612A	0612	14027-001	001	118354	MARTINSVILLE ISD	Nacogdoches	10 - Beaumont	Pages 143 & 155
0612C	0612	14352-002	001	133311	CITY OF CENTER	Shelby	10 - Beaumont	Pages 143, 157 & 160
0615A	0610	00368-000	001	001643	VERDANT INDUSTRIES LLC	Angelina	10 - Beaumont	Pages 104. 161 & 171
0615A	0610	00368-000	002	001643	VERDANT INDUSTRIES LLC	Angelina	10 - Beaumont	Pages 104. 161 & 171
0615A	0610	00368-000	004	001643	VERDANT INDUSTRIES LLC	Angelina	10 - Beaumont	Pages 104, 161 & 171
0615A	0610	00368-000	005	001643	VERDANT INDUSTRIES LLC	Angelina	10 - Beaumont	Pages 104, 161 & 171
0615A	0615	11588-001	001	054127	MOFFETT TWIN-OAKS MOBILE HOME PROPERTY TRUST	Angelina	10 - Beaumont	Pages 161 & 171
0615B	0615	04921-000	001	132578	ASPEN POWER LLC	Angelina	10 - Beaumont	Pages 161 & 171
0615B	0610	11620-001	001	056154	ANGELINA & NECHES RIVER AUTHORITY	Angelina	10 - Beaumont	Pages 104, 161 & 171
611B	0611	04198-000	001	121053	CAL-TEX LUMBER CO INC	Nacogdoches	10 - Beaumont	Pages 45 & 136 & 161
611B	0611	10342-004	001	055123	CITY OF NACOGDOCHES	Nacogdoches	10 - Beaumont	Pages 45 & 136 & 161
611B	0611	13927-001	001	118613	D & M WSC	Nacogdoches	10 - Beaumont	Pages 45 & 136 & 161

Profile of the Lower Angelina Sub-Basin

Texas Surface Water Quality Standards for the Lower Angelina Sub-Basin

Site-Specific Uses and Numeric Criteria for Classified Segments in the Lower Angelina Sub-Basin

Segment ID	Segment Name	DESIGNATED USES				CRITERIA*						
		Recreation	Aquatic Life	Domestic Water Supply	Other	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	Dissolved Oxygen (mg/L	pH Range (S.U.)	*E. coli* Bacteria #/100 mL	Temp (°F)
0609	Angelina River Below Sam Rayburn	PCR	H	PS		70	50	250	5.0	6.0 - 8.5	126	90
0610	Sam Rayburn Reservoir	PCR	H	PS		100	100	400	5.0	6.0 - 8.5	126	93
0611	Angelina River Above Sam Rayburn Reservoir	PCR	H	PS		125	50	250	5.0	6.0 - 8.5	126	90
0612	Attoyac Bayou	PCR	H	PS		75	50	200	5.0	6.0 - 8.5	126	90
0615	Angelina River/Sam Rayburn Reservoir	PCR	H	PS		150	100	500	5.0	6.5 - 9.0	126	93

PCR = Primary Contact Recreation SCR1 = Secondary Contact Recreation 1 SCR2 = Secondary Contact Recreation 2 NCR = Noncontact Recreation
H = High Aquatic Life Use I = Intermediate Aquatic Life Use
PS = Public Supply

* The criteria for Chloride, Sulfate, and TDS are listed as the maximum annual averages for the segment. Dissolved Oxygen criteria are listed as minimum 24-hour means at any site within the segment. The pH criteria are listed as minimum and maximum values expressed in standard units at any site within the segment. The criteria for Temperature are listed as maximum values at any site within the segment.

Segment 0609 - Angelina River Below Sam Rayburn Reservoir

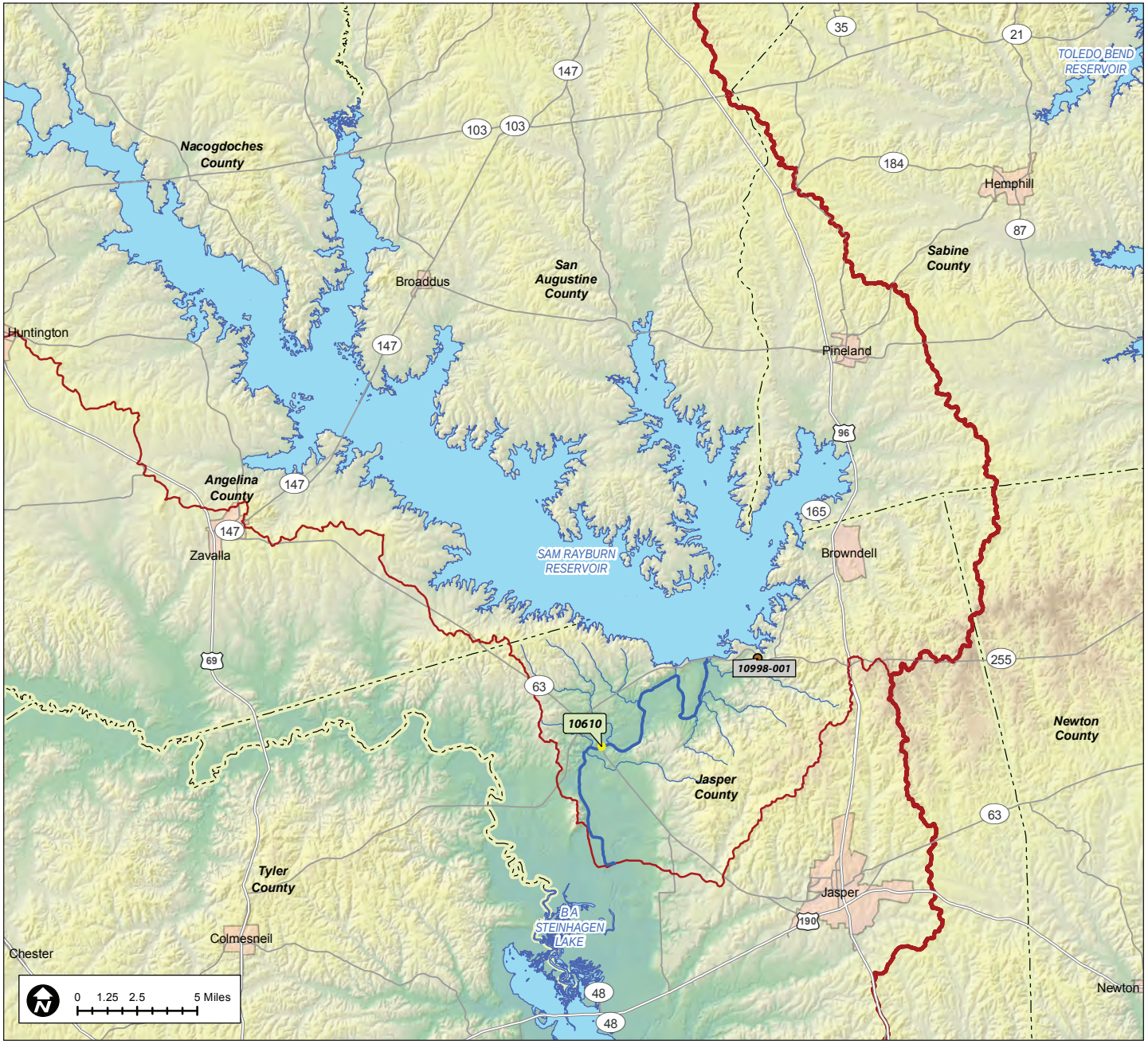
Segment Profile

The Angelina River below Sam Rayburn Reservoir stretches from a point immediately upstream of the confluence of Indian Creek in Jasper County to Sam Rayburn Dam in Jasper County.

There is one monitoring station on this segment (Monitoring Station 10610 - Angelina River at SH 63). Monitoring at this station is conducted quarterly by LNVA for conventional parameters, field parameters, flow, and *E. coli* bacteria.

There are impairments for Dioxin in edible tissue and Mercury in edible tissue listed for Segment 0609 in the Draft 2014 Integrated Report. No other impairments or concerns were identified.

For more information about this segment, please refer to the LNVA's 2015 Basin Summary Report.



Segment 0610 - Sam Rayburn Reservoir

Segment Profile

Sam Rayburn Reservoir includes the area from Sam Rayburn Dam in Jasper County to a point 5.6 kilometers (3.5 miles) upstream of Marion's Ferry on the Angelina River Arm in Angelina/ Nacogdoches County and to a point 3.9 km (2.4 miles) downstream of Curry Creek on the Attoyac Bayou Arm in Nacogdoches/San Augustine County, up to the normal pool elevation of 164.4 feet (except on the Angelina River Arm). Sam Rayburn Reservoir impounds both the Angelina River and Attoyac Bayou.

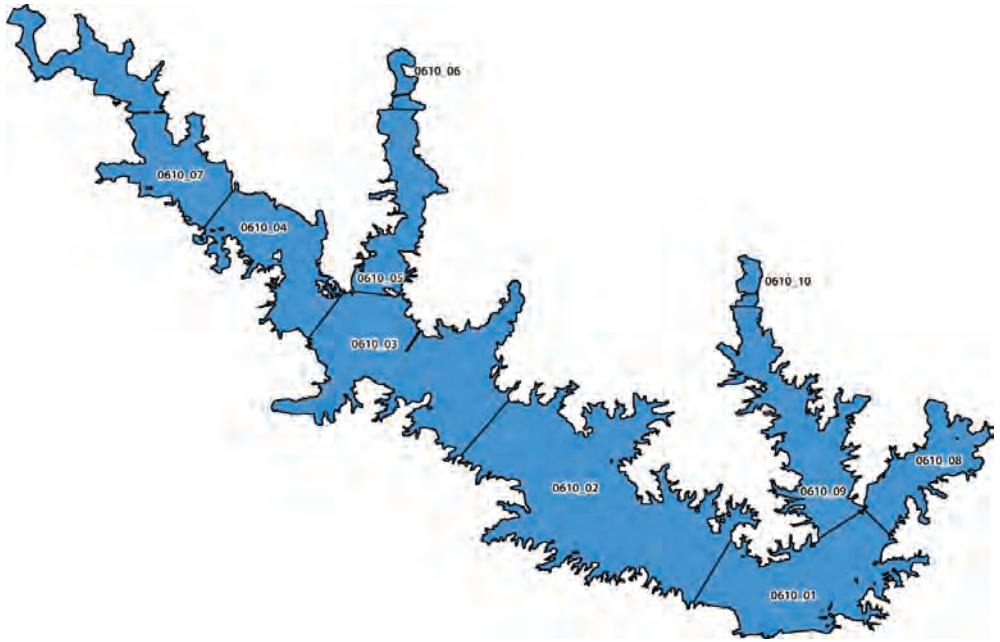
Sam Rayburn Reservoir is designed for flood regulation and control, hydroelectric power generation, and water conservation for municipal, industrial, agricultural, and recreational purposes.

The designated uses are general use, high aquatic life use, public water supply use, primary contact recreation, and fish consumption. Located around Sam Rayburn are various contact recreational areas including trails, campgrounds, boating ramps, marinas, designated swimming areas, and group areas.

Segment 0610 - Sam Rayburn Reservoir

Assessment Units

Assessment Units in the Sam Rayburn Reservoir (Segment 0610)	
AU ID	**Description**
0610_01	Sam Rayburn main pool by the dam to the Bear Creek and Ayish Arms
0610_02	Sam Rayburn lower Angelina River arm
0610_03	Sam Rayburn mid-Angelina River arm (area around SH 147)
0610_04	Sam Rayburn upper mid-Angelina River arm
0610_05	Sam Rayburn lower Attoyac Bayou arm
0610_06	Sam Rayburn upper Attoyac Bayou arm
0610_07	Sam Rayburn upper Angelina arm
0610_08	Sam Rayburn Bear Creek arm
0610_09	Sam Rayburn lower Ayish Bayou arm
0610_10	Sam Rayburn upper Ayish Bayou arm



Spillway at Dam on Sam Rayburn Reservoir

Segment 0610 - Sam Rayburn Reservoir

Monitoring Stations

There are numerous monitoring stations on Sam Rayburn Reservoir, with monitoring currently and historically being conducted by the Angelina & Neches River Authority (ANRA), Lower Neches Valley Authority (LNVA), TCEQ Region 10, and the United States Geological Survey (USGS).

Monitoring Stations in Segment 0610 - Sam Rayburn Reservoir

Assessment Unit	Monitoring Station ID	Description	Annual Frequency						Monitoring Entity
			Field	Conv	Bacteria	Flow	Metals in Water	Metals in Sediment	
0610_01	14906	SAM RAYBURN RESERVOIR AT MAIN POOL APPROXIMATELY 0.70 KM NORTH OF THE POWER PLANT INTAKE AT REC RD 255/ANGELINA RIVER	4	4	4			4	TCEQ-10
0610_02	15671	SAM RAYBURN RESERVOIR USGS SITE FC 7.21 KM SOUTHWEST OF FM 3173/FM 705 INTERSECTION	4	4	4				LNVA
0610_02	15670	SAM RAYBURN RESERVOIR USGS SITE GC 9.84 KM SOUTHEAST OF SH 147 6.56 KM NORTHEAST OF FM 2743/ FM 3373 INTERSECTION	4	4	4				LNVA
0610_03	10612	SAM RAYBURN RESERVOIR AT SH 147 BRIDGE 9.75 KM SOUTHWEST OF BROADDUS AND 12.4 KM NORTHEAST OF ZAVALLA	4	4	4			4	TCEQ-10
0610_04	15524	SAM RAYBURN RESERVOIR NEAR SHIRLEY CREEK IN THE ANGELINA RIVER CHANNEL 5.13 KM NE OF FM 2109/ FM 2801 INTERSECTION	4	4	4				ANRA
0610_05	15523	SAM RAYBURN RESERVOIR ADJACENT TO ALLIGATOR COVE IN THE ATTOYAC RIVER CHANNEL 3.94 KM NORTHWEST OF FM 3185/ SH 147 INTERSECTION	4	4	4				ANRA
0610_06	10614	SAM RAYBURN RESERVOIR WEST SHORE AT SH 103 6.6 MILES EAST OF ETOILE	4	4	4				TCEQ-10
0610_07	21100	SAM RAYBURN RESERVOIR ON ANGELINA RIVER CHANNEL 0.75 KM DOWNSTREAM OF MARIONS FERRY BOAT RAMP 4.2 KM NORTH AND 2.2 KM EAST OF FM 1669/ SH 103 INTERSECTION NEAR LUFKIN	4	4	4				ANRA
0610_07	10613	SAM RAYBURN RESERVOIR AT SH 103 3.73 KM WEST-SOUTHWEST OF ETOILE	4	4	4				TCEQ-10
0610_08	15674	SAM RAYBURN RESERVOIR USGS SITE LC 1.7 KM NORTHWEST OF MILL CREEK PARK SWIMMING AREA 3.96 KM NW OF ST LOOP 149/ US 96 INTERSECTION	4	4	4				LNVA
0610_09	15673	SAM RAYBURN RESERVOIR USGS SITE AC 2.5 KM EAST NORTHEAST OF FM 705/FM 3127 INTERSECTION	4	4	4				LNVA
0610_09	15675	SAM RAYBURN RESERVOIR USGS SITE MC 4.86 KM EAST NORTHEAST OF FM 3173/FM 705 INTERSECTION 8.8 KM DOWNSTREAM OF FM 83	4	4	4				LNVA
0610_10	14907	SAM RAYBURN RESERVOIR AT FM 83 BRIDGE CROSSING 13.5 KM WEST OF PINELAND	4	4	4				TCEQ-10

The water quality monitoring results for Sam Rayburn Reservoir are presented in this report by assessment unit. The assessment units are not presented in numerical order, but are presented beginning upstream and following the path of the Angelina River down to the dam. As the Attoyac Bayou and Ayish Bayou arms are reached, they will be discussed, followed by the Bear Creek arm, with the Main Pool presented last.

Segment 0610 - Sam Rayburn Reservoir

Description of Water Quality Issues

Site-Specific Uses and Criteria

Sam Rayburn Reservoir has a designated Public Water Supply use and a High ALU and corresponding DO criteria. Sam Rayburn Reservoir also has a designated primary contact recreation use with a corresponding *E. coli* geometric mean criteria of 126 MPN/100 mL.

Impairments and Concerns

In the Draft 2014 Texas Integrated Report, all assessment units of Sam Rayburn Reservoir are listed as impaired due to Dioxin in edible tissue and Mercury in edible tissue. The Texas Department of State Health Services (DSHS) has issued a fish consumption advisory for the reservoir.

Concerns for Iron in sediment and Manganese in sediment have also been listed for all assessment units of the reservoir.

Two assessment units (AU 0610_06 and 0610_10) have concerns for depressed Dissolved Oxygen, and one assessment unit (AU 0610_04) has a concern for pH.

A concern for Ammonia-Nitrogen has been identified in five assessment units of the reservoir. In AU 0610_02, 10 of 20 samples exceeded the screening level. In AU 0610_04, 11 of 32 samples exceeded the screening level. In AU 0610_05, the Ammonia-Nitrogen screening level was exceeded for 11 of 20 samples, and for AU 0610_08, 12 of 20 samples exceeded the screening level. The final concern, in AU 0610_09, was based upon 15 of 25 values exceeding the nutrient screening level.

Invasive species, such as the water hyacinth (pictured above), are found within the reservoir. This particular photograph was taken near the Marion's Ferry boat ramp (Monitoring Station 21100).

Assessment Summary for Segment 0610 - Sam Rayburn Reservoir as listed in the Draft 2014 Texas Integrated Report

AU	Chloride	Sulfate	TDS	DO Grab Screening Level	DO Grab Minimum	24 Hour DO Average	24 Hour DO Minimum	pH	Temp (C)	*E. coli* geomean	Ammonia Nitrogen	Nitrate Nitrogen	Total Phosphorus	Chl-*a*
	100 mg/L	100 mg/L	400 mg/L	5.00 mg/L	3.00 mg/L	5.00 mg/L	3.00 mg/L	6.0 - 8.5 SU	33.9	126 MPN /100 mL	0.11 mg/L	0.37 mg/L	0.20 mg/L	26.7 µg/L
0610_01	FS	FS	FS	NC	FS			FS	FS	FS	NC	NC	NC	NC
0610_02	FS	FS	FS	NC	FS			FS	FS	FS	CS	NC	NC	NC
0610_03	FS	FS	FS	NC	FS			FS	FS	FS	NC	NC	NC	NC
0610_04	FS	FS	FS	NC	FS	NA	NA	CN	FS	FS	CS	NC	NC	NC
0610_05	FS	FS	FS	NC	FS			FS	FS	FS	CS	NC	NC	NC
0610_06	FS	FS	FS	CS	FS	NA	NA	FS	FS	FS	NC	NC	NC	NC
0610_07	FS	FS	FS	NC	FS	NA	NA	FS	FS	FS	NC	NC	NC	NC
0610_08	FS	FS	FS	NC	FS			FS	FS	FS	CS	NC	NC	NC
0610_09	FS	FS	FS	NC	FS			FS	FS	FS	CS	NC	NC	NC
0610_10	FS	FS	FS	CS	FS			FS	FS	FS	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0610 - Sam Rayburn Reservoir

Description of Water Quality Issues

DSHS Issues Fish Consumption Advisory for Neches River

On January 27, 2014, the Texas Department of State Health Services (DSHS) issued a fish consumption advisory for portions of the Neches River Basin, including Sam Rayburn Reservoir and B.A. Steinhagen Reservoir. The advisory covers six species of fish caught between the State Highway 7 bridge west of Lufkin downstream to the U.S. Highway 96 bridge near Evadale, as well as both reservoirs. This advisory was issued after laboratory testing of fish tissue samples found elevated levels of mercury and dioxins.

DSHS recommends people limit or avoid consumption of these species as outlined in the table below because eating contaminated fish can be a health hazard.

Recommended Consumption Limits

Species Affected	Women of Childbearing Age and Children < 12	Women Past Childbearing Age and Adult Men
Blue catfish > 30 inches	**DO NOT EAT**	Two 8 oz. meals/month
Flathead catfish	**DO NOT EAT**	One 8 oz. meal/month
Gar (all species)	**DO NOT EAT**	One 8oz. meal/month
Largemouth bass > 16 inches	**DO NOT EAT**	Two 8 oz. meals/month
Smallmouth buffalo	**DO NOT EAT**	**DO NOT EAT**
Spotted bass > 16 inches	**DO NOT EAT**	Two 8 oz. meals/month

DSHS recommends children under 12 and women who are nursing, pregnant or who may become pregnant avoid eating the affected species because the nervous systems of unborn and young children are particularly susceptible to the health effects of toxins. Previous advisories for the Neches River area based on high mercury levels had recommended children limit consumption of particular fish. Recent testing prompted DSHS to recommend children under 12 not eat the affected fish at all.

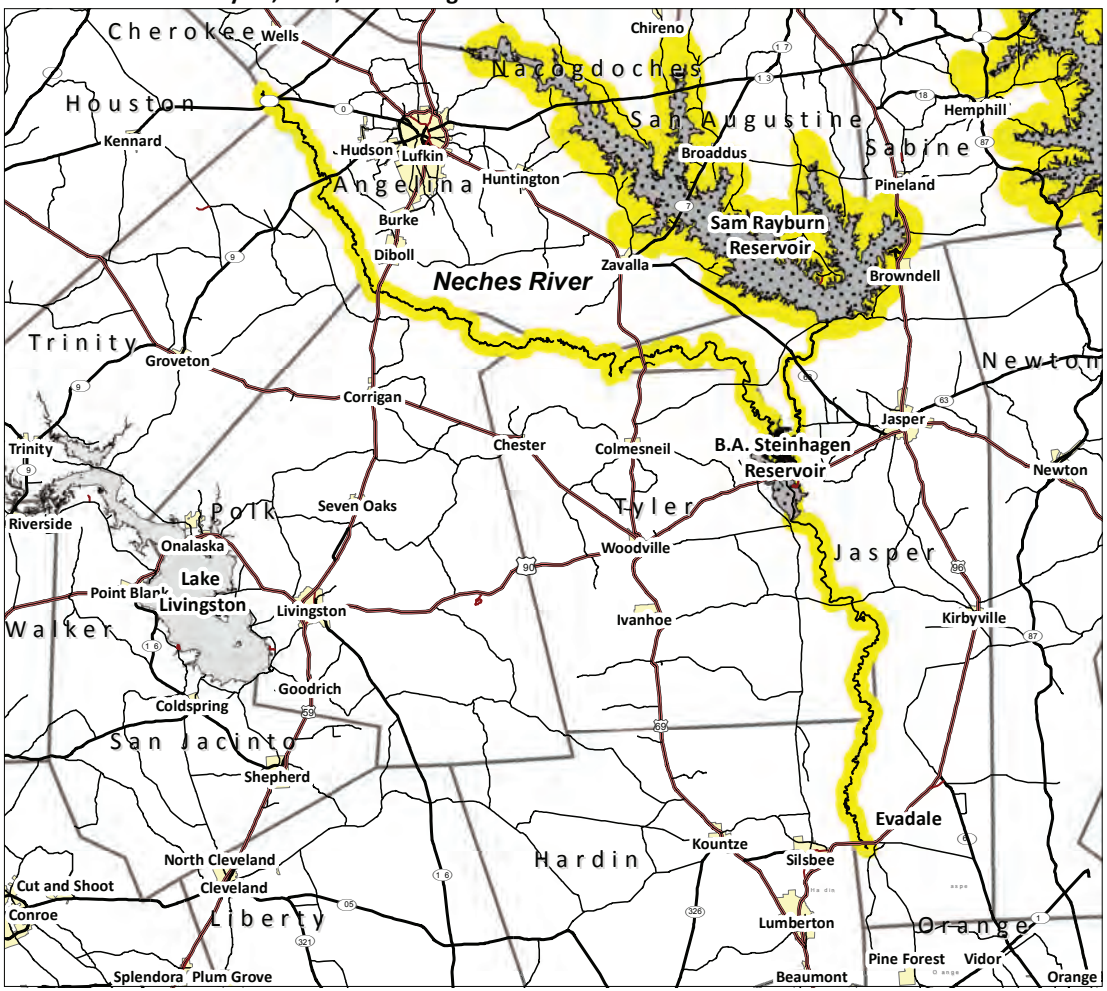
Elevated levels of mercury and dioxins in fish do not pose a health risk for people swimming or participating in other water recreation activities.

Affected Counties: Angelina, Hardin, Houston, Jasper, Polk, Sabine, San Augustine, Trinity, and Tyler

Neches River

Angelina, Hardin, Houston, Jasper, Polk, Trinity, and Tyler Counties

ADV-51 Issued January 24, 2014, Rescinding ADV-41



Advisory Area:

The Neches River and all contiguous waters from the State Highway 7 Bridge west of Lufkin downstream to the U.S. Highway 96 Bridge near Evadale

Contaminants of Concern:

Dioxins and Mercury (Hg)

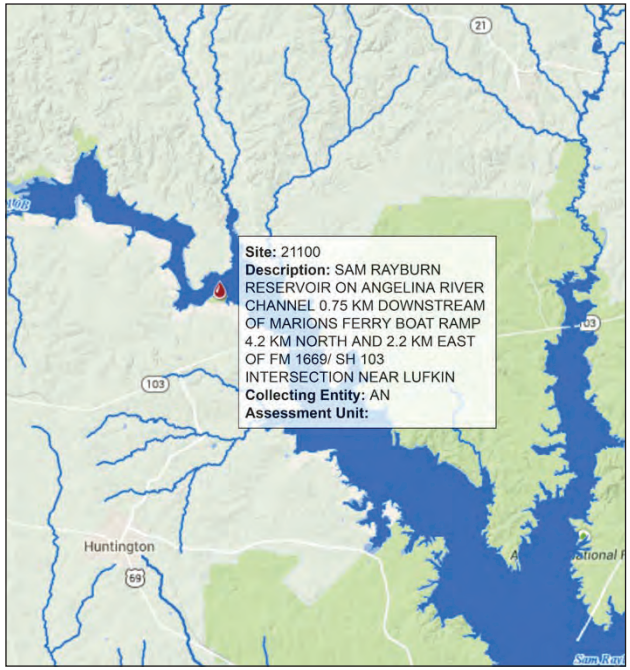
The fish consumption advisory (ADV-51) can be found online at the following website: http://www.dshs.state.tx.us/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=8589985023

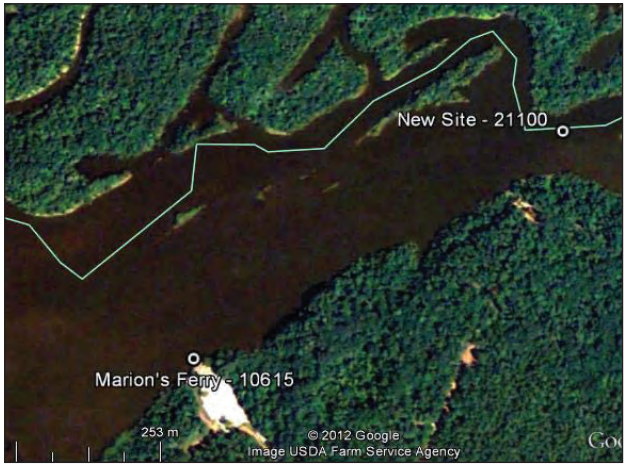
Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 21100 - Sam Rayburn Reservoir on Angelina River Channel Downstream of Marion's Ferry Boat Ramp

Monitoring Station 21100 is located in AU 0610_07. Historically, ANRA has monitored this assessment unit at Monitoring Station 10615, which is located near the boat ramp at Marion's Ferry. Due to drought conditions, it was necessary to relocate monitoring, as the site was no longer accessible as the reservoir levels dropped. In FY 2012, a new monitoring site (21100) was created three quarters of a kilometer downstream of the boat ramp on the main river channel. ANRA monitors this station quarterly for field parameters, conventionals, and *E coli* bacteria

Due to this monitoring station being recently relocated, trend analysis is not shown for this site. However, TCEQ has a monitoring station within the lower portion of this AU with a long enough period of record for statistical evaluation and trend analysis.





Aerial imagery of Marion's Ferry - October of 2005

Aerial imagery of Marion's Ferry - November of 2011

21100 - Sam Rayburn Reservoir on Angelina River Channel Downstream of Marion's Ferry Boat Ramp

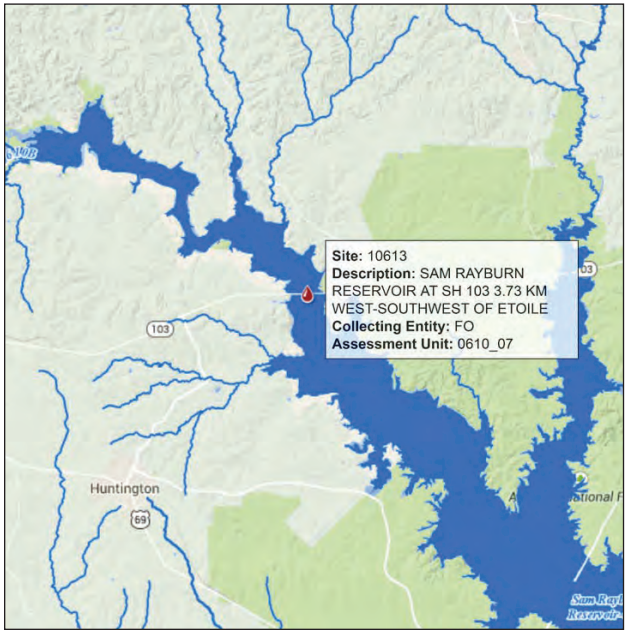
Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 10613 - Sam Rayburn Reservoir at SH 103 3.73 km West-Southwest Of Etoile

Monitoring Station 10613 is located in AU 0610_07. Monitoring is conducted at this station quarterly by the TCEQ Region 10 field office for field parameters, conventional parameters, and *E. coli* bacteria. In the past, this station has also been monitored for metals in water and metals in sediment. There are no impairments or concerns for nutrient parameters, bacteria, or dissolved solids in this assessment unit.

A statistically significant decreasing trend is observed for Total Phosphorus. However, lower values observed in 2013 and beyond are due to a lowering of the limit of quantitation and may be influencing this trend. In the data evaluated, only one value exceeded the Total Phosphorus screening level of 0.20 mg/L as P.

An increasing trend is observed with Total Suspended Solids. Although the trend is not statistically significant, it is worth noting because of the potential influence of drought conditions on the data set.

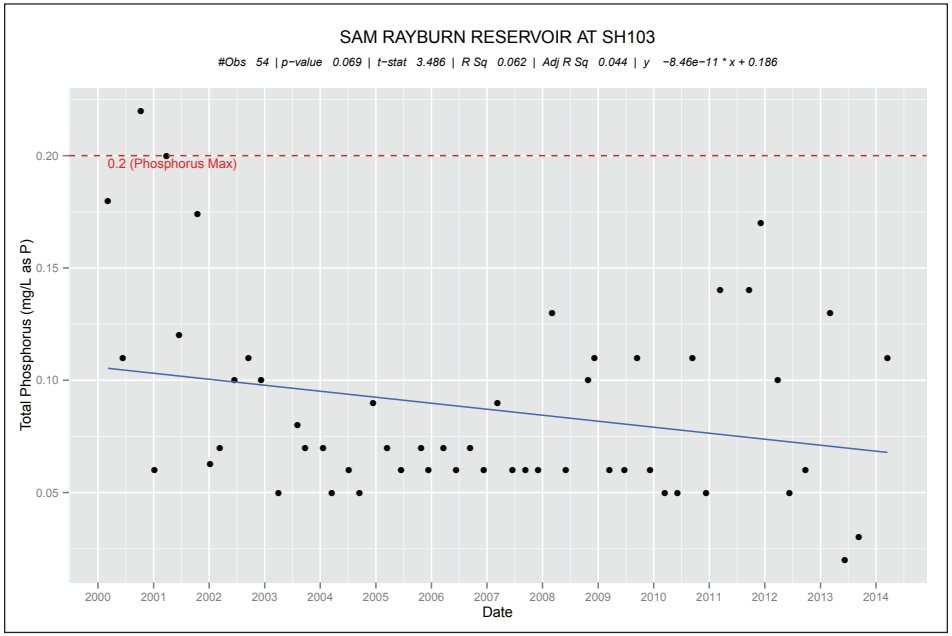


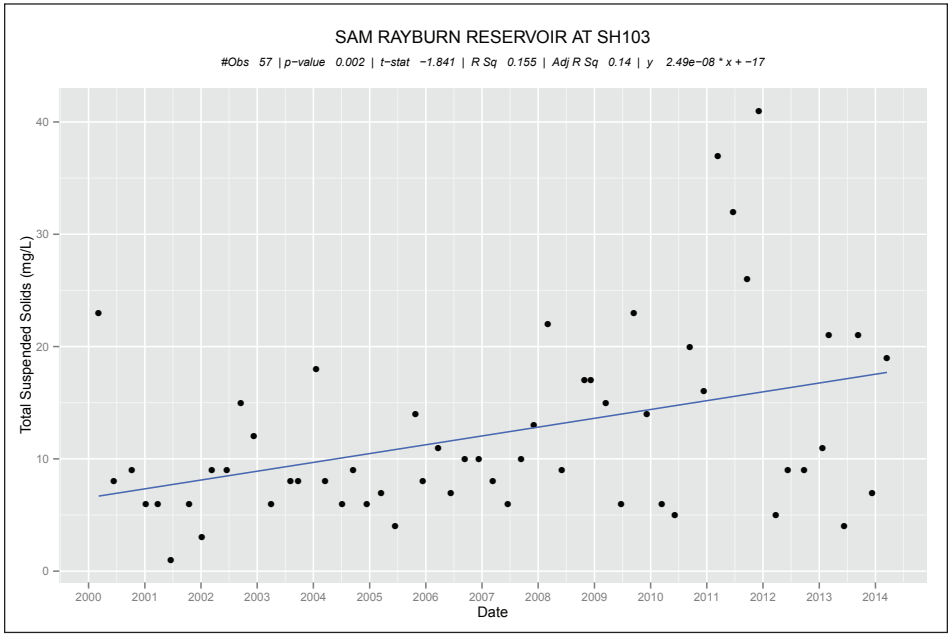
Sam Rayburn Reservoir Angelina River Arm from SH 103 Bridge (09-22-2011)

Sam Rayburn Reservoir Angelina River Arm from SH 103 Bridge (04-19-2012)

Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 10613 - Sam Rayburn Reservoir at SH 103 3.73 km West-Southwest Of Etoile





Water Quality Monitoring Results for Station 10613 - Sam Rayburn Reservoir at SH 103 3.73 KM West-Southwest of Etoile

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	58	0	93	838	196.72		2.2914	0.5133	
00300	Dissolved Oxygen (mg/L)	58	0	4.5	11.9	8.66		3.0630	0.2056	
00400	pH (S.U.)	58	4	6.4	9.1	7.57		9.2465	0.6425	
00530	Total Suspended Solids (mg/L)	57	0	1	41	12.21		-1.8407	0.0024	
00610	Ammonia-Nitrogen (mg/L as N)	55	2	0.02	0.31	0.06		0.8113	0.7479	
00630	Nitrate + Nitrite (mg/L as N)	37	1	0.0267	0.39	0.06		-0.4059	0.3907	
00665	Total Phosphorus (mg/L as P)	54	1	0.02	0.22	0.09		3.4857	0.0687	↓
00940	Chloride (mg/L)	57	1	7	149	21.33		2.1054	0.2460	
00945	Sulfate (mg/L)	57	0	9	78	27.29		1.4840	0.7007	
31699	*E. coli* (MPN/100 mL)	49	2	1	260		4.82	1.0604	0.4150	
32211+70953	Chlorophyll-*a* (µg/L)	55	11	1.42	57.9	18.05		-1.1050	0.0194	
70300	Total Dissolved Solids (mg/L)	44	1	80	512	137.07		2.5656	0.1959	

Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 15524 - Sam Rayburn Reservoir Near Shirley Creek

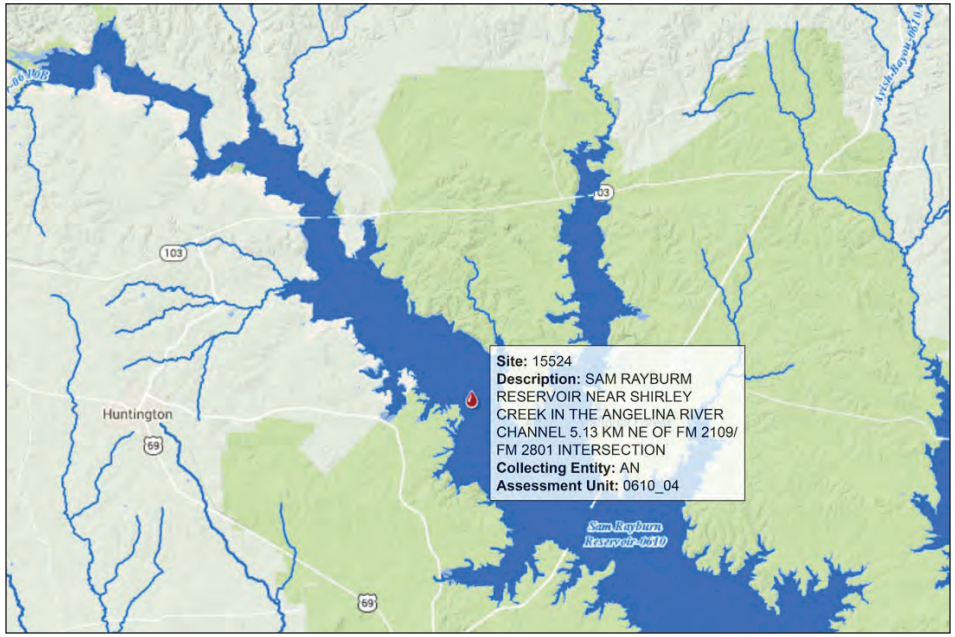
Monitoring Station 15524 is located in assessment unit AU 0610_04 (upper mid-Angelina River arm). ANRA monitors this station quarterly for field parameters, conventional parameters, and *E. coli* bacteria.

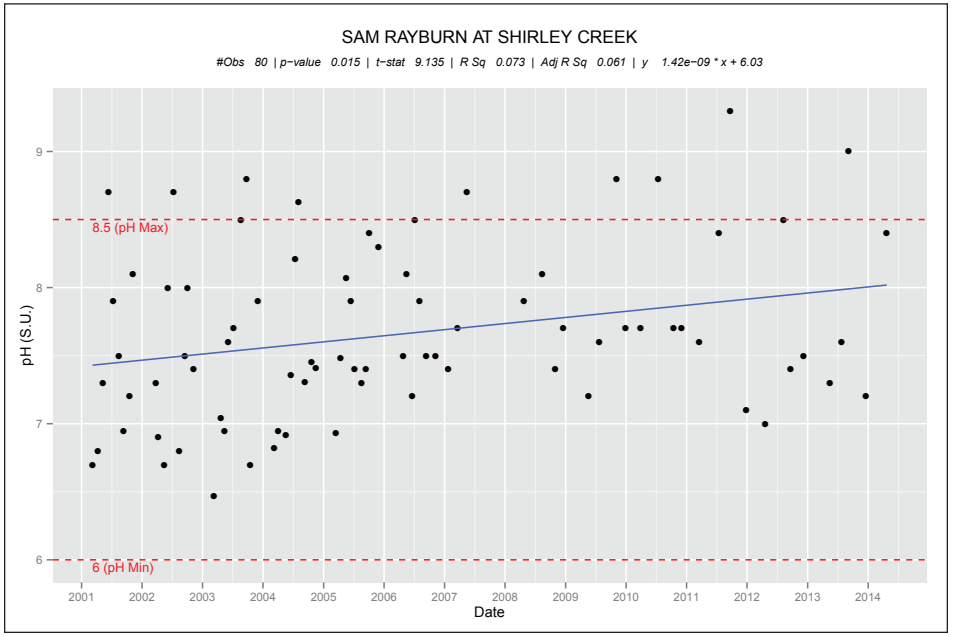
Statistically significant increasing trends were observed for Dissolved Oxygen and pH. This AU has a concern for pH as listed in the 2014 Draft Integrated Report. Numerous values were reported with a pH above 8.5 S.U.

For nutrient parameters, a statistically significant decreasing trend was observed for Total Phosphorus . Nitrate+Nitrite also exhibited a statistically significant decreasing trend. Although numerous values in the data set are censored (results less than the limit of quantitation), the data shows an improvement in water quality related to this parameter, as there has been a very noticeable reduction in elevated Nitrate+Nitrite values since the beginning of 2004.

A decreasing trend is also observed with Ammonia-Nitrogen. Although this trend is not statistically significant and the data set contains numerous values reported at the limit of quantitation, an improvement in water quality related to Ammonia-Nitrogen levels can be observed beginning in 2007. This AU has a concern for Ammonia-Nitrogen as listed in the Draft 2014 Integrated Report.

15524 - Sam Rayburn Reservoir at Shirley Creek



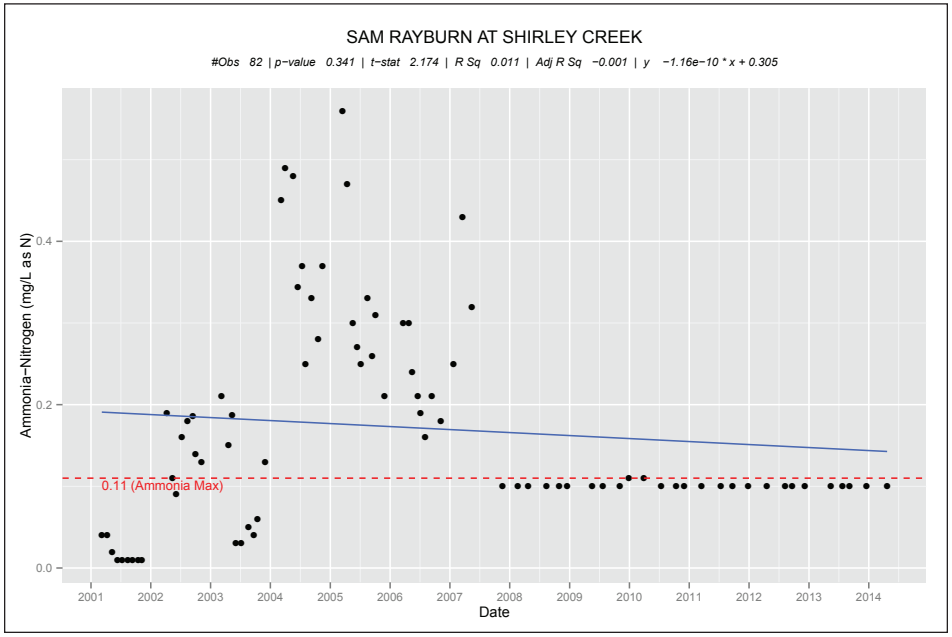


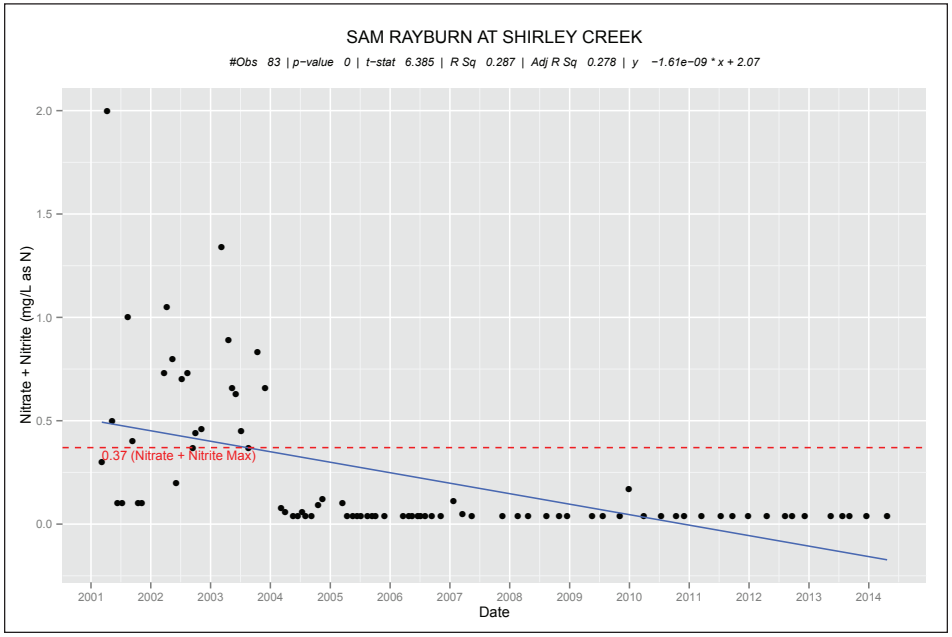
Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 15524 - Sam Rayburn Reservoir Near Shirley Creek

Water Quality Monitoring Results for Station 15524 - Sam Rayburn Reservoir Near Shirley Creek

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	81	0	90	275	142.64		-1.0385	0.0000	
00300	Dissolved Oxygen (mg/L)	81	0	5.6	13.6	8.50		2.6825	0.0046	↑
00400	pH (S.U.)	80	9	6.47	9.3	7.66		9.1347	0.0152	↑
00530	Total Suspended Solids (mg/L)	47	0	1.67	19	5.07		1.1205	0.8215	
00610	Ammonia-Nitrogen (mg/L as N)	82	39	0.01	0.56	0.17		2.1741	0.3412	
00630	Nitrate + Nitrite (mg/L as N)	83	18	0.04	2	0.23		6.3850	0.0000	↓
00665	Total Phosphorus (mg/L as P)	83	11	0.02	3.9	0.15		2.2620	0.0550	↓
00940	Chloride (mg/L)	46	0	10	44	16.92		0.9321	0.6873	
00945	Sulfate (mg/L)	47	0	16.3	38.3	25.09		-0.0259	0.0047	
31699	*E. coli* (MPN/100 mL)	83	0	1	62		1.65	0.6117	0.8338	
32211+70953	Chlorophyll-*a* (µg/L)	54	7	5	53.5	18.65		1.8248	0.5544	
70300	Total Dissolved Solids (mg/L)	47	0	10	136	96.91		-0.0938	0.0085	





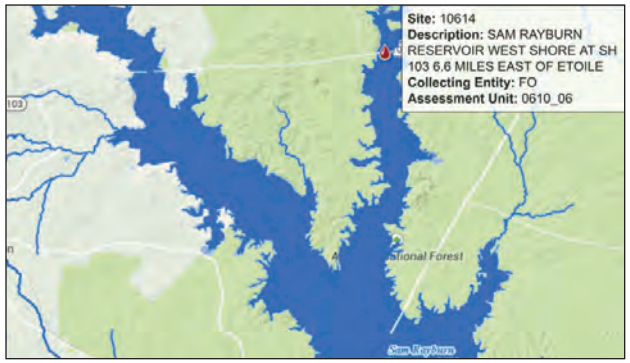
Segment 0610 - Sam Rayburn Reservoir

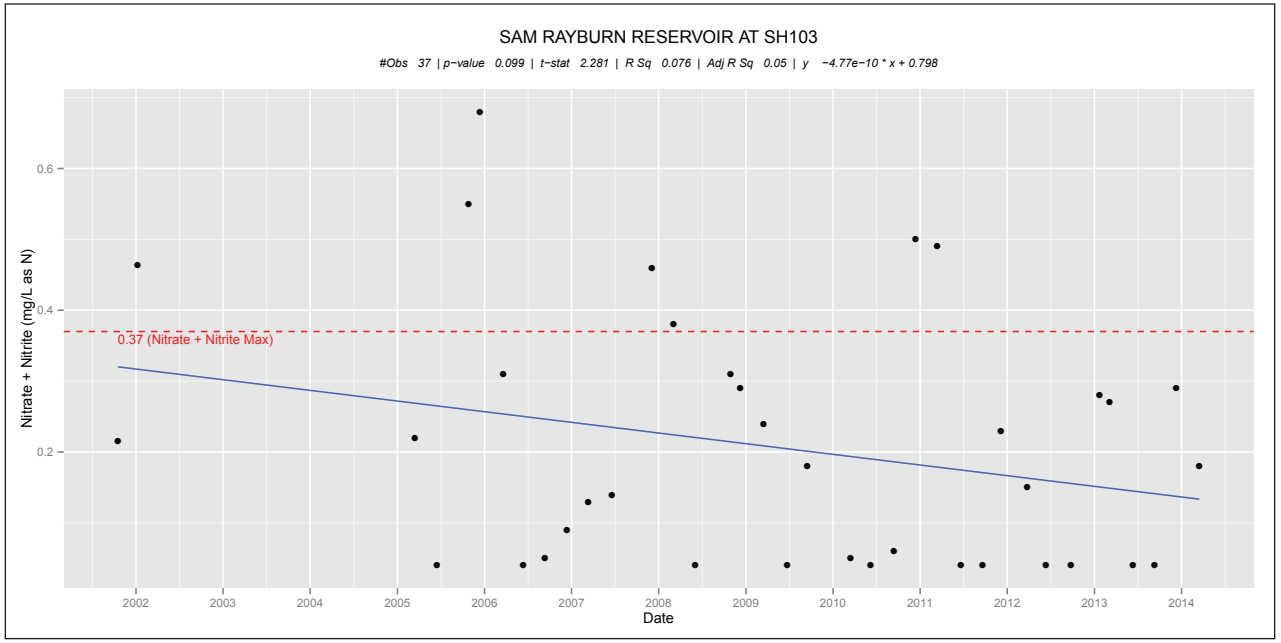
Monitoring Station 10614 - Sam Rayburn Reservoir West Shore at SH 103 East of Etoile

Monitoring Station 10614 is located in assessment unit AU 0610_06 (Upper Attoyac Bayou arm). Monitoring is conducted at this station quarterly by the TCEQ Region 10 field office for field parameters, conventional parameters, and *E. coli* bacteria.

In the Draft 2014 Integrated Report, this assessment unit has a concern for depressed Dissolved Oxygen.

A statistically significant decreasing trend was observed for Nitrate+Nitrite. No other statistically significant trends for routine conventional or field parameters were observed.





AU 0610_06 includes 1.8 sq miles of reservoir surface. It begins approximately at the confluence of the Attoyac Bayou and Granberry Branch, 5.1 miles north of the SH 103 crossing and ends approximately 0.75 miles downstream of the SH 103 crossing. Its primary inflow is the Attoyac Bayou. It includes the SH 103 crossing, one active monitoring station, and has two previously permitted Municipal Solid Waste sites in its drainage area.

Water Quality Monitoring Results for Station 10614 - Sam Rayburn Reservoir West Shore at SH 103 East of Etoile

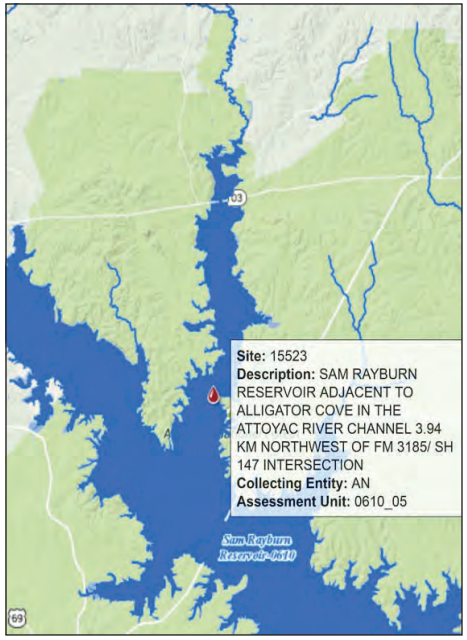
Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	59	0	13	218	132.12		-0.6625	0.0000	
00300	Dissolved Oxygen (mg/L)	59	0	3.8	11.2	7.88		4.2849	0.9782	
00400	pH (S.U.)	59	0	6.4	8.3	7.29		11.8254	0.6422	
00530	Total Suspended Solids (mg/L)	58	0	1	90	16.97		0.0393	0.3620	
00610	Ammonia-Nitrogen (mg/L as N)	56	1	0.02	0.19	0.05		2.7992	0.4974	
00630	Nitrate + Nitrite (mg/L as N)	37	7	0.04	0.68	0.21		2.2812	0.0987	↓
00665	Total Phosphorus (mg/L as P)	55	0	0.02	0.18	0.09		1.9833	0.9519	
00940	Chloride (mg/L)	58	0	6	21	10.62		1.3611	0.0672	
00945	Sulfate (mg/L)	58	0	6	33	16.79		0.3250	0.0654	
31699	*E. coli* (MPN/100 mL)	50	6	2	4800		26.68	-0.7161	0.3524	
32211+70953	Chlorophyll-*a* (µg/L)	57	11	0.55	63.4	16.26		0.2259	0.5163	
70300	Total Dissolved Solids (mg/L)	45	0	71	137	100.62		1.5082	0.0147	

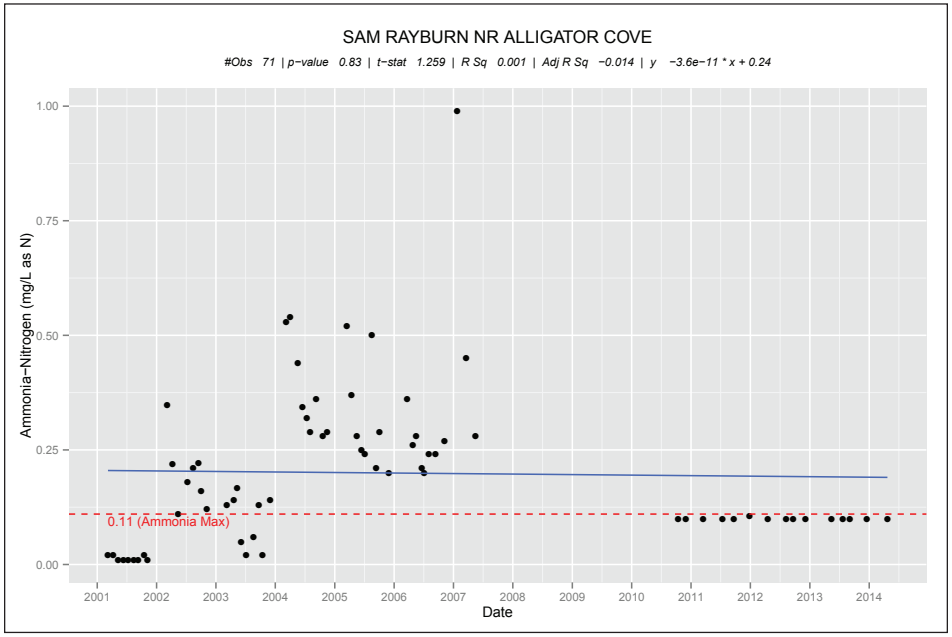
Segment 0610 - Sam Rayburn Reservoir

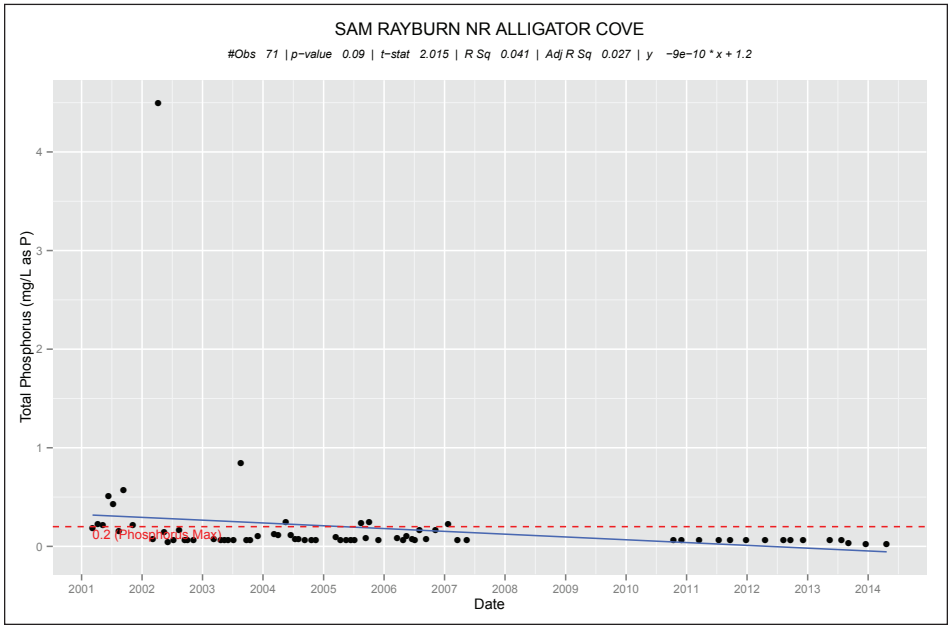
Monitoring Station 15523 - Sam Rayburn Reservoir Adjacent to Alligator Cove

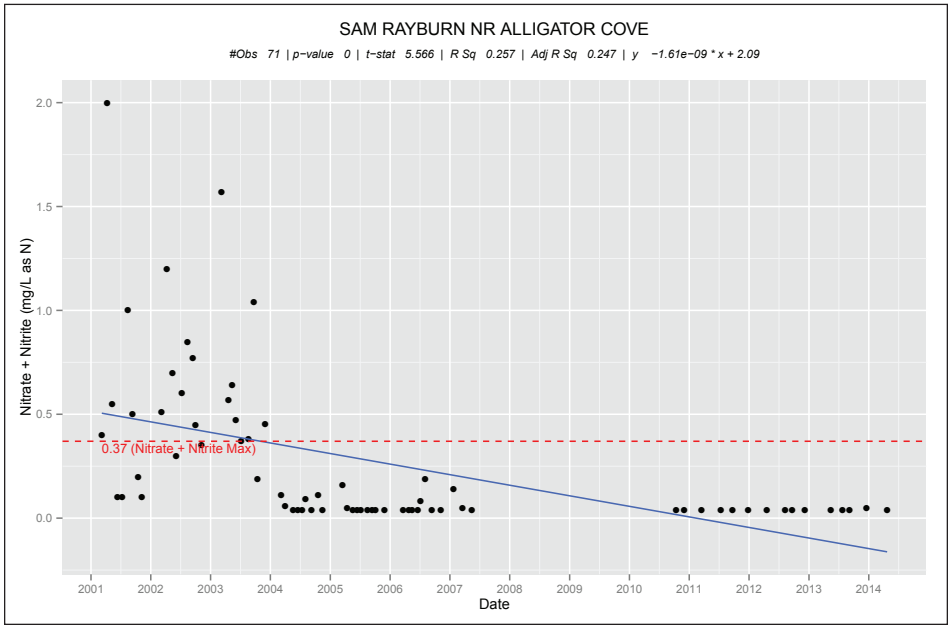
Monitoring Station 15523 is located in assessment unit AU 0610_05 (Lower Attoyac Bayou arm). Monitoring is conducted at this station quarterly by ANRA for field parameters, conventional parameters, and *E. coli* bacteria.

There are decreasing trends present for Total Phosphorus, Nitrate+Nitrite, and Ammonia-Nitrogen. Because there is a gap in the data from 2007 - 2010 where this station was not being monitored, ANRA is not classifying these trends as being statistically significant. Monitoring data does show an improvement in water quality for these parameters. This AU is listed in the Draft 2014 Integrated Report with a concern for Ammonia-Nitrogen.









Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 15523 - Sam Rayburn Reservoir Adjacent to Alligator Cove

Water Quality Monitoring Results for Station 15523 - Sam Rayburn Reservoir Adjacent to Alligator Cove in the Attoyac River Channel										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	69	0	66	270	128.94		-3.0101	0.0000	
00300	Dissolved Oxygen (mg/L)	70	0	5.8	13.2	8.50		3.7281	0.1344	
00400	pH (S.U.)	70	5	6.35	9.2	7.67		9.8559	0.1100	
00530	Total Suspended Solids (mg/L)	35	0	2.67	24	6.44		0.9150	0.9376	
00610	Ammonia-Nitrogen (mg/L as N)	71	41	0.01	0.99	0.20		1.2591	0.8303	
00630	Nitrate + Nitrite (mg/L as N)	71	19	0.04	2	0.26		5.5657	0.0000	
00665	Total Phosphorus (mg/L as P)	71	12	0.02	4.5	0.18		2.0153	0.0902	
00940	Chloride (mg/L)	34	0	10	42	16.67		0.8211	0.7660	
00945	Sulfate (mg/L)	35	0	10.6	40.9	23.95		-0.4323	0.0058	
31699	*E. coli* (MPN/100 mL)	71	0	1	41		1.46	0.6174	0.8369	
32211+70953	Chlorophyll-*a* (µg/L)	42	8	5	49.6	20.68		2.5106	0.2340	
70300	Total Dissolved Solids (mg/L)	35	0	68	201.3	99.09		0.3139	0.1203	

AU 0610_05 encompasses 10.3 sq miles of reservoir surface. It begins 0.75 miles below the SH 103 bridge over the Attoyac Bayou, and extends 8.9 miles south to the mouth of the Attoyac arm of the reservoir. It includes three inactive sampling sites, one active sampling site, a powerline crossing, and Jackson Hill Park and Marina. There are seven small - to medium-sized neighborhoods on the eastern shore, and one small neighborhood on the western shore; otherwise, the shoreline is forested. The shoreline itself appears mostly undeveloped, but there are numerous pine plantations in the drainage area, some buffered by less than 200 ft of undeveloped forest from the water's edge.

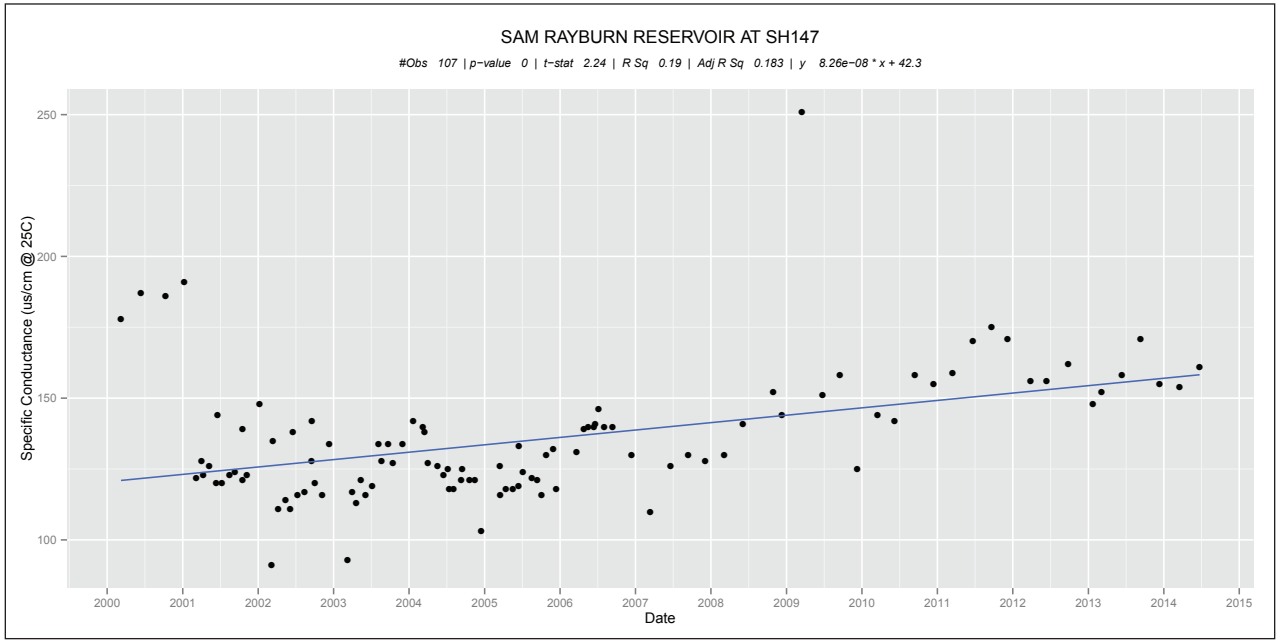
Boat Ramp at Jackson Hill Marina

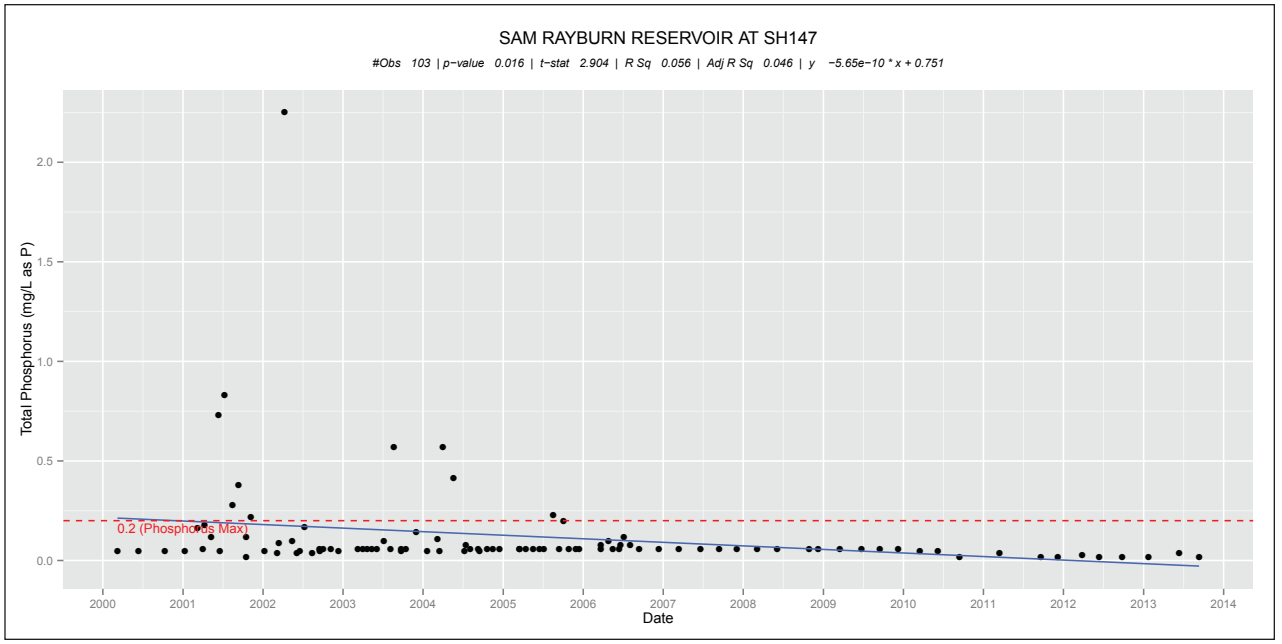
Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 10612 - Sam Rayburn Reservoir at SH 147

Monitoring Station 10612 is located in assessment unit AU 0610_03 (Mid-Angelina River arm). Monitoring is conducted at this station quarterly by the TCEQ Region 10 field office for field parameters, conventional parameters, *E. coli* bacteria, and metals in sediment.

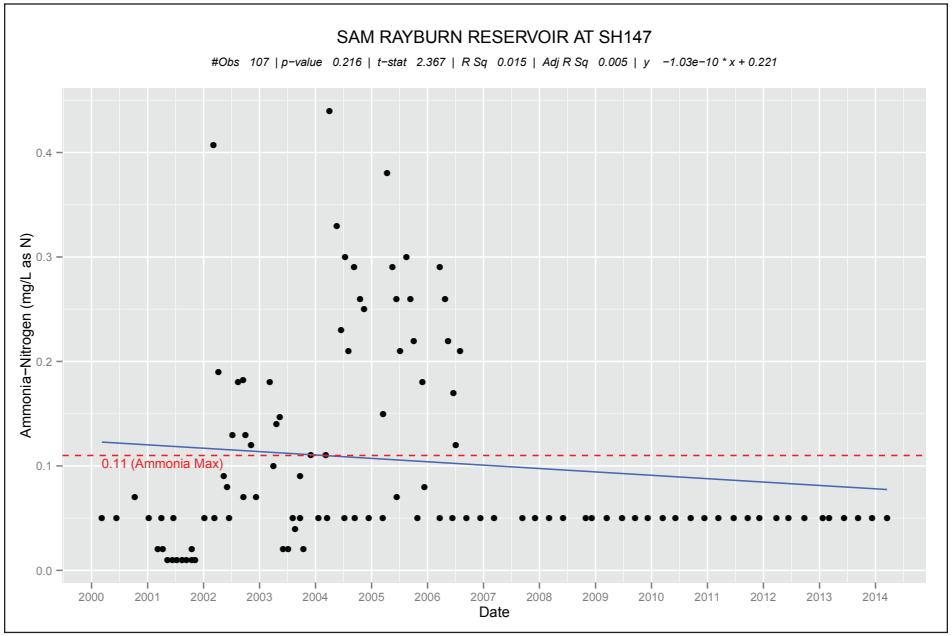
A statistically significant increasing trend is observed for Specific Conductance. A statistically significant decreasing trend is present for Total Phosphorus and Nitrate+Nitrite. However, these trends contain numerous censored values (results below the laboratory limit of quantitation). The results for these nutrient parameters, as well as Ammonia-Nitrogen, show an improvement in water quality at this station. This assessment unit has a concern for Ammonia-Nitrogen listed in the Draft 2014 Integrated Report.

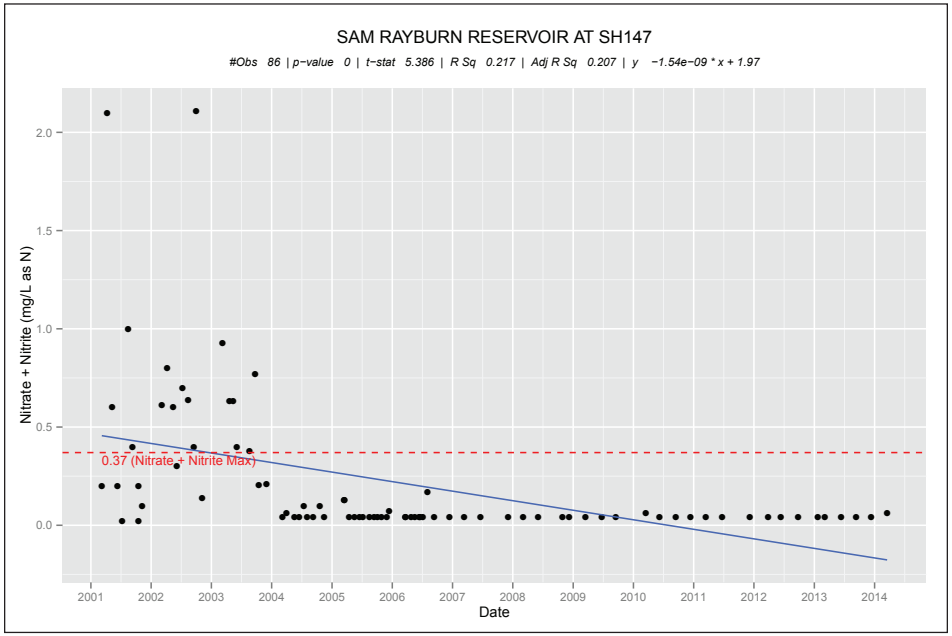




Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 10612 - Sam Rayburn Reservoir at SH 147





Water Quality Monitoring Results for Station 10612 - Sam Rayburn Reservoir at SH 147

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	107	0	91	251	135.45		2.2399	0.0000	↑
00300	Dissolved Oxygen (mg/L)	107	0	6.1	11.8	8.71		5.2784	0.1852	
00400	pH (S.U.)	108	6	6	9	7.62		15.4223	0.8724	
00530	Total Suspended Solids (mg/L)	70	0	1	22.3	4.63		0.9611	0.6121	
00610	Ammonia-Nitrogen (mg/L as N)	107	33	0.01	0.44	0.11		2.3666	0.2161	
00630	Nitrate + Nitrite (mg/L as N)	86	17	0.02	2.11	0.21		5.3856	0.0000	↓
00665	Total Phosphorus (mg/L as P)	103	10	0.02	2.25	0.12		2.9040	0.0163	↓
00940	Chloride (mg/L)	72	0	9	23	13.91		3.5159	0.9317	
00945	Sulfate (mg/L)	72	0	14	30	21.48		1.8603	0.0028	
31699	*E. coli* (MPN/100 mL)	100	0	1	20.8		1.70	0.3055	0.6055	
32211+70953	Chlorophyll-*a* (µg/L)	76	3	3.27	30.4	13.59		2.6767	0.4280	
70300	Total Dissolved Solids (mg/L)	57	0	69	137	90.51		5.2229	0.3577	

Segment 0610 - Sam Rayburn Reservoir

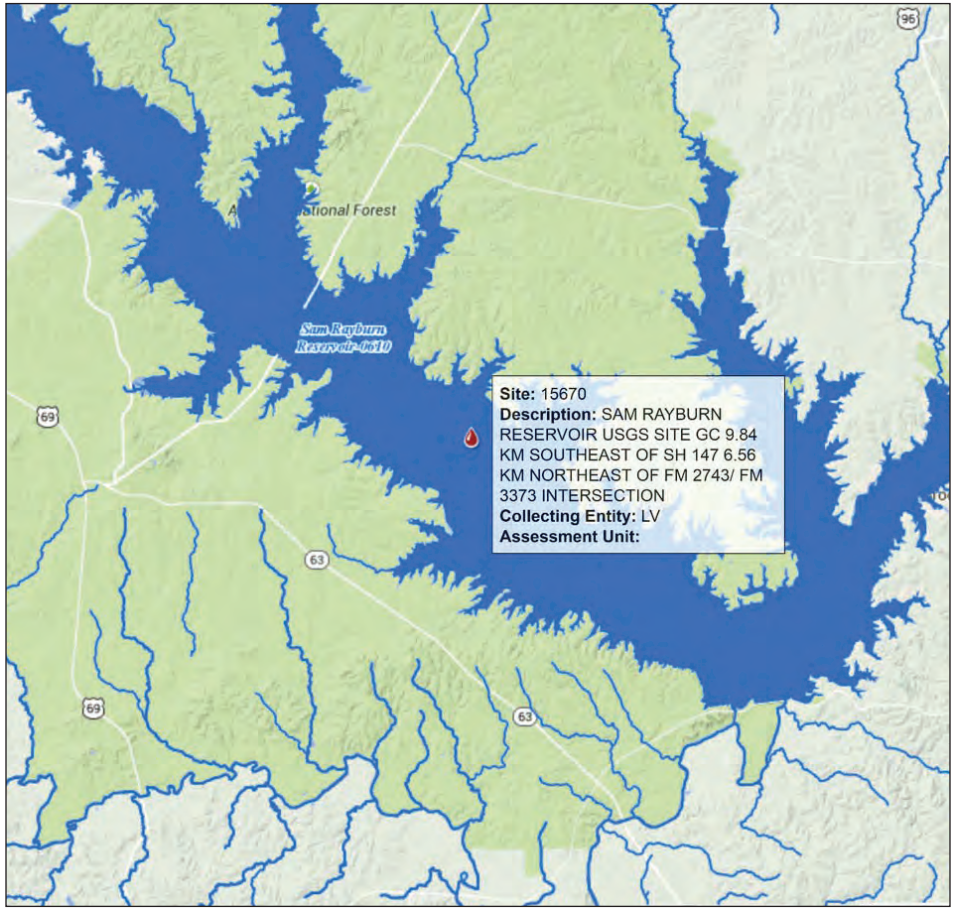
Monitoring Stations 15670 - Sam Rayburn Reservoir USGS Site GC and 15671 - Sam Rayburn Reservoir USGS Site FC

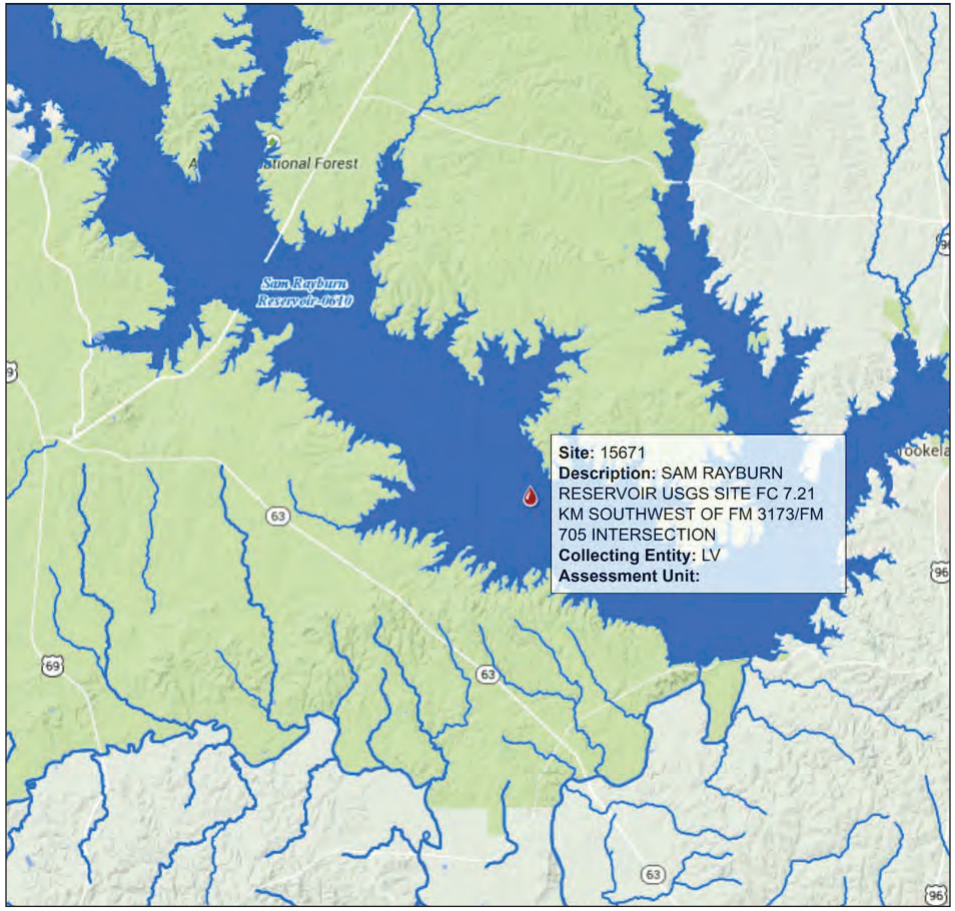
Monitoring Stations 15670 and 15671 are in assessment unit 0610_02 (Lower Angelina River arm). Station 15670 is located 9.84 km southeast of SH 147 and 6.56 km northeast of the FM 2743/FM 3373 intersection. Station 15671 is located 7.21 km southwest of the FM 3173/FM 705 intersection.

Monitoring is conducted at these stations quarterly by LNVA for field parameters, conventional parameters, and *E. coli* bacteria. There are not enough data points at these stations to properly conduct statistical review and trend analyses. Summaries of water quality results at these stations are provided.

Monitoring was previously conducted in this AU at Monitoring Station 15522 - Sam Rayburn Reservoir Near Veach Basin. Monitoring was transitioned to the current stations in 2008.

Assessment Unit 0610_02 encompasses 43.7 sq miles of reservoir surface. It begins 4.8 miles southeast of the SH 147 bridge, and extends 11.6 miles southeast to a point about half a mile northwest of the intersection of Angelina, San Augustine and Jasper Counties. It includes two inactive sampling sites, two active sampling sites, and one permitted wastewater discharge. This AU has a concern for Ammonia-Nitrogen.





Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 15670 - Sam Rayburn Reservoir USGS Site GC

Water Quality Monitoring Results for Station 15670 - Sam Rayburn Reservoir USGS Site GC										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	9	0	124	164	148.78		-0.8285	0.0108	
00300	Dissolved Oxygen (mg/L)	9	0	7.3	11.2	9.23		1.3989	0.6940	
00400	pH (S.U.)	9	0	6.4	8.4	7.32		1.4205	0.5467	
00530	Total Suspended Solids (mg/L)	9	0	4	5.4	4.44		-0.5970	0.0845	
00630	Nitrate + Nitrite (mg/L as N)	9	0	0.05	0.06	0.05		1.2113	0.3033	
00665	Total Phosphorus (mg/L as P)	9	0	0.02	0.06	0.04		6.8914	0.0004	
00940	Chloride (mg/L)	9	0	11	15.2	13.48		0.3473	0.2375	
00945	Sulfate (mg/L)	9	0	19	34.9	25.64		-1.2295	0.0564	

Monitoring Station 15671 - Sam Rayburn Reservoir USGS Site FC

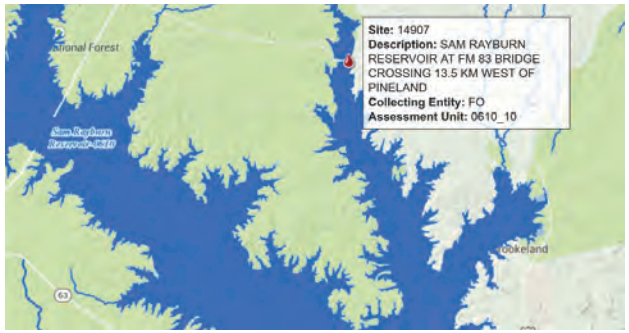
Water Quality Monitoring Results for Station 15671 - Sam Rayburn Reservoir USGS Site FC										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	9	0	123	165	149.89		-0.3893	0.0109	
00300	Dissolved Oxygen (mg/L)	9	0	7.1	11.3	9.40		1.3862	0.6919	
00400	pH (S.U.)	9	0	6.8	8.2	7.41		2.1955	0.6751	
00530	Total Suspended Solids (mg/L)	9	0	4	5	4.33		-1.1950	0.0188	
00630	Nitrate + Nitrite (mg/L as N)	9	0	0.05	0.06	0.05		1.2113	0.3033	
00665	Total Phosphorus (mg/L as P)	9	0	0.02	0.06	0.04		6.8914	0.0004	
00940	Chloride (mg/L)	9	0	11	15.3	13.44		0.8129	0.4126	
00945	Sulfate (mg/L)	9	0	18.7	34.9	25.02		-0.8460	0.1174	

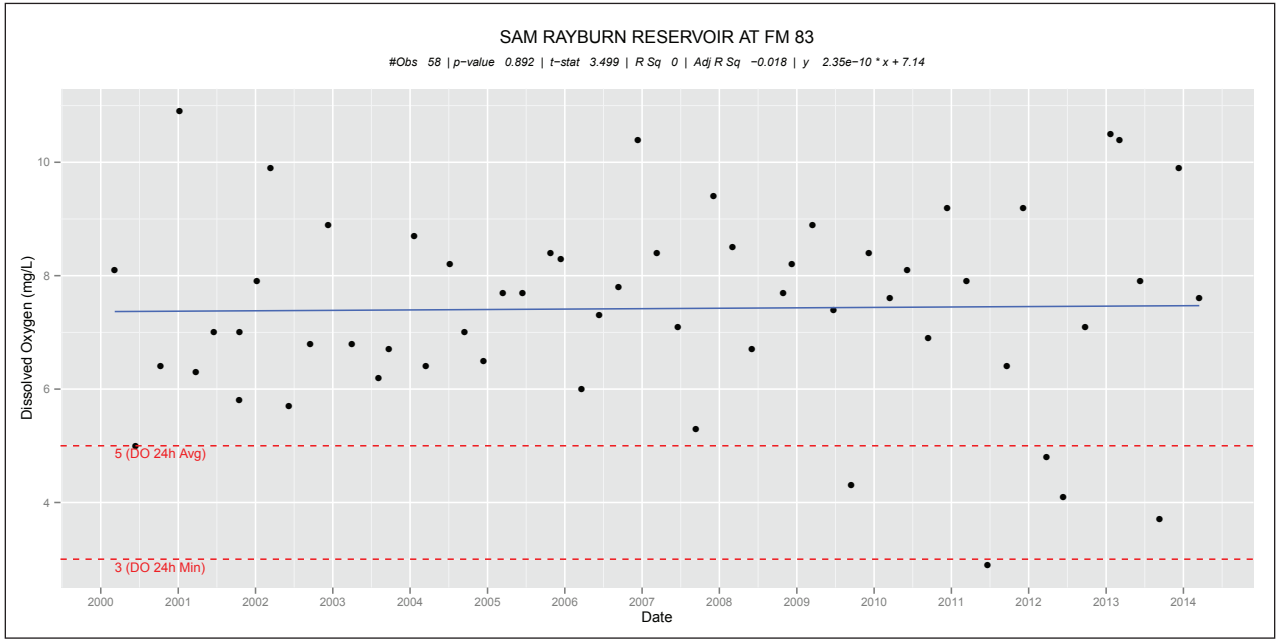
Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 14907 - Sam Rayburn Reservoir at FM 83

Monitoring Station 14907 is located in AU 0610_10 (Upper Ayish Bayou arm). Monitoring is conducted at this station quarterly by the TCEQ Region 10 field office for field parameters, conventional parameters, and *E. coli* bacteria.

A statistically significant increasing trend is observed for Specific Conductance. Several low Dissolved Oxygen values have been observed, particularly during the drought. This assessment unit has a concern for depressed Dissolved Oxygen listed in the Draft 2014 Integrated Report.





Water Quality Monitoring Results for Station 14907 - Sam Rayburn Reservoir at FM 83

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	58	0	87	204	143.33		2.4286	0.0088	↑
00300	Dissolved Oxygen (mg/L)	58	1	2.9	10.9	7.42		3.4986	0.8924	
00400	pH (S.U.)	58	2	5.8	8.5	7.22		11.5163	0.2460	
00530	Total Suspended Solids (mg/L)	58	0	1	56	13.88		-1.8047	0.0060	
00610	Ammonia-Nitrogen (mg/L as N)	57	3	0.02	0.19	0.06		2.3749	0.5492	
00630	Nitrate + Nitrite (mg/L as N)	37	1	0.0218	0.58	0.08		-0.6415	0.3019	
00665	Total Phosphorus (mg/L as P)	54	0	0.02	0.16	0.07		1.3264	0.6391	
00940	Chloride (mg/L)	58	0	5	19	11.37		1.9269	0.1171	
00945	Sulfate (mg/L)	58	0	11	47	18.66		-1.0414	0.0002	
31699	*E. coli* (MPN/100 mL)	48	8	2	4800		19.15	-1.1454	0.1768	
32211+70953	Chlorophyll-*a* (µg/L)	56	1	0.43	43.7	11.34		0.9757	0.7377	
70300	Total Dissolved Solids (mg/L)	46	0	74	160	102.78		2.1787	0.2098	

Segment 0610 - Sam Rayburn Reservoir

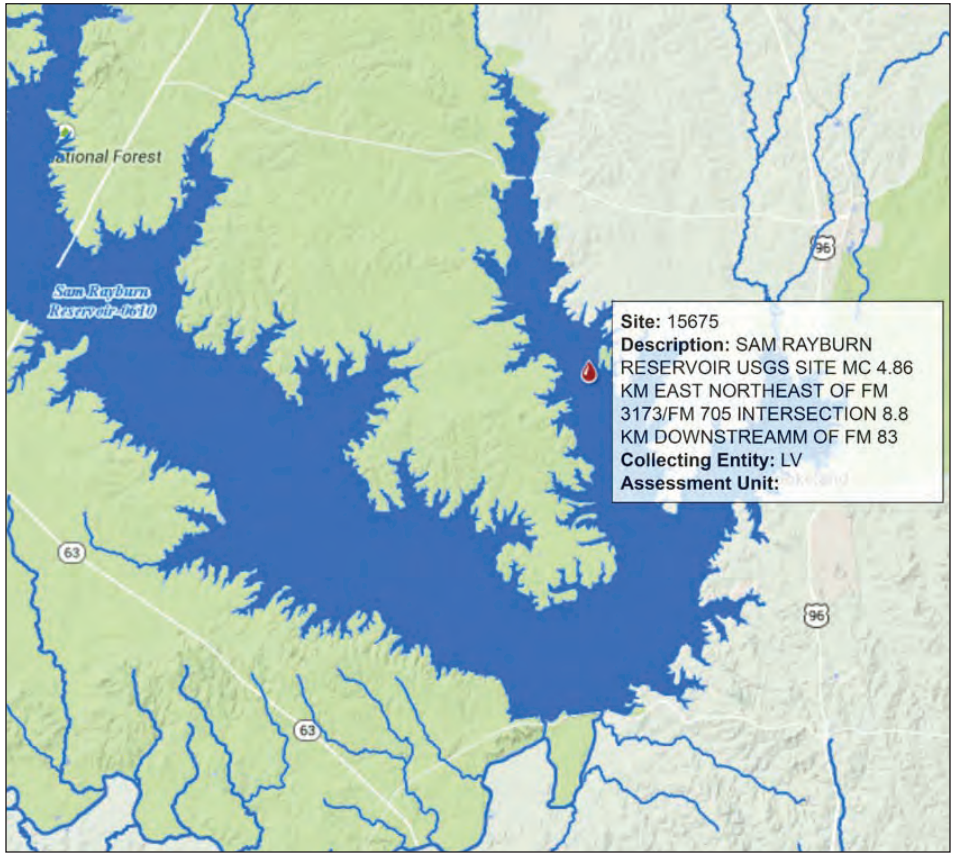
Monitoring Stations 15675 - Sam Rayburn Reservoir USGS Site MC and 15673 - Sam Rayburn Reservoir USGS Site AC

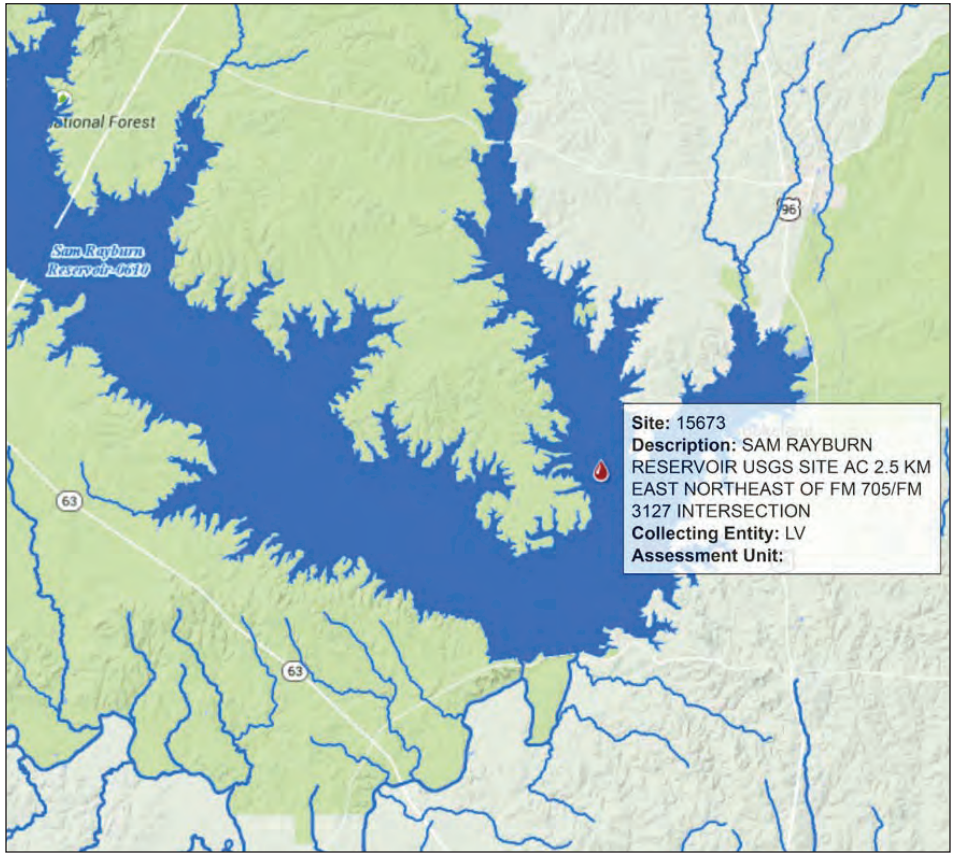
Monitoring Stations 15675 and 15673 are in assessment unit 0610_09 (Lower Ayish Bayou arm). Station 15675 is located 4.86 km east northeast of the FM 3173/FM 705 intersection 8.8 km downstream of FM 83. Station 15673 is located 2.5 km east northea t of the FM 705/FM 3127 intersection.

Monitoring is conducted at these stations quarterly by LNVA for field parameters, conventional parameters, and *E. coli* bacteria. With less than 20 data points, there is not enough data at these stations to properly conduct statistical review and trend analyses. Summaries of water quality results at these stations are provided.

Monitoring was previously conducted in this AU as Monitoring Station 15526 - Sam Rayburn Reservoir at Needmore Point. Monitoring was transitioned to the current stations in 2008.

This AU covers 17.5 sq miles of reservoir surface. It begins approximately 0.6 miles south of the FM 83 crossing and extends 11.1 miles downstream to the mouth of the Attoyac arm of the reservoir. The entire western shore is designated Angelina National Forest, but only a single 530-acre tract of the shoreline itself is owned by the US Forest Service. The eastern shore is almost entirely privately owned, with the exception of one 300-acre tract designated Angelina National Forest and owned by the US Forest Service, and San Augustine Park, a 250-acre USACE park. The drainage area contains two previously permitted MSW sites, two inactive monitoring sites, and two active monitoring sites. This AU has a concern for Ammonia-Nitrogen.





Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 15675 - Sam Rayburn Reservoir USGS Site MC

Water Quality Monitoring Results for Station 15675 - Sam Rayburn Reservoir USGS Site MC										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	14	0	105	158	133.07		-0.7272	0.0022	
00300	Dissolved Oxygen (mg/L)	13	1	1.5	11.4	8.13		0.2787	0.6669	
00400	pH (S.U.)	14	0	6.7	8.2	7.36		6.5082	0.1271	
00530	Total Suspended Solids (mg/L)	14	0	1	9.2	4.75		-2.4537	0.0078	
00610	Ammonia-Nitrogen (mg/L as N)	13	4	0.046	0.32	0.14		2.3406	0.0909	
00630	Nitrate + Nitrite (mg/L as N)	14	0	0.04	0.15	0.06		1.7271	0.2656	
00665	Total Phosphorus (mg/L as P)	14	0	0.02	0.06	0.05		8.4340	0.0000	
00940	Chloride (mg/L)	14	0	9.4	25.5	13.75		2.5216	0.1508	
00945	Sulfate (mg/L)	14	0	15.1	28.2	22.23		-1.4259	0.0071	
31699	*E. coli* (MPN/100 mL)	14	0	1	13		1.33	1.5169	0.2029	
32211+70953	Chlorophyll-*a* (µg/L)	5	0	5	13.7	6.74		1.7663	0.1809	
70300	Total Dissolved Solids (mg/L)	5	0	67.7	97.3	79.92		0.9582	0.4542	

Monitoring Station 15673 - Sam Rayburn Reservoir USGS Site AC

Water Quality Monitoring Results for Station 15673 - Sam Rayburn Reservoir USGS Site AC										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	9	0	122	162	142.67		-0.7789	0.0199	
00300	Dissolved Oxygen (mg/L)	9	0	7.2	11.1	9.20		1.4443	0.6367	
00400	pH (S.U.)	9	0	6.8	8.2	7.28		2.1298	0.6488	
00530	Total Suspended Solids (mg/L)	9	0	4	6	4.50		-0.7533	0.1089	
00610	Ammonia-Nitrogen (mg/L as N)	8	0	0.1	0.11	0.10		4.7649	0.5271	
00665	Total Phosphorus (mg/L as P)	9	0	0.02	0.06	0.04		6.8914	0.0004	
00940	Chloride (mg/L)	9	0	11	14.7	12.70		0.6958	0.4976	
00945	Sulfate (mg/L)	9	0	20	30.4	25.01		-1.3951	0.0196	
31699	*E. coli* (MPN/100 mL)	9	0	1	2		1.08	1.5007	0.3487	

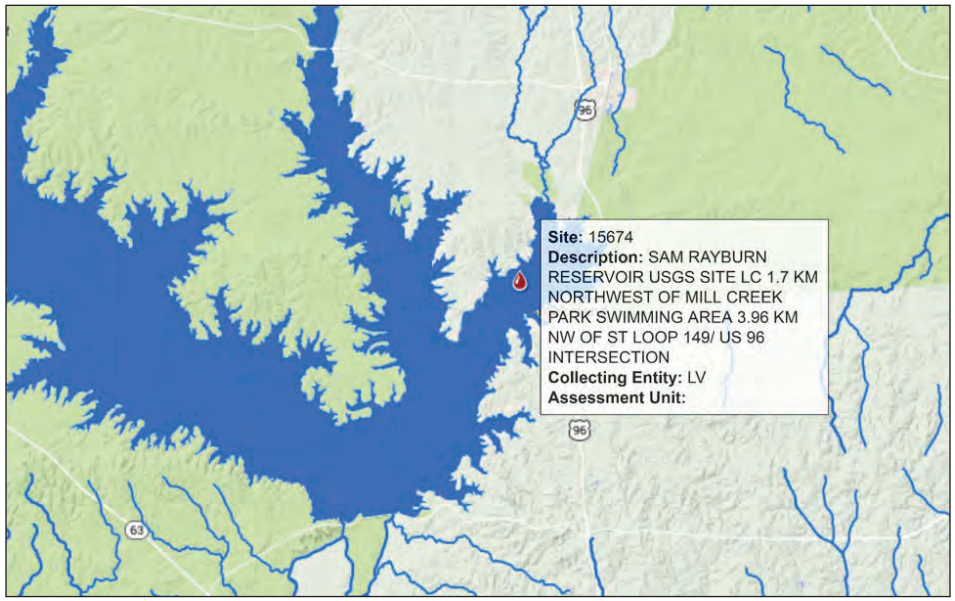
Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 15674 - Sam Rayburn Reservoir USGS Site LC

Monitoring Station 15674 is located in assessment unit 0610_08 (Upper Bear Creek arm). This station is located 1.7 km northwest of the Mill Creek Park swimming area, 3.69 km northwest of the Loop 149/US 96 intersection. Monitoring is conducted at this station quarterly by LNVA for field parameters, conventional parameters, and *E. coli* bacteria. There are not enough data points at this station to properly conduct statistical review and trend analyses. A summary of water quality results at this station is provided.

Monitoring was previously conducted in this AU by ANRA at Monitoring Station 15527 - Sam Rayburn Reservoir Near Mill Creek. Monitoring was transitioned to the current station in 2008.

AU 0610_08 covers 9.7 sq miles of reservoir surface, beginning 1000 ft upstream of US 96 at the Devils Ford/Curry Creek crossing and extending southeast 6.4 miles to the mouth of the Bear Creek Arm of the reservoir. It drains approximately 140 sq miles, 54 of which are Sabine National Forest. The AU contains two inactive sampling sites, and one active site. The drainage area contains the incorporated Cities of Pineland and Browndell, four previously permitted municipal solid waste sites, and six permitted wastewater outfalls. This AU has a concern for Ammonia-Nitrogen.



Water Quality Monitoring Results for Station 15674 - Sam Rayburn Reservoir USGS Site LC

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	9	0	115	159	139.56		-0.8621	0.0275	
00300	Dissolved Oxygen (mg/L)	9	0	6.6	11.6	9.10		0.8118	0.9698	
00400	pH (S.U.)	9	0	6.7	7.5	7.11		3.2322	0.5815	
00530	Total Suspended Solids (mg/L)	9	0	4	10.6	5.92		-1.2248	0.1447	
00610	Ammonia-Nitrogen (mg/L as N)	8	1	0.1	0.12	0.10		2.7428	0.5271	
00665	Total Phosphorus (mg/L as P)	9	0	0.02	0.06	0.04		6.8914	0.0004	
00940	Chloride (mg/L)	9	0	10.4	14.4	12.38		0.6153	0.5404	
00945	Sulfate (mg/L)	9	0	20.6	28.9	24.69		-2.0014	0.0046	
31699	*E. coli* (MPN/100 mL)	9	0	1	3		1.28	0.7011	0.6529	

Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 14906 - Sam Rayburn Reservoir at Main Pool

Station 14906 is located in AU 0610_01. Monitoring is conducted at this station quarterly by the TCEQ Region 10 field office for field parameters, conventional parameters, *E. coli* bacteria, and metals in sediment.

A statistically significant increasing trend is observed for Specific Conductance.

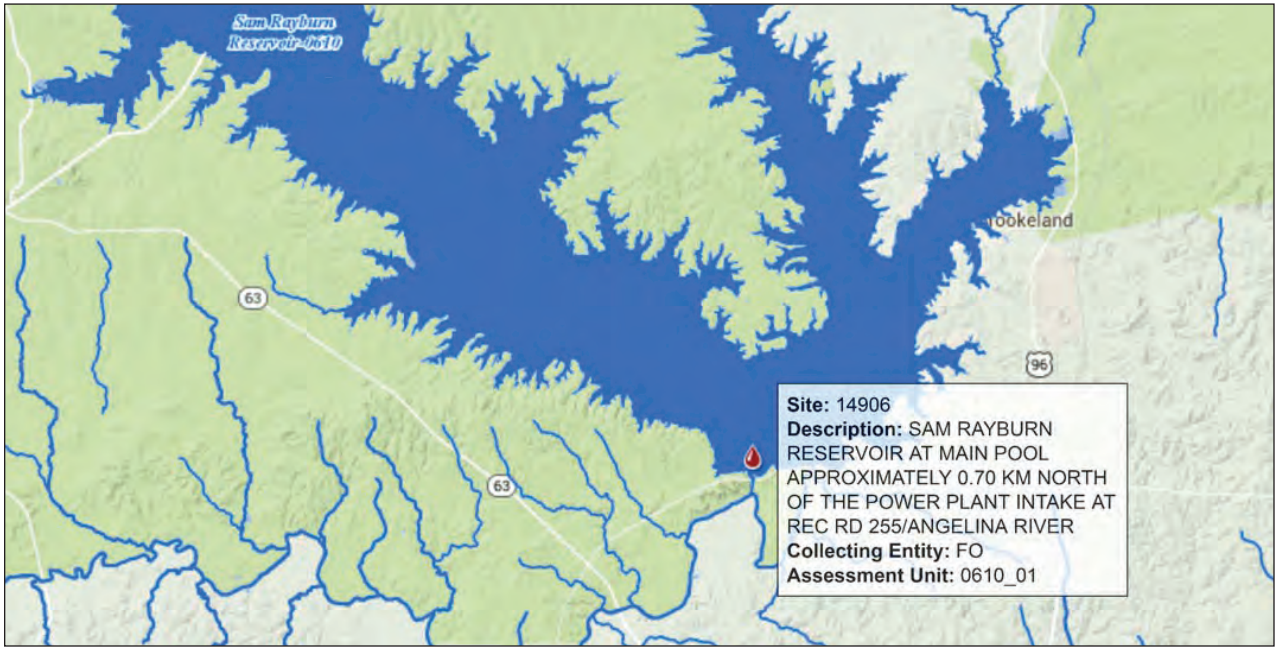
Decreasing trends are observed for both Ammonia-Nitrogen and Nitrate+Nitrite, with the trend for Nitrate+Nitrite being statistically significant. Although the Ammonia-Nitrogen trend is not considered to be statistically significant, and the data sets for both Ammonia-Nitrogen and Nitrate+Nitrite contain numerous values below the laboratory limit of quantitation, this data indicates a reduction in nitrogen levels in the reservoir. This same trend with Ammonia-Nitrogen and Nitrate+Nitrite is seen in several assessment units within the reservoir.

A statistically significant decreasing trend is seen for Total Phosphorus, but the majority of the data is at or below the limit of quantitation. Because of elevated historical data prior to 2003, ANRA still considers this trend to be significant.

A decreasing trend is also observed for Chlorophyll-*a*, but it is influenced by data reported at or below the limit of quantitation.

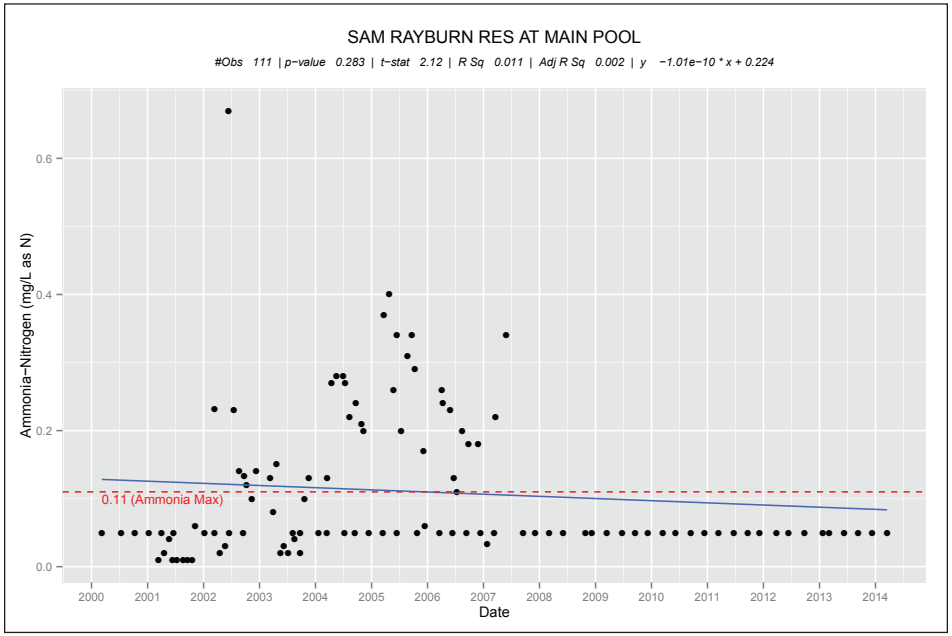
Assessment Unit 0610_01 (Sam Rayburn Main Pool) covers 21.7 sq miles of reservoir surface. It begins in the northwest at the mouth of the lower Angelina arm of the reservoir, and in the northeast at the mouths of the lower Ayish arm and the Bear Creek arm of the reservoir. It extends down to the dam. It contains 5 inactive sampling sites, and one active sampling site. Its drainage area contains two permitted wastewater outfalls.

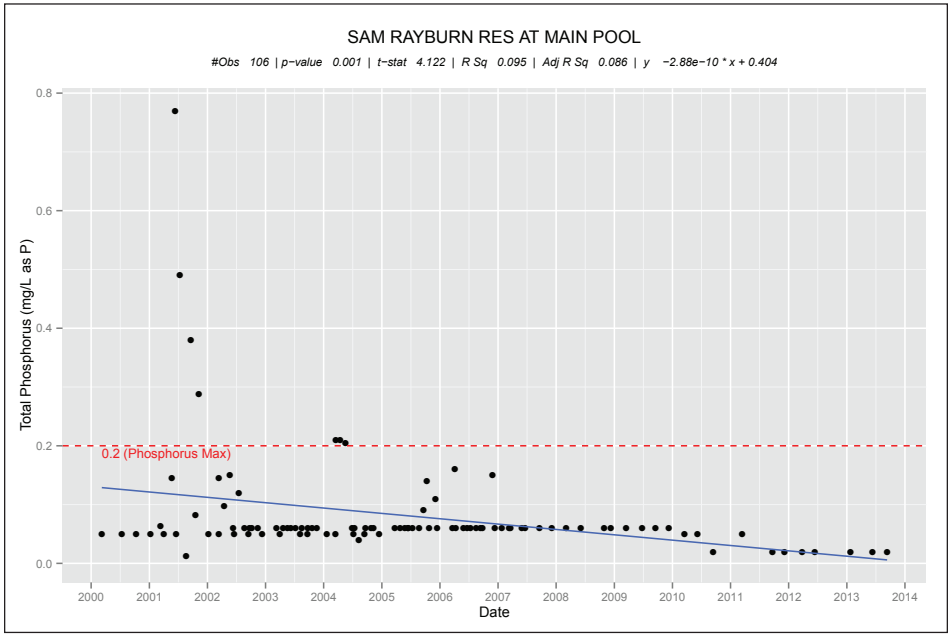
Sam Rayburn Reservoir at the dam

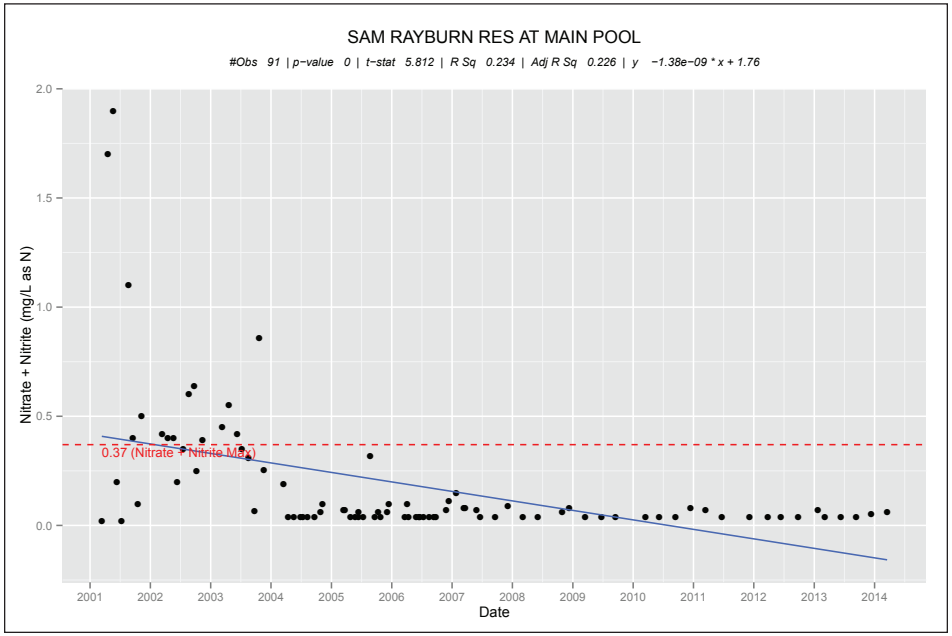


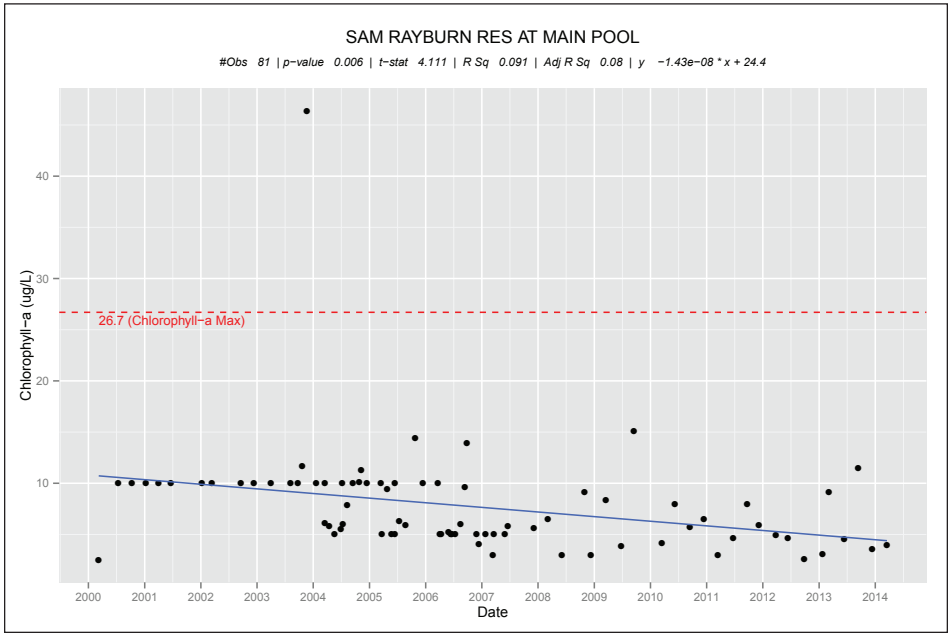
Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 14906 - Sam Rayburn Reservoir at Main Pool









Segment 0610 - Sam Rayburn Reservoir

Monitoring Station 14906 - Sam Rayburn Reservoir at Main Pool

Water Quality Monitoring Results for Station 14906 - Sam Rayburn Reservoir at Main Pool

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	112	0	99	245	130.47		2.9131	0.0000	↑
00300	Dissolved Oxygen (mg/L)	107	0	5	11.8	8.58		4.7601	0.2248	
00400	pH (S.U.)	110	1	6.5	8.6	7.51		17.7905	0.2741	
00530	Total Suspended Solids (mg/L)	75	0	1	59.7	4.47		0.5470	0.9827	
00610	Ammonia-Nitrogen (mg/L as N)	111	37	0.01	0.67	0.11		2.1196	0.2827	
00630	Nitrate + Nitrite (mg/L as N)	91	15	0.02	1.9	0.19		5.8117	0.0000	↓
00665	Total Phosphorus (mg/L as P)	106	7	0.013	0.77	0.08		4.1219	0.0013	↓
00940	Chloride (mg/L)	76	0	9	36	13.57		2.1259	0.6573	
00945	Sulfate (mg/L)	76	0	15	28	20.03		0.3537	0.0000	
31699	*E. coli* (MPN/100 mL)	104	0	1	40		1.61	-0.2325	0.4499	
32211+70953	Chlorophyll-*a* (µg/L)	81	1	2.52	46.4	7.77		4.1111	0.0062	↓
70300	Total Dissolved Solids (mg/L)	63	0	48	262	87.35		2.4977	0.6797	

Sam Rayburn Reservoir at the dam

Segment 0610 - Sam Rayburn Reservoir

Summary of Water Quality Trends

A summary of trend analyses for each assessment unit of Sam Rayburn Reservoir is presented below. Three AUs show statistically significant increasing trends for Specific Conductance.

The most notable trend in Sam Rayburn Reservoir relates to overall nitrogen levels. Four AUs show a statistically significant decreasing trend for Nitrate+Nitrite. In the other AUs, results typically show a decreasing trend, but it either is not statistically significant, there is a gap in the data, or the data set does not contain enough samples for proper statistical analysis. This same pattern is seen with Ammonia-Nitrogen. Although none of the AUs had a statistically significant trend, the general pattern for the reservoir was an overall decrease in Ammonia-Nitrogen results over the period of review.

Trend Analysis Summary for Segment 0610 - Sam Rayburn Reservoir

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Sam Rayburn Reservoir	0610_01	14906	Sam Rayburn Reservoir at Main Pool						↑					↓	
	0610_02	15671	Sam Rayburn Reservoir USGS Site FC	Trend analysis not performed due to insufficient data (sampling began 2008)											
		15670	Sam Rayburn Reservoir USGS Site GC	Trend analysis not performed due to insufficient data (sampling began 2008)											
	0610_03	10612	Sam Rayburn Reservoir at SH 147						↑					↓	
	0610_04	15524	Sam Rayburn Reservoir near Shirley Creek		↑	↑								↓	↓
	0610_05	15523	Sam Rayburn Reservoir near Alligator Cove	Trend analysis not performed due to gap in data set (site not monitored from 2007 - 2010)											
	0610_06	10614	Sam Rayburn Reservoir at SH 103 East of Etoile											↓	
	0610_07	21100	Sam Rayburn Reservoir downstream of Marion's Ferry	Trend analysis not performed due to insufficient data (sampling site relocated due to drought)											
		10613	Sam Rayburn Reservoir at SH 103 West of Etoile												↓
	0610_08	15674	Sam Rayburn Reservoir USGS Site LC	Trend analysis not performed due to insufficient data (sampling began 2008)											
	0610_09	15673	Sam Rayburn Reservoir USGS Site AC	Trend analysis not performed due to insufficient data (sampling began 2008)											
		15675	Sam Rayburn Reservoir USGS Site MC	Trend analysis not performed due to insufficient data (sampling began 2006)											
	0610_10	14907	Sam Rayburn Reservoir at FM 83						↑						

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Segment 0610 - Sam Rayburn Reservoir

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0610 - Sam Rayburn Reservoir				
Water Quality Issue	**Affected Area**	**Possible Influences/Causes**	**Possible Effects**	**Possible Solutions / Actions Taken**
Dioxin in Edible Tissue	The Neches River (Segment 0604) and all contiguous waters from the SH 7 bridge west of Lufkin, TX downstream to the US 96 bridge near Evadale, TX including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir	• Pulp and paper bleaching processes	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for six species of fish • ADV-51 issued on January 24, 2014
Mercury in Edible Tissue	The Neches River (Segment 0604) and all contiguous waters from the SH 7 bridge west of Lufkin, TX downstream to the US 96 bridge near Evadale, TX including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir	• Atmospheric deposition from coal-fired power plants, large boilers and heaters, steel production, and incinerators	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for six species of fish • ADV-51 issued on January 24, 2014
Metals in Sediment (Iron and Manganese)	Entire reservoir	• Iron oxide coatings on sediments are ubiquitous in the oxygenated environment • Weathering of geological formations • Discharge of surface and groundwater into the lake, followed by sedimentation • Organic and inorganic particulate matter	• Source of dissolved iron and manganese in water	• Collect additional data and re-evaluate
Depressed Dissolved Oxygen	Upper Attoyac Bayou arm Upper Ayish Bayou arm	• Vegetation in the lake, including invasive species • Point and Nonpoint sources of pollution • Nutrient loading into the reservoir	• Low Dissolved Oxygen levels may be harmful to the aquatic community	• Continue monitoring • Conduct 24-hour DO measurements and/or depth profiles • In the Upper Attoyac Bayou arm, the concern for DO was based on 4 of 28 samples below the DO grab screening level, with a mean exceedance of 3.94 mg/L • In the Upper Ayish Bayou arm, the concern for DO was based on 4 of 28 samples below the DO grab screening level, with a mean exceedance of 4.13 mg/L
Concern for pH	Upper Mid-Angelina River arm	• This concern was based on 4 of 29 samples exceeding the high pH criteria of 8.0 S.U., with a mean exceedance of 8.9 S.U. • The source is unknown	• Detrimental effect on aquatic biological community	• Continue monitoring
Concern for Ammonia-Nitrogen	Lower Angelina River arm Upper Mid-Angelina River arm Lower Attoyac Bayou arm Bear Creek arm Lower Ayish Bayou arm	• Municipal wastewater discharge • Nonpoint source pollution, such as failing septic systems • Stormwater runoff • Domestic animals and wildlife • Improper fertilizer use	• Detrimental effect on aquatic biological community	• Continue monitoring • Continued enforcement of on-site sewage facility regulations in the Sam Rayburn Reservoir Control Zone • Replacement or repair of failing septic systems around Sam Rayburn Reservoir and within close proximity of stream segments which flow into Sam Rayburn Reservoir

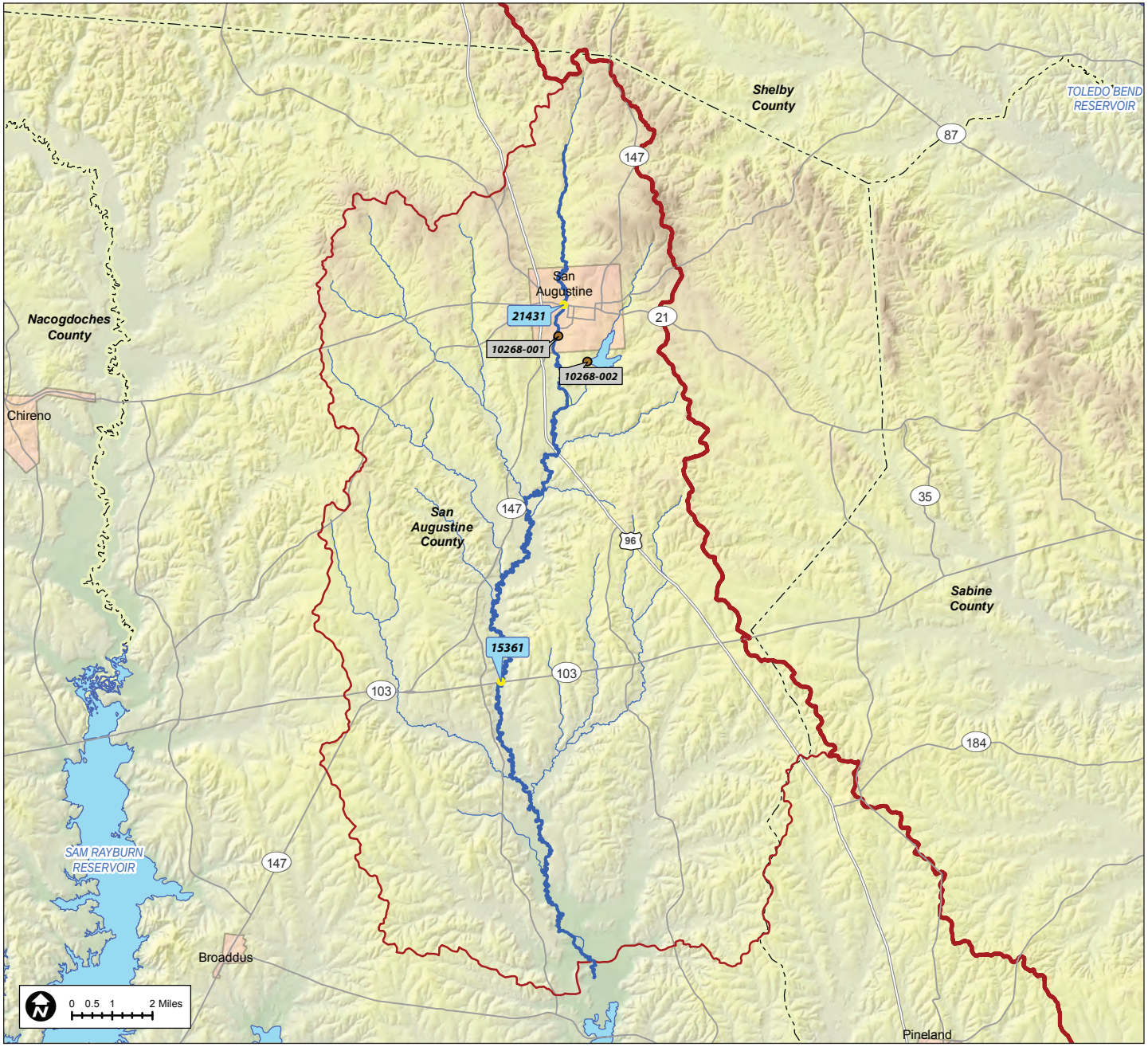
Segment 0610A - Ayish Bayou

Segment Profile

Ayish Bayou (Segment 0610A) is an unclassified 32 mile-length perennial freshwater stream extending from the confluence with Sam Rayburn Reservoir south of San Augustine in San Augustine County to the dam impounding Bland Lake, approximately 0.1 km upstream of FM 1279 near the City of San Augustine.

The Ayish Bayou watershed is 123,540 acres (193 sq. miles) and drains into the northeast arm of Sam Rayburn Reservoir. It is primarily situated in San Augustine County, but does extend very slightly into Sabine (903 acres) and Shelby (13 acres) Counties.

The City of San Augustine is the only incorporated city within the watershed and it is fully contained in the watershed.



Segment 0610A - Ayish Bayou

Assessment Units

Assessment Units in Segment 0610A - Ayish Bayou	
AU ID	**Description**
0610A_01	From the headwaters of Sam Rayburn Reservoir, per WQS App. D, about 2.4 km north of FM 83 upstream to confluence with unnamed tributary about 0.4 km SW of intersection of SH 147 and AT and SF Railroad at NHD RC 12020005000036.
0610A_02	From the confluence with unnamed tributary about 0.4 km SW of intersection of SH 147 and AT and SF Railroad in the City of San Augustine upstream to the Bland Lake dam, per WQS App. D.

Monitoring Stations

Monitoring Stations in Segment 0610A - Ayish Bayou									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0610A_01	15361	AYISH BAYOU AT SH 103 0.8 KM EAST OF FM 705	4	4	4	4			ANRA
0610A_02	21431	AYISH BAYOU AT WEST COLUMBIA STREET IN CITY OF SAN AUGUSTINE	4	4	4	4			ANRA

Description of Water Quality Issues

Site-Specific Uses and Criteria

Ayish Bayou has a designated High ALU and corresponding dissolved oxygen criteria of 5.0 mg/L (average)/3.0 mg/L (minimum) in Appendix D of the TSWQS. The perennial stream has a primary contact recreation use with a corresponding *E. coli* geometric mean criteria of 126 MPN/100 mL.

Impairments and Concerns

Ayish Bayou (Segment 0610A) is listed on the Draft 2014 303(d) List for not supporting primary contact recreation due to bacteria impairments. Both Assessment Units are listed as category 5b.

In AU 0610A_01, the geometric mean for *E. coli* exceeded the criterion of 126 MPN/100 mL with a value of 151.45 MPN/100 mL, based upon 27 samples assessed. A concern for Ammonia-Nitrogen that was identified in the 2012 assessment has been removed in the Draft 2014 assessment. A concern for depressed Dissolved Oxygen was also identified in the 2012 assessment, but there is no concern identified in the Draft 2014 assessment.

In AU 0610A_02, the geometric mean for *E. coli* exceeded the standard with a value of 223.99 MPN/100 mL, based upon 11 samples assessed.

Assessment Summary for Segment 0610A - Ayish Bayou as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	75 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.2**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0610A_01				NC	FS					**NS**	NC	NC	NC	NC
0610A_02										**NS**				

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0610A - Ayish Bayou

Monitoring Station 15361 - Ayish Bayou at SH 103

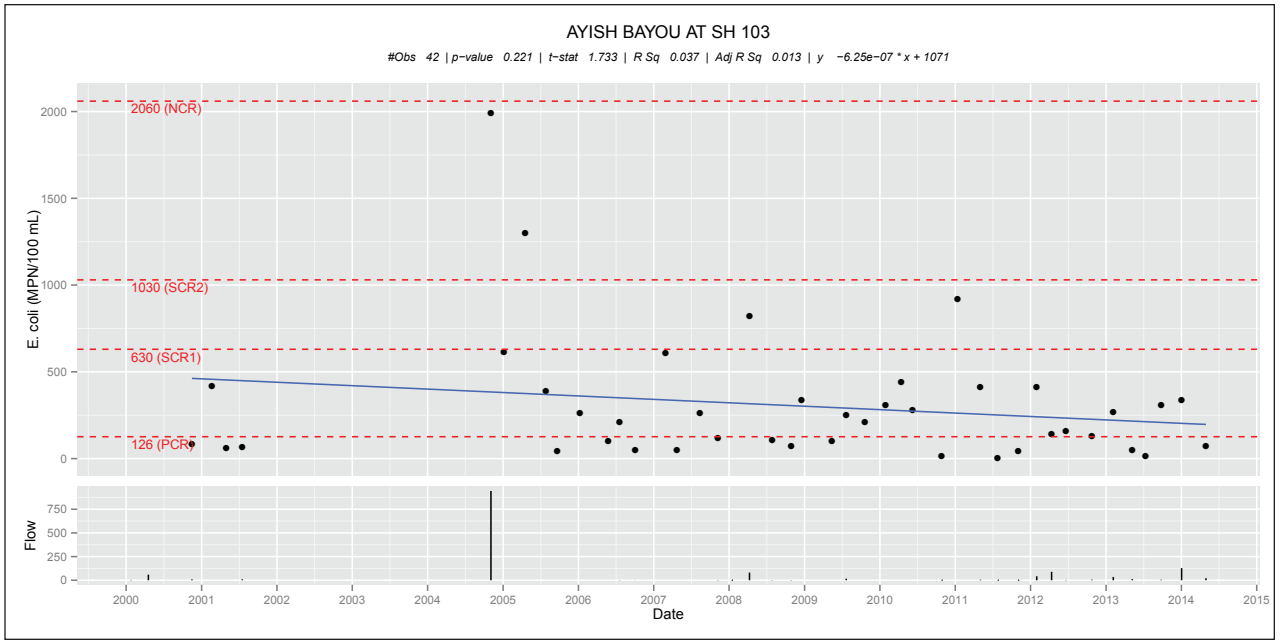
Located in AU 0610A_01, Monitoring Station ID 15361 is monitored quarterly for field and conventional parameters, flow, and *E. coli* bacteria. This monitoring station is located downstream of the City of San Augustine's wastewater treatment facility. The waterbody is effluent-dominated.

This AU, as well as AU 0610A_02, is listed as impaired for *E. coli* bacteria in the Draft 2014 assessment. While many values exceed the criteria established for Primary Contact Recreation, most results are below the criteria established for Secondary Contact Recreation. Ayish Bayou is currently being evaluated by TCEQ as part of the RUAA process to determine if a more appropriate contact recreation standard should be applied to the waterbody.

Statistical analysis of the water quality data for nutrient analyses shows significantly decreasing trends for Nitrate+Nitrite and Total Phosphorus A decreasing trend is also observed for Ammonia-Nitrogen, but the trend is not statistically significant and the data set contains numerous censored values (<LOQ). The decreasing trend is important though, as this AU had a concern for Ammonia-Nitrogen in the 2012 assessment, but is now listed as No Concern in the Draft 2014 assessment.

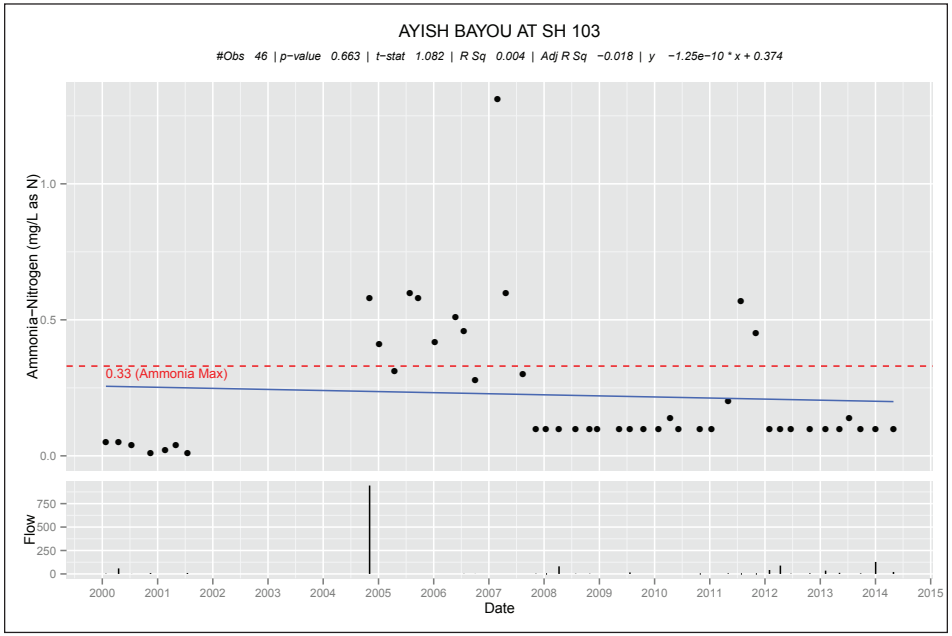
A statistically significant decreasing trend was also identified for pH. All values for pH are within criteria.

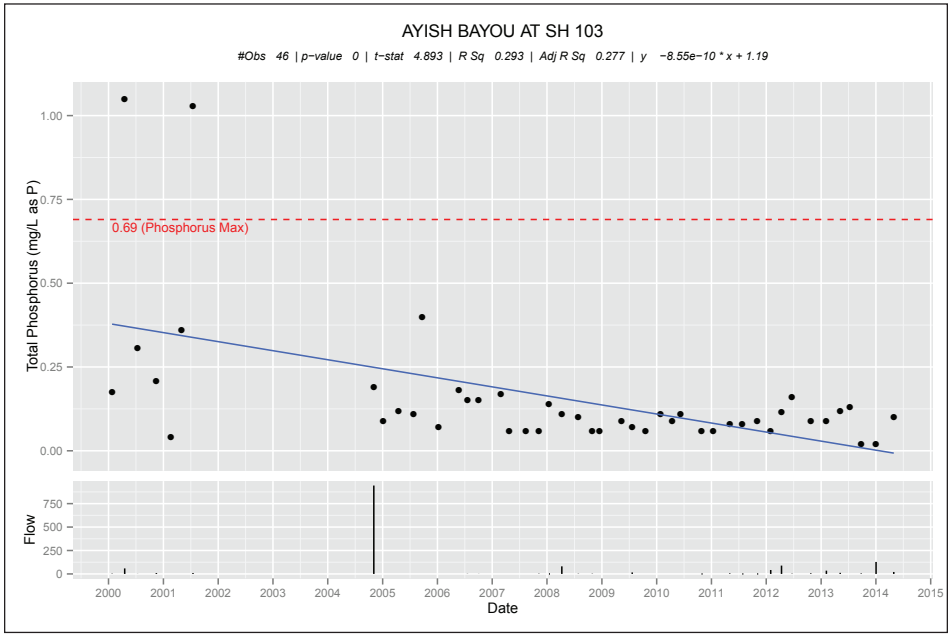
15361 - Ayish Bayou at SH 103



Segment 0610A - Ayish Bayou

Monitoring Station 15361 - Ayish Bayou at SH 103





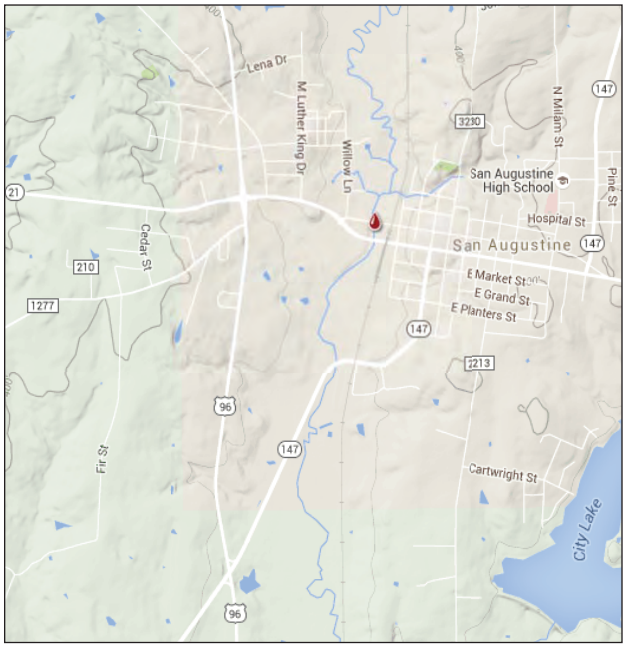
Water Quality Monitoring Results for Station 15361 - Ayish Bayou at SH 103

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	47	0	93	312	167.23		-1.0501	0.0002	
00300	Dissolved Oxygen (mg/L)	46	3	1.2	11.2	6.61		2.4691	0.5009	
00400	pH (S.U.)	45	1	6.2	8.7	7.30		13.8554	0.0289	↓
00530	Total Suspended Solids (mg/L)	46	0	1.33	75.7	16.66		0.4947	0.7392	
00610	Ammonia-Nitrogen (mg/L as N)	46	11	0.01	1.31	0.22		1.0821	0.6630	
00630	Nitrate + Nitrite (mg/L as N)	46	2	0.04	3.2	0.42		4.4220	0.0003	↓
00665	Total Phosphorus (mg/L as P)	46	2	0.02	1.048	0.16		4.8930	0.0001	↓
00940	Chloride (mg/L)	46	0	5	35	12.46		0.6906	0.2966	
00945	Sulfate (mg/L)	46	0	8.1	49.6	19.87		2.1619	0.5068	
31699	*E. coli* (MPN/100 mL)	42	25	2	1990		103.23	1.7329	0.2209	
32211+70953	Chlorophyll-*a* (µg/L)	38	3	2	34.9	4.96		-0.2885	0.5550	
70300	Total Dissolved Solids (mg/L)	46	0	81.3	270	120.56		0.4221	0.0139	

Segment 0610A - Ayish Bayou

Monitoring Station 21431 - Ayish Bayou at West Columbia Street in the City of San Augustine

In order to assess water quality in AU 0610_02, Monitoring Station 21431 was added in FY 2014. There is currently not enough monitoring data to perform trend analysis for this station.



21431 - Ayish Bayou at West Columbia Street

Water Quality Monitoring Results for Station 21431 - Ayish Bayou at West Columbia Street in the City of San Augustine

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	3	0	100	152	129.67				
00300	Dissolved Oxygen (mg/L)	3	0	7	11	8.80				
00400	pH (S.U.)	3	0	6	6.8	6.27				
00530	Total Suspended Solids (mg/L)	3	0	3.5	23.4	11.97				
00630	Nitrate + Nitrite (mg/L as N)	3	0	0.06	0.59	0.25				
00665	Total Phosphorus (mg/L as P)	3	0	0.02	0.1	0.05				
00940	Chloride (mg/L)	3	0	8.6	13.6	11.00				
00945	Sulfate (mg/L)	3	0	14	24.8	20.87				
31699	*E. coli* (MPN/100 mL)	3	3	180	490		338.56			
32211+70953	Chlorophyll-*a* (µg/L)	3	0	2	6.26	3.42				
70300	Total Dissolved Solids (mg/L)	3	0	92	112	99.33				

Segment 0610A - Ayish Bayou

Summary of Water Quality Trends

The following table summarizes the trend analysis for the Ayish Bayou watershed. Monitoring Station 21431 is not included due to monitoring not being conducted for a long enough time frame.

Trend Analysis Summary for Segment 0610A - Ayish Bayou

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Ayish Bayou	0610A_01	15361	Ayish Bayou at SH 103		↓									↓	↓
	0610A_02	21431	Ayish Bayou at West Columbia Street	Trend analysis not performed due to insufficient data.											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

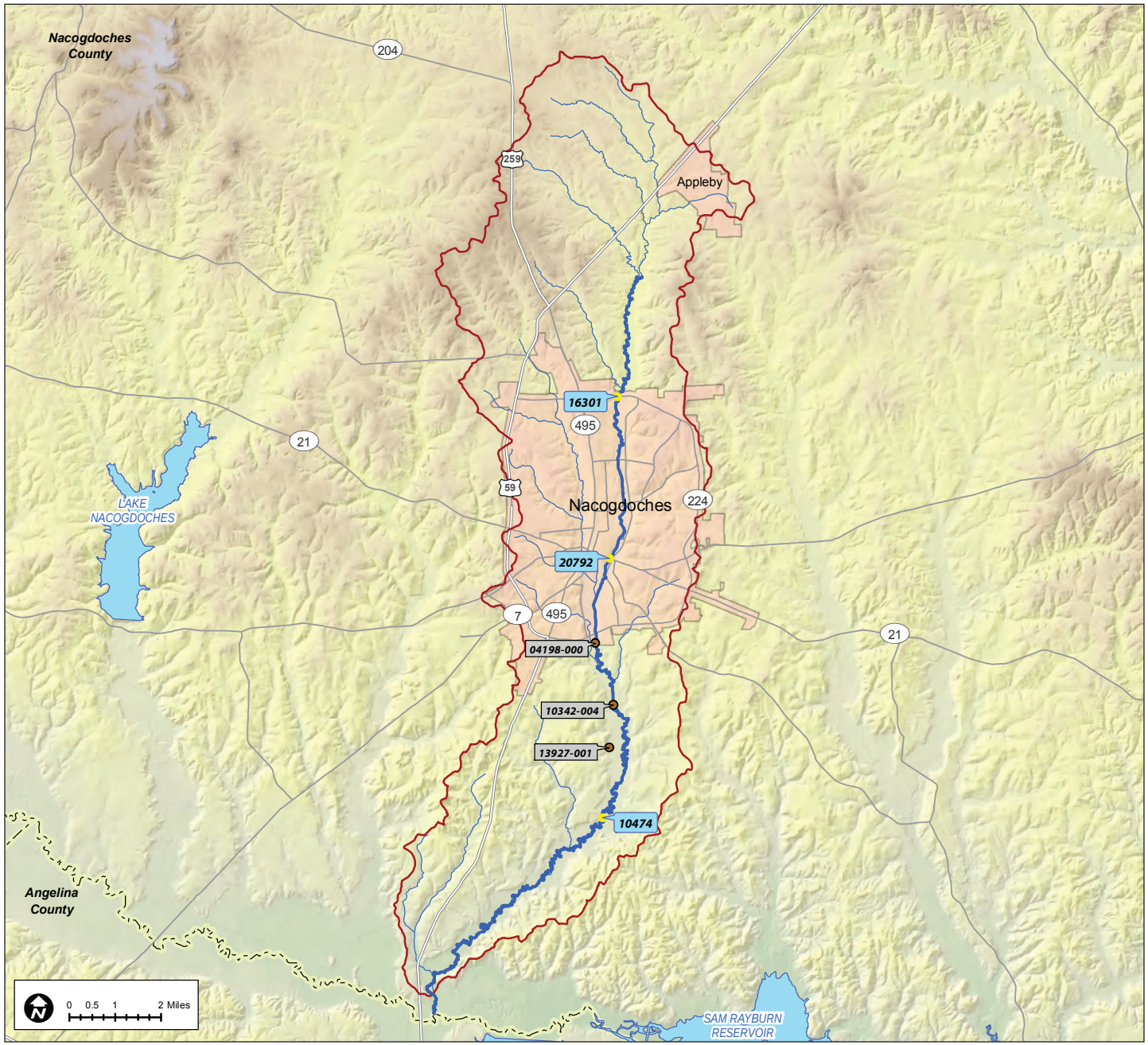
Water Quality Issues Summary for Segment 0610A - Ayish Bayou

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment for *E. coli* bacteria	Both assessment units	• Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Stormwater runoff • Failing (and non-existent) septic systems • Domestic animals and wildlife • Livestock and agricultural operations	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A RUAA is being conducted by TCEQ on this water body to determine if the most appropriate contact recreation standard is being applied
Decreasing trends for nutrient parameters (Ammonia-Nitrogen, Nitrate-Nitrogen, and Total Phosphorus)	AU 0610A_01 (lower assessment unit)	• The reduction in nutrient parameters is most likely due to improvements with the sewage collection system and wastewater treatment facility in the City of San Augustine	• Improvements in water quality are beneficial to the aquatic biological community	• Continue monitoring • Continue improvements to City of San Augustine's sewage collection system and wastewater treatment facility

Segment 0611B - La Nana Bayou

Segment Profile

La Nana Bayou (Segment 0611B) is a 32 mile freshwater stream that extends from the confluence of the Angelina River south of Nacogdoches in Nacogdoches County to the upstream perennial portion of the stream north of Nacogdoches in Nacogdoches County.



Segment 0611B - La Nana Bayou

Assessment Units

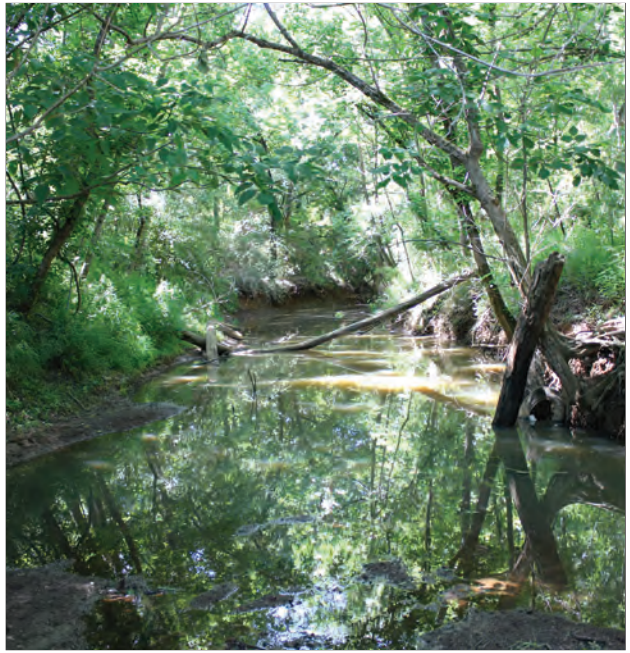
Assessment Units in Segment 0611B - La Nana Bayou	
AU ID	**Description**
0611B_01	From the confluence with Angelina River (0611), per WQS App. D, upstream to State Loop 224 in City of Nacogdoches.
0611B_02	From the upstream side of State Loop 224 upstream to FM 1878 in City of Nacogdoches, per WQS App. D.
0611B_03	From the upstream side of FM 1878 in City of Nacogdoches upstream to confluence with Banita Creek.

Monitoring Stations

Monitoring Stations in Segment 0611B - La Nana Bayou									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0611B_01	10474	LA NANA BAYOU AT NACOGDOCHES CR 526 6.9 MI SOUTH OF NACOGDOCHES BETWEEN FM 2863 AND FM 3228	4	4	4	4			ANRA
0611B_02	20792	LA NANA BAYOU IMMEDIATELY UPSTREAM OF EAST MAIN STREET/STATE HIGHWAY 7/ STATE HIGHWAY 21 IN NACOGDOCHES	4	4	4	4			ANRA
0611B_03	16301	LA NANA BAYOU AT LOOP 224 NORTH IN THE CITY OF NACOGDOCHES 1.2 KM EAST OF THE INTERSECTION OF US BUS 59F/ST LOOP 224 NORTH	4	4	4	4			ANRA

10474 - La Nana Bayou at CR 526

20792 - La Nana Bayou at East Main Street



16301 - La Nana Bayou at Loop 224N

Segment 0611B - La Nana Bayou

Description of Water Quality Issues

Site-Specific Uses and Criteria

La Nana Bayou has a designated Intermediate ALU and corresponding dissolved oxygen criteria of 4.0 mg/L in Appendix D of the TSWQS. The perennial stream has a primary contact recreation use with a corresponding *E. coli* geometric mean criteria of 126 MPN/100 mL.

Impairments and Concerns

La Nana Bayou is listed on the Draft 2014 303(d) List for not supporting primary contact recreation due to *E. coli* bacteria impairments. In AU 0611B_01, the geometric mean for *E. coli* exceeded the criterion of 126 MPN/100 mL with a value of 261.29 MPN/100 mL, based upon 51 samples assessed. In AU 0611B_02, the geometric mean for *E. coli* exceeded the standard with a value of 504.26 MPN/100 mL, based upon 44 samples assessed. In AU 0611B_03, a concern of *E. coli* bacteria was indicated, with a geometric mean of 170.07 MPN/100 mL, based on 13 samples. Concerns for Ammonia-Nitrogen, Nitrate+Nitrite, and Total Phosphorus are also present in AU 0611B_01.

Assessment Summary for Segment 0611B - La Nana Bayou as listed in the Draft 2014 Texas Integrated Report

AU	Chloride	Sulfate	TDS	DO Grab Screening Level	DO Grab Minimum	24 Hour DO Average	24 Hour DO Minimum	pH	Temp (C)	*E. coli* geomean	Ammonia Nitrogen	Nitrate Nitrogen	Total Phosphorus	Chl-*a*
	125 mg/L	50 mg/L	250 mg/L	4.00 mg/L	3.00 mg/L	5.00 mg/L	3.00 mg/L	6.0 - 8.5 SU	32.2	126 MPN /100 mL	0.33 mg/L	1.95 mg/L	0.69 mg/L	14.1 µg/L
0611B_01				NC	FS					**NS**	CS	CS	CS	NC
0611B_02				NC	FS					**NS**	NC	NC	NC	NC
0611B_03				NC	FS	NA	NA			CN	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Flow Measurement at Monitoring Station 16301 - La Nana Bayou at Loop 224N

Segment 0611B - La Nana Bayou

Monitoring Station 10474 - La Nana Bayou at CR 526

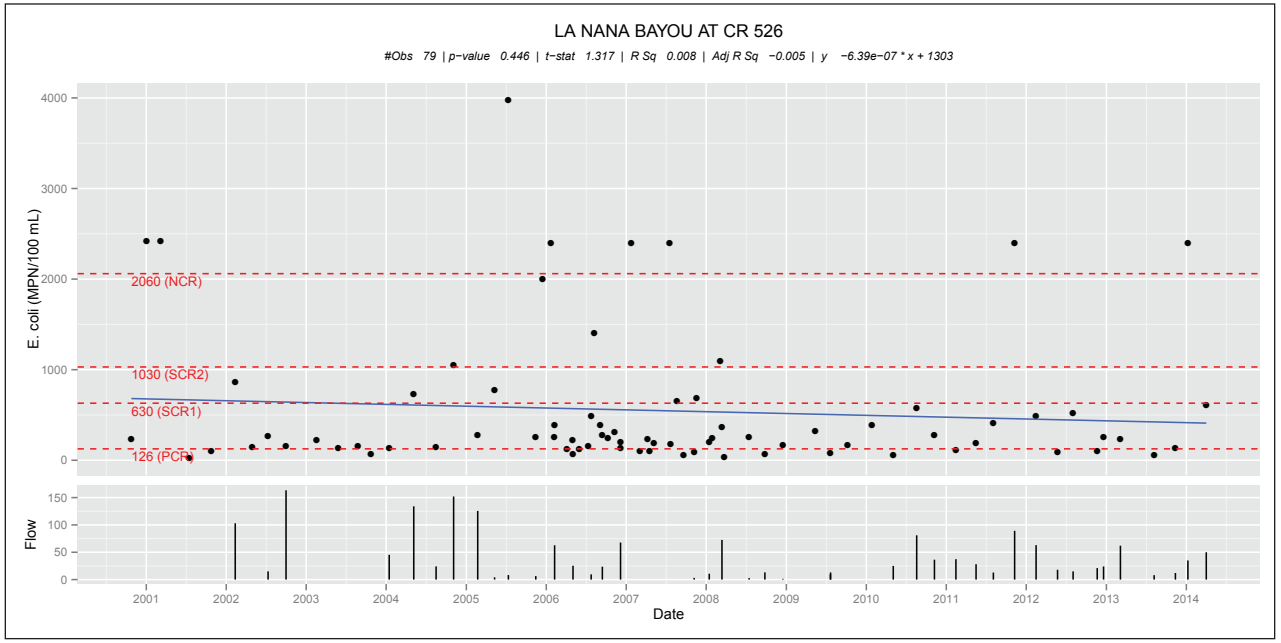
Located in AU 0611B_01, Monitoring Station ID 10474 is monitored quarterly for field and conventional parameters, flow, and *E. coli* bacteria. This monitoring station is located 6.9 miles south of Nacogdoches at CR 526.

This AU, as well as AU 0610A_02, is listed as impaired for *E. coli* bacteria in the Draft 2014 assessment.

This assessment unit has concerns for Ammonia-Nitrogen, Nitrate+Nitrite, and Total Phosphorus. Statistical analysis of the water quality data for the nutrient parameters shows an increasing trend for Nitrate+Nitrite, although the trend is not significant. A decreasing trend for Total Phosphorus is observed, but it is not statistically significant.

A decreasing trend for Chlorophyll-*a* is due to results reported at or below the limit of quantitation.

For Total Dissolved Solids, 17 of 58 samples exceeded 250 mg/L.

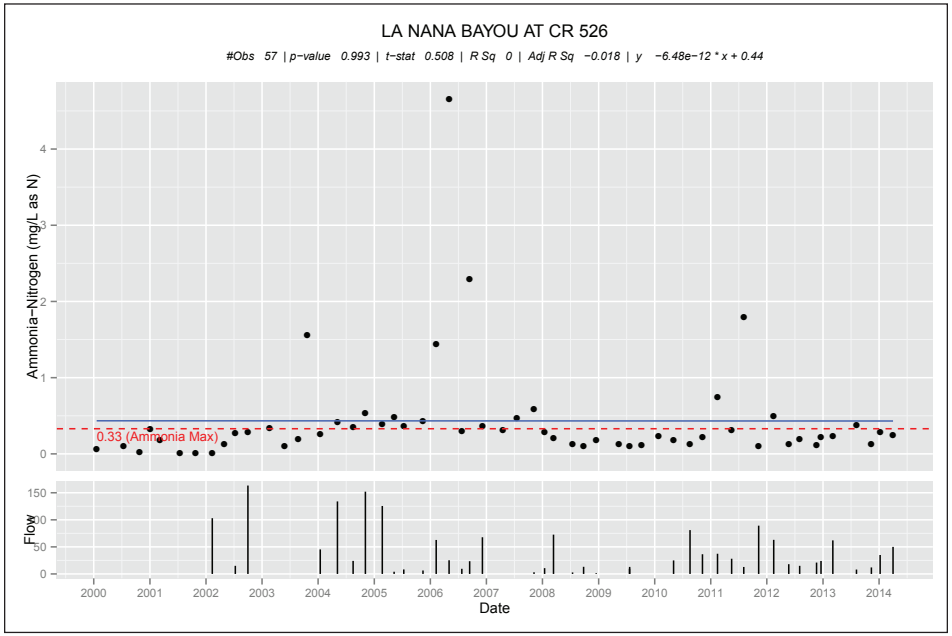


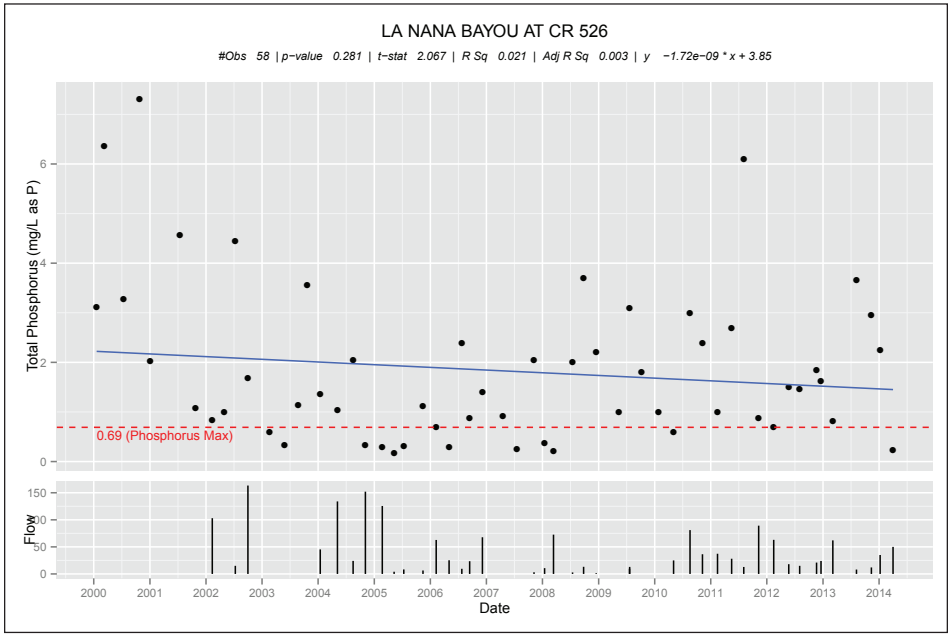
Water Quality Monitoring Results for Station 10474 - La Nana Bayou at CR 526

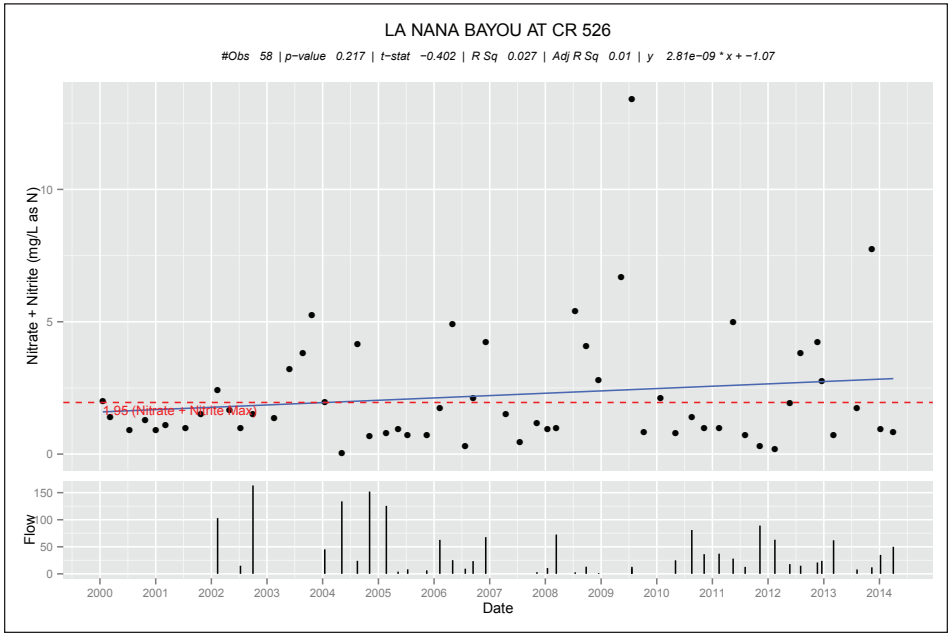
Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	58	0	135	632	357.74		0.6220	0.0753	
00300	Dissolved Oxygen (mg/L)	56	1	2.8	13.4	7.33		2.3968	0.7190	
00400	pH (S.U.)	55	2	6.5	9.4	7.26		13.3857	0.8419	
00530	Total Suspended Solids (mg/L)	58	0	2.8	340	16.30		-0.6610	0.3298	
00610	Ammonia-Nitrogen (mg/L as N)	57	19	0.01	4.65	0.43		0.5080	0.9930	
00630	Nitrate + Nitrite (mg/L as N)	58	21	0.04	13.4	2.23		-0.4019	0.2166	
00665	Total Phosphorus (mg/L as P)	58	44	0.17	7.3	1.83		2.0673	0.2806	
00940	Chloride (mg/L)	58	0	9.7	100	46.21		0.4012	0.1628	
00945	Sulfate (mg/L)	58	7	8.9	108	40.81		0.7364	0.0991	
31699	*E. coli* (MPN/100 mL)	79	60	29.8	3972		257.56	1.3165	0.4462	
32211+70953	Chlorophyll-*a* (µg/L)	42	2	2	54.7	4.99		3.5656	0.0023	
70300	Total Dissolved Solids (mg/L)	58	17	87	364	214.53		0.9339	0.0854	

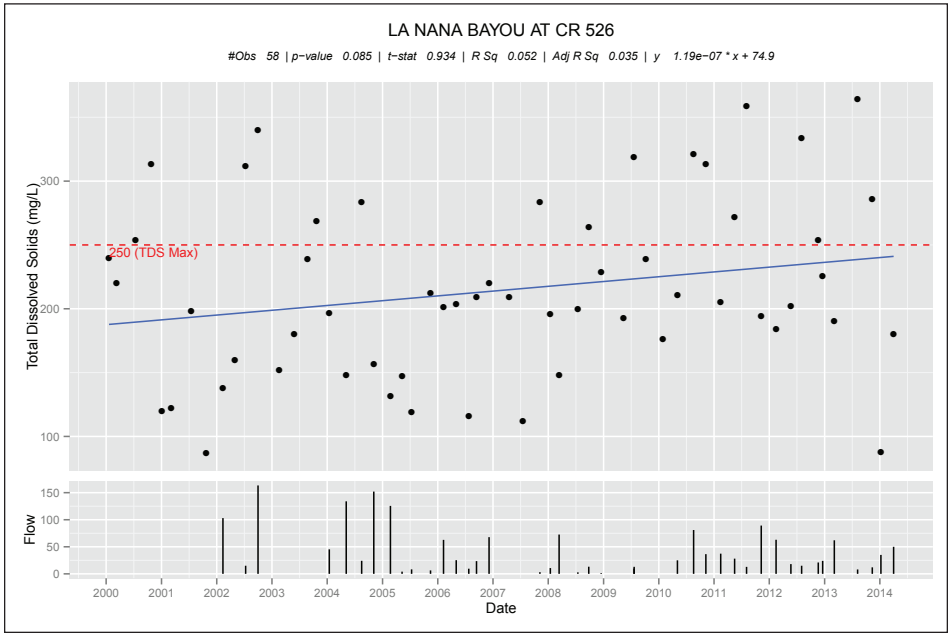
Segment 0611B - La Nana Bayou

Monitoring Station 10474 - La Nana Bayou at CR 526









Segment 0611B - La Nana Bayou

Monitoring Station 20792 - La Nana Bayou at East Main Street

Located in AU 0611B_02, Monitoring Station ID 20792 is monitored quarterly for field and conventional parameters, flow, and *E. coli* bacteria. Because there are less than 20 samples, any trends at this station are not considered to be statistically significant.

Water Quality Monitoring Results for Station 20792 - La Nana Bayou at East Main Street

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	15	0	171	370	267.60		1.3794	0.3805	
00300	Dissolved Oxygen (mg/L)	15	0	3.4	13	8.20		-0.6504	0.3652	
00400	pH (S.U.)	15	0	6.4	7.8	7.04		7.5835	0.0004	
00530	Total Suspended Solids (mg/L)	15	0	2.5	44	10.73		2.4049	0.0375	
00610	Ammonia-Nitrogen (mg/L as N)	15	1	0.1	0.54	0.15		-0.0113	0.9004	
00630	Nitrate + Nitrite (mg/L as N)	15	0	0.04	0.65	0.26		-0.4301	0.5756	
00665	Total Phosphorus (mg/L as P)	15	0	0.03	0.1	0.06		2.7973	0.0310	
00940	Chloride (mg/L)	15	0	9.3	23.4	16.03		-1.2778	0.1088	
00945	Sulfate (mg/L)	15	0	22	49.4	35.29		-1.6638	0.0515	
31699	*E. coli* (MPN/100 mL)	15	11	23	2400		241.26	0.9164	0.4117	
32211+70953	Chlorophyll-*a* (µg/L)	15	0	2	3.1	2.16		0.6418	0.9690	
70300	Total Dissolved Solids (mg/L)	15	0	74	207	154.93		1.4835	0.3181	

Monitoring Station 16301 - La Nana Bayou at Loop 224N

Located in AU 0611B_03, Monitoring Station ID 16301 is monitored quarterly for field and conventional parameters, flow, and *E. coli* bacteria. Because of a gap in data from 2000 to 2008, any trends at this station are not considered to be statistically significant.

Water Quality Monitoring Results for Station 16301- La Nana Bayou at Loop 224N

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	25	0	161	354	227.96		1.0759	0.2196	
00300	Dissolved Oxygen (mg/L)	25	2	1.3	13	6.94		-0.0872	0.2251	
00400	pH (S.U.)	25	2	5.7	7.9	7.08		9.6235	0.0332	
00530	Total Suspended Solids (mg/L)	25	0	1.2	95	12.84		-0.1788	0.6186	
00610	Ammonia-Nitrogen (mg/L as N)	24	1	0.03	0.37	0.11		-0.7154	0.1562	
00630	Nitrate + Nitrite (mg/L as N)	25	0	0.04	1.3	0.29		3.3388	0.0095	
00665	Total Phosphorus (mg/L as P)	25	1	0.02	0.8	0.13		3.5743	0.0047	
00940	Chloride (mg/L)	25	0	5	23.7	12.18		0.8480	0.7030	
00945	Sulfate (mg/L)	25	3	9	67	34.91		0.0112	0.2226	
31699	*E. coli* (MPN/100 mL)	22	17	4	2400		179.99	0.1096	0.9800	
32211+70953	Chlorophyll-*a* (µg/L)	22	2	2	71.4	6.99		-0.1434	0.8246	
70300	Total Dissolved Solids (mg/L)	25	0	89.3	236	140.69		2.0425	0.8733	

Segment 0611B - La Nana Bayou

Summary of Water Quality Trends

Although there was an increasing trend for Nitrate-N and a decreasing trend for Total Phosphorus in AU 0611B_01, neither trend was statistically significant. For the monitoring station in AU 0611B_02, there was an insufficient number of samples to perform statistical evaluation. There was a gap in monitoring for AU 0611B_03, so trends for that assessment unit are not considered to be statistically significant.

The following table summarizes the trend analysis for the La Nana Bayou watershed.

Trend Analysis Summary for Segment 0611B - La Nana Bayou

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
La Nana Bayou	0611B_01	10474	La Nana Bayou at CR 526	No trends were statistically significant.											
	0611B_02	20792	La Nana Bayou at E. Main Street	Insufficient samples for statistical analysis.											
	0611B_03	16301	La Nana Bayou at Loop 224N	Gap in data from 2000 to 2008.											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0611B - La Nana Bayou

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairments and concerns for *E. coli* bacteria	Entire waterbody Impairments in AU 0611B_01 and AU 0611B_02; concern in AU 0611B_03	• Municipal wastewater discharge • Nonpoint sources of pollution • Stormwater runoff	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring
Concern for Ammonia-Nitrogen	AU 0611B_01 (lower assessment unit)	• Municipal wastewater discharge • Nonpoint sources of pollution • Stormwater runoff	• Detrimental effect on aquatic biological community	• Continue monitoring • Evaluate wastewater effluent permit limits
Concern for Nitrate-Nitrogen	AU 0611B_01 (lower assessment unit)	• Municipal wastewater discharge • Nonpoint sources of pollution • Stormwater runoff	• Detrimental effect on aquatic biological community	• Continue monitoring • Evaluate wastewater effluent permit limits
Concern for Total Phosphorus	AU 0611B_01 (lower assessment unit)	• Municipal wastewater discharge • Nonpoint sources of pollution • Stormwater runoff	• Can increase production of algae • Algae production can cause swings in dissolved oxygen, which can be detrimental to the aquatic biological community	• Continue monitoring • Evaluate wastewater effluent permit limits

Segment 0612 - Attoyac Bayou

Segment Profile

The Attoyac Bayou is 92 miles long from the intermittent headwaters, all the way downstream to the riverine portion of Sam Rayburn Reservoir just north of where the Attoyac arm of Sam Rayburn crosses SH 103. The area surrounding the watershed is managed for agricultural (cattle and poultry), silvicultural, recreational, and wildlife uses.

The Attoyac Bayou flows from the north into Sam Rayburn Reservoir. Its watershed encompasses slightly more than 364,350 acres (569 square miles) and includes portions of four counties. Rusk and Nacogdoches County are on the west and Shelby and San Augustine County to the east. Approximately two thirds of the border between Rusk and Shelby Counties is demarcated by the Attoyac Bayou, as well as the entire shared border between Nacogdoches and Shelby Counties, and the shared border between Nacogdoches and San Augustine Counties.

Segment 0612 - Attoyac Bayou

Assessment Units

Assessment Units in Segment 0612 - Attoyac Bayou	
AU ID	**Description**
0612_01	From the lower boundary approximately at confluence with Granberry Branch upstream to confluence with Polly Branch.
0612_02	From a point immediately upstream of Polly Branch confluence upstream to confluence with Bear Bayou.
0612_03	From a point immediately upstream of Bear Bayou upstream to upper boundary at FM 95.

Monitoring Stations

Monitoring Stations in Segment 0612 - Attoyac Bayou									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0612_01	10636	ATTOYAC BAYOU AT SH 21 0.71 KM WEST OF INTERSECTION OF SH 21/ FM 1196 4.77 KM EAST OF CHIRENO	4	4	4	4			ANRA
0612_02	15253	ATTOYAC BAYOU AT SH 7 1.75 KM NORTHEAST OF MARTINSVILLE	4	4	4	4			ANRA
0612_03	16076	ATTOYAC BAYOU AT US 59 4.12 KM NORTHEAST OF GARRISON	4	4	4	4			ANRA

ANRA is currently monitoring at an additional station (20841 - Attoyac Bayou at FM 138). This station is part of a Clean Water Act Section 319 grant. Since the monitoring is not routine and is biased to assess the implementation of best management practices listed in the Attoyac Bayou Watershed Protection Plan, this data will not be presented in the Basin Summary Report.

10636 - Attoyac Bayou at SH 21

15253 - Attoyac Bayou at SH 7

Bridge Crossing at 16076 - Attoyac Bayou at US 59

Segment 0612 - Attoyac Bayou

Description of Water Quality Issues

Site-Specific Uses and Criteria

Attoyac Bayou has a designated Public Water Supply use and a High ALU and corresponding DO criteria. Attoyac Bayou also has a designated contact recreation use with a corresponding *E. coli* geometric mean criteria of 126 MPN/100 mL.

Impairments and Concerns

Attoyac Bayou (Segment 0612) is listed on the Draft 2014 303(d) List for not supporting primary contact recreation due to bacteria impairments. All three Assessment Units are listed as category 5b, and were first listed in 2004.

In AU 0612_01, the geometric mean for *E. coli* exceeded the standard of 126 MPN/100 mL, with a value of 178.54 MPN/100 mL based upon 71 samples assessed from the period of 12/1/2005 to 11/20/2012. In the prior 2012 assessment, this AU had a geometric mean of 235.67 MPN/100 mL, based upon 35 samples assessed. The 2014 Draft Integrated Report included additional data from intensive monitoring conducted as part of a project to develop a watershed protection plan for the Attoyac Bayou. The additional water quality monitoring data from this project was not available for the 2012 assessment.

In AU 0612_02, the geometric mean for *E. coli* exceeded the standard of 126 MPN/100 mL with a value of 195.04 MPN/100 mL based upon an assessment of 115 samples in the Draft 2014 Integrated Report. As with AU 0612_01, this assessment period included additional monitoring from the Attoyac Bayou RUAA and WPP project, with the bacteria geomean being lower than that reported for the 2012 assessment (234.00 MPN/100 mL, based upon 48 samples assessed). This AU also had a concern for depressed Dissolved Oxygen, with 17 of 100 values below the screening level of 5.0 mg/L. In the 2012 assessment, this AU had a concern for Ammonia-Nitrogen, with 14 of 48 samples exceeding the criteria of 0.33 mg/L. Based upon the data assessed for the Draft 2014 Integrated Report, this AU is now fully supporting for Ammonia-Nitrogen, with only 14 of 119 values exceeding the criteria.

In AU 0612_03, the geometric mean for *E. coli* exceeded the standard of 126 MPN/100 mL with a value of 147.25 MPN/100 mL based upon 109 samples assessed in the Draft 2014 assessment. This compares to a geomean of 288.18 MPN/100 mL (based upon 60 samples) in the 2012 assessment. This AU also had a concern for depressed Dissolved Oxygen, with 24 of 67 values below the screening level of 5.0 mg/L. A concern for Ammonia-Nitrogen was also identified for this AU, with 29 of 98 samples exceeding the nutrient screening level of 0.33 mg/L.

Freshwater Mussel at Station 15253 - Attoyac Bayou at SH 7

Assessment Summary for Segment 0612 - Attoyac Bayou as listed in the Draft 2014 Texas Integrated Report

AU	Chloride	Sulfate	TDS	DO Grab Screening Level	DO Grab Minimum	24 Hour DO Average	24 Hour DO Minimum	pH	Temp (C)	*E. coli* geomean	Ammonia Nitrogen	Nitrate Nitrogen	Total Phosphorus	Chl-*a*
	75 mg/L	50 mg/L	200 mg/L	5.00 mg/L	3.00 mg/L			6.0 - 8.5 SU	32.2	126 MPN /100 mL	0.33 mg/L	1.95 mg/L	0.69 mg/L	14.1 µg/L
0612_01	FS	FS	FS	NC	FS			FS	FS	**NS**	NC	NC	NC	NC
0612_02	FS	FS	FS	CS	FS			FS	FS	**NS**	NC	NC	NC	NC
0612_03	FS	FS	FS	CS	FS			FS	FS	**NS**	CS	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

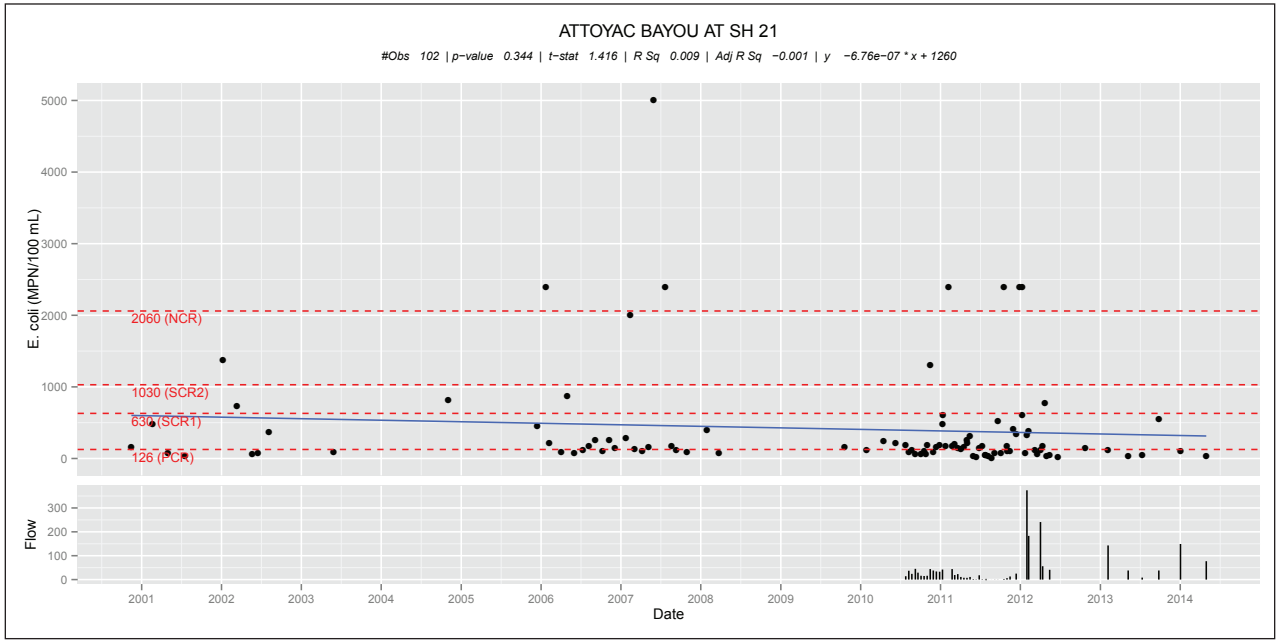
Segment 0612 - Attoyac Bayou

Monitoring Station 10636 - Attoyac Bayou at SH 21

Monitoring Station 10636 is located in AU_0612_01. ANRA monitors this station quarterly for field and conventional parameters, flow, and *E. coli* bacteria.

This AU is listed as impaired for *E. coli* bacteria. No other impairments or concerns are identified for this AU in the Draft 2014 Integrated Report. *E. coli* results for this segment are typically above standard for Primary Contact Recreation, but below the standard for Secondary Contact Recreation.

Trends for this station are not considered to be statistically significant due to a gaps in the data set from periods when this station was not being routinely monitored.



Water Quality Monitoring Results for Station 10636 - Attoyac Bayou at SH 21

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	78	0	86	278	145.24		-0.8148	0.0000	
00300	Dissolved Oxygen (mg/L)	77	0	3.5	12.3	7.90		3.8399	0.7606	
00400	pH (S.U.)	78	7	6.34	8.9	7.64		10.6483	0.1977	
00530	Total Suspended Solids (mg/L)	82	0	2.9	176	35.84		0.1176	0.3462	
00610	Ammonia-Nitrogen (mg/L as N)	82	1	0.01	0.71	0.10		-0.2586	0.1528	
00630	Nitrate + Nitrite (mg/L as N)	77	2	0.04	5.4	0.54		6.7305	0.0000	
00665	Total Phosphorus (mg/L as P)	82	2	0.02	1.622	0.18		5.0334	0.0001	
00940	Chloride (mg/L)	34	0	6	44	12.44		1.0928	0.6738	
00945	Sulfate (mg/L)	34	1	6	68.1	24.64		0.8469	0.5406	
31699	*E. coli* (MPN/100 mL)	102	58	13	5000		182.08	1.4156	0.3439	
32211+70953	Chlorophyll-*a* (µg/L)	25	0	0.995	10	3.81		6.4594	0.0000	
70300	Total Dissolved Solids (mg/L)	34	0	54	156	111.90		1.0740	0.0048	

Segment 0612 - Attoyac Bayou

Monitoring Station 15253 - Attoyac Bayou at SH 7

Monitoring Station ID 15253 is located in AU_0612_02. ANRA monitors this station quarterly for field and conventional parameters, flow, and *E. coli* bacteria.

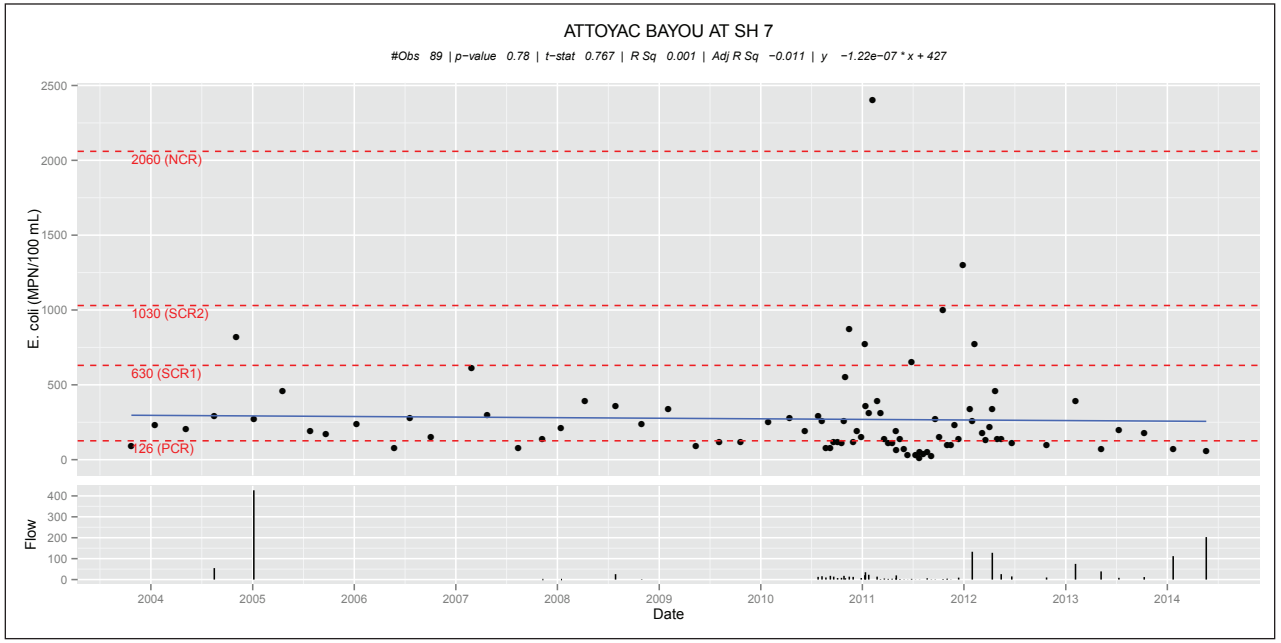
This AU is listed as impaired for *E. coli* bacteria. A concern for depressed Dissolved Oxygen is also identified for this AU in the Draft 2014 Integrated Report.

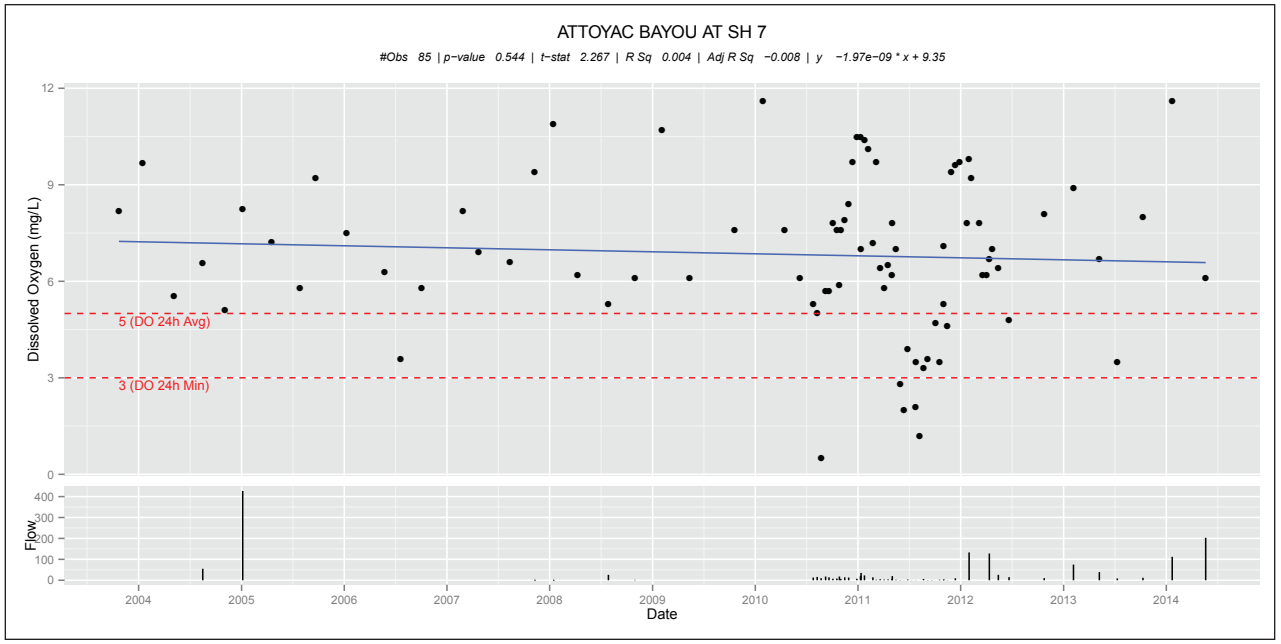
For nutrient parameters, there is a decreasing trend for Ammonia-Nitrogen. However, the dataset contains >50% censored data (values below the LOQ). In the 2012 assessment, this segment had a concern for Ammonia-Nitrogen. This concern is no longer listed in the Draft 2014 assessment. Statistically significant decreasing trends were also observed for Nitrate+Nitrite and Total Phosphorus.

A statistically significant increasing trend is observed for pH. Specific Conductance and Total Dissolved Solids also demonstrate increasing trends, but neither trend is statistically significant.

This monitoring station was sampled extensively in 2011 and 2012 as part of the Attoyac Bayou WPP project. The monitoring regime for this project included biweekly sampling (compared to quarterly monitoring during the rest of the period of record). This intensive monitoring also occurred during a time of severe drought. The reduction in flow during this period of drought could play a significant role in the results being observed, particularly the changes being seen with Specific Conductance, Total Dissolved Solids, and pH.

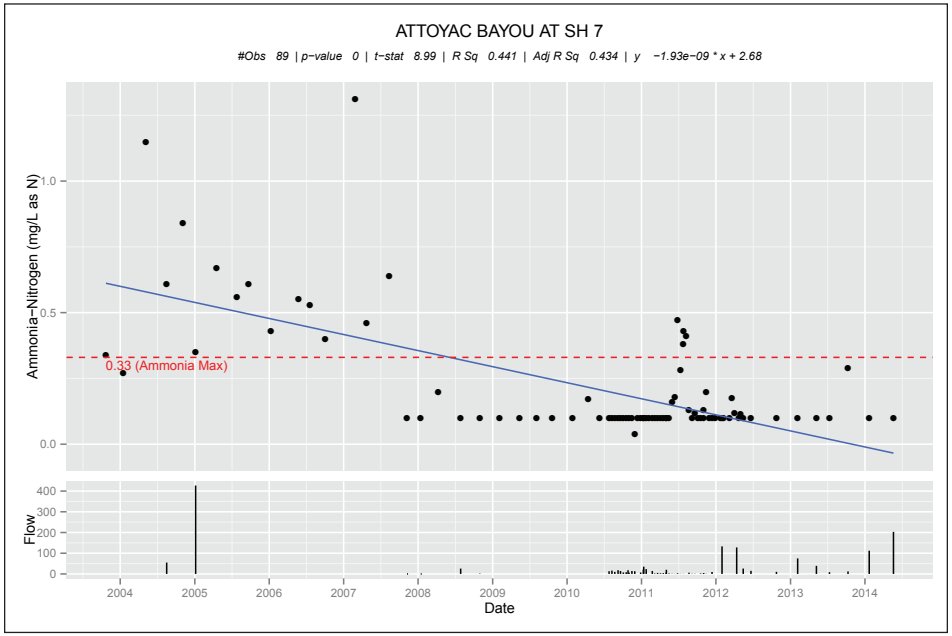
A decreasing trend for Chlorophyll-*a* is due to a reduction in the limit of quantitation and is therefore not considered to be statistically significant.

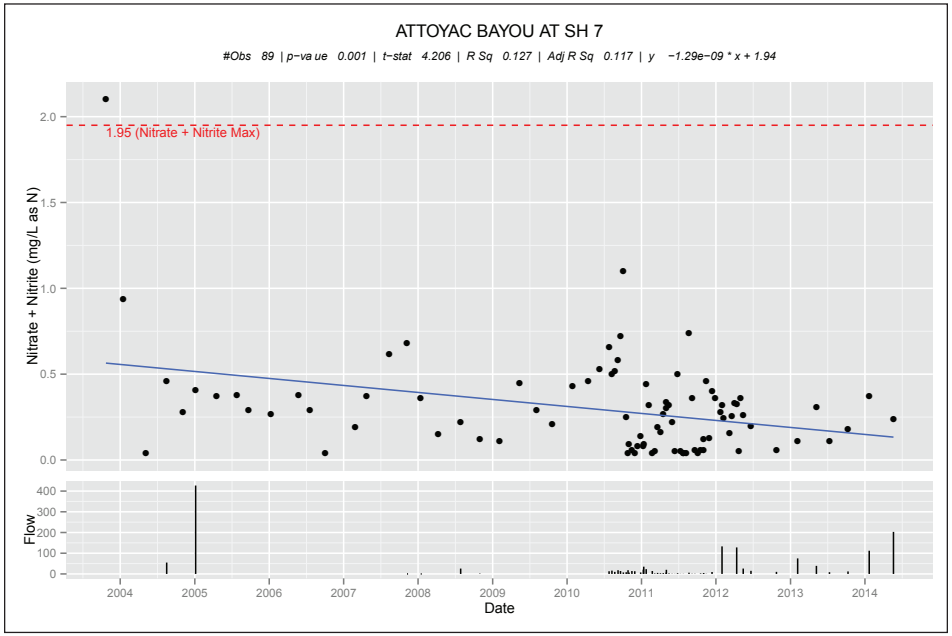


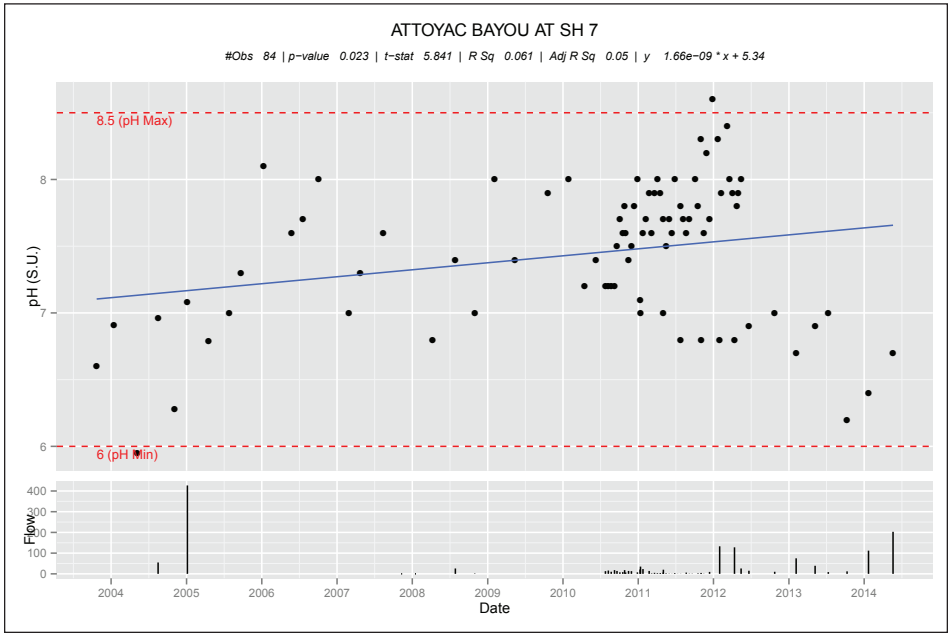


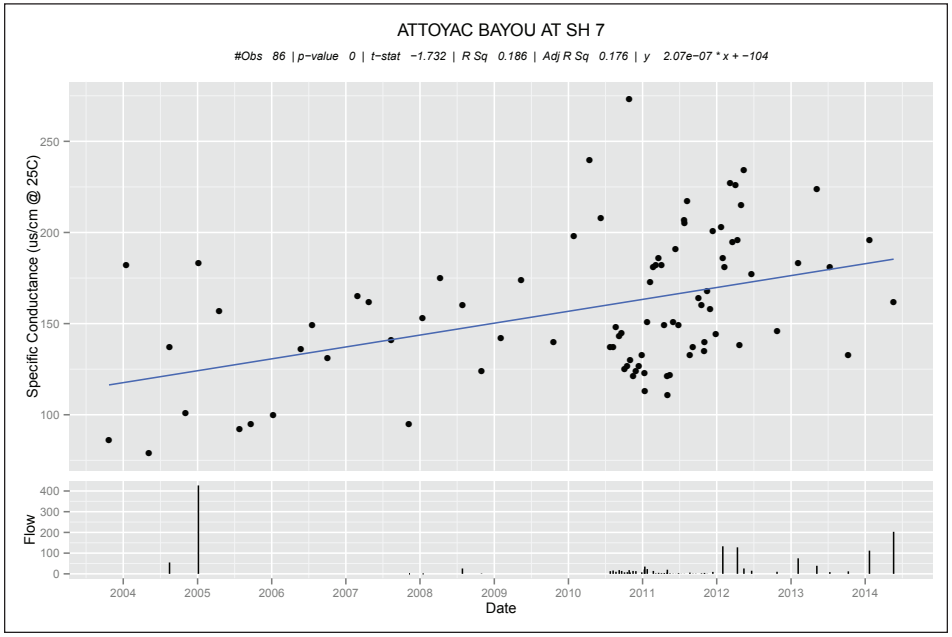
Segment 0612 - Attoyac Bayou

Monitoring Station 15253 - Attoyac Bayou at SH 7









Segment 0612 - Attoyac Bayou

Monitoring Station 15253 - Attoyac Bayou at SH 7

Water Quality Monitoring Results for Station 15253 - Attoyac Bayou at SH 7										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	86	0	79	273	158.51		-1.7316	0.0000	
00300	Dissolved Oxygen (mg/L)	85	5	0.5	11.6	6.84		2.2674	0.5439	
00400	pH (S.U.)	84	2	5.95	8.6	7.44		5.8409	0.0233	↑
00530	Total Suspended Solids (mg/L)	89	0	1	280	34.13		-0.5501	0.2740	
00610	Ammonia-Nitrogen (mg/L as N)	89	19	0.04	1.31	0.22		8.9897	0.0000	↓
00630	Nitrate + Nitrite (mg/L as N)	89	1	0.04	2.1	0.30		4.2062	0.0006	↓
00665	Total Phosphorus (mg/L as P)	89	0	0.04	0.427	0.18		3.9620	0.0084	↓
00940	Chloride (mg/L)	43	0	5.6	24	13.64		-0.2955	0.0452	
00945	Sulfate (mg/L)	43	1	9.4	64.9	22.27		0.0334	0.3675	
31699	*E. coli* (MPN/100 mL)	89	58	14	2400		180.37	0.7666	0.7805	
32211+70953	Chlorophyll-*a* (µg/L)	42	1	2	14.3	4.34		5.4669	0.0000	
70300	Total Dissolved Solids (mg/L)	43	0	81.3	183	120.19		0.5546	0.0420	

15253 - Attoyac Bayou at SH 7

Segment 0612 - Attoyac Bayou

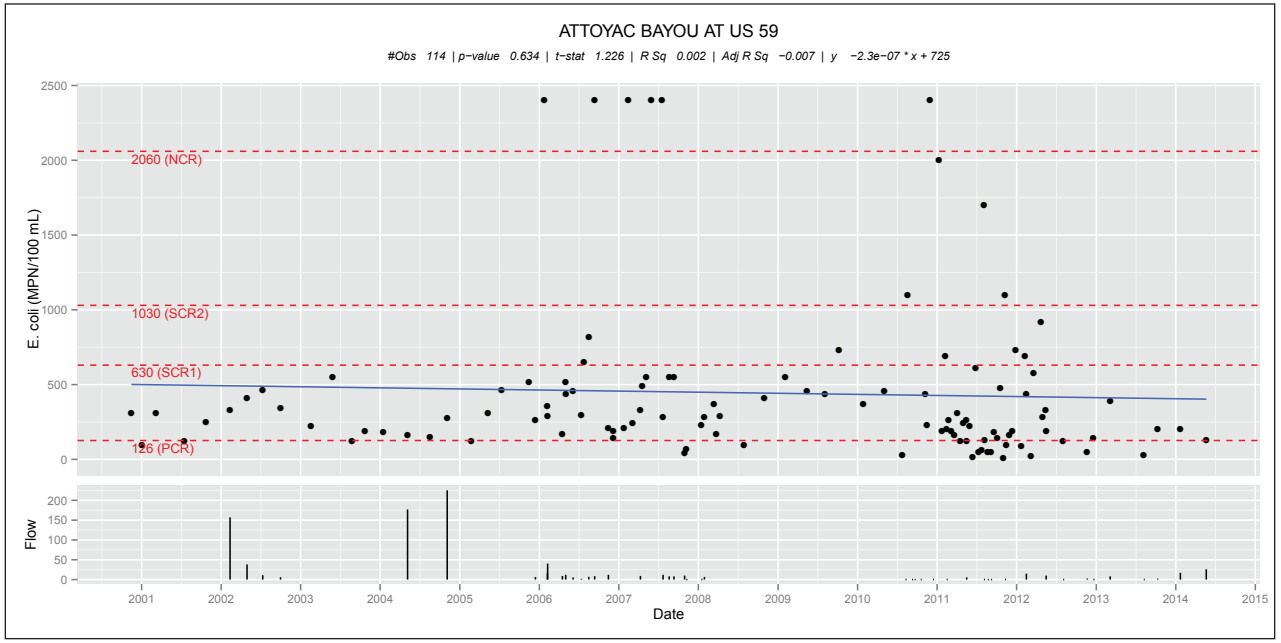
Monitoring Station 16076 - Attoyac Bayou at US 59

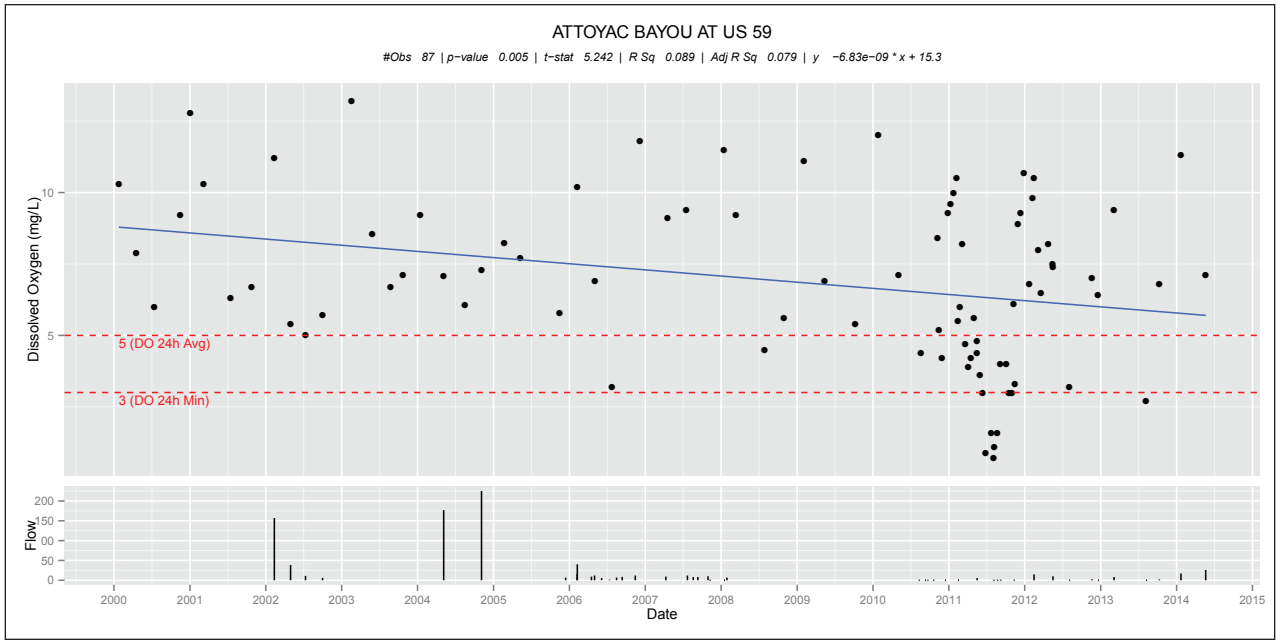
Located in AU 0612_03, Monitoring Station 16076 is ANRA's most northern sampling location on the Attoyac Bayou. ANRA monitors this station quarterly for field and conventional parameters, flow, and *E. coli* bacteria.

This AU, as with all assessment units of the Attoyac Bayou, is listed as impaired for *E. coli* bacteria. The vast majority of results at this site exceed the standard for Primary Contact Recreation. However, most results are below the standard for Secondary Contact Recreation. This same pattern holds true for monitoring stations within the other AUs. Based upon surveys done as part of the Attoyac Bayou RUAA, it is very likely that a Secondary Contact Recreation designated use may be suitable for this waterbody.

For field measurements, there is a statistically significant decreasing trend for Dissolved Oxygen, as well as a statistically significant increasing trend for pH. An increasing trend is also observed for Specific Conductance, but the trend is not statistically significant.

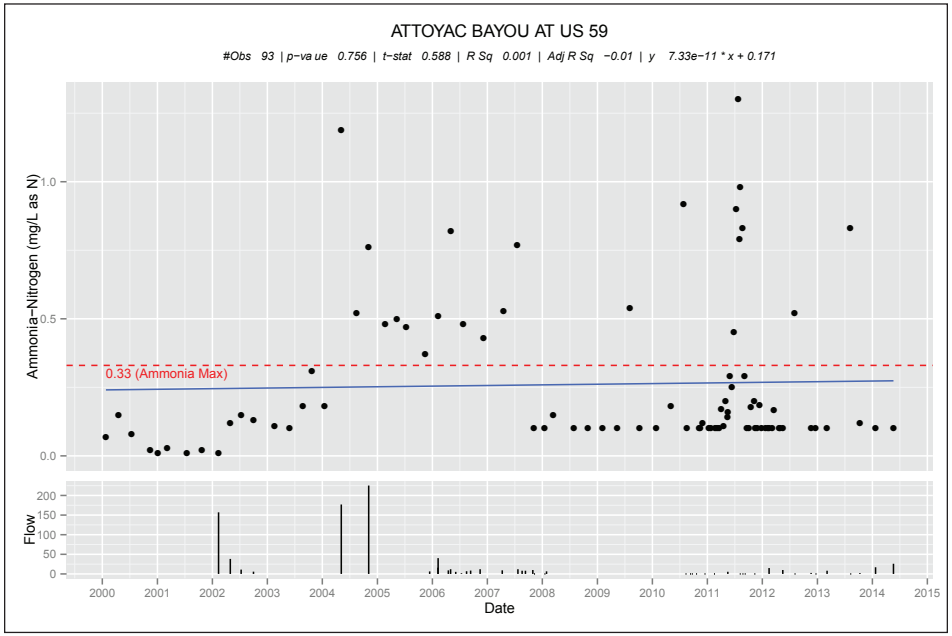
Statistical analysis of the water quality data for nutrient analysis shows a statistically significant decreasing trend for Nitrate+Nitrite. There were numerous instances of Ammonia-Nitrogen exceeding the nutrient screening level, with 23 of 93 results exceeding the screening level. Results for this parameter ranged from <0.01 to 1.3 mg/L as N.

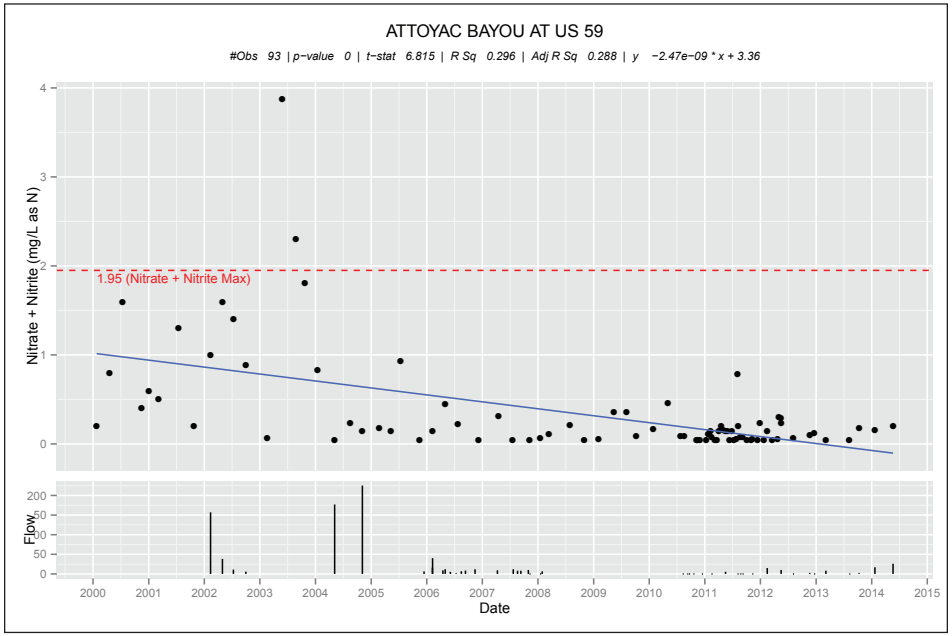


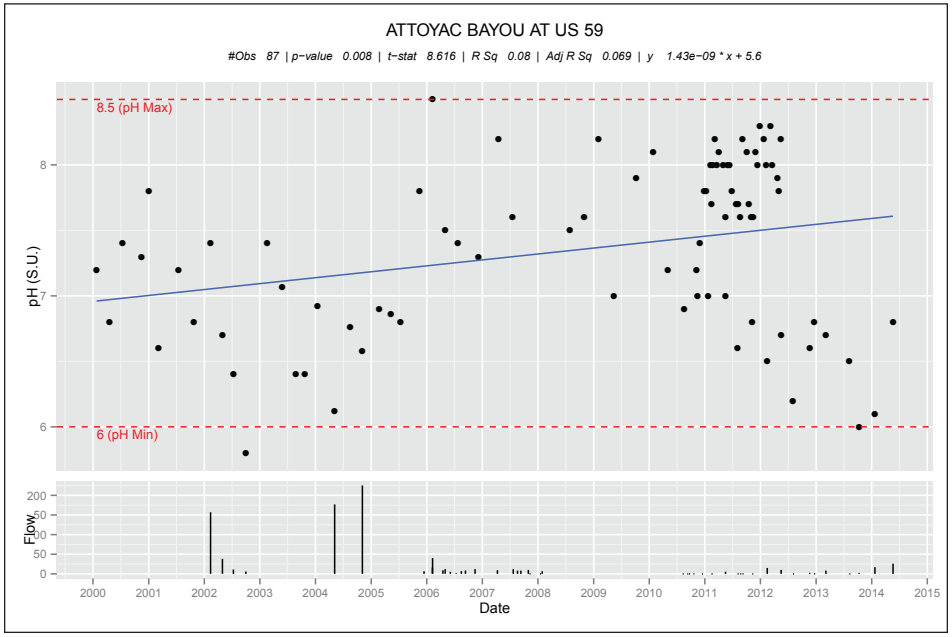


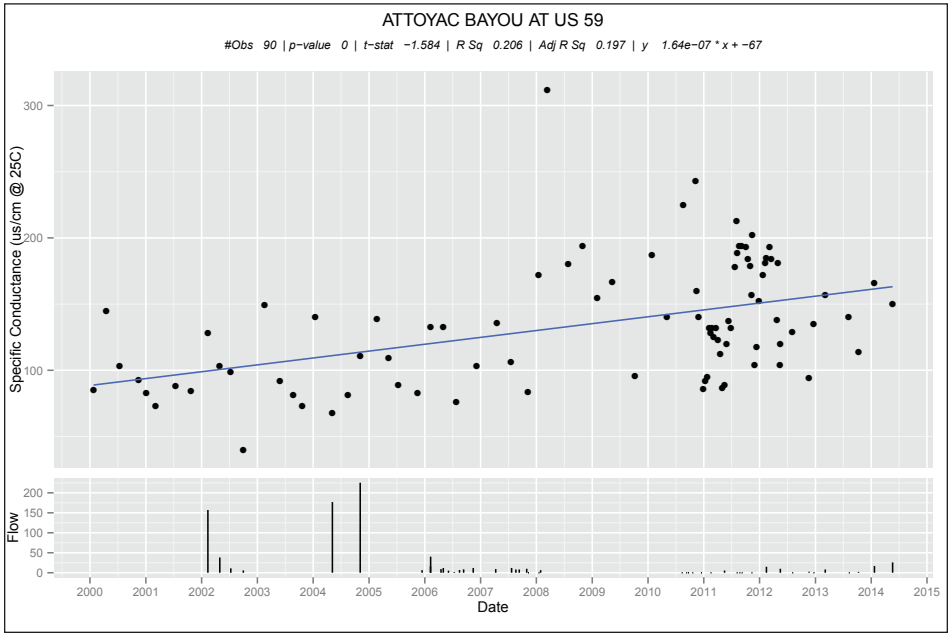
Segment 0612 - Attoyac Bayou

Monitoring Station 16076 - Attoyac Bayou at US 59









Segment 0612 - Attoyac Bayou

Monitoring Station 16076 - Attoyac Bayou at US 59

Water Quality Monitoring Results for Station 16076 - Attoyac Bayou at US 59										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	90	0	40	312	134.37		-1.5842	0.0000	
00300	Dissolved Oxygen (mg/L)	87	6	0.7	13.2	6.90		5.2421	0.0049	↓
00400	pH (S.U.)	87	1	5.8	8.5	7.36		8.6156	0.0079	↑
00530	Total Suspended Solids (mg/L)	93	0	5.33	790	41.72		-0.8107	0.2204	
00610	Ammonia-Nitrogen (mg/L as N)	93	23	0.01	1.3	0.26		0.5882	0.7564	
00630	Nitrate + Nitrite (mg/L as N)	93	2	0.04	3.87	0.33		6.8152	0.0000	↓
00665	Total Phosphorus (mg/L as P)	92	2	0.02	4	0.22		0.8026	0.7635	
00940	Chloride (mg/L)	57	0	5	40	12.79		2.8735	0.4847	
00945	Sulfate (mg/L)	57	1	3.5	55.3	20.01		2.0176	0.6277	
31699	*E. coli* (MPN/100 mL)	114	92	12	2400		209.76	1.2262	0.6336	
32211+70953	Chlorophyll-*a* (µg/L)	41	6	2	326	15.47		-0.5959	0.4569	
70300	Total Dissolved Solids (mg/L)	57	1	51	314	109.47		-0.3181	0.0052	

16076 - Attoyac Bayou at US 59

Segment 0612 - Attoyac Bayou

Summary of Water Quality Trends

Although not statistically significant, increasing trends for Specific Conductance and Total Dissolved Solids are observed. These trends are related to an intensive monitoring regime that occurred in 2011 and 2012 during a period of drought. The drought also affected the trends for pH and Dissolved Oxygen. For AU 0612_02 and 0612_03, there was a statistically increasing trend for pH. There was a statistically decreasing trend for Dissolved Oxygen in AU 0612_03.

Decreasing trends were observed for nutrient parameters in Attoyac Bayou, with the trends in AU 0612_02 for Ammonia-Nitrogen, Nitrate+Nitrite, and Total Phosphorus all being statistically significant.

The following table summarizes the statistically significant trends for the Attoyac Bayou.

Trend Analysis Summary for Segment 0612 - Attoyac Bayou

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Attoyac Bayou	0612_01	10636	Attoyac Bayou at SH 21	Trend analysis not performed due to gap in data.											
	0612_02	15253	Attoyac Bayou at SH 7		↑								↓	↓	↓
	0612_03	16076	Attoyac Bayou at US 59		↑	↓								↓	

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

10636 - Attoyac Bayou at SH 21

Segment 0612 - Attoyac Bayou

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0612 - Attoyac Bayou				
Water Quality Issue	**Affected Area**	**Possible Influences/Causes**	**Possible Effects**	**Possible Solutions / Actions Taken**
Impairment for *E. coli* bacteria	Attoyac Bayou (upper, middle, and lower portions)	• Municipal wastewater discharge • Failing (and non-existent) septic systems • Wildlife (deer and feral hogs) • Livestock and agricultural operations, including cattle and poultry operations	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A TSSWCB-funded CWA §319 grant was used to assess nutrient parameters, develop load duration curves, perform bacterial source tracking, conduct a RUAA, and develop a watershed protection plan (WPP) • The Attoyac Bayou WPP has been accepted by EPA • ANRA is using a TCEQ-funded CWA §319 grant to replace failing septic systems within the watershed • Other BMPs will be implemented as part of the Attoyac Bayou WPP • A RUAA has been submitted to TCEQ for evaluation, which may result in a more appropriate contact recreation standard being applied to the water body
Depressed Dissolved Oxygen	Attoyac Bayou (upper and middle portion)	• Nonpoint sources of pollution • Nutrient loading into the water body • Low flows	• Detrimental effect on aquatic biological community	• Continue monitoring • Conduct 24-hour DO measurements
Concern for Ammonia-Nitrogen	Attoyac Bayou (upper portion) Waffelow Creek	• Municipal wastewater discharges • Failing (and non-existent) septic systems • Wildlife (deer and feral hogs) • Livestock and agricultural operations, including cattle and poultry operations	• Detrimental effect on aquatic biological community	• Continue monitoring • Replacement of failing on-site septic facilities in the watershed • Implement BMPs and agricultural water quality management plans as part of implementing the Attoyac Bayou WPP

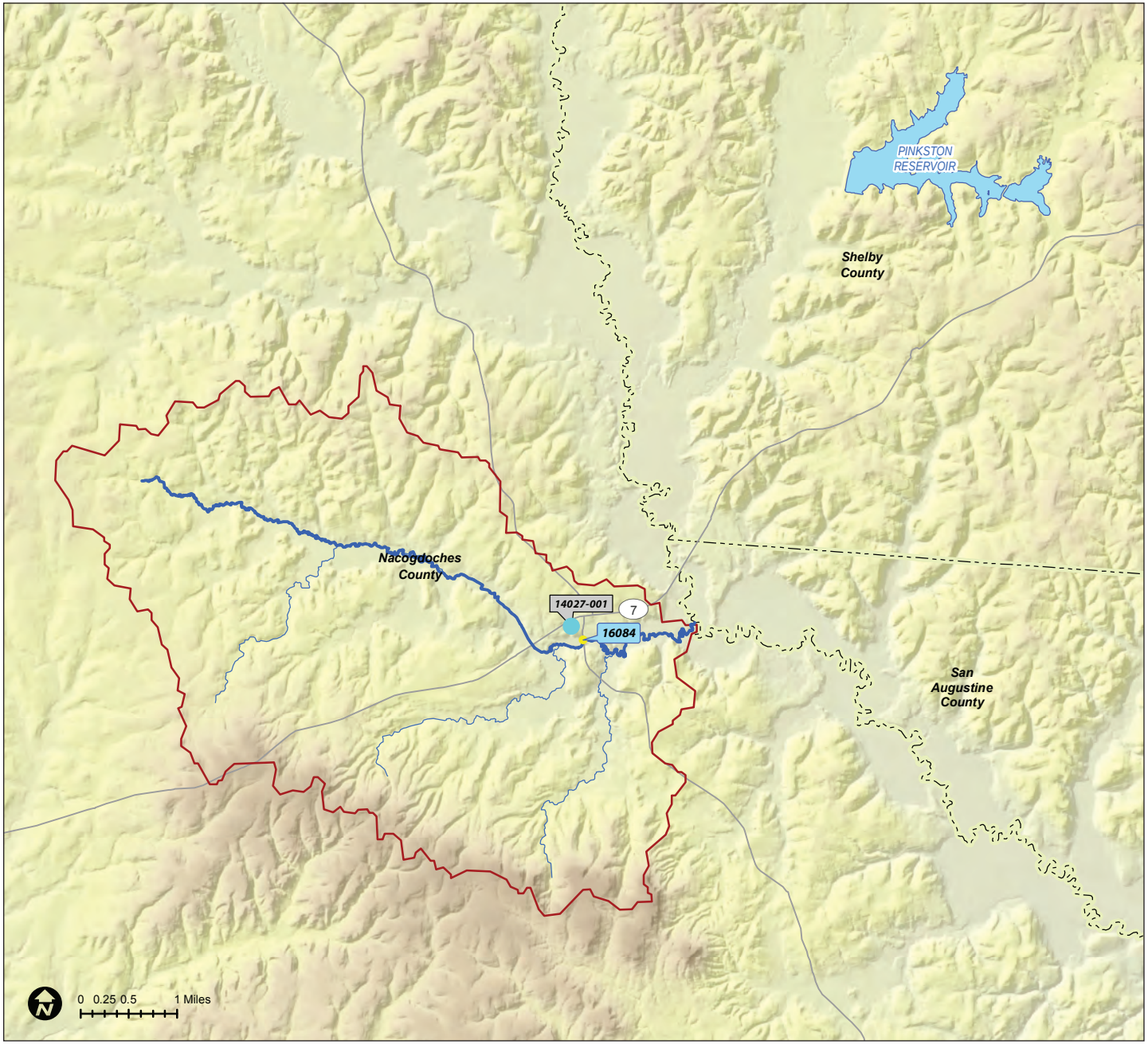
Segment 0612A - Terrapin Creek

Segment Profile

This segment is an 9.5 mile-length freshwater stream from the confluence of Attoyac Bayou east of Martinsville in Nacogdoches County to the upstream perennial portion of the stream northwest of Martinsville in Nacogdoches County.

A tributary to the Attoyac Bayou, Terrapin Creek was monitored in 2011 and 2012 as part of the study to develop a watershed protection plan for the Attoyac. It is currently being monitored by ANRA as part of a 2 year study to assess BMP effectiveness in the watershed.

Due to the limited time frame of sampling, data for this unclassified segment is not presented in the Basin Summary Report.



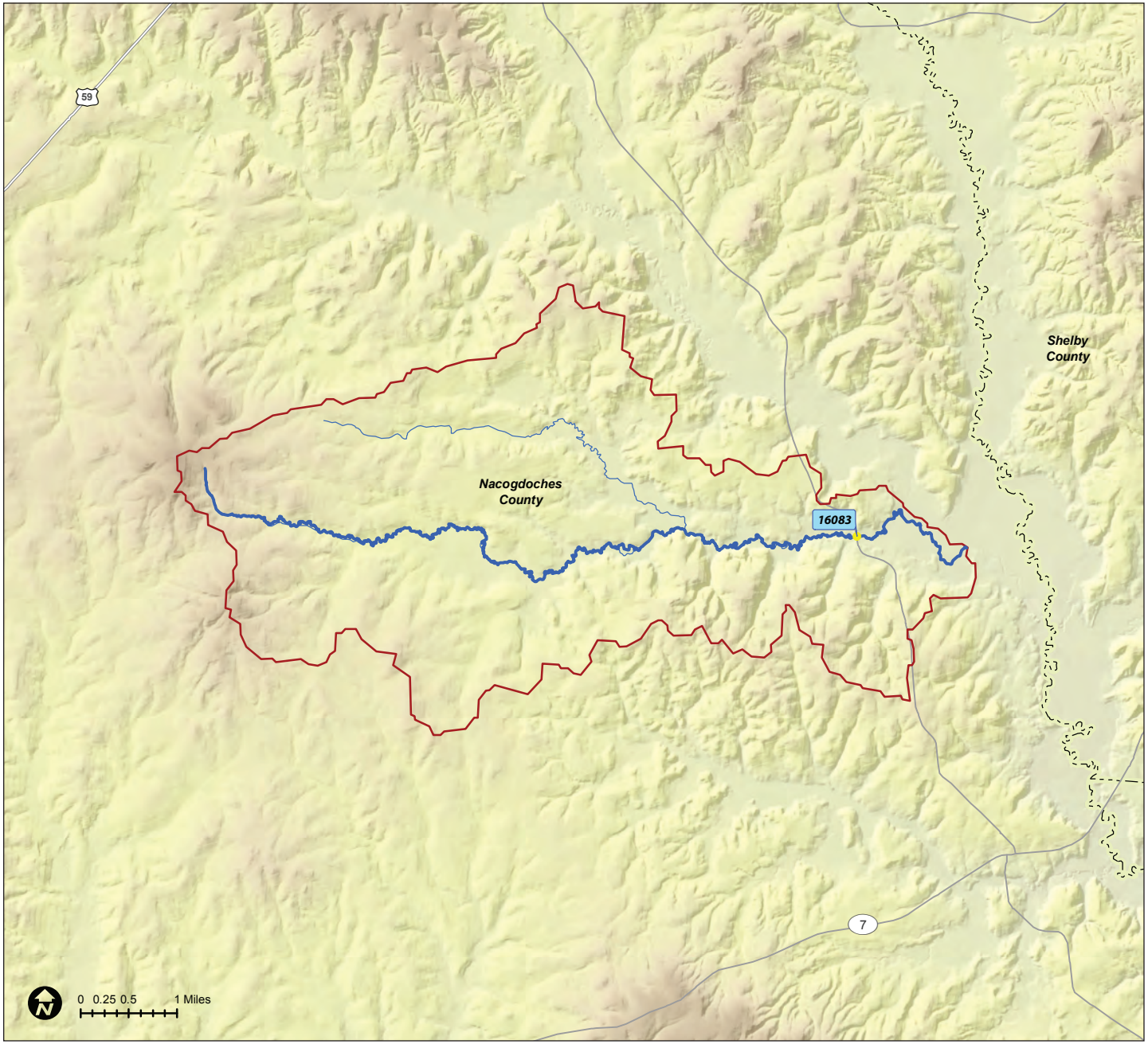
Segment 0612B - Waffelow Creek

Segment Profile

This segment is a 14 mile-length freshwater stream from the confluence of Attoyac Bayou north of Martinsville in Nacogdoches County to the upstream perennial portion of the stream northeast of Nacogdoches in Nacogdoches County.

A tributary to the Attoyac Bayou, Waffelow Creek was monitored in 2011 and 2012 as part of the study to develop a watershed protection plan for the Attoyac. It is currently being monitored by ANRA as part of a 2 year study to assess BMP effectiveness in the watershed.

Due to the limited time frame of sampling, data for this unclassified segment is not presented in the Basin Summary Report.



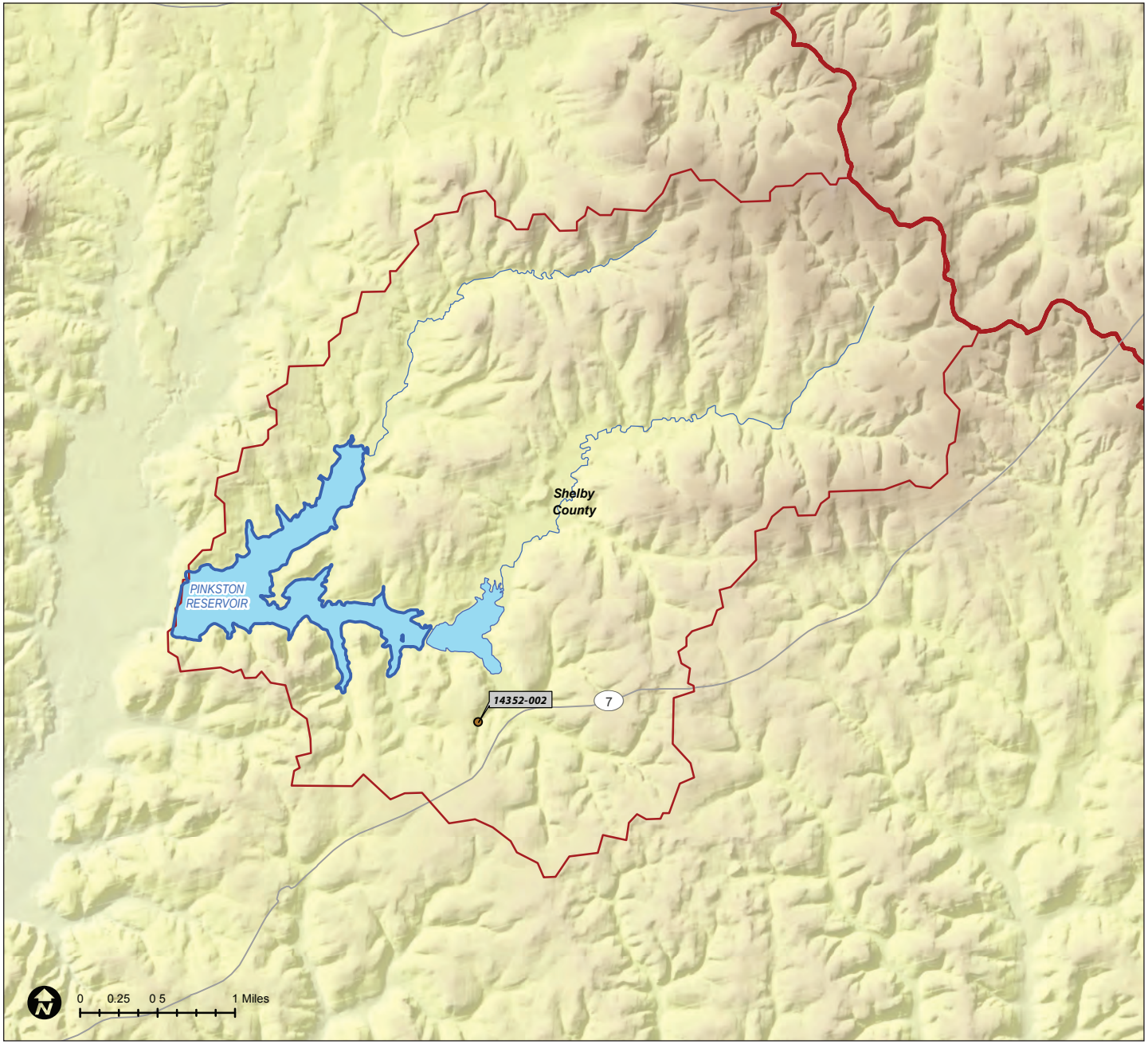
Segment 0612C - Pinkston Reservoir

Segment Profile

Segment 0612C (unclassified) includes 523 acres composed of a freshwater reservoir which is located approximately 12 miles southwest of Center in Shelby County, impounding Sandy Creek.

There are no monitoring stations for this segment listed on the Coordinated Monitoring Schedule.

Screening levels and criteria have not been assessed, and limited data exists for this unclassified segment.



Segment 0612D - Naconiche Creek

Segment Profile

A tributary to the Attoyac Bayou, Naconiche Creek is 32 miles long and stretches from the confluence with the Attoyac Bayou in Nacogdoches County to the headwaters located approximately 3.2 km upstream of FM 1087 in Rusk County. Naconiche Creek was monitored in 2011 and 2012 as part of the study to develop a watershed protection plan for the Attoyac. It is currently being monitored by ANRA as part of a 2 year study to assess BMP effectiveness in the watershed.

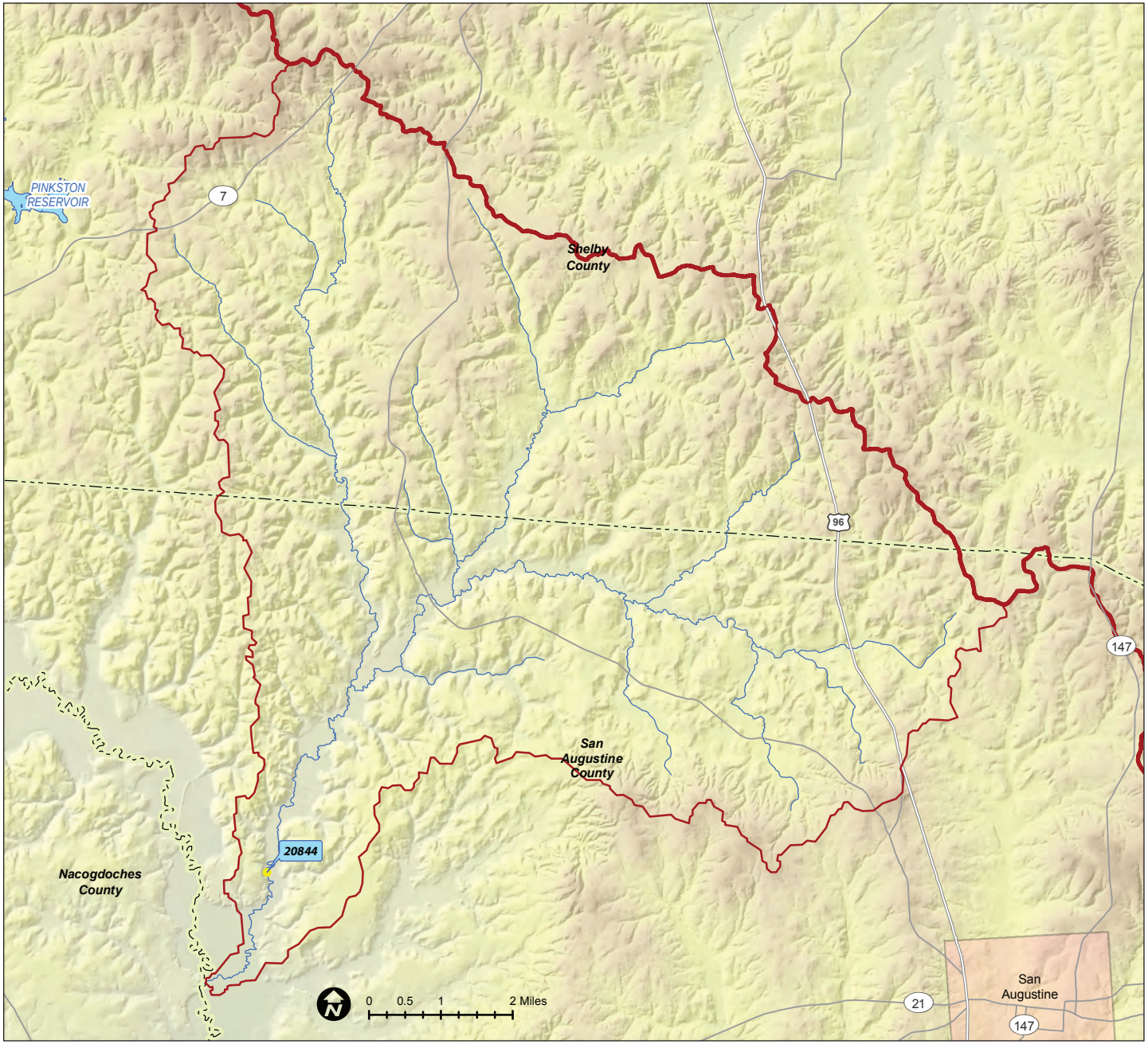
Due to the limited time frame of sampling, data for this unclassified segment is not presented in the Basin Summary Report.

Segment 0612E - Big Iron Ore Creek

Segment Profile

Big Iron Ore Creek is a tributary to the Attoyac Bayou. This 24.3 miles long stream stretches from the confluence with the Attoyac Bayou in San Augustine County to the headwaters approximately 4.3 km upstream of US Hwy 96. This segment was monitored in 2011 and 2012 as part of the study to develop a watershed protection plan for the Attoyac. It is currently being monitored by ANRA as part of a 2 year study to assess BMP effectiveness in the watershed.

Due to the limited time frame of sampling, data for this unclassified segment is not presented in the Basin Summary Report.

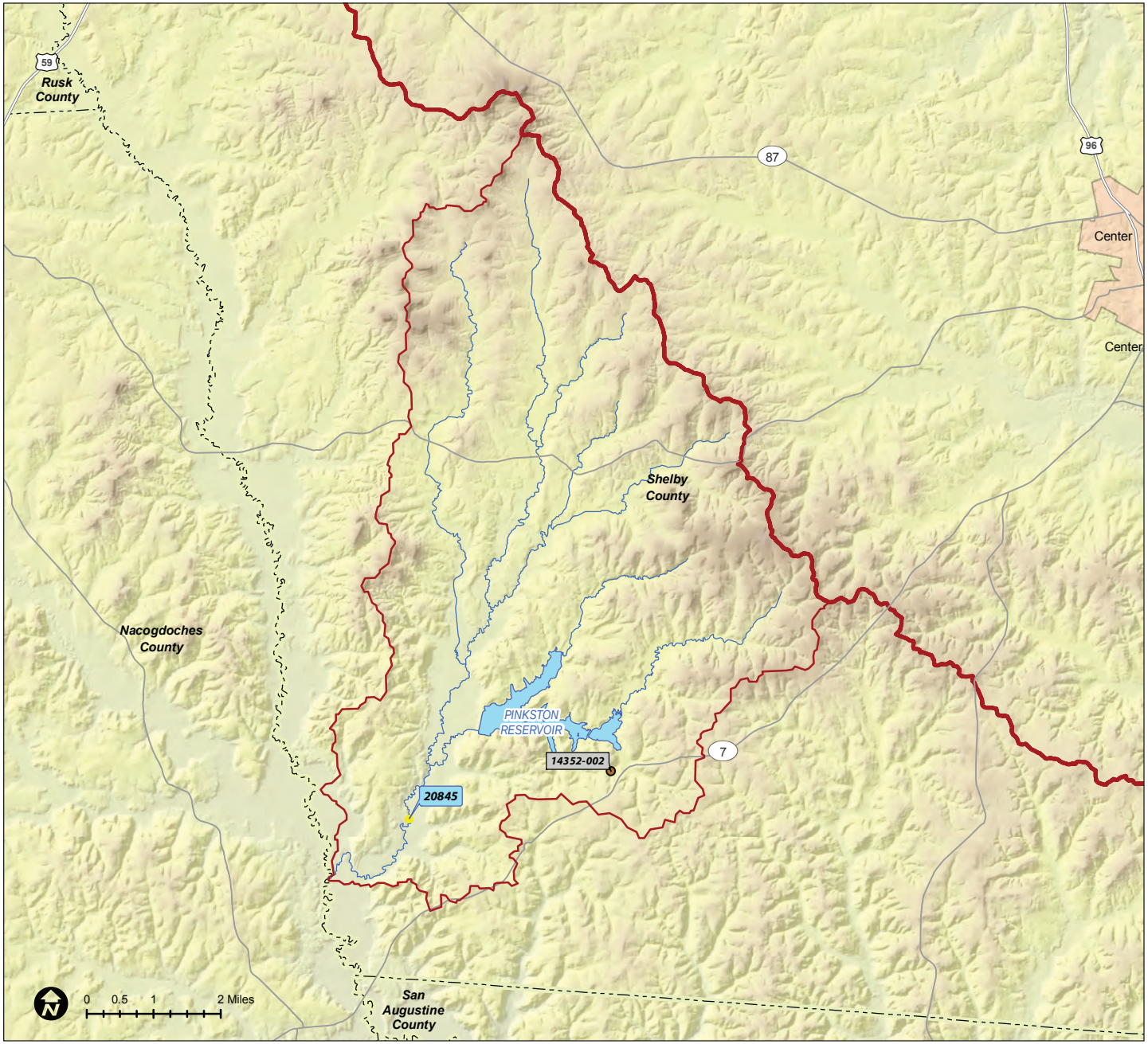


Segment 0612F - West Creek

Segment Profile

West Creek is a tributary to the Attoyac Bayou. This 20.5 miles long stream stretches from the confluence with Attoyac Bayou in Shelby County to the headwaters approximately 2.2 km upstream of CR 4054. This segment was monitored in 2011 and 2012 as part of the study to develop a watershed protection plan for the Attoyac. It is currently being monitored by ANRA as a routine Clean Rivers Program monitoring station.

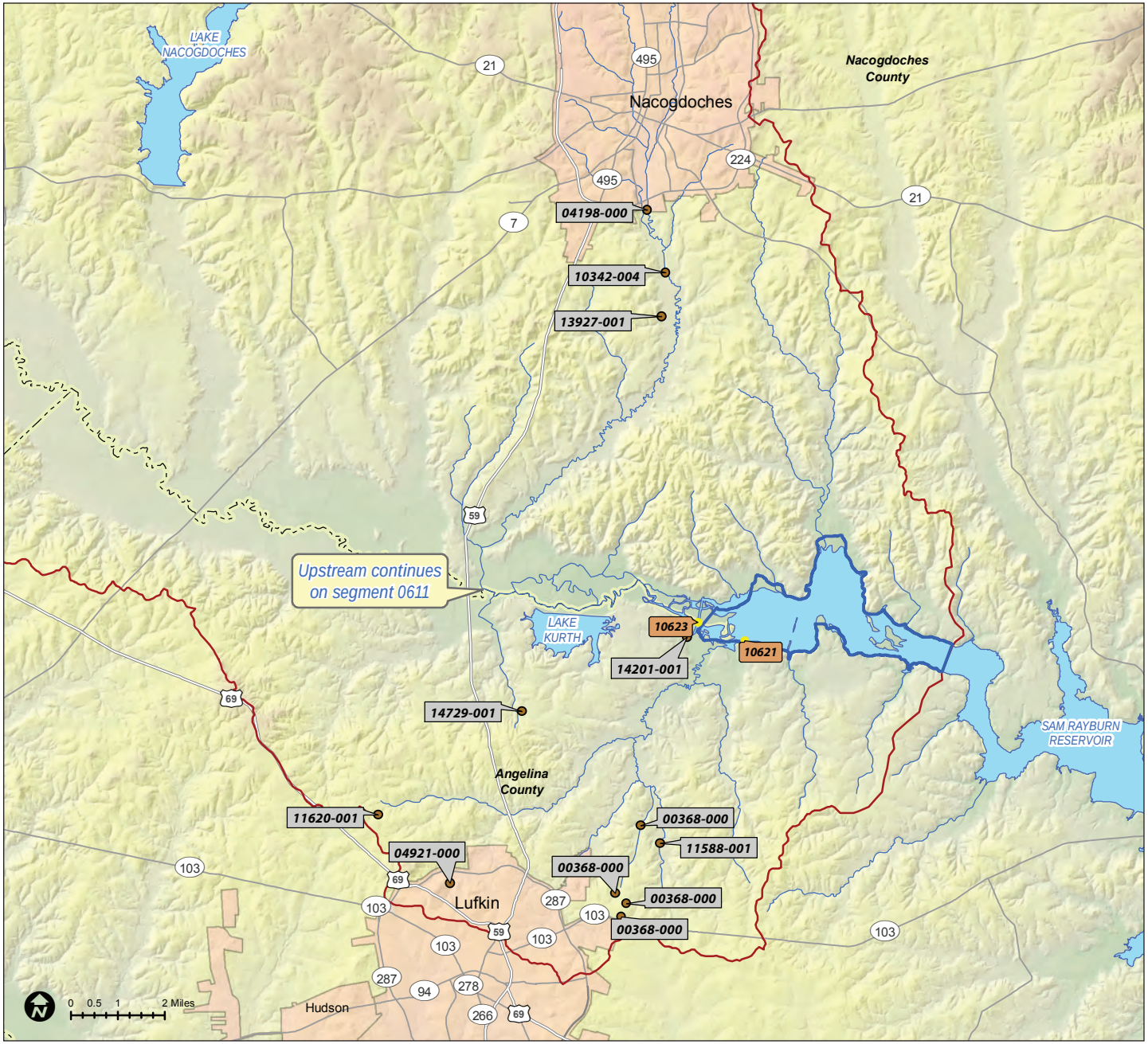
Due to the limited time frame of sampling, data for this unclassified segment is not presented in the Basin Summary Report.



Segment 0615 - Angelina River / Sam Rayburn Reservoir

Segment Profile

The riverine portion of Sam Rayburn Reservoir extends from a point 5.6 kilometers (3.5 miles) upstream of Marion's Ferry to a point 2.75 kilometers (1.71 miles) upstream of the confluence of Paper Mill Creek. The segment includes 5,068 acres. The designated uses for this segment include intermediate aquatic life use, contact recreation, general use, and public water supply.



Segment 0615 - Angelina River / Sam Rayburn Reservoir

Assessment Units

Assessment Units in Segment 0615 - Angelina River / Sam Rayburn Reservoir	
AU ID	**Description**
0615_01	Entire water body

Monitoring Stations

Monitoring Stations in Segment 0615 - Angelina River / Sam Rayburn Reservoir									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0615_01	10623	SAM RAYBURN RESERVOIR AT CONFLUENCE OF ANGELINA RIVER 0.75 KM NORTHWEST OF PAPER MILL CREEK	4	4	4				TCEQ-10
0615_01	10621	SAM RAYBURN RESERVOIR NEAR ANGELINA RIVER 0.7 KM DOWNSTREAM OF CONFLUENCE WITH PAPER MILL CREEK LOWER CHANNEL	4	4	4				TCEQ-10

Description of Water Quality Issues

Impairments and Concerns

Segment 0615 is listed in the Draft 2014 Integrated Report as impaired for depressed Dissolved Oxygen. For its Aquatic Life Use, this segment is listed as Not Supporting for an impaired fish community. A fish consumption advisory is also in affect for Dioxin in Edible Tissue and Mercury in Edible Tissue.

For nutrient parameters, there are concerns for both Nitrate+Nitrite and Total Phosphorus.

Assessment Summary for Segment 0615 - Angelina River / Sam Rayburn Reservoir as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	150 mg/L	**100 mg/L**	**500 mg/L**	**5.00 mg/L**	**3.00 mg/L**	**5.00 mg/L**	**3.00 mg/L**	**6.0 - 9.0 SU**	**33.9**	**126 MPN /100 mL**	**0.11 mg/L**	**0.37 mg/L**	**0.20 mg/L**	**26.7 µg/L**
0615_01	FS	FS	FS	NC	FS	**NS**	NC	FS	FS	FS	NC	CS	CS	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0615 - Angelina River / Sam Rayburn Reservoir

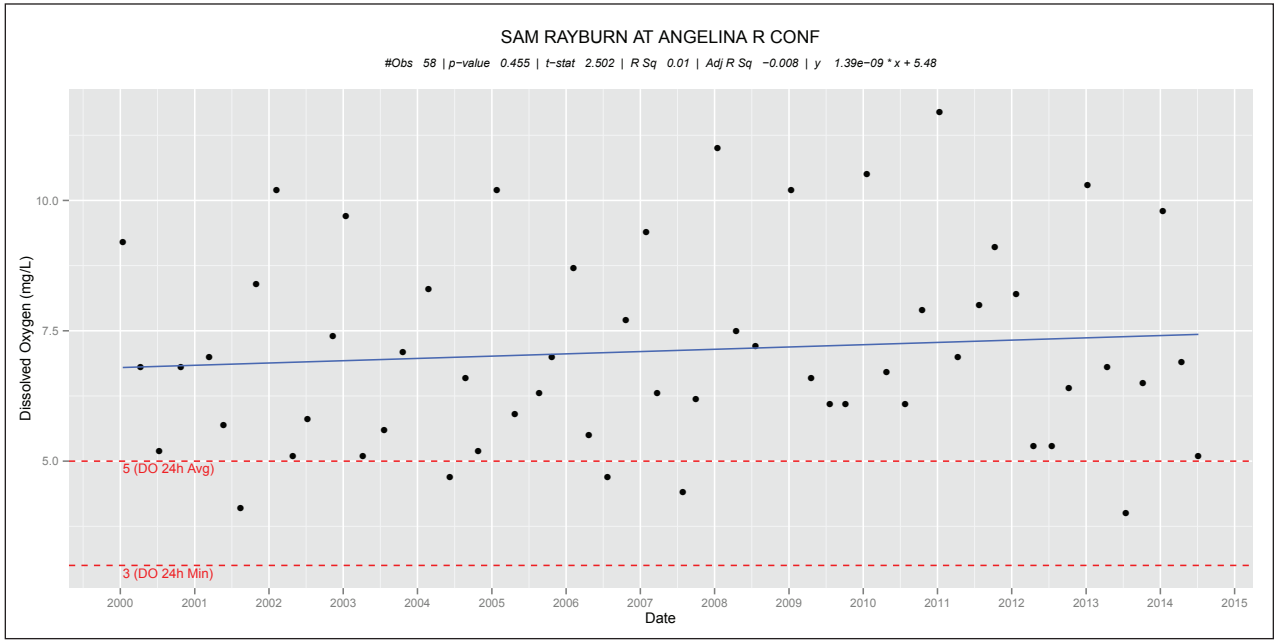
Monitoring Station 10623 - Sam Rayburn Reservoir at Confluence of Angelina River Northwest of Paper Mill Creek

Monitoring Station 10623 is monitored quarterly by TCEQ Region 10 personnel for field and conventional parameters and for *E. coli* bacteria.

This assessment unit is listed for Non Support for its Aquatic Life Use due to depressed Dissolved Oxygen. Although data at this station is showing an increasing trend for Dissolved Oxygen, this trend is not statistically significant. Since 2000, 5 of 58 values were below the 5.0 mg/L criteria for Dissolved Oxygen, although no values fell below 3.0 mg/L.

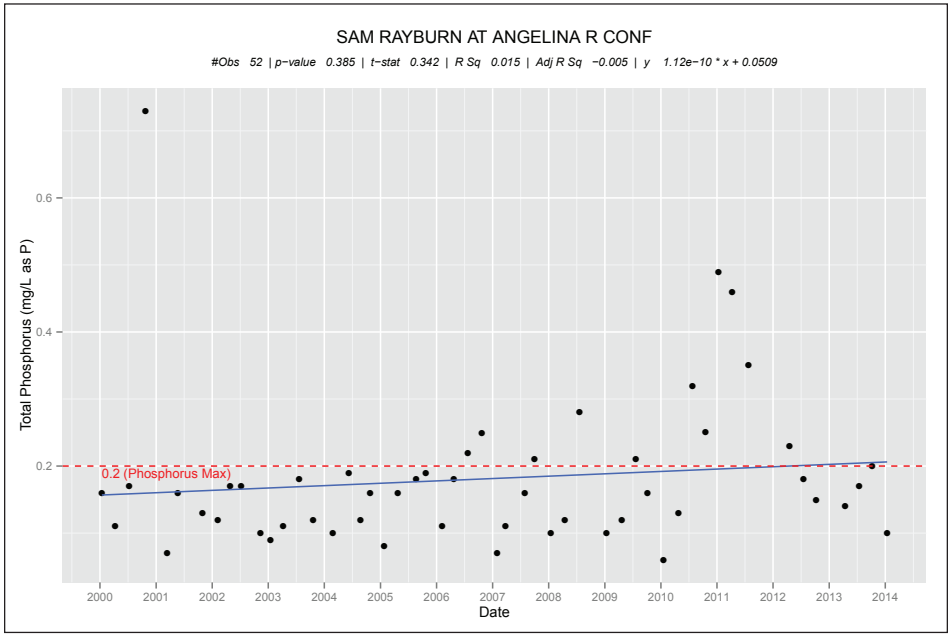
An increasing trend was observed for Specific Conductance, although the trend was not statistically significant. The data showed elevated values in 2011 and 2012 during a period of drought, and these data points are influencing the overall trend.

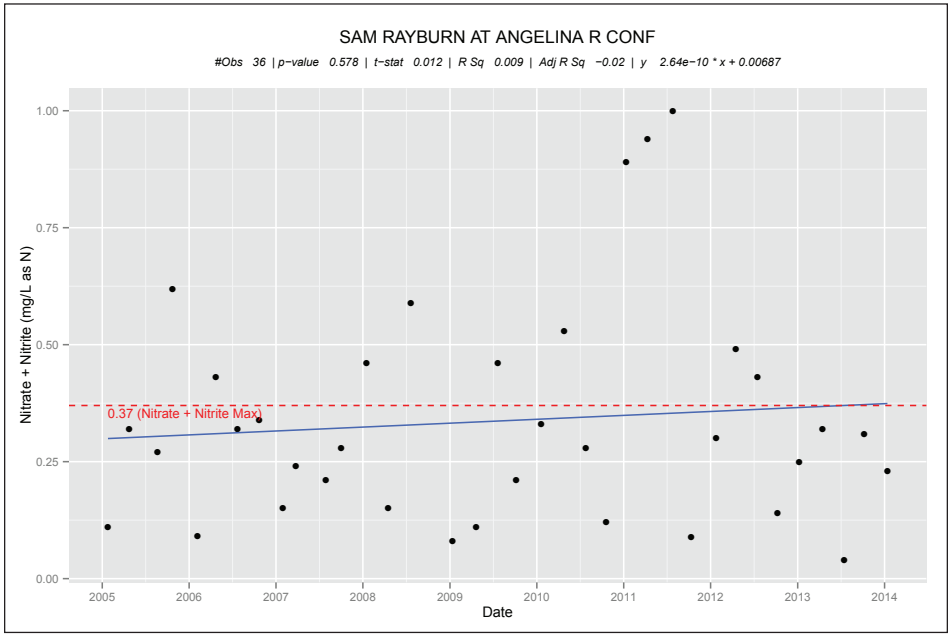
Increasing trends are observed for both Total Phosphorus and Nitrate+Nitrite, although neither trend is statistically significant. There are concerns for both parameters, with numerous values that exceed the nutrient screening levels. For Total Phosphorus, results ranged from <0.06 to 0.73 mg/L as P, with a mean of 0.18. The screening level of 0.20 mg/L as P was exceeded for 12 of 52 samples. Nitrate+Nitrite results ranged from <0.04 to 1.0 mg/L, with the nutrient screening level of 0.37 mg/L as N being exceeded for 11 of 36 samples. For both parameters, many of the highest results were recorded during the height of the drought in 2011 and 2012.



Segment 0615 - Angelina River / Sam Rayburn Reservoir

Monitoring Station 10623 - Sam Rayburn Reservoir at Confluence of Angelina River Northwest of Paper Mill Creek





Water Quality Monitoring Results for Station 10623 - Sam Rayburn Reservoir at Confluence of Angelina River Northwest of Paper Mill Creek

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	58	0	104	520	214.71		-0.0512	0.0133	
00300	Dissolved Oxygen (mg/L)	58	0	4	11.7	7.11		2.5021	0.4555	
00400	pH (S.U.)	58	1	6.4	8.1	7.22		12.6079	0.4464	
00530	Total Suspended Solids (mg/L)	57	0	5	47	16.58		0.4135	0.2055	
00610	Ammonia-Nitrogen (mg/L as N)	57	2	0.05	0.13	0.06		1.7654	0.4304	
00630	Nitrate + Nitrite (mg/L as N)	36	11	0.04	1	0.34		0.0117	0.5779	
00665	Total Phosphorus (mg/L as P)	52	12	0.06	0.73	0.18		0.3416	0.3851	
00940	Chloride (mg/L)	55	0	8	79	22.20		-0.1551	0.0561	
00945	Sulfate (mg/L)	57	0	7	68	26.40		0.4981	0.0709	
31699	*E. coli* (MPN/100 mL)	46	14	2	4800		66.54	2.0136	0.0756	
32211+70953	Chlorophyll-*a* (µg/L)	56	5	1	168	14.03		-0.2645	0.4466	
70300	Total Dissolved Solids (mg/L)	45	0	97	300	147.58		1.9325	0.4717	

Segment 0615 - Angelina River / Sam Rayburn Reservoir

Monitoring Station 10621 - Sam Rayburn Reservoir Near Angelina River Downstream of Confluence with Paper Mill Creek

Monitoring Station 10621 is monitored quarterly by TCEQ Region 10 personnel for field and conventional parameters and for *E. coli* bacteria.

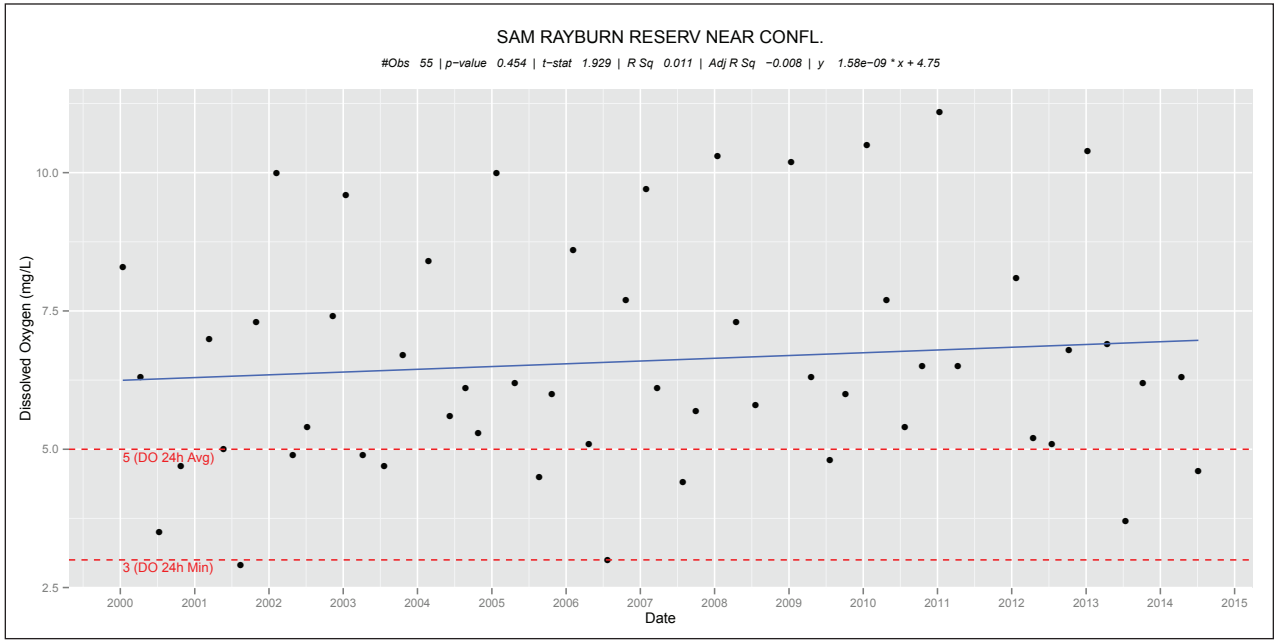
Segment 0615 is listed for not supporting its designated Aquatic Life Use due to depressed Dissolved Oxygen. Although data at this station is showing an increasing trend for Dissolved Oxygen, this trend is not statistically significant.

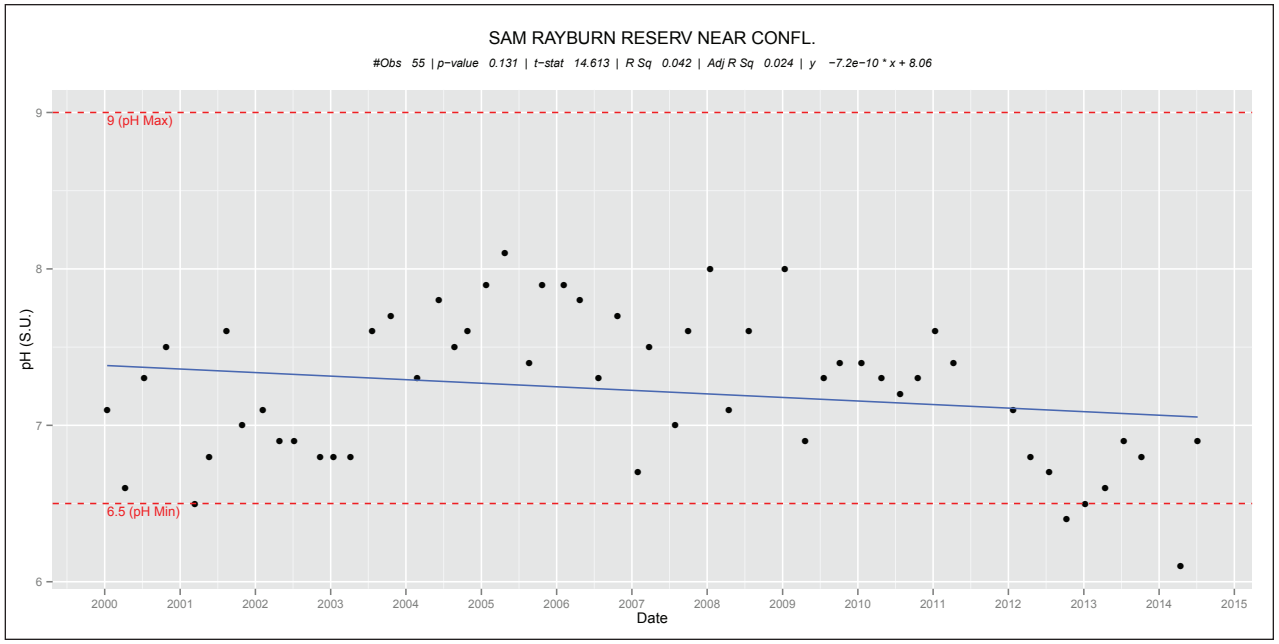
Statistically significant decreasing trends were observed for Specific Conductance, Total Dissolved Solids, Sulfate, and Chloride. For these parameters, the decrease in results begins in 2004, which coincides with the shuttering of the paper mill in Lufkin. The wastewater treatment plant at this facility discharged to Paper Mill Creek.

A decreasing trend is present for pH, although this trend is not statistically significant. A statistically significant decreasing trend is present for Alkalinity, so the decrease seen with pH could be related to changes in the buffering capacity of the water. The decreasing trend for Alkalinity begins in 2004 as well.

A statistically significant decreasing trend is observed for Ammonia-Nitrogen, Total Kjeldhal Nitrogen, and Total Organic Carbon. These decreases also coincide with the closure of the paper mill.

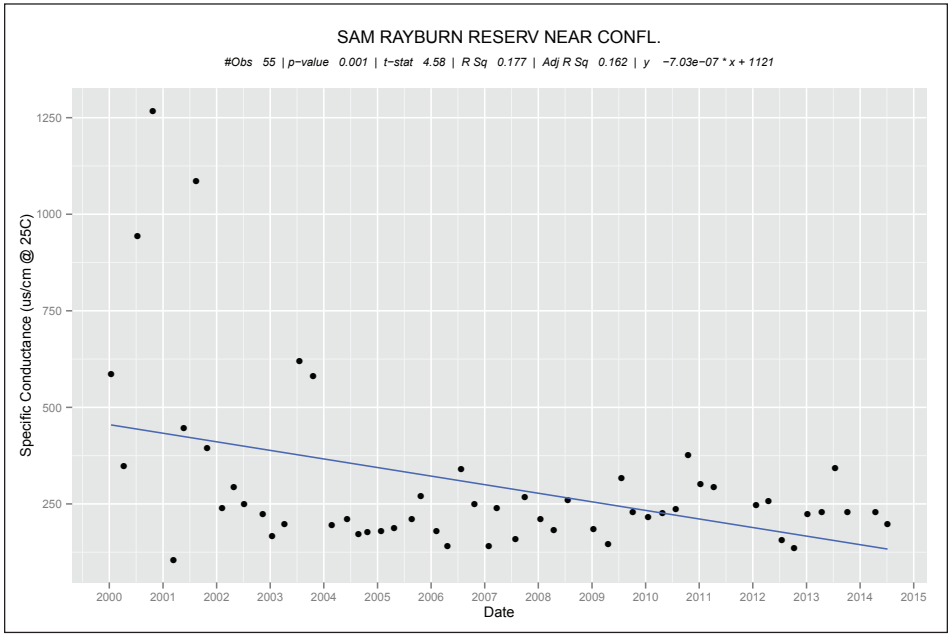
For Total Phosphorus and Nitrate+Nitrite, there are no significant trends. However, there are numerous results for both parameters that exceed the nutrient screening criteria. This segment has concerns for both parameters.

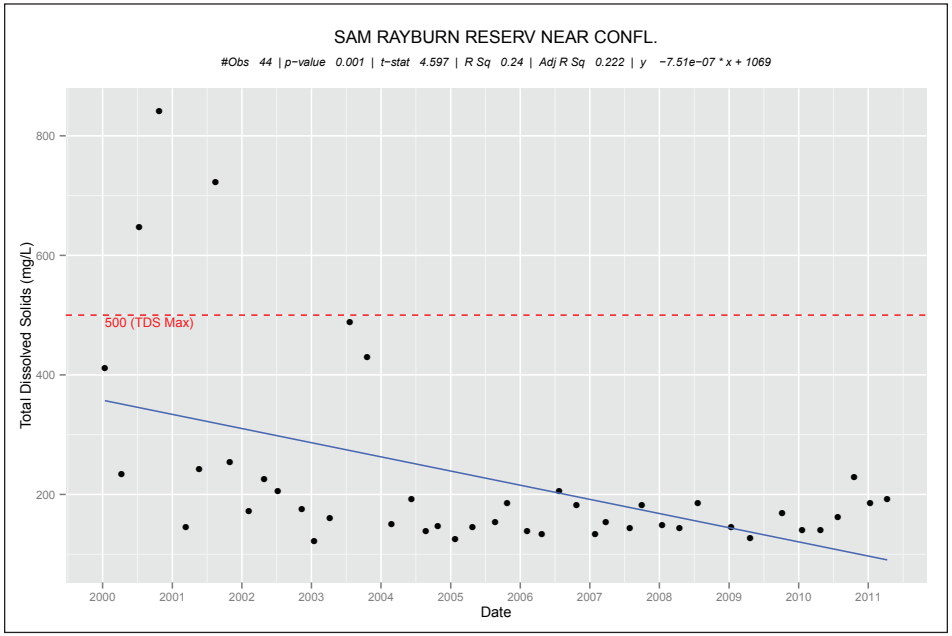


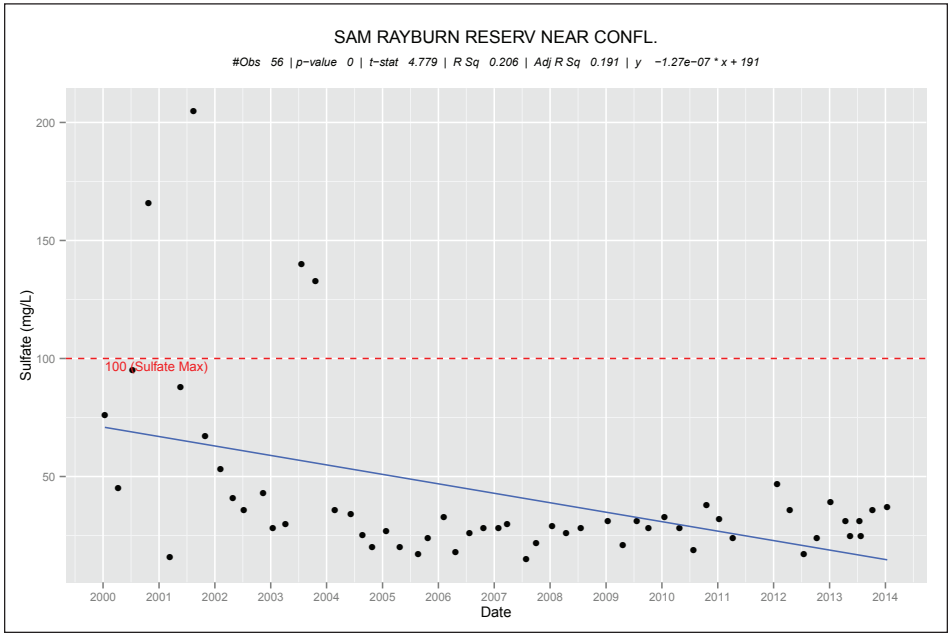


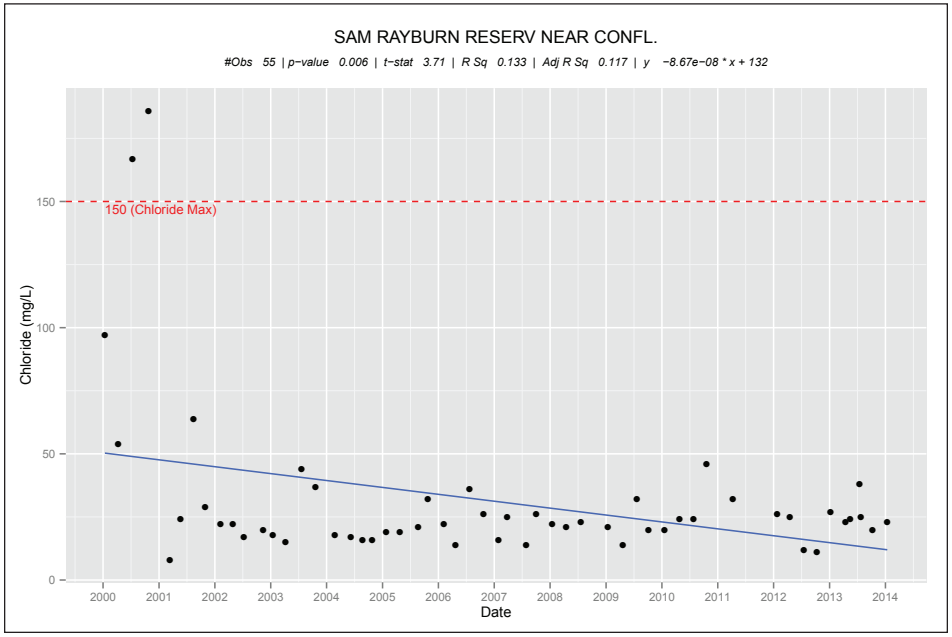
Segment 0615 - Angelina River / Sam Rayburn Reservoir

Monitoring Station 10621 - Sam Rayburn Reservoir Near Angelina River Downstream of Confluence with Paper Mill Creek



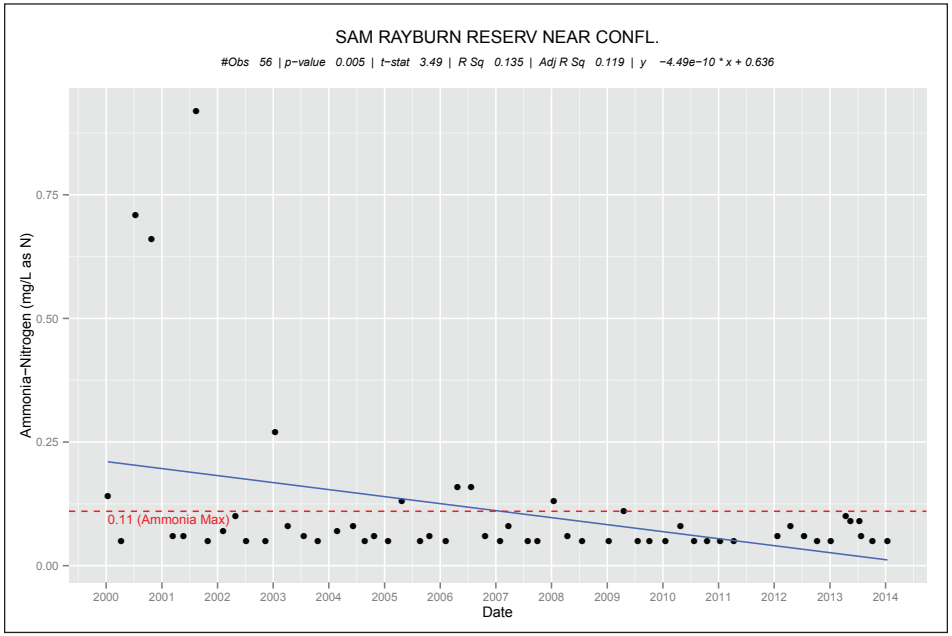


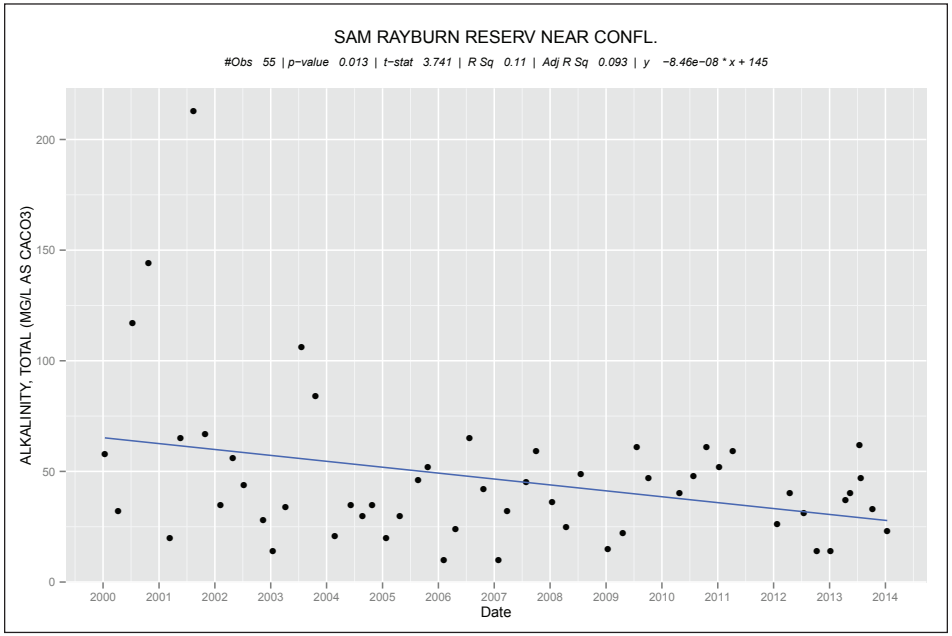


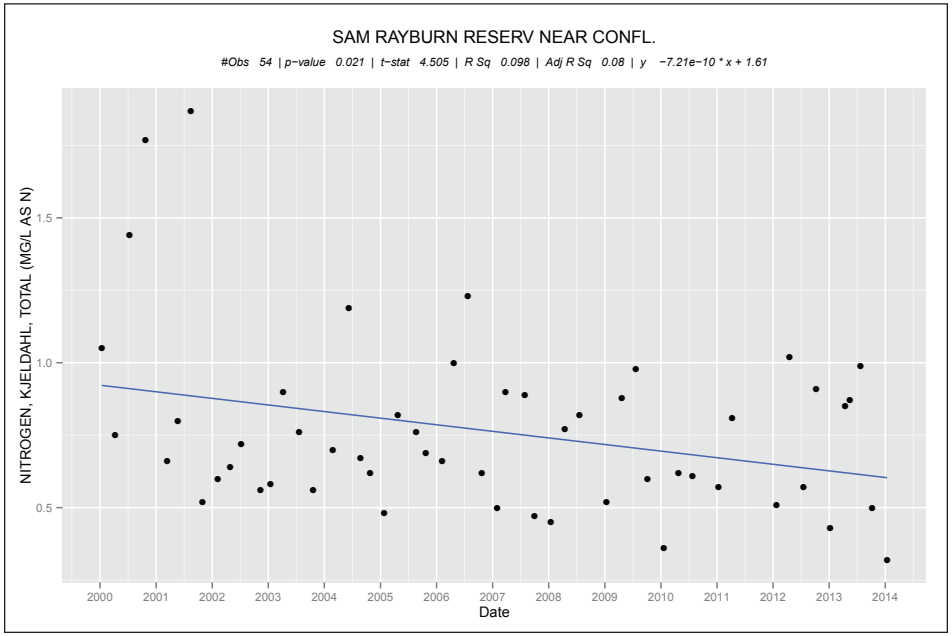


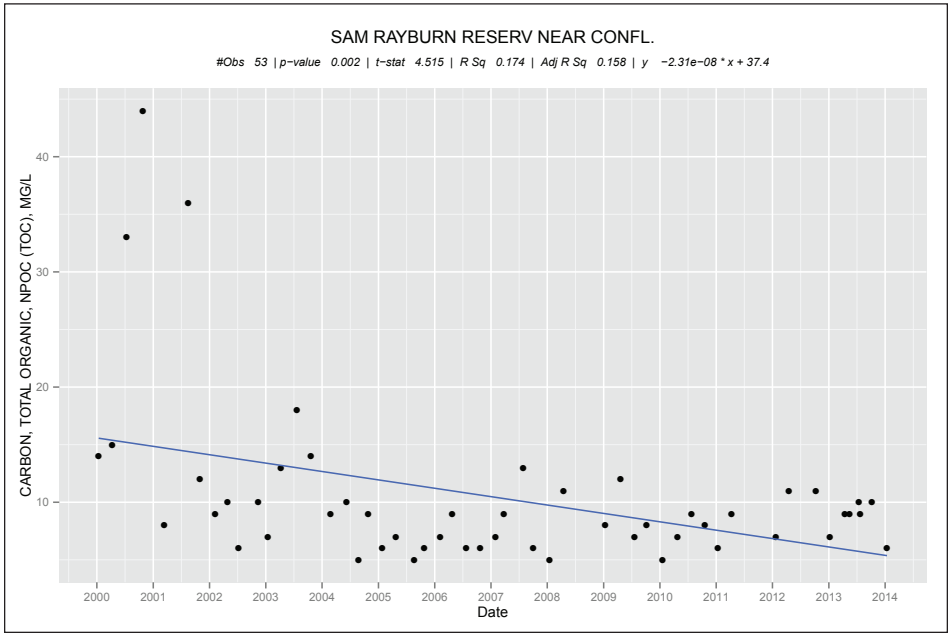
Segment 0615 - Angelina River / Sam Rayburn Reservoir

Monitoring Station 10621 - Sam Rayburn Reservoir Near Angelina River Downstream of Confluence with Paper Mill Creek



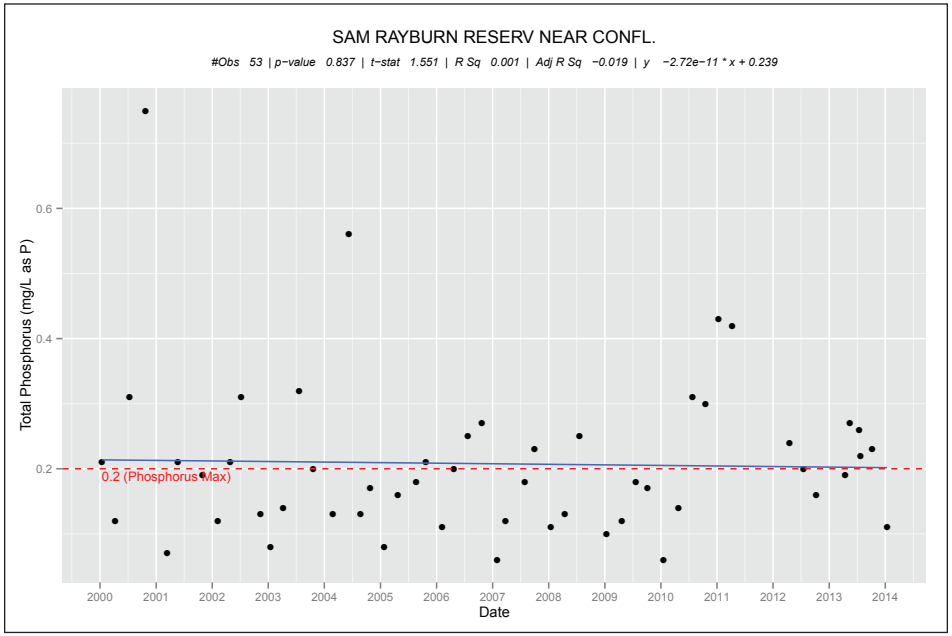


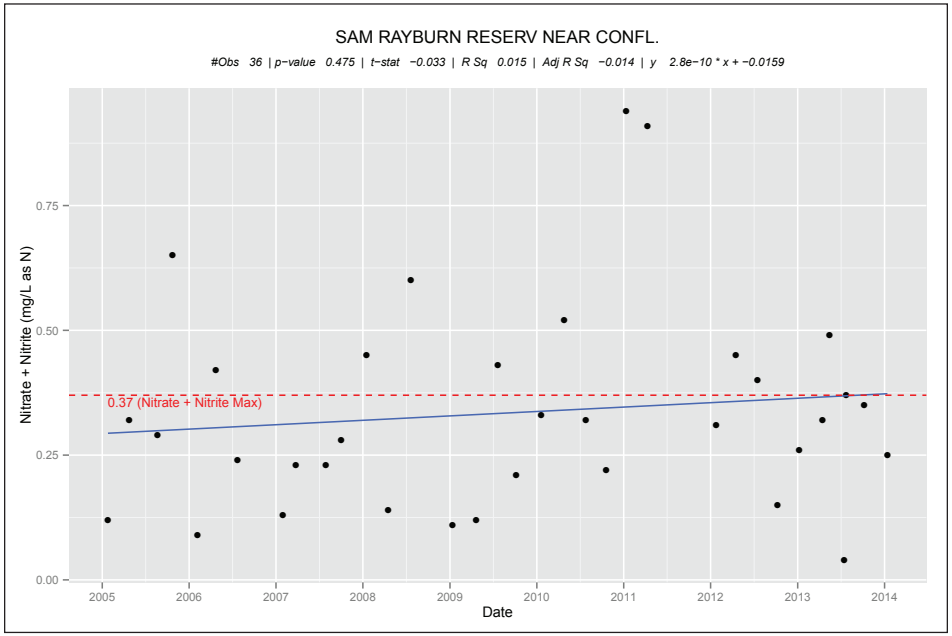




Segment 0615 - Angelina River / Sam Rayburn Reservoir

Monitoring Station 10621 - Sam Rayburn Reservoir Near Angelina River Downstream of Confluence with Paper Mill Creek





Water Quality Monitoring Results for Station 10621 - Sam Rayburn Reservoir Near Angelina River Downstream of Confluence with Paper Mill Creek

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	55	0	105	1268	299.80		4.5802	0.0014	↓
00300	Dissolved Oxygen (mg/L)	55	1	2.9	11.1	6.59		1.9288	0.4543	
00400	pH (S.U.)	55	2	6.1	8.1	7.22		14.6133	0.1312	
00530	Total Suspended Solids (mg/L)	56	0	4	115	23.13		0.6504	0.5971	
00610	Ammonia-Nitrogen (mg/L as N)	56	9	0.05	0.92	0.11		3.4898	0.0053	↓
00630	Nitrate + Nitrite (mg/L as N)	36	11	0.04	0.94	0.33		-0.0326	0.4755	
00665	Total Phosphorus (mg/L as P)	53	22	0.06	0.75	0.21		1.5515	0.8370	
00940	Chloride (mg/L)	55	2	8	186	31.16		3.7100	0.0061	↓
00945	Sulfate (mg/L)	56	4	15	205	42.52		4.7793	0.0004	↓
31699	*E. coli* (MPN/100 mL)	47	17	10	4800		107.65	2.6038	0.0235	
32211+70953	Chlorophyll-*a* (µg/L)	55	1	1	36.2	8.44		1.7496	0.5715	
70300	Total Dissolved Solids (mg/L)	44	3	122	842	226.50		4.5973	0.0007	↓

Segment 0615 - Angelina River / Sam Rayburn Reservoir

Summary of Water Quality Trends

At Monitoring Station 10623 (Sam Rayburn Reservoir at the confluence of the Angelina River), there were no statistically significant trends observed.

Numerous statistically significant trends were observed at Monitoring Station 10621, which is located downstream of the Paper Mill Creek confluence. Statistically significant decreasing trends were observed for Specific Conductance, Total Dissolved Solids, Sulfate, Chloride, Alkalinity, Total Organic Carbon, Ammonia-Nitrogen, and Total Kjeldahl Nitrogen. For each of these parameters, the decrease in reported results begins around the time that the paper mill in Lufkin ceased operation. The paper mill discharged wastewater effluent into Paper Mill Creek. These same trends are not seen at station 10623, which is upstream of the confluence with Paper Mill Creek.

Trend Analysis Summary for Segment 0615 - Angelina River / Rayburn Reservoir

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Angelina River / Sam Rayburn Reservoir	0615_01	10623	Sam Rayburn Reservoir at Confluence of Angelina River	No statistically significant trends at this station.											
	0615_01	10621	Sam Rayburn Reservoir Downstream of Paper Mill Creek				↓	↓	↓	↓			↓		

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Segment 0615 - Angelina River / Sam Rayburn Reservoir

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0615 - Angelina River / Rayburn Reservoir

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Dioxin in Edible Tissue	The Neches River (Segment 0604) and all contiguous waters from the SH 7 bridge west of Lufkin, TX downstream to the US 96 bridge near Evadale, TX including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir	• Pulp and paper bleaching processes	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for six species of fish • ADV-51 issued on January 24, 2014
Mercury in Edible Tissue	The Neches River (Segment 0604) and all contiguous waters from the SH 7 bridge west of Lufkin, TX downstream to the US 96 bridge near Evadale, TX including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir	• Atmospheric deposition from coal-fired power plants, large boilers and heaters, steel production, and incinerators	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for six species of fish • ADV-51 issued on January 24, 2014
Depressed Dissolved Oxygen	Entire segment	• Aquatic vegetation • Nutrient loading into the water body	• Detrimental effect on aquatic biological community	• Continue monitoring • Conduct 24-hour DO measurements • Conduct an Aquatic Life UAA
Concern for Nitrate-Nitrogen	Entire segment	• Municipal wastewater discharge • Nonpoint sources of pollution • Stormwater runoff	• Detrimental effect on aquatic biological community	• Continue monitoring • Evaluate wastewater effluent permit limits
Concern for Total Phosphorus	Entire segment	• Municipal wastewater discharge • Nonpoint sources of pollution • Stormwater runoff	• Can increase production of algae • Algae production can cause swings in dissolved oxygen, which can be detrimental to the aquatic biological community	• Continue monitoring • Evaluate wastewater effluent permit limits
Decreasing trends for Specific Conductance, Total Dissolved Solids, Chloride, and Sulfate	Entire segment	• Improvements in water quality observed beginning in 2004 coincide with the closure of the paper mill in Lufkin, which discharged to Segment 0615	• Beneficial effect on aquatic biological community	• Continue monitoring
Decreasing trends for Ammonia-Nitrogen, Total Kjeldahl Nitrogen, and Total Organic Carbon	Entire segment	• Improvements in water quality observed beginning in 2004 coincide with the closure of the paper mill in Lufkin, which discharged to Segment 0615	• Beneficial effect on aquatic biological community	• Continue monitoring

Segment 0615A - Paper Mill Creek

Segment Profile

This segment includes a total of 9 miles from the confluence of Sam Rayburn Reservoir (Angelina River Arm) northeast of Lufkin in Angelina County to the upstream perennial portion of the stream in Lufkin in Angelina County. The designated uses for this segment include aquatic life, general, and contact recreation use.

Segment 0615A - Paper Mill Creek

Assessment Units

Assessment Units in Segment 0615A - Paper Mill Creek	
AU ID	**Description**
0615A_01	Entire water body

Monitoring Stations

Monitoring Stations in Segment 0615A - Paper Mill Creek									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0615_01	10502	PAPER MILL CREEK UPPER BIFURCATION CHANNEL IMMEDIATELY UPSTREAM OF ANGELINA RIVER CONFLUENCE NW CORNER OF SAM RAYBURN RESERVOIR	4	4	4				TCEQ-10

Description of Water Quality Issues

Impairments and Concerns

Segment 0615A is listed as impaired for *E. coli* bacteria in the Draft 2014 Integrated Report, with a geometric mean of 134.25 MPN/100 mL based on 25 samples.

This segment is also listed as Not Supporting its Aquatic Life Use due to Aluminum in water.

Assessment Summary for Segment 0615A - Paper Mill Creek														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	150 mg/L	**100 mg/L**	**500 mg/L**	**2.00 mg/L**	**1.50 mg/L**	**5.00 mg/L**	**3.00 mg/L**	**6.0 - 9.0 SU**	**33.9**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0615A_01				NC	FS					**NS**	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0615A - Paper Mill Creek

Monitoring Station 10502 - Paper Mill Creek Upper Channel Upstream of Angelina River Confluence

Monitoring Station 10502 is monitored quarterly by TCEQ Region 10 personnel for field and conventional parameters and for *E. coli* bacteria.

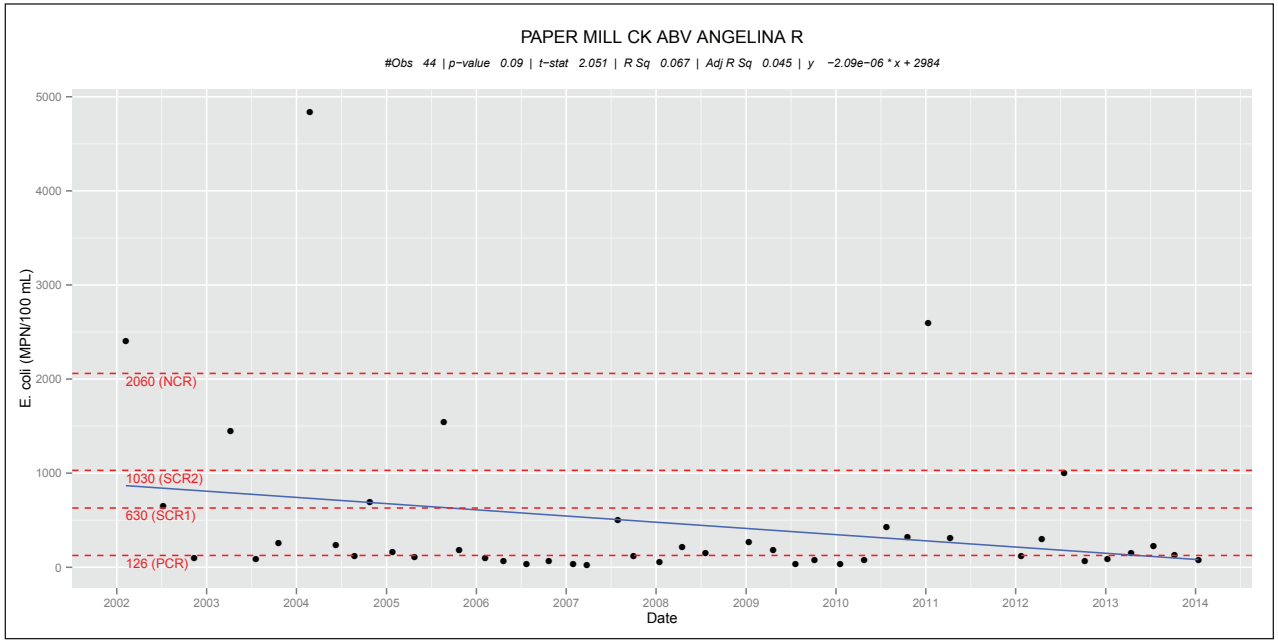
This assessment unit is listed as impaired for *E. coli* bacteria.

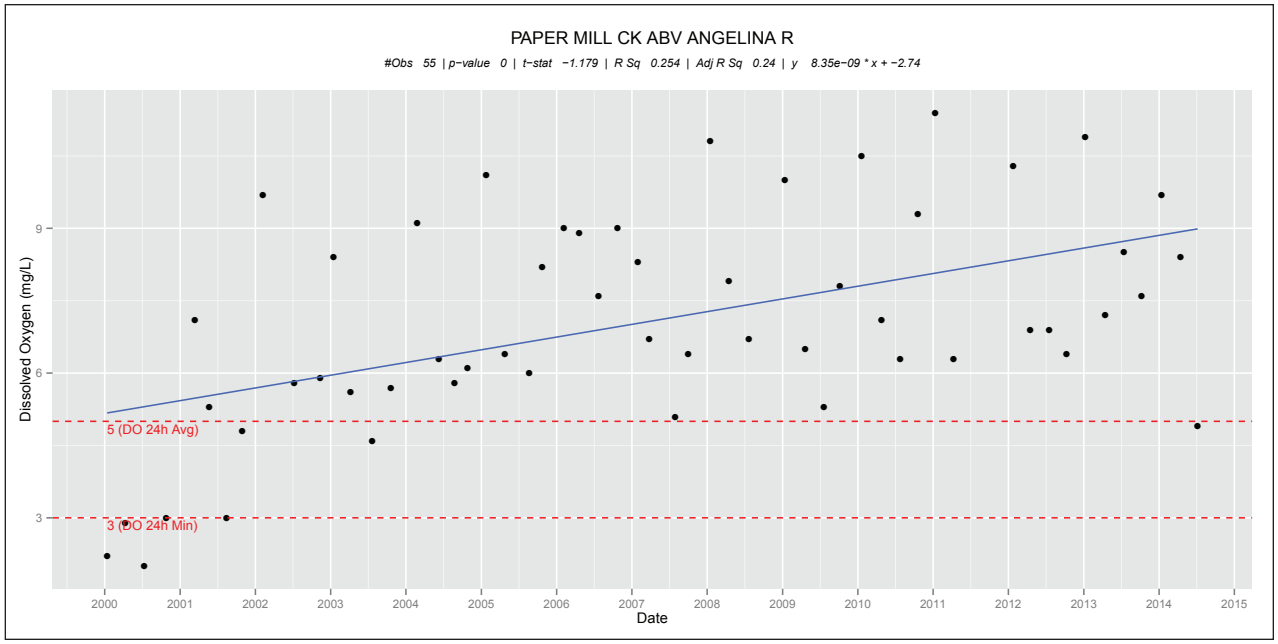
There is an increasing trend for Dissolved Oxygen, although this trend is not statistically significant. Several depressed Dissolved Oxygen measurements were recorded between 2000 and 2002.

Statistically significant decreasing trends were observed for Specific Conductance, Total Dissolved Solids, Sulfate, Chloride, and Color. For these parameters, the decrease in results begins in 2004, which coincides with the closure of the paper mill in Lufkin. The wastewater treatment plant at this facility discharged to Paper Mill Creek.

A statistically decreasing trend is present for both pH and Alkalinity.

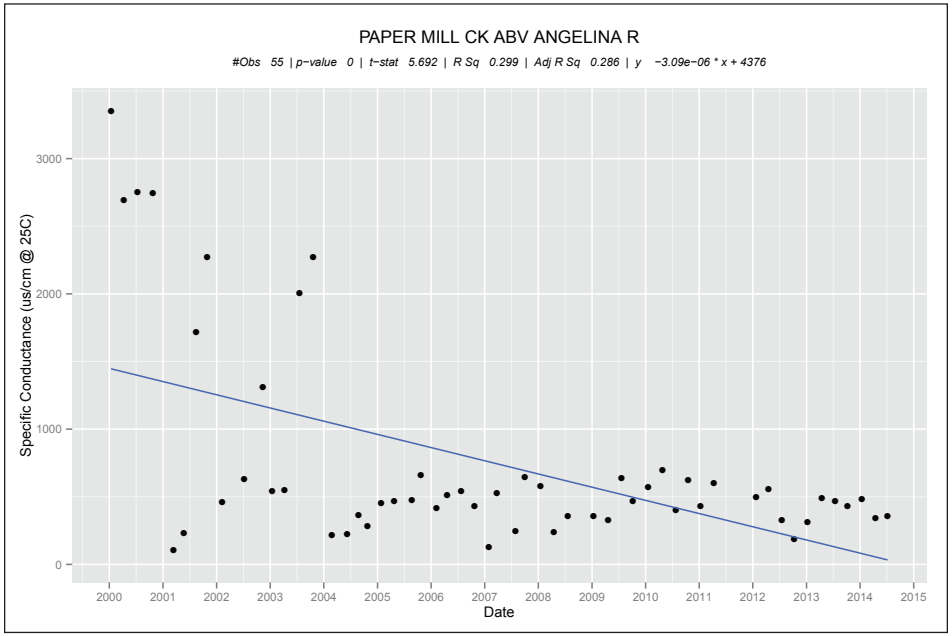
A statistically significant decreasing trend is observed for Ammonia-Nitrogen, Total Kjeldhal Nitrogen, and Total Organic Carbon. These decreases also coincide with the closure of the paper mill. There is also a statistically significant decreasing trend for Total Phosphorus.

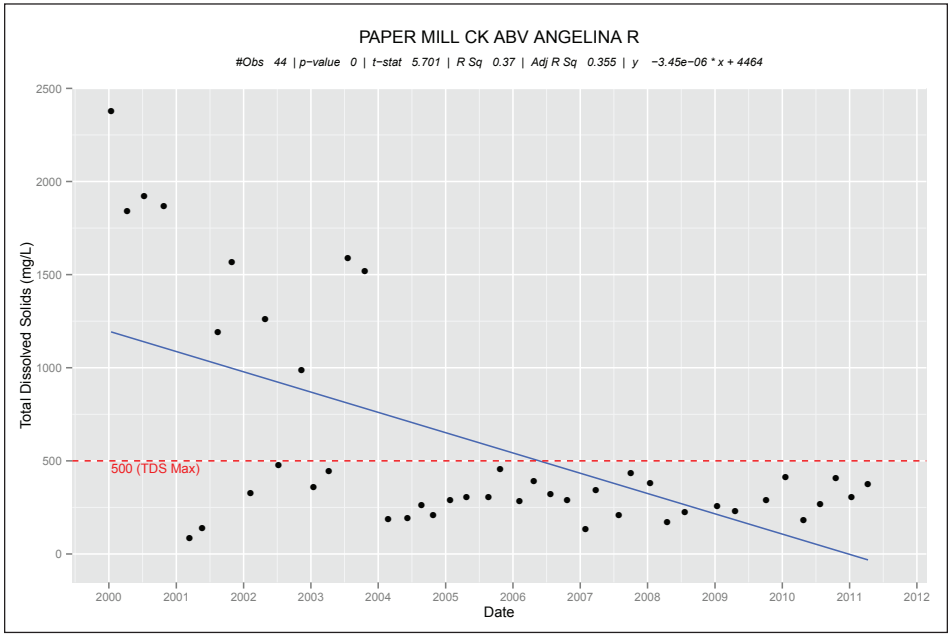


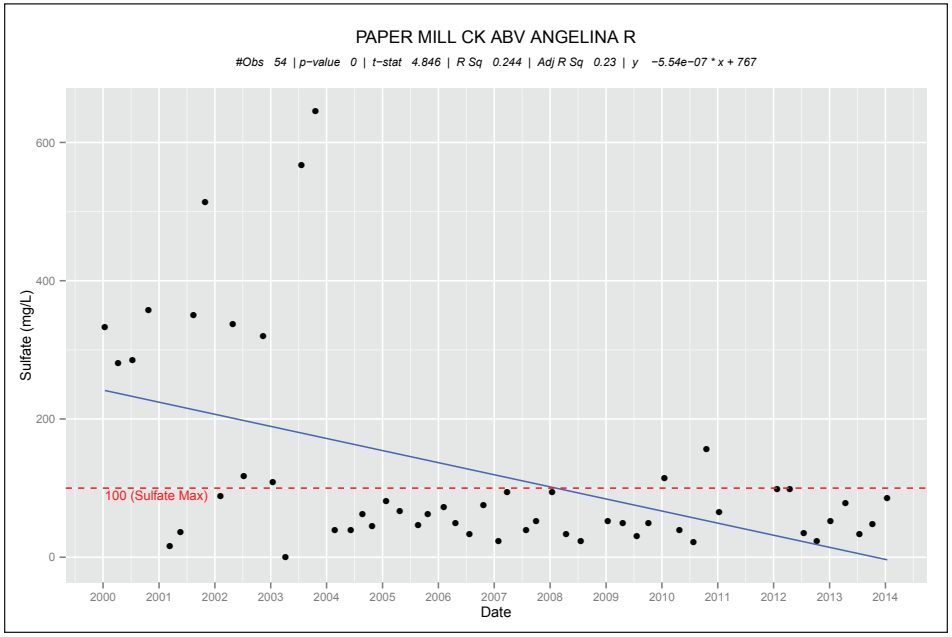


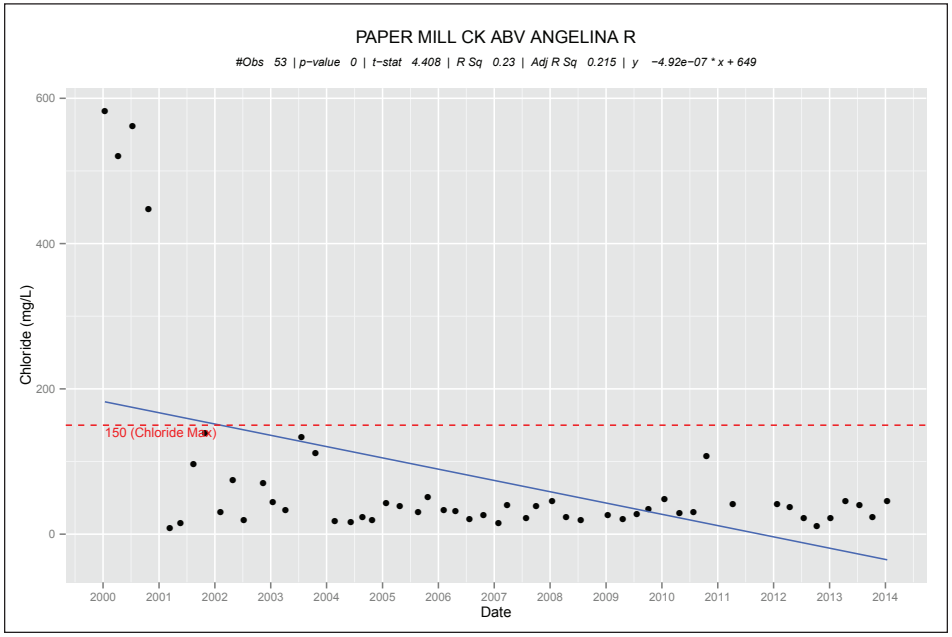
Segment 0615A - Paper Mill Creek

Monitoring Station 10502 - Paper Mill Creek Upper Channel Upstream of Angelina River Confluence



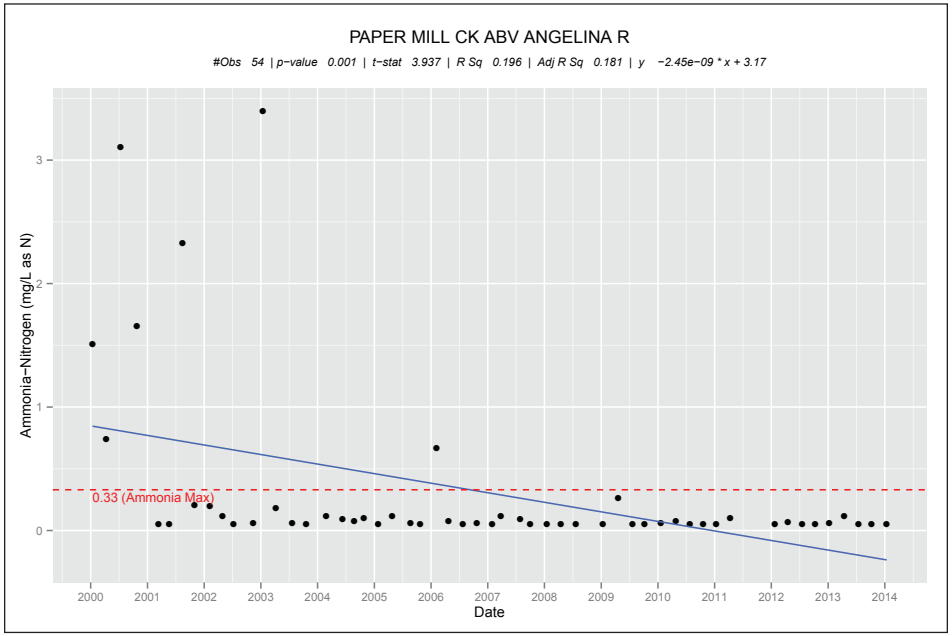


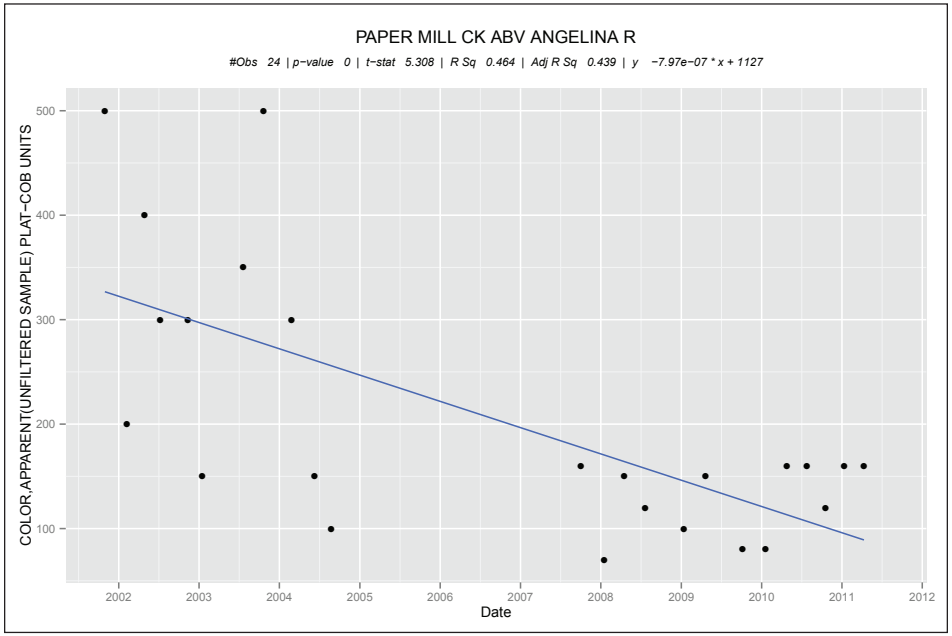


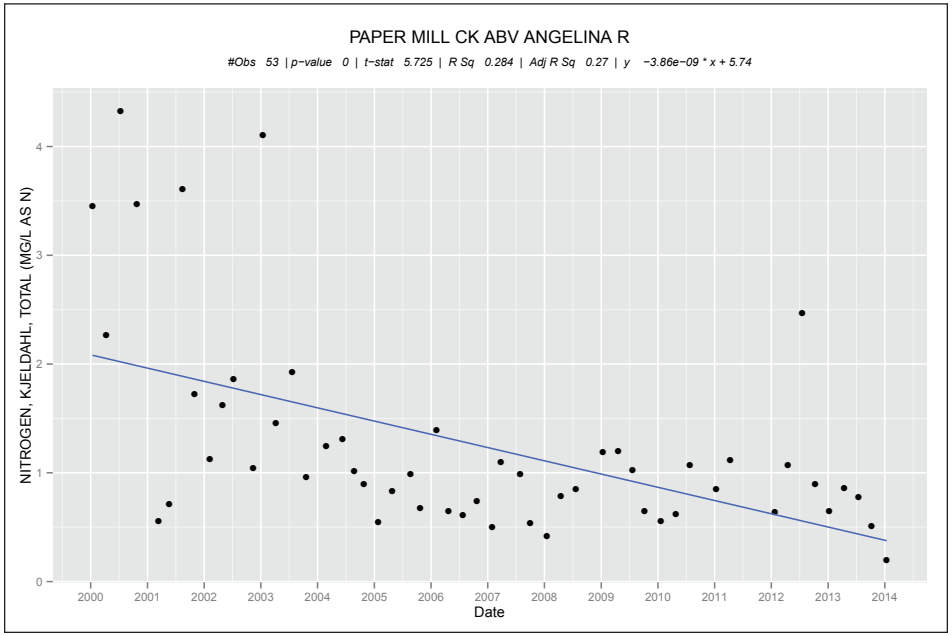


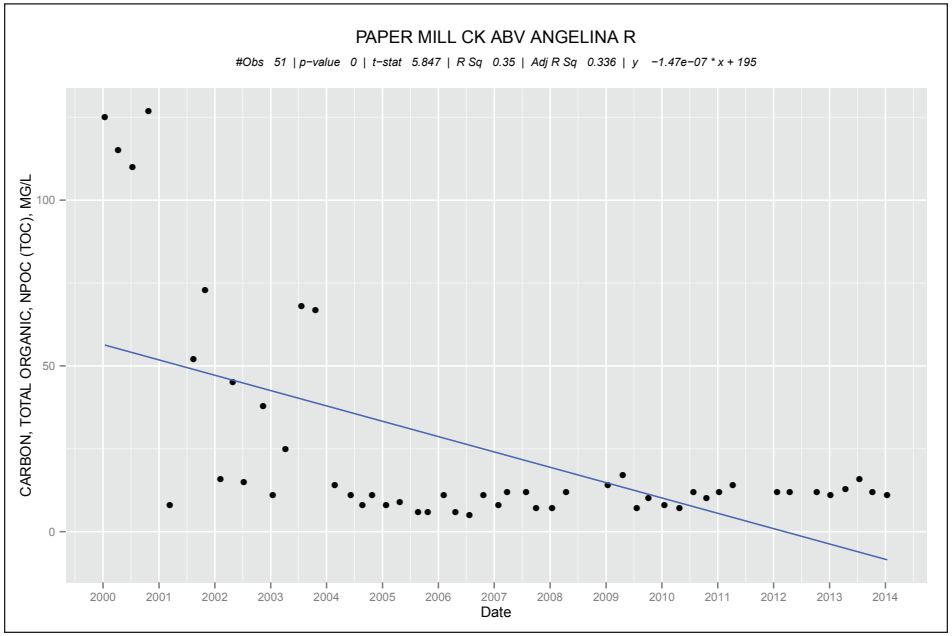
Segment 0615A - Paper Mill Creek

Monitoring Station 10502 - Paper Mill Creek Upper Channel Upstream of Angelina River Confluence



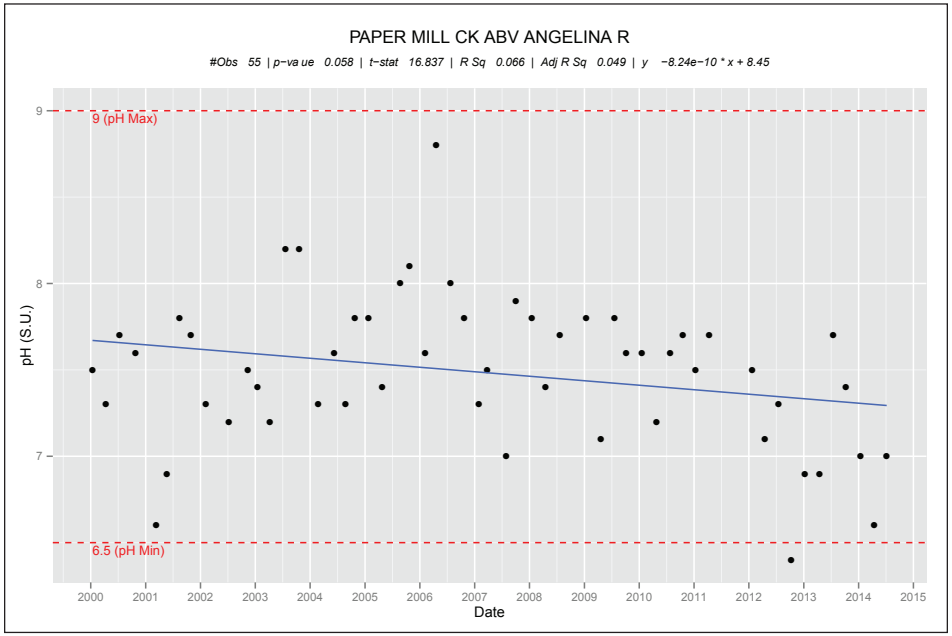


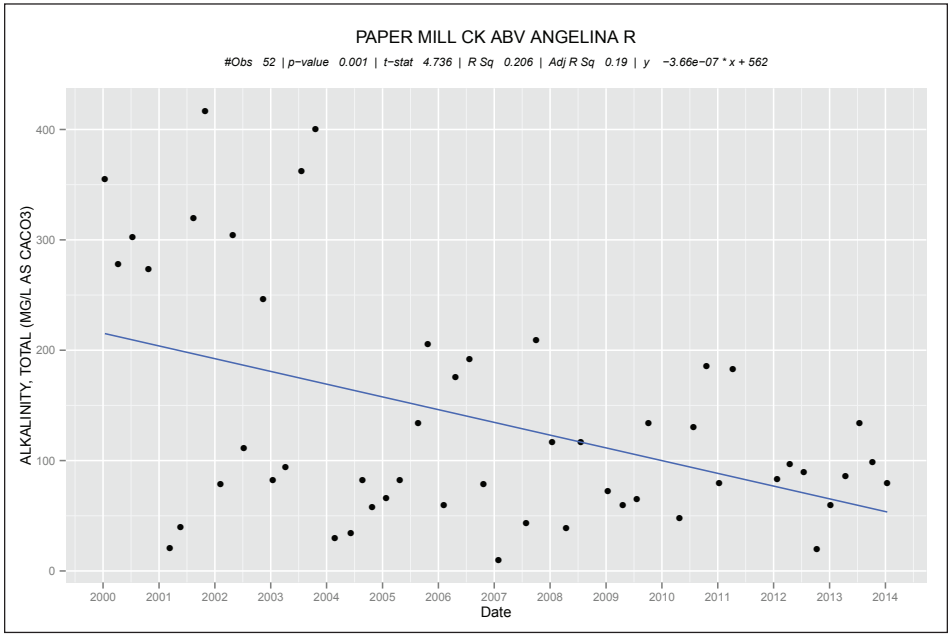




Segment 0615A - Paper Mill Creek

Monitoring Station 10502 - Paper Mill Creek Upper Channel Upstream of Angelina River Confluence





Water Quality Monitoring Results for Station 10502 - Paper Mill Creek Upper Channel Upstream of Angelina River Confluence

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	55	0	104	3354	745.22		5.6918	0.0000	↓
00300	Dissolved Oxygen (mg/L)	55	3	2	11.4	7.07		-1.1790	0.0001	
00400	pH (S.U.)	55	1	6.4	8.8	7.48		16.8366	0.0577	↓
00530	Total Suspended Solids (mg/L)	54	0	5	149	26.41		-0.4410	0.2706	
00610	Ammonia-Nitrogen (mg/L as N)	54	7	0.05	3.4	0.32		3.9375	0.0008	↓
00630	Nitrate + Nitrite (mg/L as N)	34	0	0.1	1.7	0.32		-0.8256	0.2185	
00665	Total Phosphorus (mg/L as P)	50	6	0.05	7.17	0.51		2.2507	0.0689	↓
00940	Chloride (mg/L)	53	4	8	583	77.38		4.4082	0.0003	↓
00945	Sulfate (mg/L)	54	14	1	646	121.81		4.8463	0.0001	↓
31699	*E. coli* (MPN/100 mL)	44	24	20	4840		167.64	2.0513	0.0902	
32211+70953	Chlorophyll-*a* (µg/L)	53	7	1	101	11.59		-0.5269	0.2541	
70300	Total Dissolved Solids (mg/L)	44	10	86	2380	593.43		5.7013	0.0000	↓

Segment 0615A - Paper Mill Creek

Summary of Water Quality Trends

Numerous statistically significant trends were observed for Paper Mill Creek at Monitoring Station 10502. Statistically significant decreasing trends were observed for Specific Conductance, Total Dissolved Solids, Sulfate, Chloride, Alkalinity, Total Organic Carbon, Ammonia-Nitrogen, Total Kjeldahl Nitrogen and Color. For each of these parameters, the decrease in reported results begins around the time that the paper mill in Lufkin ceased operation. The paper mill discharged wastewater effluent into Paper Mill Creek.

Statistically significant decreasing trends were also reported for pH and Total Phosphorus.

Trend Analysis Summary for Segment 0615A - Paper Mill Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Paper Mill Creek	0615A_01	10502	Paper Mill Creek Upper Channel Upstream of Angelina River Confluence		↓		↓	↓	↓	↓			↓		↓

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0615A - Paper Mill Creek

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Toxic substances in water (Aluminum)	Entire water body	• This concern was based upon carry-forward data	• Metals in water can be toxic to the aquatic biological community	• Collect additional data and re-evaluate
Impairment for *E. coli* bacteria	Entire water body	• Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A RUAA is being conducted by TCEQ on this water body to determine if the most appropriate contact recreation standard is being applied
Decreasing trends for Specific Conductance, Total Dissolved Solids, Chloride, and Sulfate	Entire segment	• Improvements in water quality observed beginning in 2004 coincide with the closure of the paper mill in Lufkin, which discharged to Segment 0615	• Beneficial effect on aquatic biological community	• Continue monitoring
Decreasing trends for Ammonia-Nitrogen, Total Kjeldahl Nitrogen, and Total Organic Carbon	Entire segment	• Improvements in water quality observed beginning in 2004 coincide with the closure of the paper mill in Lufkin, which discharged to Segment 0615	• Beneficial effect on aquatic biological community	• Continue monitoring

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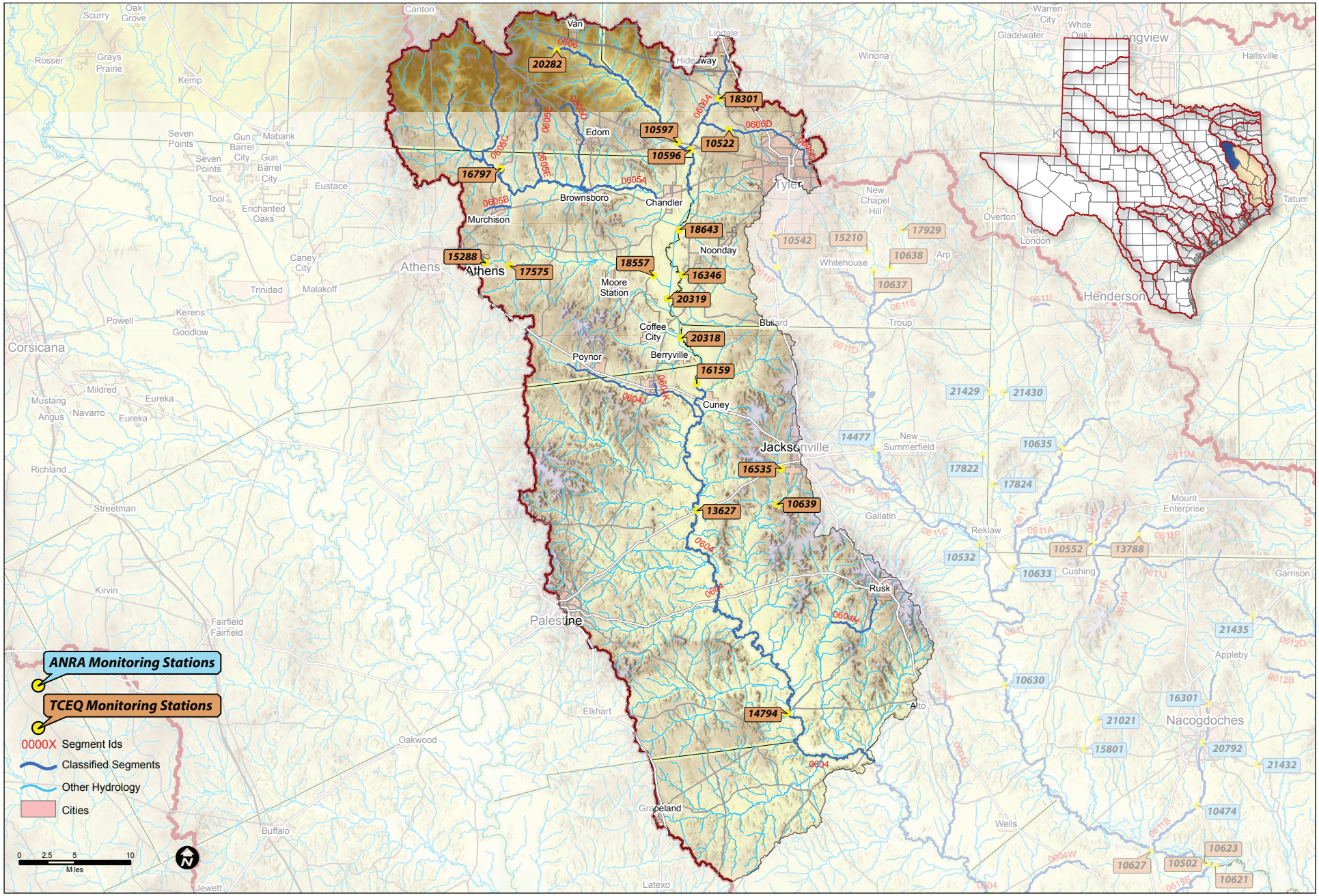
Upper Neches Overview Map



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Profile of the Upper Neches Sub-Basin

Population

The counties included within the sub-basin are Anderson, Cherokee, Henderson, Houston, Smith, and Van Zandt. The following cities lie partially or wholly within the sub-basin: Van, Edom, Murchison, Brownsboro, Noonday, Chandler, Moore Station, Coffee City, Berryville, Cuney, Frankston, Poynor, Palestine, Jacksonville, Grapeland, Alto, Rusk, and Bullard. Lake Athens, Lake Palestine, and Lake Jacksonville are major reservoirs located within the sub-basin. As of the 2010 census, there are an estimated 69,780 households, including 165,557 individuals residing within the sub-basin.

Land Characteristics and Use

Land use coverage includes hay, pasture, mixed forest, woody wetland, deciduous forest, and cultivated crops. In the southern portion, evergreen, deciduous, and mixed forest dominate the region. Within the Lake Palestine area, there is developed open space, mixed forest, and hay/pasture. Floodplains and low terraces (South Central Plains), northern post oak savanna (East Central Plains), and tertiary uplands (South Central Plains) are the major Ecoregions located in the sub-basin.

Segments in the Upper Neches Sub-Basin

Segment ID	Segment Name
0604	Neches River Below Lake Palestine
0604H	One Eye Creek
0605	Lake Palestine
0605A	Kickapoo Creek
0606	Neches River Above Lake Palestine
0606A	Prairie Creek
0614	Lake Jacksonville

Lake Palestine

Profile of the Upper Neches Sub-Basin

Permitted Discharges in the Upper Neches Sub-Basin

A total of thirty-four permitted discharges are within the Upper Neches sub-basin.

Permitted Discharges in the Upper Neches Sub-Basin

First Segment in Drainage Path	Segment ID as identified in Permit	Permit Number	Outfall Number	NPDES Number	Permittee	County	TCEQ Region	Map Locations
0604	0604	05144-000	001	135861	APEX TEXAS POWER LLC	Cherokee	05 - Tyler	Page 184
0604	0604	10181-002	001	055239	CITY OF GRAPELAND	Houston	10 - Beaumont	Page 184
0604	0604	11787-001	001	071188	CITY OF BULLARD	Cherokee	05 - Tyler	Page 184
0604	0604	13728-001	001	112593	CITY OF CUNEY	Cherokee	05 - Tyler	Page 184
0604	0604	15094-001	001	134571	CRAFT-TURNEY WSC	Cherokee	05 - Tyler	Page 184
0605	0605	11012-001	001	033499	CITY OF CHANDLER	Henderson	05 - Tyler	Pages 191 & 201
0605	0605	13849-001	001	134252	ALGONQUIN WATER RESOURCES OF TEXAS LLC	Smith	05 - Tyler	Page 191
0605	0605	14079-001	001	118273	SOUTHERN UTILITIES CO	Cherokee	05 - Tyler	Page 191
0605	0605	14080-001	001	118362	SOUTHERN UTILITIES CO	Smith	05 - Tyler	Page 191
0606	0606	10376-001	001	054071	CITY OF VAN	Van Zandt	05 - Tyler	Page 206
0606	0606	13905-001	001	118591	BEN WHEELER WSC	Van Zandt	05 - Tyler	Page 206
0606	0606	13974-001	001	065650	BEN WHEELER WSC	Van Zandt	05 - Tyler	Page 206
0606	0606	13974-002	001	070548	BEN WHEELER WSC	Van Zandt	05 - Tyler	Page 206
0606	0606	15068-001	001	133931	FREE STATE SEWER SERVICE AND WATER SUPPLY CORP	Van Zandt	05 - Tyler	Page 206
0604H	0604	10447-001	001	054399	CITY OF RUSK	Cherokee	05 - Tyler	Pages 184 & 190
0604J	0604	13538-001	001	105902	LA POYNOR ISD	Henderson	05 - Tyler	Page 184
0604K	0604	10441-001	001	033456	CITY OF FRANKSTON	Anderson	05 - Tyler	Page 184
0605A	0605	10540-001	001	062707	CITY OF BROWNSBORO	Henderson	05 - Tyler	Pages 191 & 201
0605A	0605	15007-001	001	133086	RPM WSC	Van Zandt	05 - Tyler	Pages 191 & 201
0605B	0605	13972-001	001	072087	CITY OF MURCHISON	Henderson	05 - Tyler	Pages 191 & 201
0606A	0606	10412-002	001	105066	CITY OF LINDALE	Smith	05 - Tyler	Pages 206 & 213
0606A	0606	15074-001	001	134287	HELMS, TONDA JOLANE	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	001	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	002	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	003	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	004	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	005	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	006	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	008	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	010	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	011	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	012	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	01590-000	013	001449	DELEK REFINING LTD	Smith	05 - Tyler	Pages 206 & 213
0606D	0606	10653-001	001	047996	CITY OF TYLER	Smith	05 - Tyler	Pages 206 & 213

Profile of the Upper Neches Sub-Basin

Texas Surface Water Quality Standards for the Upper Neches Sub-Basin

Site-Specific Uses and Numeric Criteria for Classified Segments in the Upper Neches Sub-Basin

Segment ID	Segment Name	DESIGNATED USES				CRITERIA*						
		Recreation	Aquatic Life	Domestic Water Supply	Other	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	Dissolved Oxygen (mg/L	pH Range (S.U.)	*E. coli* Bacteria #/100 mL	Temp (°F)
0604	Neches River Below Lake Palestine	PCR	H	PS		50	50	200	5.0	6.0 - 8.5	126	91
0605	Lake Palestine	PCR	H	PS		50	50	200	5.0	6.5 - 9.0	126	90
0606	Neches River Above Lake Palestine	PCR	I	PS		100	50	300	4.0	6.0 - 8.5	126	95
0614	Lake Jacksonville	PCR	H	PS		50	75	750	5.0	6.5 - 9.0	126	93

PCR = Primary Contact Recreation SCR1 = Secondary Contact Recreation 1 SCR2 = Secondary Contact Recreation 2 NCR = Noncontact Recreation
H = High Aquatic Life Use I = Intermediate Aquatic Life Use
PS = Public Supply

* The criteria for Chloride, Sulfate, and TDS are listed as the maximum annual averages for the segment. Dissolved Oxygen criteria are listed as minimum 24-hour means at any site within the segment. The pH criteria are listed as minimum and maximum values expressed in standard units at any site within the segment. The criteria for Temperature are listed as maximum values at any site within the segment.

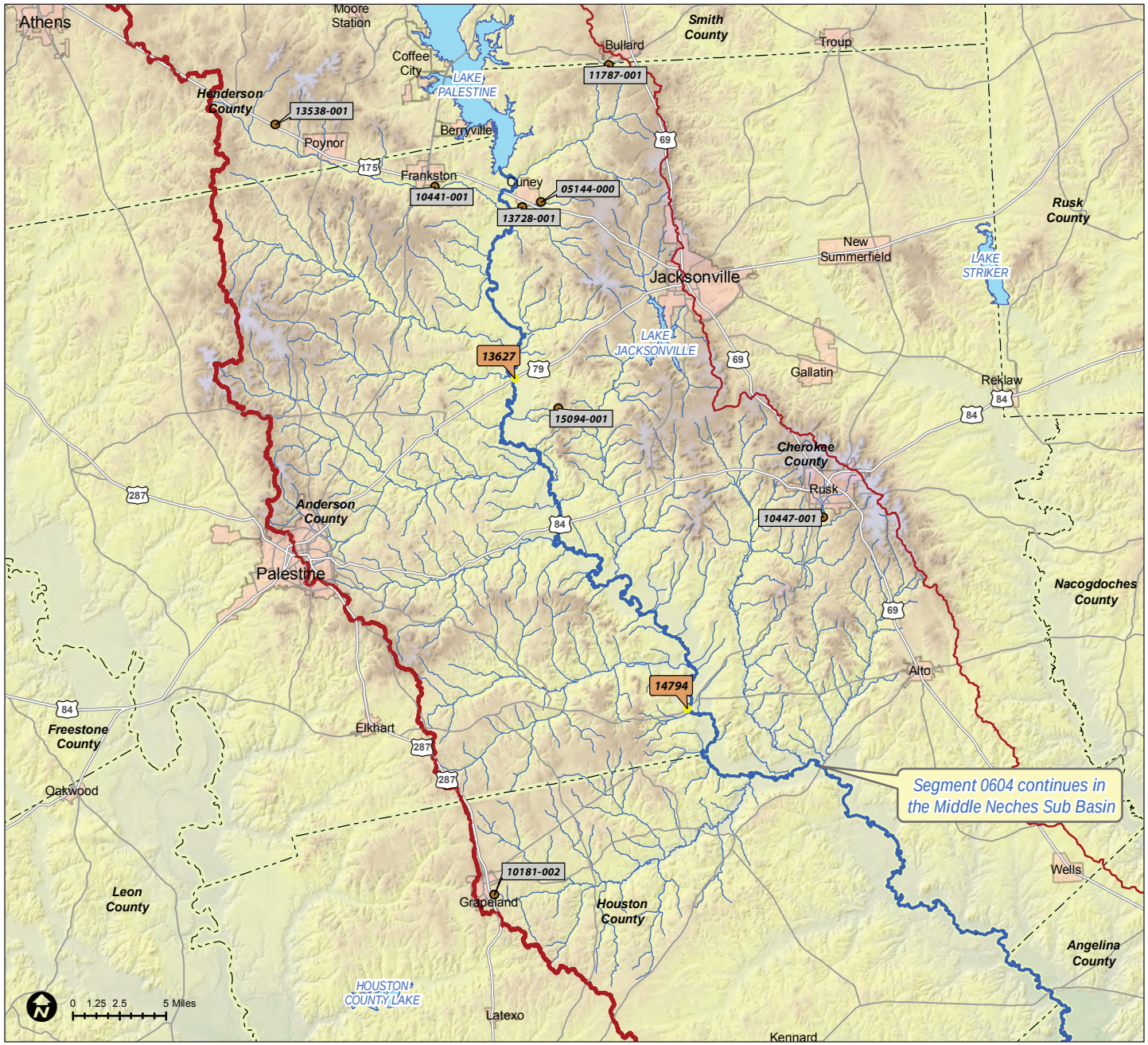
Texas Stream Team training for the Greater Lake Palestine Council (GLPC) volunteer monitoring program, June 27, 2014

Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)

Segment Profile

This 231 miles-long freshwater stream extends from a point immediately upstream of the confluence of Hopson Mill Creek in Jasper/Tyler County to Blackburn Crossing Dam in Anderson/ Cherokee County. Contact recreation, public water supply, general, and high aquatic life use are the designated uses for this segment. Segment 0604 spans the Upper, Middle, and Lower Neches Sub-Basins.

Assessment Units 0604_04 and 0604_05 are located within the Upper Neches Sub-Basin.



Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)

Assessment Units

Assessment Units in Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)	
AU ID	**Description**
0604_04	From the confluence with Cedar Creek in Cherokee County near Hargrove Lake upstream to the confluence with Beech Creek in Anderson County at NHD RC 12020001006717
0604_05	From the confluence with Beech Creek in Anderson County upstream to the Blackburn Crossing Dam

Monitoring Stations

Monitoring Stations in Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604_04	14794	NECHES RIVER AT SH 294 23.12 KM SOUTHWEST OF RUSK IN ANDERSON COUNTY	4	4	4	4			TCEQ-5
0604_05	13627	NECHES RIVER DOWNSTREAM LAKE PALESTINE AT US 79 4.4 MI NORTH OF NECHES 0.67 MI DOWNSTREAM FROM RAILROAD BRIDGE	4	4	4	4			TCEQ-5

Description of Water Quality Issues

Impairments and Concerns

Assessment units 0604_04 and 0604_05 are both listed in the Draft 2014 Integrated Report with concerns for Chlorophyll-*a*. For AU 0604_04, 9 of 26 samples for the 2014 assessment exceeded the nutrient screening level. For AU 0604_05, the northernmost assessment unit and the one closest to Lake Palestine, the nutrient screening level was exceeded for 29 of 42 samples assessed.

Assessment Summary for Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion) as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**	**5.00 mg/L**	**3.00 mg/L**	**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604_04				NC	FS	FS	FS	FS	FS	FS	NC	NC	NC	CS
0604_05				NC	FS	FS	FS	FS	FS	FS	NC	NC	NC	CS

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)

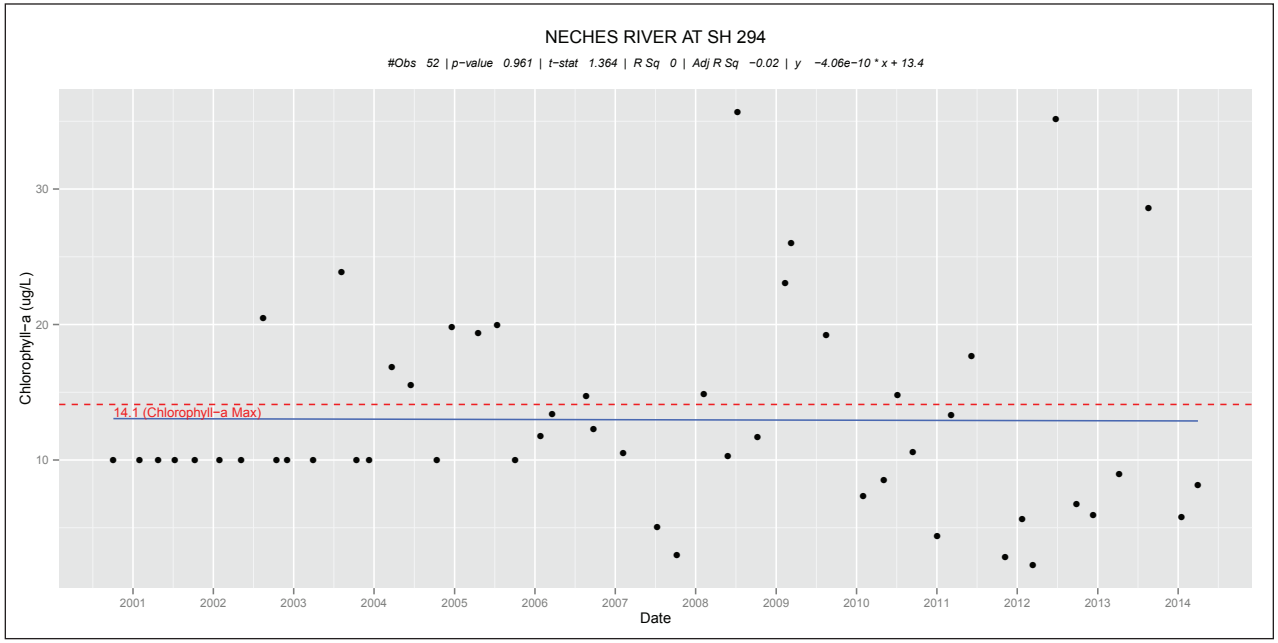
Monitoring Station 14794 - Neches River at SH 294

Monitoring Station 14794 is in assessment unit 0604-04. This station is located on the Neches River at SH 294 and is monitored quarterly by TCEQ Region 5 (Tyler) personnel for field parameters, conventional parameters, flow and *E. coli* bacteria.

Increasing trends are observed for Specific Conductance, Total Dissolved Solids, Chloride, and Sulfate, but none of these trends are considered to be statistically significant.

A decreasing trend is observed for Total Phosphorus, but this trend seems to be influenced by a lower limit of quantitation for more recent analyses. All Total Phosphorus results were low, with a minimum reported value of <0.02 mg/L as P and a maximum of 0.19 mg/L as P.

There is a concern for Chlorophyll-*a* at this monitoring station, with numerous values exceeding the nutrient screening level.



Water Quality Monitoring Results for Station 14794 - Neches River at SH 294

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	54	0	116	284	189.67		1.3548	0.0022	
00300	Dissolved Oxygen (mg/L)	54	0	4.2	11.1	8.23		3.5864	0.8069	
00400	pH (S.U.)	52	1	5.9	7.6	6.99		17.7564	0.7500	
00530	Total Suspended Solids (mg/L)	53	0	4	78	25.68		1.4063	0.8798	
00610	Ammonia-Nitrogen (mg/L as N)	53	0	0.05	0.09	0.05		5.1612	0.5726	
00630	Nitrate + Nitrite (mg/L as N)	34	0	0.04	0.55	0.14		1.6017	0.2903	
00665	Total Phosphorus (mg/L as P)	51	0	0.02	0.19	0.07		3.1711	0.1690	
00940	Chloride (mg/L)	53	0	12	40	24.32		1.0697	0.0134	
00945	Sulfate (mg/L)	54	0	12	50	22.69		-1.8099	0.0000	
31699	*E. coli* (MPN/100 mL)	46	9	0	2000		27.88	-0.2572	0.5472	
32211+70953	Chlorophyll-*a* (µg/L)	52	17	2.22	35.7	12.97		1.3637	0.9613	
70300	Total Dissolved Solids (mg/L)	41	0	83	183	130.41		1.9266	0.0898	

Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)

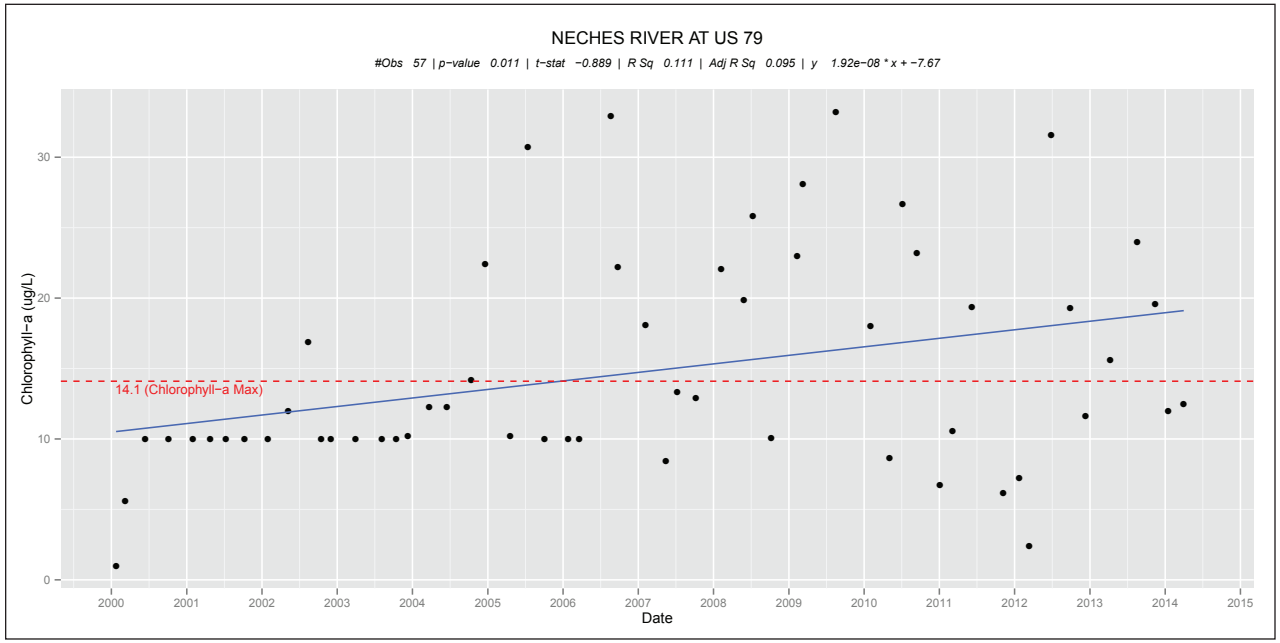
Monitoring Station 13627 - Neches River at US 79

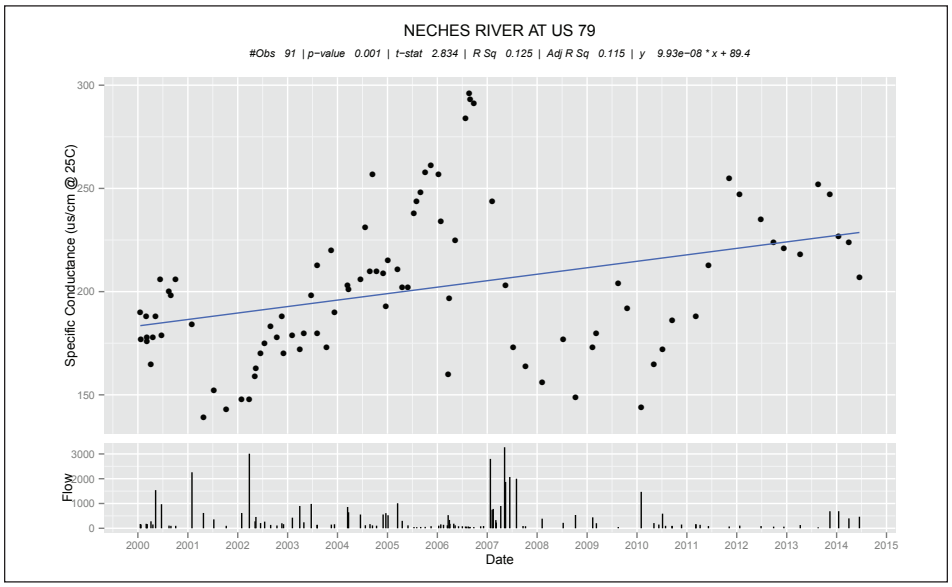
Monitoring Station 13627 is found within AU 0604_05. This station is located on the Neches River at the US 79 bridge crossing downstream from Lake Palestine and is monitored quarterly by TCEQ Region 5 (Tyler) personnel for field parameters, conventional parameters, flow and *E. coli* bacteria.

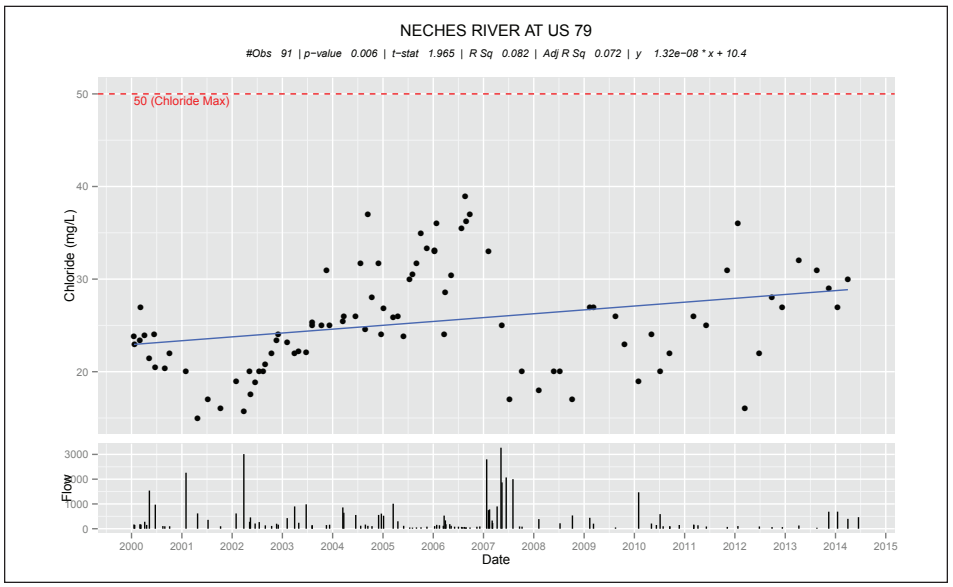
There are statistically significant increasing trends for Specific Conductance and Total Dissolved Solids at this station. Trends for Sulfate and Chloride are also increasing, but neither trend is significant.

Decreasing trends are observed for Total Phosphorus and Ammonia-Nitrogen, but both data sets contain greater than 50% of data at or below the limit of quantitation. All Total Phosphorus results were low, with a minimum reported value of <0.02 mg/L as P and a maximum of 0.11 mg/L as P. A lower LOQ in recent years is influencing the trend for Total Phosphorus.

There is a concern for Chlorophyll-*a* at this monitoring station, with numerous values exceeding the nutrient screening level.

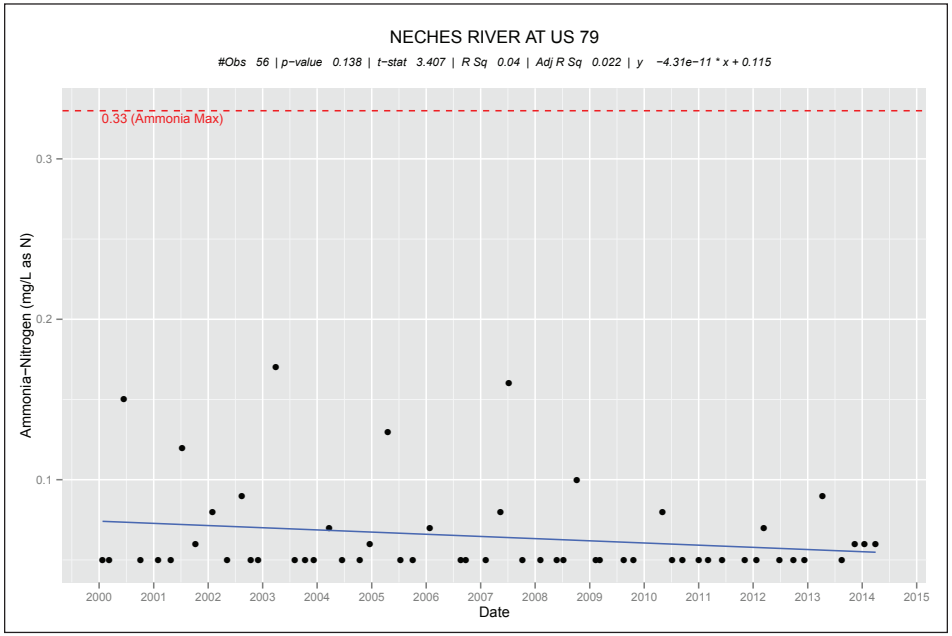


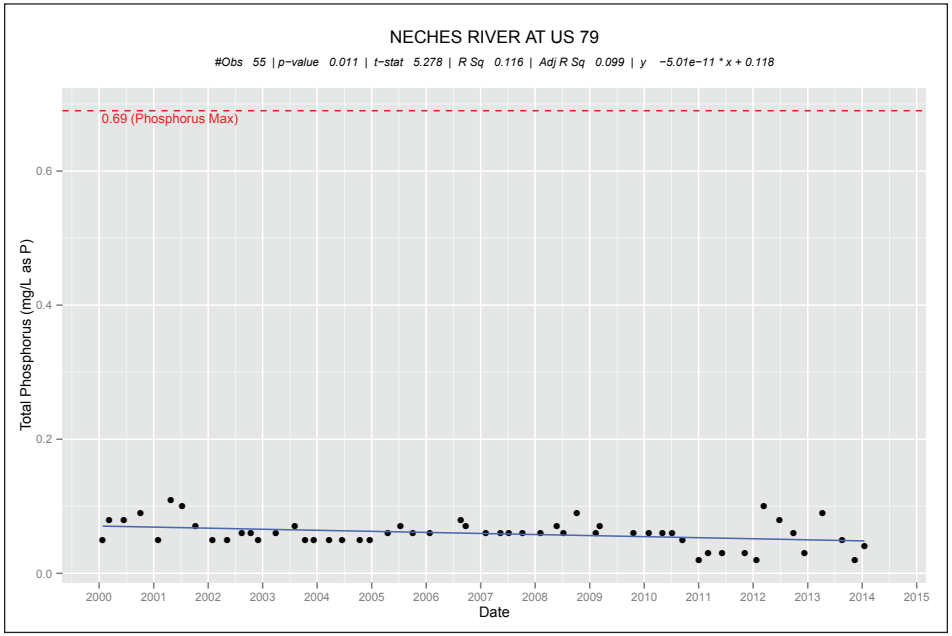




Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)

Monitoring Station 13627 - Neches River at US 79





Water Quality Monitoring Results for Station 13627 - Neches River at US 79

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	91	0	139	296	201.21		2.8341	0.0006	↑
00300	Dissolved Oxygen (mg/L)	91	0	3.9	11.3	7.93		4.1640	0.4513	
00400	pH (S.U.)	90	1	5.7	8.1	7.07		17.9821	0.6941	
00530	Total Suspended Solids (mg/L)	58	0	3	44	18.34		2.0147	0.7045	
00610	Ammonia-Nitrogen (mg/L as N)	56	0	0.05	0.17	0.06		3.4068	0.1381	
00630	Nitrate + Nitrite (mg/L as N)	36	0	0.04	0.51	0.16		1.3436	0.4352	
00665	Total Phosphorus (mg/L as P)	55	0	0.02	0.11	0.06		5.2777	0.0110	
00940	Chloride (mg/L)	91	0	15	39	25.36		1.9652	0.0058	
00945	Sulfate (mg/L)	92	0	10	47	21.77		-1.4584	0.0000	
31699	*E. coli* (MPN/100 mL)	56	17	16	2400		6.49	-0.2347	0.5787	
32211+70953	Chlorophyll-*a* (µg/L)	57	22	1	33.2	14.79		-0.8892	0.0113	
70300	Total Dissolved Solids (mg/L)	45	0	91	197	128.71		2.0364	0.0827	↑

Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)

Summary of Water Quality Trends

In assessment units 0604_04 and 0604_05, increasing trends were observed for Specific Conductance, Total Dissolved Solids, Chloride, and Sulfate. In AU 0604_05, the trends for Specific Conductance and Total Dissolved Solids were considered to be statistically significant.

There is a decreasing trend for Total Phosphorus in both assessment units, but these trends are being influenced by a lower limit of quantitation in recent years. Although values of the t-stat and p-value for the data at station 13627 meet the criteria for statistical significance, ANRA is not classifying this trend as significant due to the influence that the limit of quantitation is having on the overall trend.

Trend Analysis Summary for Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Neches River Below Lake Palestine	0604_04	14794	Neches River at SH 294	No trends were statistically significant.											
	0604_05	13627	Neches River at US 79						↑	↑					

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0604 - Neches River Below Lake Palestine (Upper Neches Sub-Basin Portion)

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Elevated Chlorophyll-*a*	AU 0604_04 AU 0604_05	• Nonpoint sources of pollution • Stormwater runoff • Improper use of fertilizers	• Aesthetic issues • Effect on dissolved oxygen levels	• Continue monitoring
Increasing trends for Total Dissolved Solids, Specific Conductance, Chloride, and Sulfate				

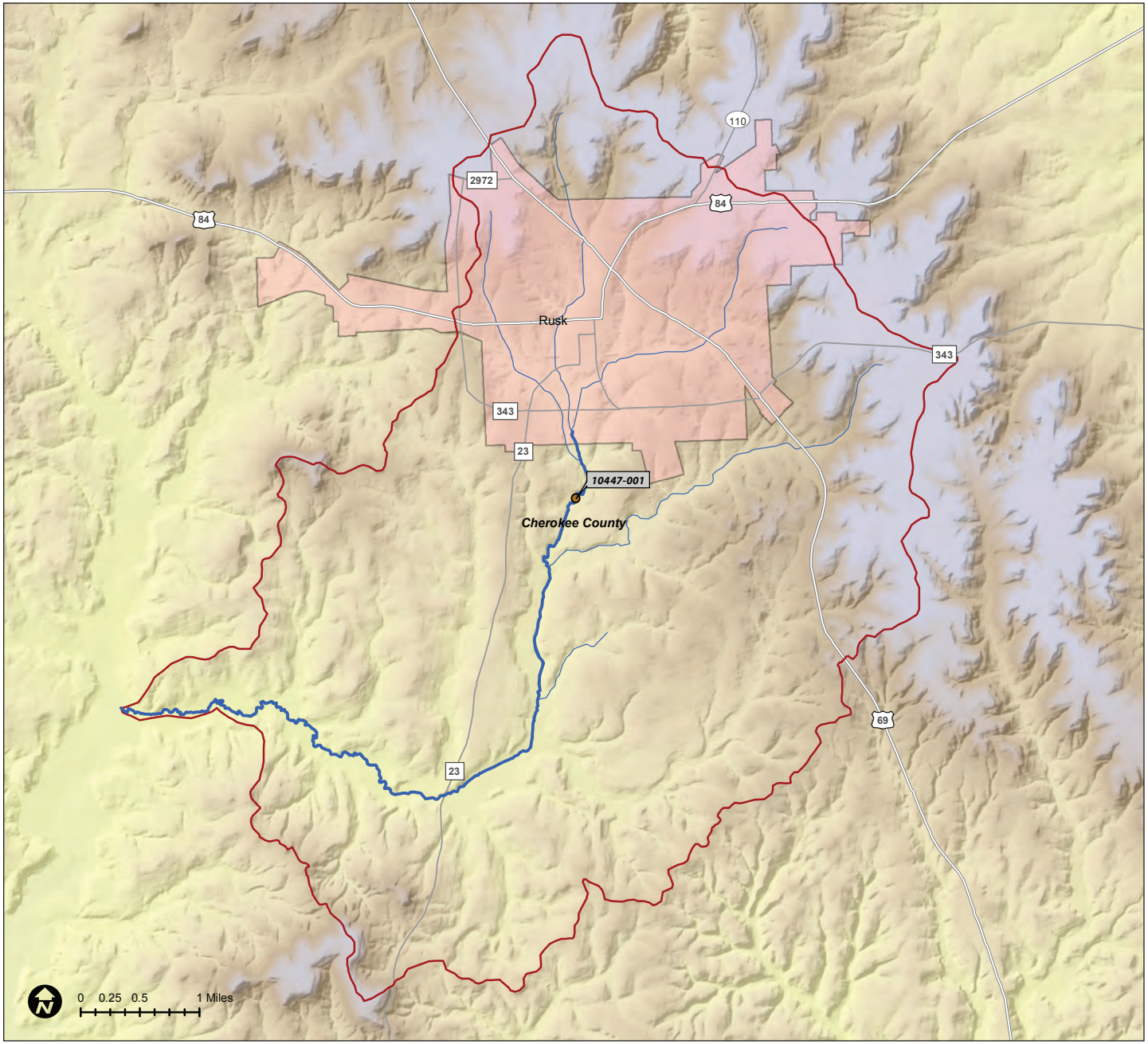
Segment 0604H - One-Eye Creek

Segment Profile

One-Eye Creek is a 9.4 mile-length perennial stream from the confluence with Beans Creek southwest of Rusk to the dam at State Hospital Reservoir north of Rusk in Cherokee County.

The City of Rusk's wastewater treatment facility discharges to One-Eye Creek.

There are no monitoring stations on this unclassified segment, and this segment has not been assessed for the Draft 2014 Integrated Report.

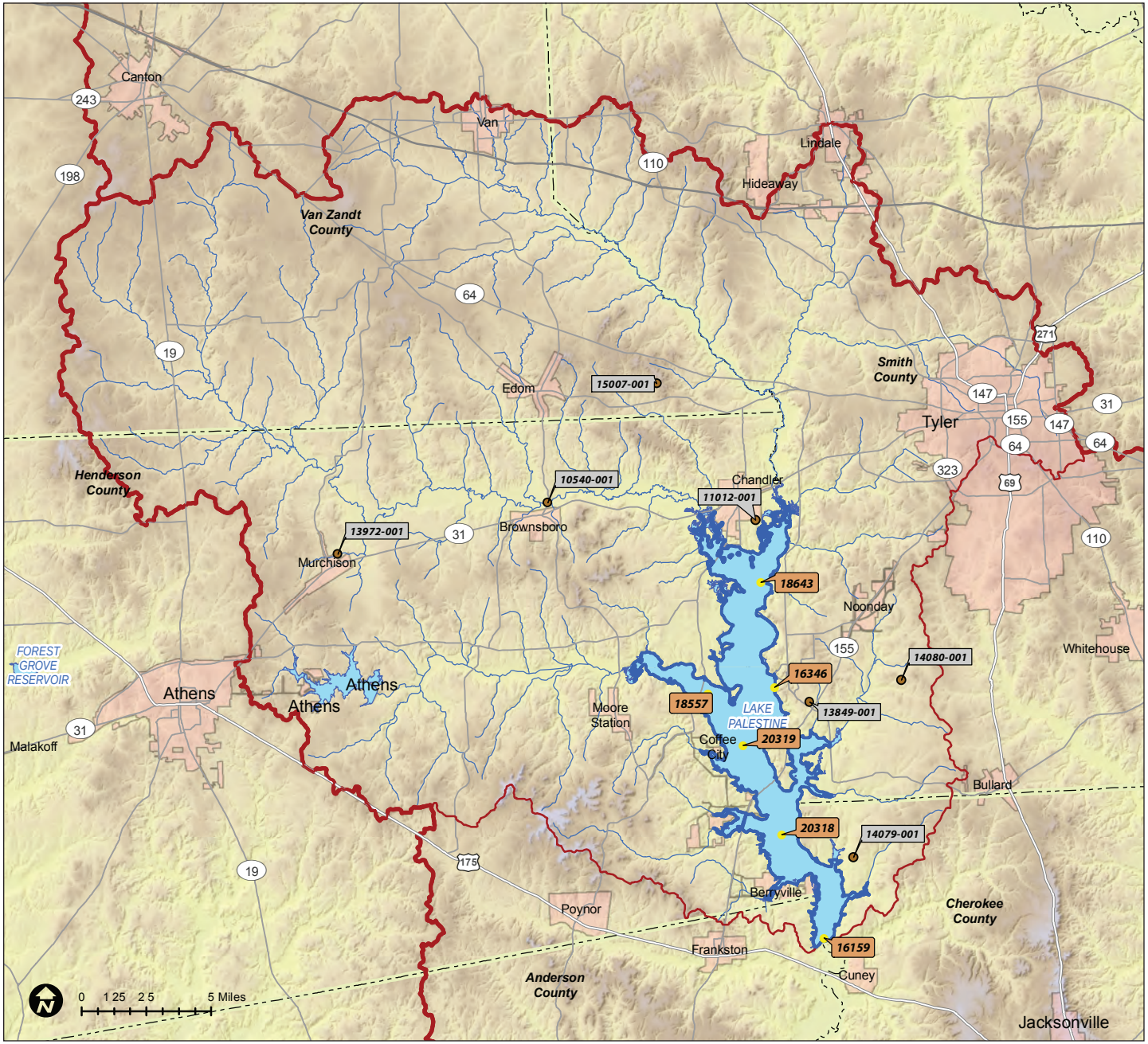


Segment 0605 - Lake Palestine

Segment Profile

Lake Palestine is a 23,500-acre reservoir from the Blackburn Crossing Dam in Anderson/Cherokee County to a point 6.7 km (4.2 miles) downstream of FM 279 in Henderson/Smith County, up to normal pool elevation of 345 feet (impounds Neches River). It was impounded in 1962. Designated uses for this segment are general, public water supply, contact recreation, fish consumption, and high aquatic life use.

Lake Palestine is a popular angler site and houses several largemouth bass tournaments annually. Predominate fish species located within the lake include largemouth bass, spotted bass, white and hybrid striped bass, crappie, flathead and channel catfish, and sunfish. Vegetation within the reservoir is moderate in the upper end and creek arms, especially near Kickapoo Creek. The upper lake is shallow and has heavy aquatic vegetation.



Segment 0605 - Lake Palestine

Assessment Units

Assessment Units in Segment 0605 - Lake Palestine	
AU ID	**Description**
0605_01	Lower portion of reservoir near dam to the first bend in reservoir
0605_02	From the first bend in lower portion of reservoir up to the SH 155 Bridge crossing
0605_03	Upper mid-lake including Tyler Public Water Supply intake
0605_09	Flat Creek Arm
0605_10	Upper Lake
0605_11	From the SH 155 Bridge crossing to the Flat Creek Arm and across the main portion of the lake at the Flat Creek Arm

Monitoring Stations

Monitoring Stations in Segment 0605 - Lake Palestine

Assessment Unit	Monitoring Station ID	Description	Annual Frequency						Monitoring Entity
			Field	Conv	Bacteria	Flow	Metals in Water	Metals in Sediment	
0605_01	16159	LAKE PALESTINE AT DAM	4	4	4				TCEQ-5
0605_02	20318	LAKE PALESTINE, MIDLAKE, APPROXIMATELY 2.35 MILES DUE SOUTH OF THE NORTH END OF THE SH155 BRIDGE	4	4	4				TCEQ-5
0605_03	16346	LAKE PALESTINE AT TYLER INTAKE	4	4	4				TCEQ-5
0605_09	18557	LAKE PALESTINE IN FLAT BAY	4	4	4				TCEQ-5
0605_10	18643	UPPER LAKE PALESTINE NE	4	4	4				TCEQ-5
0605_11	20319	LAKE PALESTINE CWQMN SITE, MID-LAKE, 1.13 KM EAST TO THE END OF CAPE TRANQUILITY DRIVE AND 1.35 KM WEST TO THE END OF REGAL ROW	4	4	4				TCEQ-5

Segment 0605 - Lake Palestine

Description of Water Quality Issues

Impairments and Concerns

In AU 0605_01, there is a concern for depressed Dissolved Oxygen. This concern has not been identified for any other assessment unit in the lake.

There are issues with elevated pH and Chlorophyll-*a* throughout the reservoir. In AU 0605_01, pH is listed in the Draft 2014 Integrated Report with a concern for near non-attainment. For other assessment units, it is listed as not supporting its designated general use due to high pH. A concern for Chlorophyll-*a* is identified for all assessment units evaluated in the assessment.

Assessment Summary for Segment 0605 - Lake Palestine as listed in the Draft 2014 Texas Integrated Report

AU	Chloride	Sulfate	TDS	DO Grab Screening Level	DO Grab Minimum	24 Hour DO Average	24 Hour DO Minimum	pH	Temp (C)	*E. coli* geomean	Ammonia Nitrogen	Nitrate Nitrogen	Total Phosphorus	Chl-*a*
	50 mg/L	50 mg/L	200 mg/L	5.00 mg/L	3.00 mg/L	5.00 mg/L	3.00 mg/L	6.0 - 8.5 SU	32.2	126 MPN /100 mL	0.11 mg/L	0.37 mg/L	0.20 mg/L	26.7 µg/L
0605_01	FS	FS	FS	CS	FS			CN (high)	FS	NC	NC	NC	NC	CS
0605_02	FS	FS	FS											
0605_03	FS	FS	FS	NC	FS	FS	FS	**NS (high)**	FS	FS	NC	NC	NC	CS
0605_09	FS	FS	FS	NC	FS	FS	FS	**NS (high)**	FS	NC	NC	NC	NC	CS
0605_10	FS	FS	FS	NC	FS	FS	FS	**NS (high)**	FS	NC	NC	NC	NC	CS
0605_11	FS	FS	FS	NC	FS	FS	FS	**NS (high)**	FS	NC	NC	NC	NC	CS

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Lake Palestine at SH 315 bridge

Segment 0605 - Lake Palestine

Monitoring Station 16159 - Lake Palestine at Dam

Monitoring Station 16159 is located in AU 0605_01. This station is located at the dam on Lake Palestine equidistant from both shorelines and is monitored quarterly by TCEQ Region 5 (Tyler) personnel for field parameters, conventional parameters, and *E. coli* bacteria.

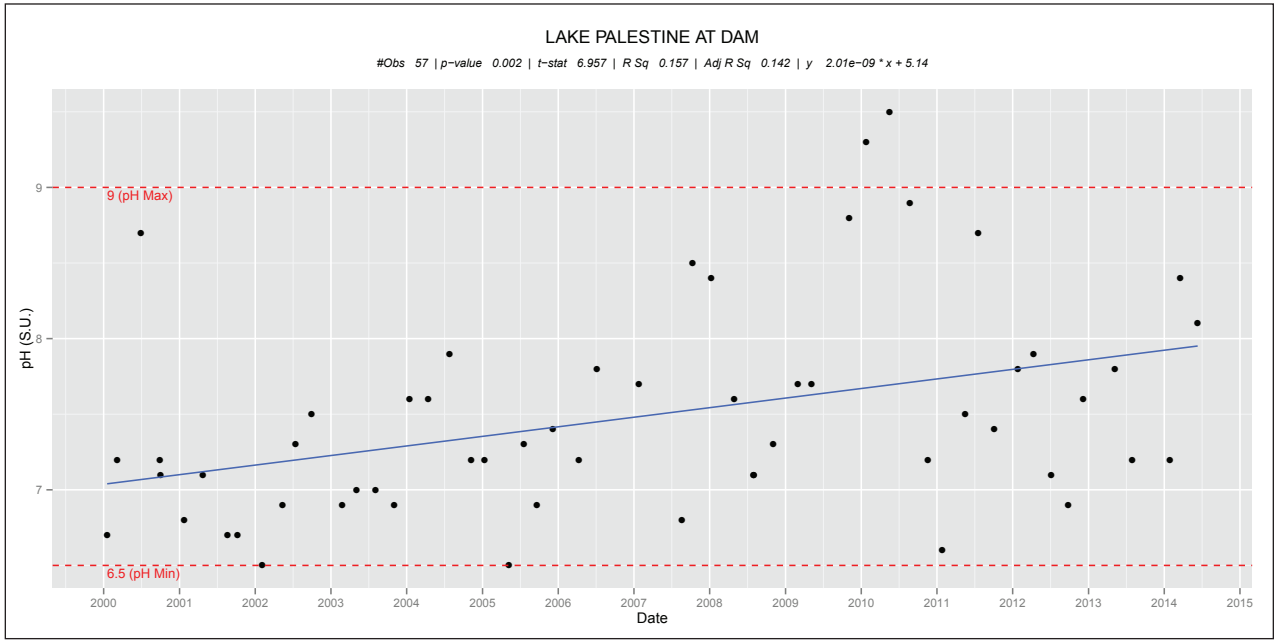
For this assessment unit, there is a concern for near nonattainment for pH. There is a statistically significant decreasing trend for this parameter.

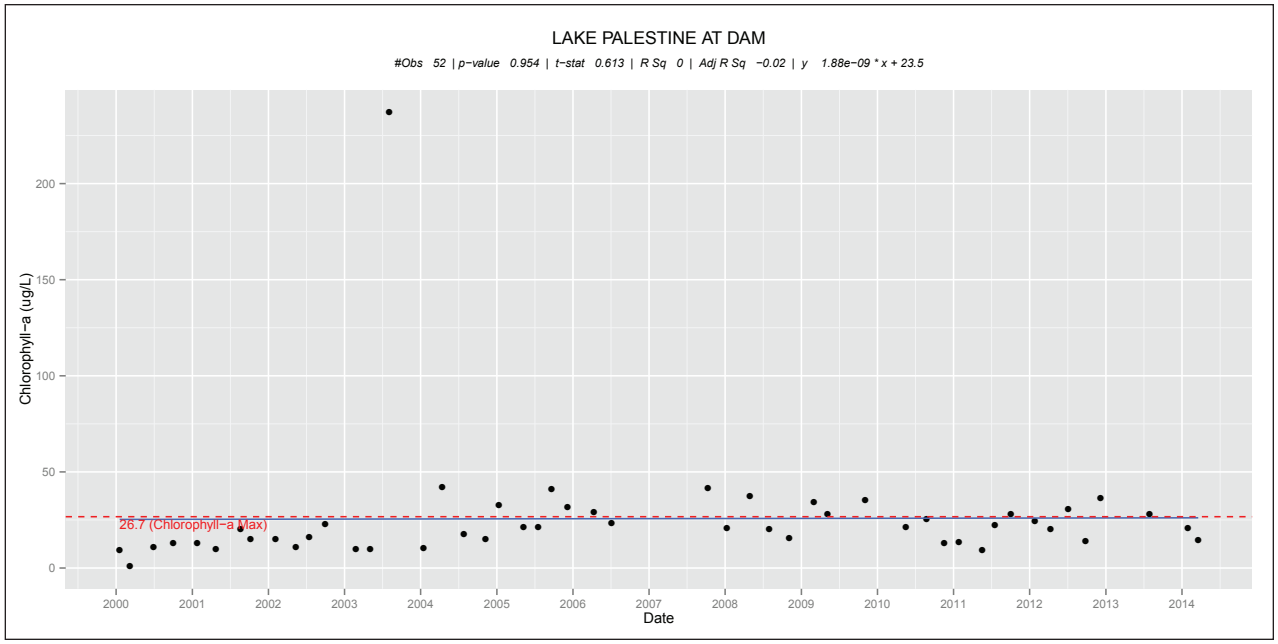
A concern for Chlorophyll-*a* is identified in the Draft 2014 Integrated Report. Numerous values for this parameter exceed the screening level.

This assessment unit is listed in the Draft 2014 Integrated Report for a concern for depressed Dissolved Oxygen. There is an increasing trend for Dissolved Oxygen at this station, although that trend is not statistically significant.

For Specific Conductance and Chloride, there are increasing trends, although these trends are not statistically significant.

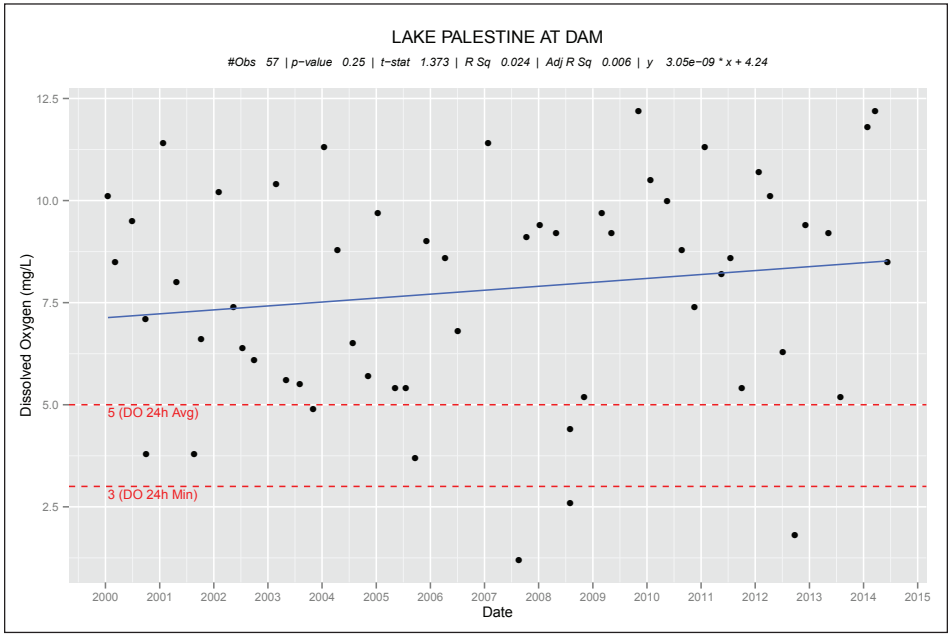
There is a decreasing trend for Ammonia-Nitrogen; however, this trend is not statistically significant. Most values for this parameter are reported at or below the limit of quantitation, although there are several values which exceed the screening level criteria.

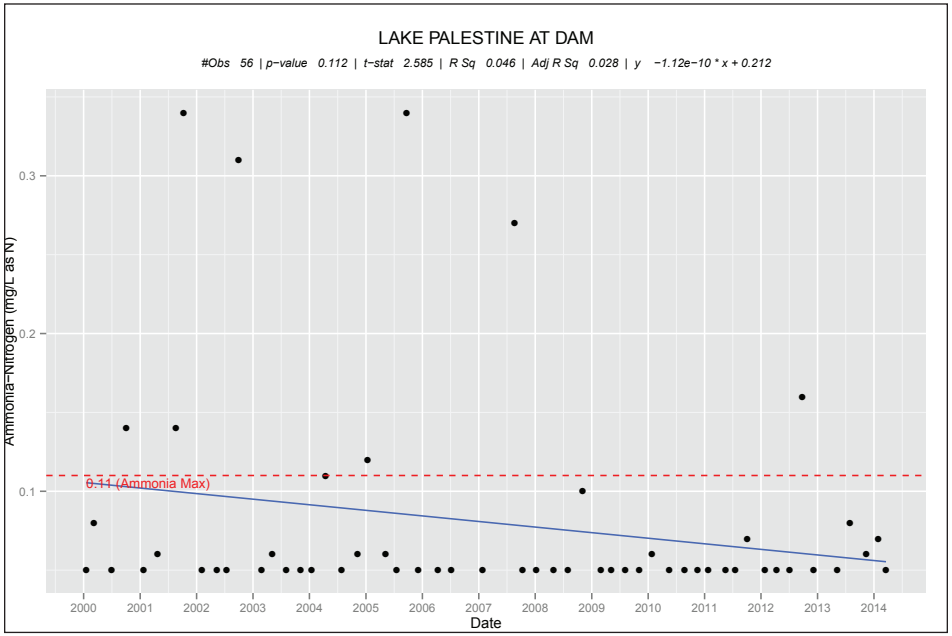




Segment 0605 - Lake Palestine

Monitoring Station 16159 - Lake Palestine at Dam





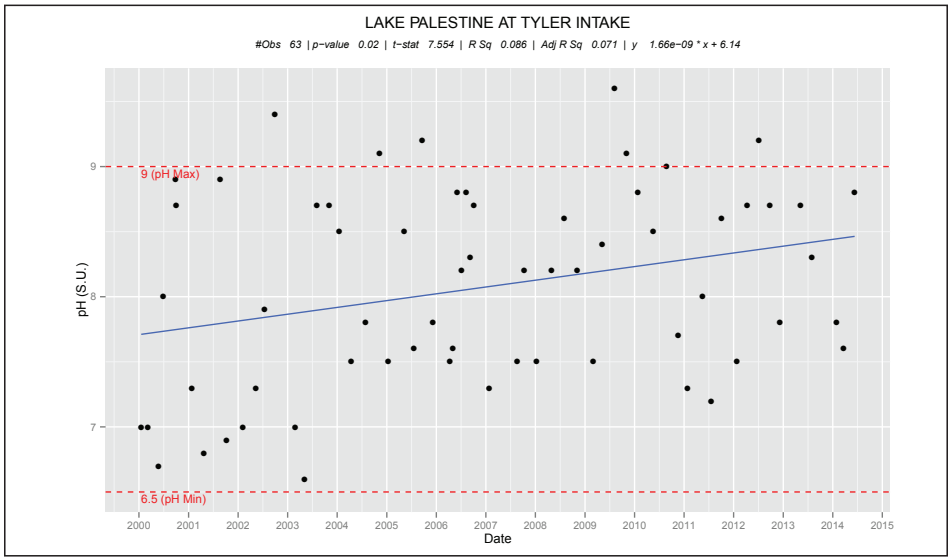
Water Quality Monitoring Results for Station 16159 - Lake Palestine at Dam

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	57	0	126	270	195.68		1.6824	0.0008	
00300	Dissolved Oxygen (mg/L)	57	3	1.2	12.2	7.81		1.3735	0.2497	
00400	pH (S.U.)	57	2	6.5	9.5	7.48		6.9567	0.0023	↑
00530	Total Suspended Solids (mg/L)	53	0	1	9	4.96		1.1607	0.0846	
00610	Ammonia-Nitrogen (mg/L as N)	56	8	0.05	0.34	0.08		2.5853	0.1118	
00630	Nitrate + Nitrite (mg/L as N)	35	2	0.04	0.46	0.11		0.4739	0.9038	
00665	Total Phosphorus (mg/L as P)	47	0	0.02	0.07	0.05		5.2043	0.1785	
00940	Chloride (mg/L)	56	0	12	37	22.95		1.6029	0.0834	
00945	Sulfate (mg/L)	56	0	9	43	24.29		-1.5749	0.0000	
31699	*E. coli* (MPN/100 mL)	39	0	1	20		2.00	0.2861	0.8298	
32211+70953	Chlorophyll-*a* (µg/L)	52	15	1	237	25.70		0.6133	0.9542	
70300	Total Dissolved Solids (mg/L)	41	0	85	195	123.68		2.5223	0.3097	

Segment 0605 - Lake Palestine

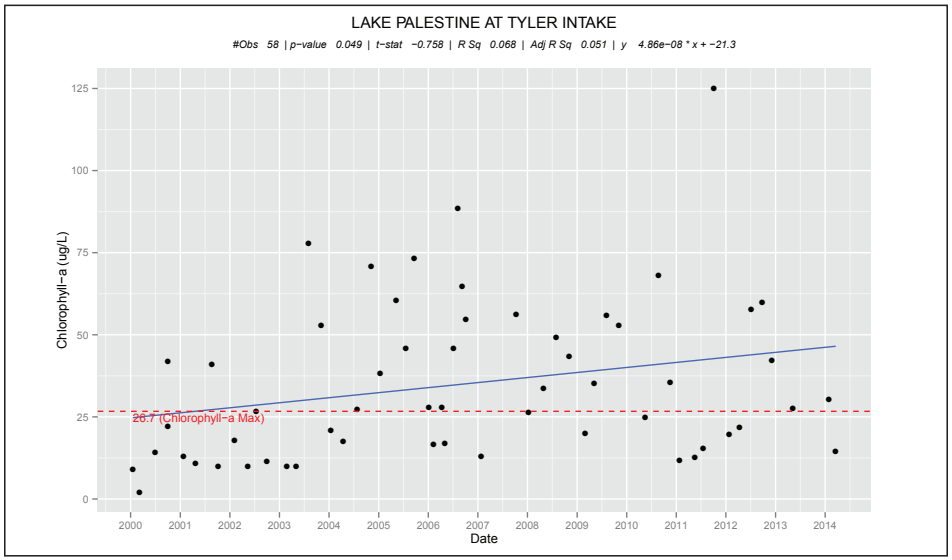
Monitoring Station 20318 - Lake Palestine Southeast of the SH 155/FM 3506 Intersection

Monitoring Station 20318 is located in AU 0605_02. This station is located 2.28 km east and 1.95 km south from the intersection of SH 155 and FM 3506 west of Eagles Bluff Country Club. It is monitored quarterly by TCEQ Region 5 (Tyler) personnel for field parameters, conventional parameters, and *E. coli* bacteria. There is less than 10 years worth of data for this station, so none of the trends are considered to be statistically significant.



Monitoring Station 16346- Lake Palestine at the City of Tyler Raw Water Intake Structure

Monitoring Station 16346 is located in AU 0605_03. This station is located 0.96 km west of FM 2661 and 2.7 km northwest of the intersection of FM 2661/SH155. It is monitored quarterly by TCEQ Region 5 (Tyler) personnel for field parameters, conventional parameters, and *E. coli* bacteria. There is an impairment for pH and a concern for Chlorophyll-*a* for this assessment unit. For pH, there is a statistically significant increasing trend.



Water Quality Monitoring Results for Station 16346 - Lake Palestine at City of Tyler Raw Water Intake Structure

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	63	0	128	307	205.08		1.9551	0.0136	
00300	Dissolved Oxygen (mg/L)	63	0	4.4	13.2	9.21		3.1916	0.1964	
00400	pH (S.U.)	63	6	6.6	9.6	8.07		7.5536	0.0199	↑
00530	Total Suspended Solids (mg/L)	60	0	4	23	9.15		2.6629	0.9967	
00610	Ammonia-Nitrogen (mg/L as N)	61	3	0.05	0.22	0.06		2.1887	0.6745	
00630	Nitrate + Nitrite (mg/L as N)	40	0	0.04	0.15	0.05		0.3247	0.5546	
00665	Total Phosphorus (mg/L as P)	53	1	0.03	0.34	0.07		2.1420	0.3625	
00940	Chloride (mg/L)	61	1	9	66	24.77		1.2691	0.2564	
00945	Sulfate (mg/L)	62	0	7	46	25.60		-0.5855	0.0003	
31699	*E. coli* (MPN/100 mL)	43	0	0	20		2.44	-1.3155	0.0577	
32211+70953	Chlorophyll-*a* (µg/L)	58	31	2.14	125	35.04		-0.7581	0.0487	
70300	Total Dissolved Solids (mg/L)	45	2	74	206	131.11		1.4852	0.1792	

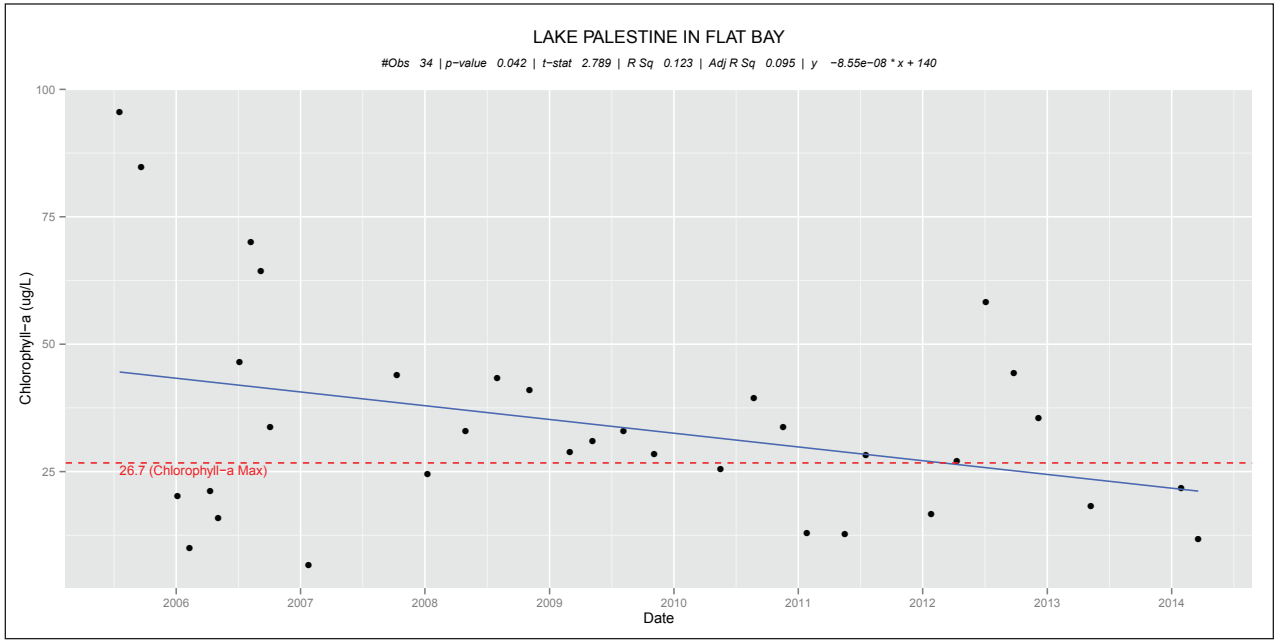
Segment 0605 - Lake Palestine

Monitoring Station 18557 - Lake Palestine in Flat Bay

Monitoring Station 18557 is located near the mouth of Flat Bay in the Flat Creek Arm of Lake Palestine. This station is located in assessment unit 0605_09. Station 18557 is monitored quarterly by TCEQ Region 5 (Tyler) personnel for field parameters, conventional parameters, and *E. coli* bacteria.

This assessment unit is listed as impaired for pH in the Draft 2014 Integrated Report. At this monitoring station, pH measurements ranged from 7.0 – 9.5 S.U., with several samples exceeding the high pH standard of 8.5 S.U.

A nutrient concern exists in this assessment unit for Chlorophyll-*a*. Results ranged from 6.59 – 95.6 µg/L. The Chlorophyll-*a* screening level for Lake Palestine is 26.7 µg/L. The trend for this parameter is decreasing at this station. Although the t-stat and p-value meet the criteria for statistical significance, ANRA does not consider this trend to be statistically significant because there is less than 10 years of data.



Water Quality Monitoring Results for Station 18557 - Lake Palestine in Flat Bay

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	38	0	130	301	211.71		2.5832	0.4848	
00300	Dissolved Oxygen (mg/L)	38	0	6.2	13.7	9.19		0.5263	0.1003	
00400	pH (S.U.)	38	4	7	9.5	8.26		5.7259	0.9291	
00530	Total Suspended Solids (mg/L)	36	0	5	15	8.56		2.7181	0.2193	
00610	Ammonia-Nitrogen (mg/L as N)	37	0	0.05	0.08	0.05		5.2317	0.3546	
00630	Nitrate + Nitrite (mg/L as N)	38	0	0.04	0.17	0.05		1.0561	0.7957	
00665	Total Phosphorus (mg/L as P)	30	0	0.02	0.09	0.06		5.4817	0.0003	
00940	Chloride (mg/L)	37	0	11	42	25.57		2.9731	0.1106	
00945	Sulfate (mg/L)	38	0	10	44	27.03		-0.1852	0.1044	
31699	*E. coli* (MPN/100 mL)	23	0	1	10		2.51	-0.5155	0.4085	
32211+70953	Chlorophyll-*a* (µg/L)	34	21	6.59	95.6	34.19		2.7885	0.0424	
70300	Total Dissolved Solids (mg/L)	22	1	97	204	142.82		4.0462	0.0090	

Segment 0605 - Lake Palestine

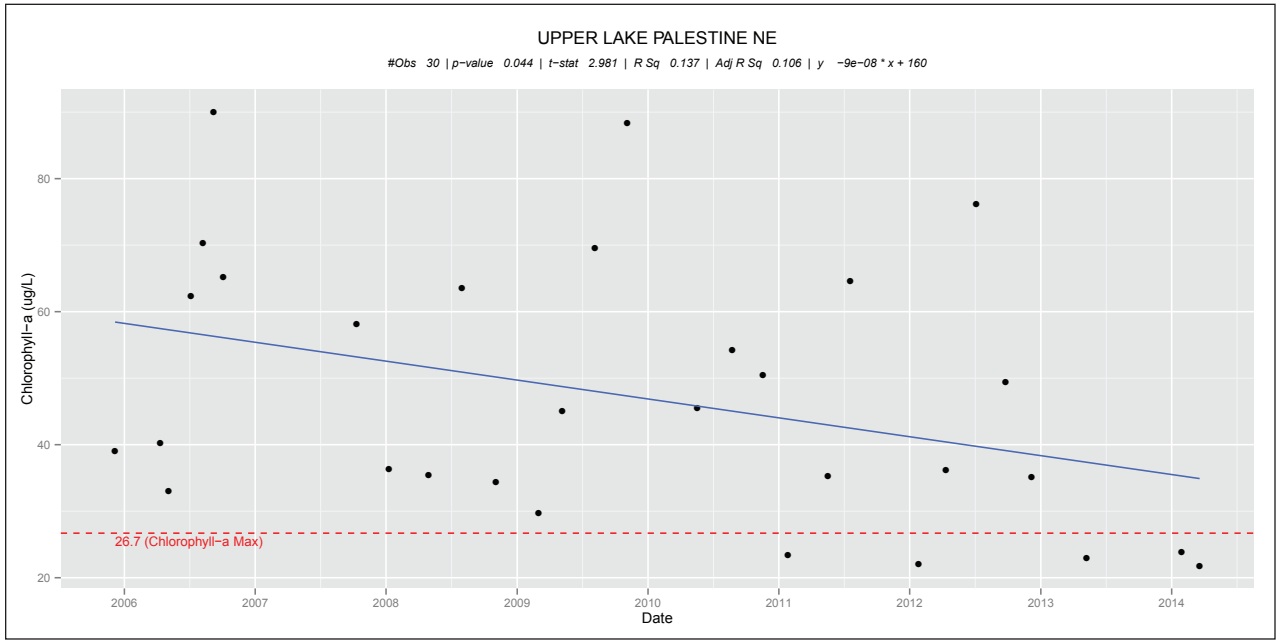
Monitoring Station 18643 - Lake Palestine Upper Lake

Monitoring Station 18643 is located in the upper portion of Lake Palestine near the east shore and is in AU 0605_10. This station is monitored quarterly by TCEQ Region 5 (Tyler) personnel for field parameters, conventional parameters, and *E. coli* bacteria.

This assessment unit is listed as impaired for pH in the Draft 2014 Integrated Report. At this monitoring station, pH measurements ranged from 6.9 – 9.6 S.U., with several samples exceeding the high pH standard of 8.5 S.U. The Alkalinity at this station shows a statistically significant decreasing trend (t-stat = 2.859, p-value – 0.077).

There is a concern for Chlorophyll-*a* in this assessment unit as well. Results for Chlorophyll-*a* analyses ranged from 21.8 µg/L to 90 µg/L, with a mean value of 47.7 µg/L. The nutrient criteria for this parameter is 26.7 µg/L, with the majority of results exceeding that level. The trend for this parameter is not considered to be significant due to the period of record being less than 10 years.

Decreasing trends are also observed at this station for Total Dissolved Solids and Chloride.



Water Quality Monitoring Results for Station 18643 - Lake Palestine Upper Lake

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	34	0	102	353	228.38		2.7277	0.2712	
00300	Dissolved Oxygen (mg/L)	34	0	6.6	12	9.08		0.0051	0.0330	
00400	pH (S.U.)	34	3	6.9	9.6	8.12		4.3273	0.8085	
00530	Total Suspended Solids (mg/L)	33	0	7	24	13.70		1.6155	0.6948	
00610	Ammonia-Nitrogen (mg/L as N)	33	0	0.05	0.1	0.05		1.1965	0.3911	
00630	Nitrate + Nitrite (mg/L as N)	34	0	0.04	0.3	0.07		0.4869	0.9308	
00665	Total Phosphorus (mg/L as P)	26	2	0.06	0.22	0.11		2.0391	0.1975	
00940	Chloride (mg/L)	33	0	11	46	27.06		3.6120	0.0212	
00945	Sulfate (mg/L)	34	1	12	69	29.74		0.1541	0.3814	
31699	*E. coli* (MPN/100 mL)	20	0	1	14		2.87	0.2605	0.9770	
32211+70953	Chlorophyll-*a* (µg/L)	30	25	21.8	90	47.39		2.9814	0.0444	
70300	Total Dissolved Solids (mg/L)	20	3	97	233	152.45		4.8887	0.0012	

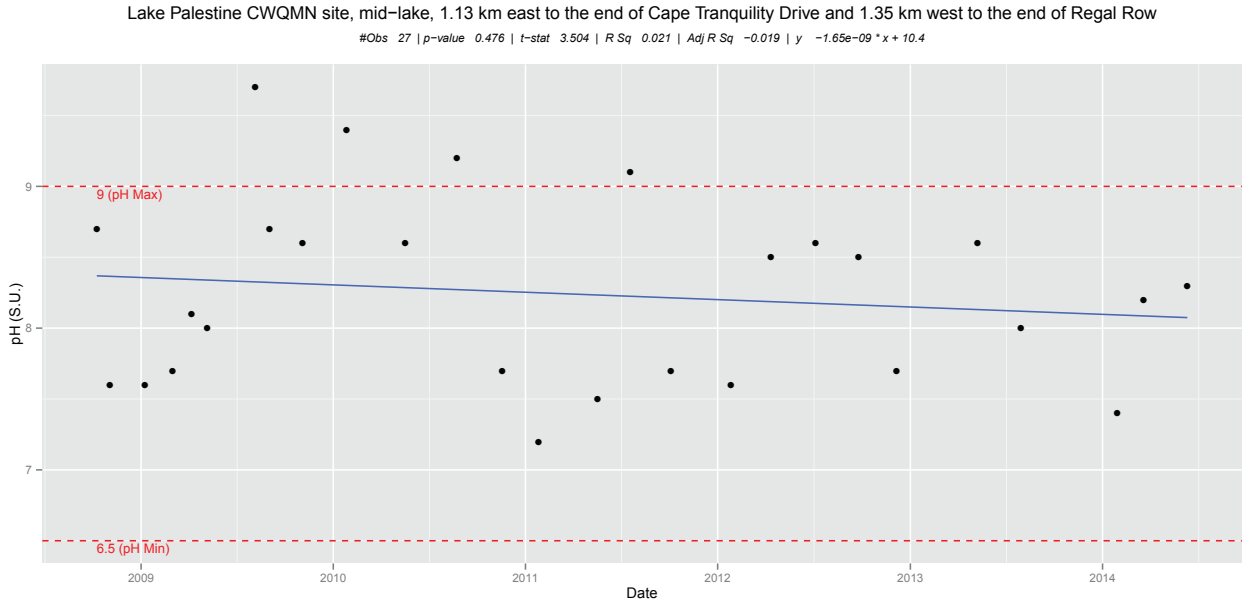
Segment 0605 - Lake Palestine

Monitoring Station 20319 - Lake Palestine Between Flat Bay and SH 155

Monitoring Station 20319 was a part of the Continuous Water Quality Monitoring Network (CWQMN). Real-time monitoring began on 2/20/2008, with the site being deactivated 9/3/2009. The station was located in a eutrophic section of the lake, which subjected the multiprobe instrument to biofouling.

Station 20319 is located mid-lake 1.13 km east of the end of Cape Tranquility Drive and 1.35 km west of the end of Regal Row. This station is in AU 0605_11 and is monitored quarterly for conventional parameters, field parameters, and *E. coli* bacteria.

Because sampling has been conducted at this station for less than 10 years, ANRA does not consider any trends at this site to be statistically significant.



Water Quality Monitoring Results for Station 20319 - Lake Palestine Between Flat Bay and SH 155

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	27	0	147	258	203.59		-3.4329	0.0000	
00300	Dissolved Oxygen (mg/L)	27	0	6.2	12.2	9.64		1.6278	0.8171	
00400	pH (S.U.)	27	4	7.2	9.7	8.24		3.5037	0.4758	
00530	Total Suspended Solids (mg/L)	25	0	4	11	7.80		0.1115	0.4517	
00610	Ammonia-Nitrogen (mg/L as N)	27	0	0.05	0.07	0.05		2.5170	0.7618	
00630	Nitrate + Nitrite (mg/L as N)	26	0	0.04	0.16	0.05		-1.1202	0.1335	
00665	Total Phosphorus (mg/L as P)	19	0	0.02	0.07	0.05		3.1874	0.0204	
00940	Chloride (mg/L)	25	0	16	31	23.56		-2.9538	0.0001	
00945	Sulfate (mg/L)	26	0	17	43	28.62		-2.2685	0.0027	
31699	*E. coli* (MPN/100 mL)	16	0	1	75		4.01	2.0610	0.0686	
32211+70953	Chlorophyll-*a* (µg/L)	23	14	12.9	61.2	33.82		1.4149	0.3369	
70300	Total Dissolved Solids (mg/L)	12	0	103	139	121.00		0.5370	0.7488	

Segment 0605 - Lake Palestine

Summary of Water Quality Trends

For four of the assessment units in Lake Palestine, sampling has been conducted for less than 10 years at these stations. Therefore, ANRA does not consider any trends for these AUs to be statistically significant.

In AU 0605_01 and AU 0605_03, there were statistically significant increasing trends for pH.

Trend Analysis Summary for Segment 0605 - Lake Palestine

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Lake Palestine	0605_01	16159	Lake Palestine at Dam		↑										
	0605_02	20318	Lake Palestine Southeast of SH 155/FM 3506	Trend analysis not performed due to insufficient data (<10 years)											
	0605_03	16346	Lake Palestine at City of Tyler Raw Water Intake Structure		↑										
	0605_09	18557	Lake Palestine in Flat Bay	Trend analysis not performed due to insufficient data (<10 years)											
	0605_10	18643	Lake Palestine Upper Lake East Shore	Trend analysis not performed due to insufficient data (<10 years)											
	0605_11	20319	Lake Palestine Between Flat Bay and SH 155	Trend analysis not performed due to insufficient data (<10 years)											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0605 - Lake Palestine

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Depressed Dissolved Oxygen	AU 0605_01	• Aquatic vegetation • Nutrient loading into the water body • Nonpoint source pollution	• Detrimental effect on aquatic biological community	• Continue monitoring • Conduct 24-hour DO measurements
Elevated pH	Entire water body	• Municipal wastewater discharge • Eutrophication • Low alkalinity results in reduced pH buffering capacity	• Detrimental effect on aquatic biological community • Effect on public water supply use	• Continue monitoring
Concern for Chlorophyll-*a*	Entire water body	• Municipal wastewater discharge • Nonpoint sources of pollution, including dairy farms • Stormwater runoff • Improper use of fertilizers	• Aesthetic issues • Effect on dissolved oxygen levels	• Continue monitoring

Segment 0605A - Kickapoo Creek

Segment Profile

Kickapoo Creek extends 42.6 miles from the confluence of Lake Palestine east of Brownsboro in Henderson County to the upstream perennial portion of the stream northeast of Murchinson in Henderson County. Aquatic life, general, and contact recreation are the designated uses for this segment.

Segment 0605A - Kickapoo Creek

Assessment Units

Assessment Units in Segment 0605A - Kickapoo Creek	
AU ID	**Description**
0605A_01	From the confluence with Lake Palestine (0605) east of Brownsboro in Henderson County to the confluence with Slater Creek (0605E)
0605A_02	From the confluence with Slater Creek (0605E) upstream to confluence with unnamed tributary about 1.62 km north of FM 858 in Van Zandt County at NHD RC 12020001000161

Monitoring Stations

Monitoring Stations in Segment 0605A - Kickapoo Creek									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0605A_01	10517	KICKAPOO CREEK AT FM 314 (NO LONGER MONITORED)	4	4	4	4			TCEQ-5
0605A_02	16797	KICKAPOO CREEK AT FM 773	4	4	4	4			TCEQ-5

Description of Water Quality Issues

Impairments and Concerns

Assessment unit 0605A_01 is listed in the Draft 2014 Integrated Report as impaired for depressed Dissolved Oxygen. This AU also has a concern for Ammonia-Nitrogen. Sampling in this assessment unit was conducted by TCEQ Region 5 at Station 10517 (Kickapoo Creek at FM 314), but sampling was discontinued at that station in 2010.

Both AU 0605A_01 and AU 0605A_02 are listed as Not Supporting primary contact recreation due to elevated *E. coli* bacteria.

Assessment Summary for Segment 0605A - Kickapoo Creek as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	75 mg/L	**50 mg/L**	**200 mg/L**	**3.00 mg/L**	**2.00 mg/L**	**3.00 mg/L**	**2.00 mg/L**	**6.0 - 8.5 SU**	**32.2**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0605A_01				CS	**NS**	**NS**	**NS**			**NS**	CS	NC	NC	NC
0605A_02				NC	FS					**NS**	NC	NC	NC	NC

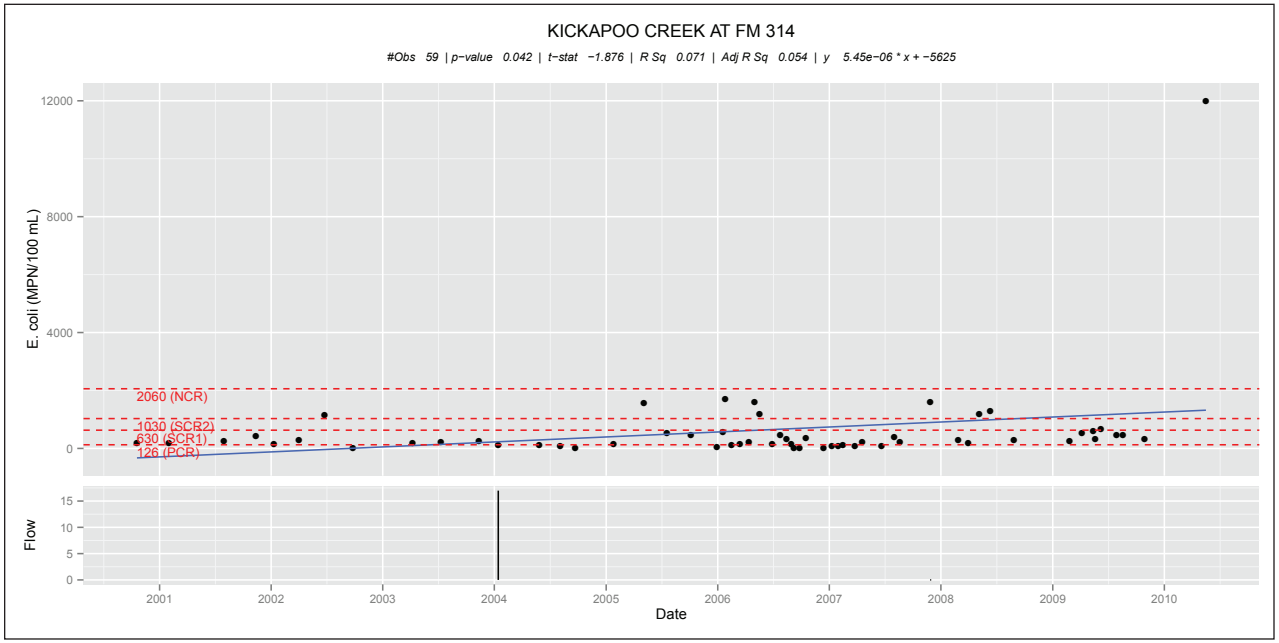
FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

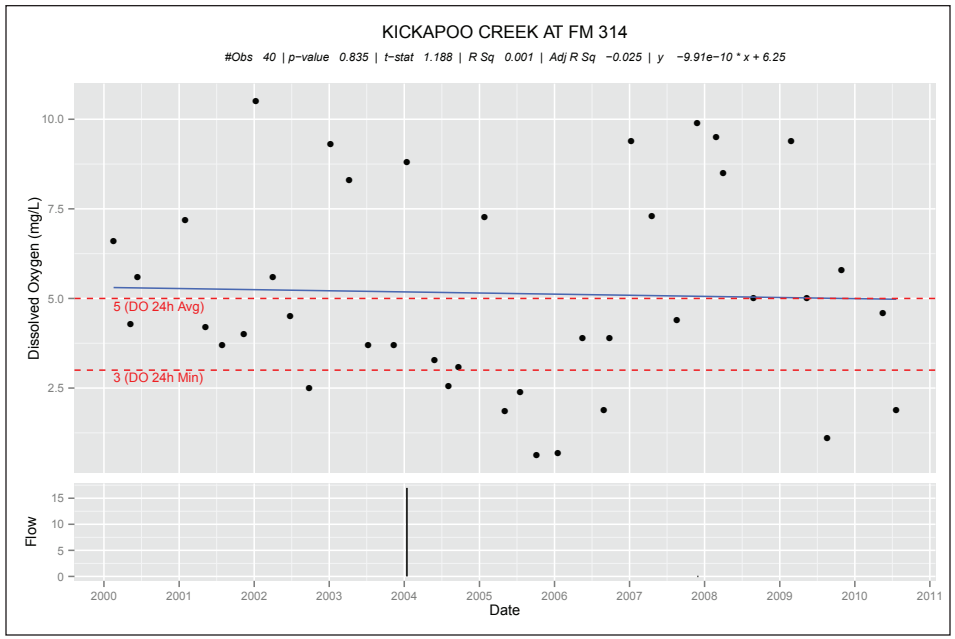
Segment 0605A - Kickapoo Creek

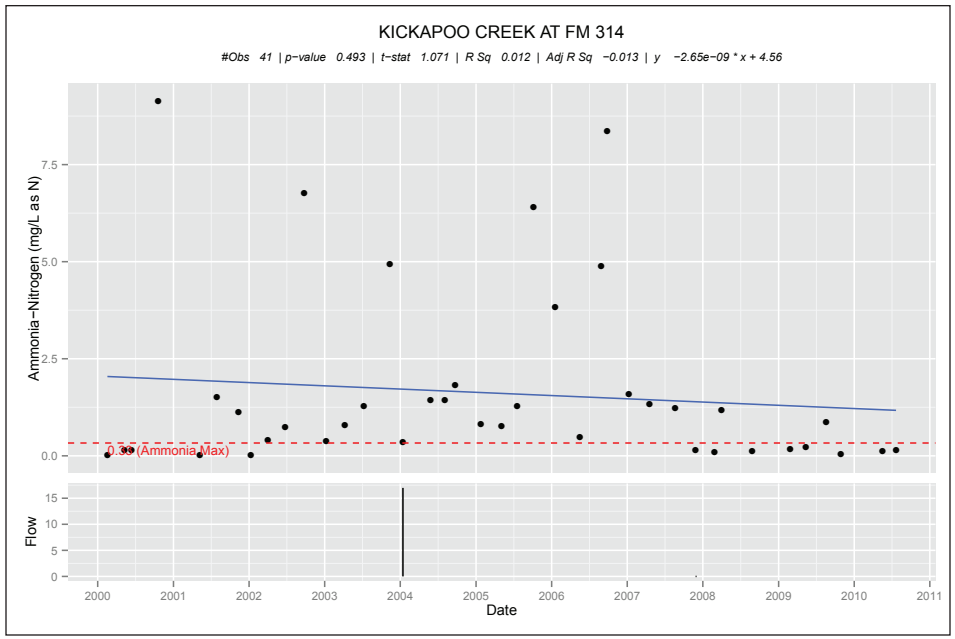
Monitoring Station 10517 - Kickapoo Creek at FM 314

Monitoring Station 10517 is no longer monitored, although it has been monitored in the past by TCEQ Region 5 personnel for conventional parameters, field parameters, flow, and *E. coli* bacteria. Monitoring at this station was discontinued in 2010. Because impairments appear in the Draft 2014 Integrated Report for monitoring conducted at this station, limited data is presented below. However, ANRA is not presenting the statistical data or considering any trends for this data to be statistically significant since there is no current data at this station.

This AU is listed as impaired for *E. coli* bacteria and depressed Dissolved Oxygen. There is also a concern for Ammonia-Nitrogen.





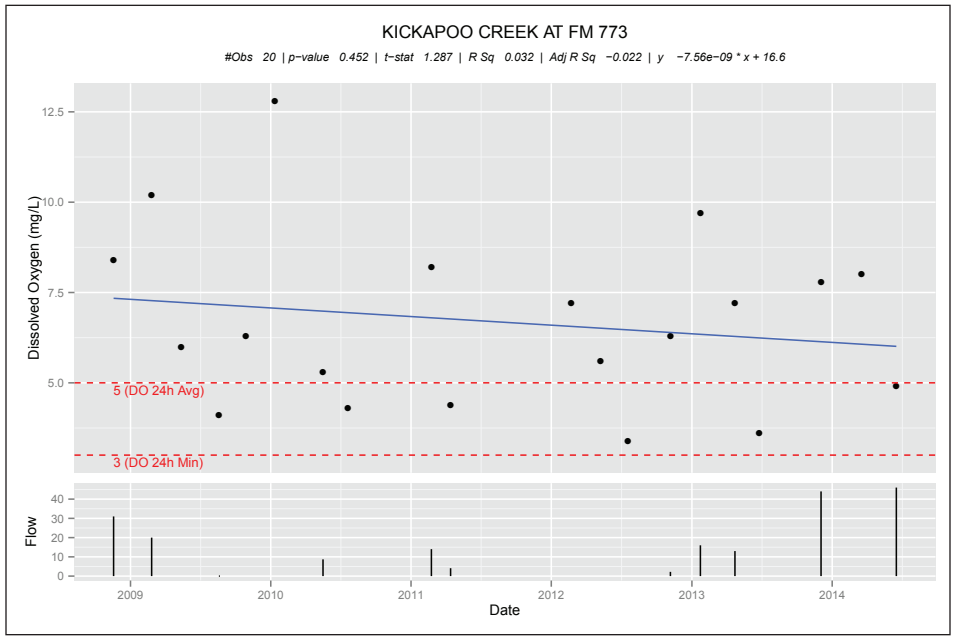


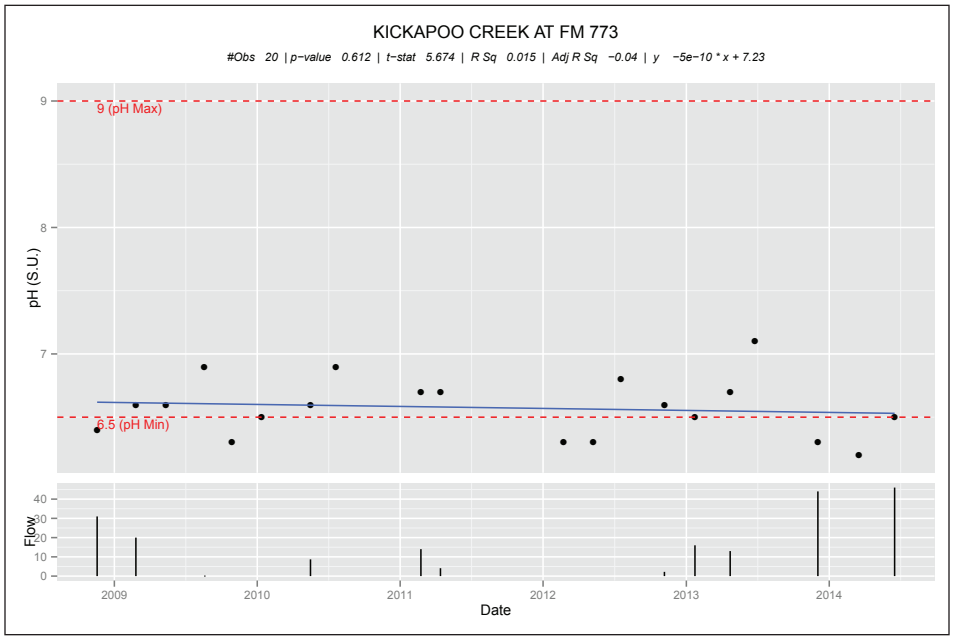
Segment 0605A - Kickapoo Creek

Monitoring Station 16797 - Kickapoo Creek at FM 773

Monitoring Station 16797 is monitored quarterly by TCEQ Region 5 (Tyler) personnel for field parameters, conventional parameters, flow, and *E. coli* bacteria.

There is less than 10 years of monitoring data at this station, so any trends observed are not considered to be statistically significant.





Water Quality Monitoring Results for Station 16797 - Kickapoo Creek at FM 773

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	20	0	85	398	257.90		1.3277	0.5297	
00300	Dissolved Oxygen (mg/L)	20	0	3.4	12.8	6.69		1.2866	0.4516	
00400	pH (S.U.)	20	6	6.2	7.1	6.58		5.6740	0.6124	
00530	Total Suspended Solids (mg/L)	19	0	6	154	30.84		-1.1109	0.2253	
00610	Ammonia-Nitrogen (mg/L as N)	19	1	0.05	0.38	0.09		-0.7869	0.3399	
00630	Nitrate + Nitrite (mg/L as N)	19	0	0.04	0.56	0.23		0.5756	0.7531	
00665	Total Phosphorus (mg/L as P)	15	0	0.04	0.45	0.16		-0.8605	0.2970	
00940	Chloride (mg/L)	18	0	8	49	30.67		1.1414	0.5502	
00945	Sulfate (mg/L)	19	8	11	98	48.11		1.0102	0.4955	
31699	*E. coli* (MPN/100 mL)	17	11	20	24000		27.52	-0.6379	0.4985	
32211+70953	Chlorophyll-*a* (µg/L)	18	3	1.13	29.6	7.87		-0.3712	0.5979	
70300	Total Dissolved Solids (mg/L)	8	5	116	270	209.25		3.8150	0.0145	

Segment 0605A - Kickapoo Creek

Summary of Water Quality Trends

Trend analysis was not performed on this segment. For assessment unit 0605A_01, monitoring was discontinued in 2010. Since there is not current water quality monitoring data, it is not possible to assess the trends for this AU. Sampling in assessment unit 0605A_02 has been conducted for less than 10 years, so there is insufficient data to consider these trends to be statistically significant.

Trend Analysis Summary for Segment 0605A - Kickapoo Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Kickapoo Creek	0605A_01	10517	Kickapoo Creek at FM 314	Monitoring discontinued in 2010											
	0605A_02	16797	Kickapoo Creek at FM 773	Trend analysis not performed due to insufficient data (<10 years)											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

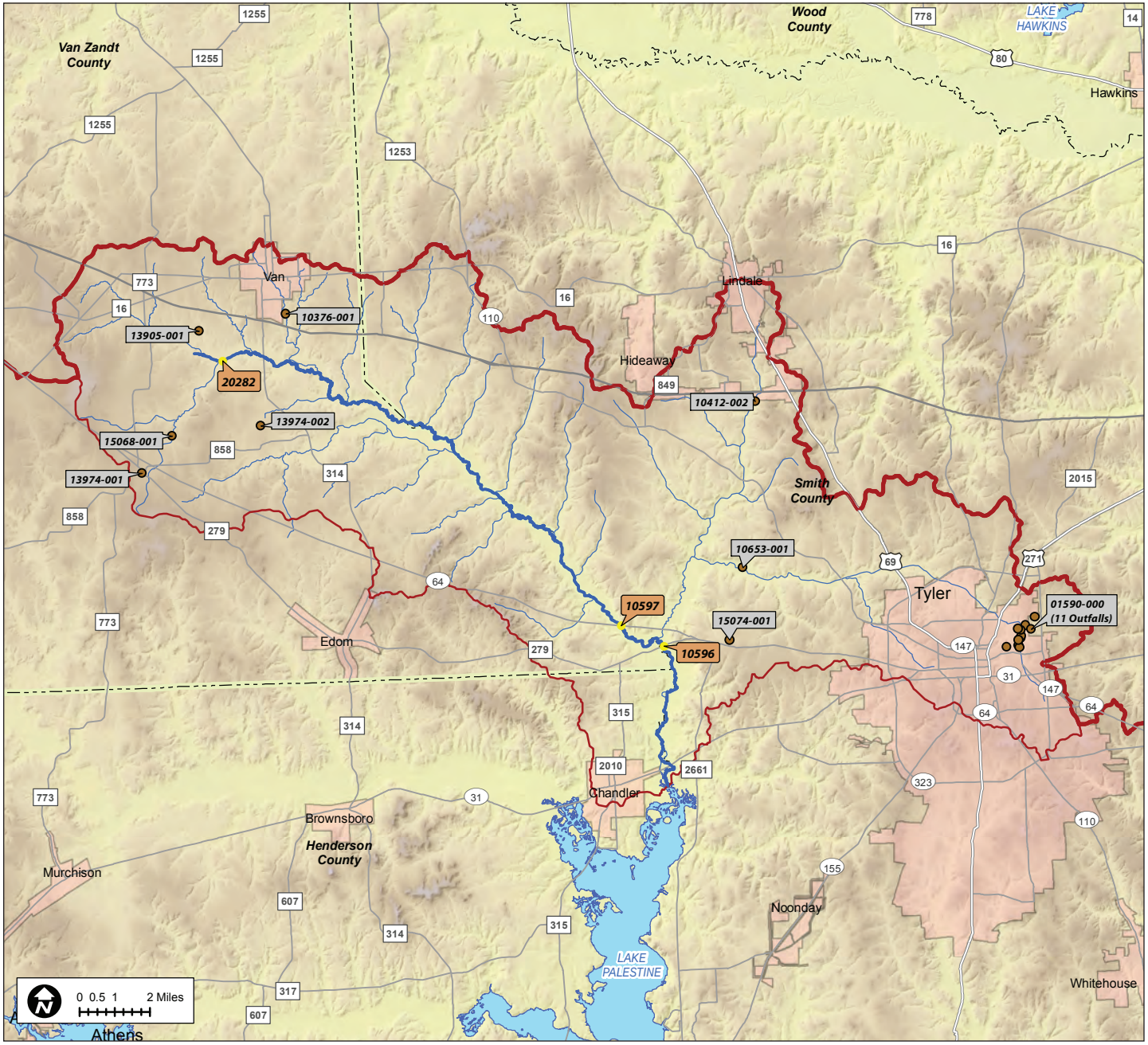
Water Quality Issues Summary for Segment 0605A - Kickapoo Creek

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment for *E. coli* bacteria	Entire water body	• Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring
Depressed Dissolved Oxygen	AU 0605A_01 (lower assessment unit)	• Municipal wastewater discharge • Aquatic vegetation • Nutrient loading into the water body	• Detrimental effect on aquatic biological community	• Continue monitoring • Conduct 24-hour DO measurements • Conduct Aquatic Life UAA
Concern for Ammonia-Nitrogen	AU 0605A_01 (lower assessment unit)	• Municipal wastewater discharges • Nonpoint sources of pollution • Stormwater runoff • Wildlife (deer and feral hogs) • Livestock and agricultural operations, including cattle and poultry operations	• Detrimental effect on aquatic biological community	• Continue monitoring

Segment 0606 - Neches River Above Lake Palestine

Segment Profile

This freshwater stream includes 27 miles from a point 6.7 km (4.2 miles) downstream of FM 279 in Henderson/ Smith County to Rhines Lake Dam in Van Zandt County. Aquatic life, general, contact recreation, and public water supply are the designated uses for this segment.



Segment 0606 - Neches River Above Lake Palestine

Assessment Units

Assessment Units in Segment 0606 - Neches River Above Lake Palestine	
AU ID	**Description**
0606_01	From a point approximately 0.06km (0.03 mi) south of St. Louis Southwestern Railroad upstream to the confluence with Prairie Creek (0606A)
0606_02	From the confluence with Prairie Creek (0606A) upstream to the Rhines Lake Dam

Monitoring Stations

Monitoring Stations in Segment 0606 - Neches River Above Lake Palestine									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0606_01	10596	NECHES RIVER AT FM 279 WEST OF TYLER AND NE OF CHANDLER	4	4	4	4			TCEQ-5
0606_02	10597	NECHES RIVER UPSTREAM LAKE PALESTINE AT SH 64 WEST OF TYLER	4	4	4	4	5		TCEQ-5

Description of Water Quality Issues

Impairments and Concerns

For the Neches River Above Lake Palestine, assessment unit 0606_01 has an impairment for *E. coli* bacteria. Nutrient concerns are also listed for Total Phosphorus and Nitrate+Nitrite. In AU 0606_02, there are impairments for depressed Dissolved Oxygen and pH (low), as well as concerns for *E. coli* bacteria and Zinc in water.

Assessment Summary for Segment 0606 - Neches River Above Lake Palestine as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	100 mg/L	**50 mg/L**	**300 mg/L**	**4.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**35**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0606_01	FS	FS	FS	NC	FS					**NS**	NC	CS	CS	NC
0606_02	FS	FS	FS	CS	**NS**	CN		NS		CN	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0606 - Neches River Above Lake Palestine

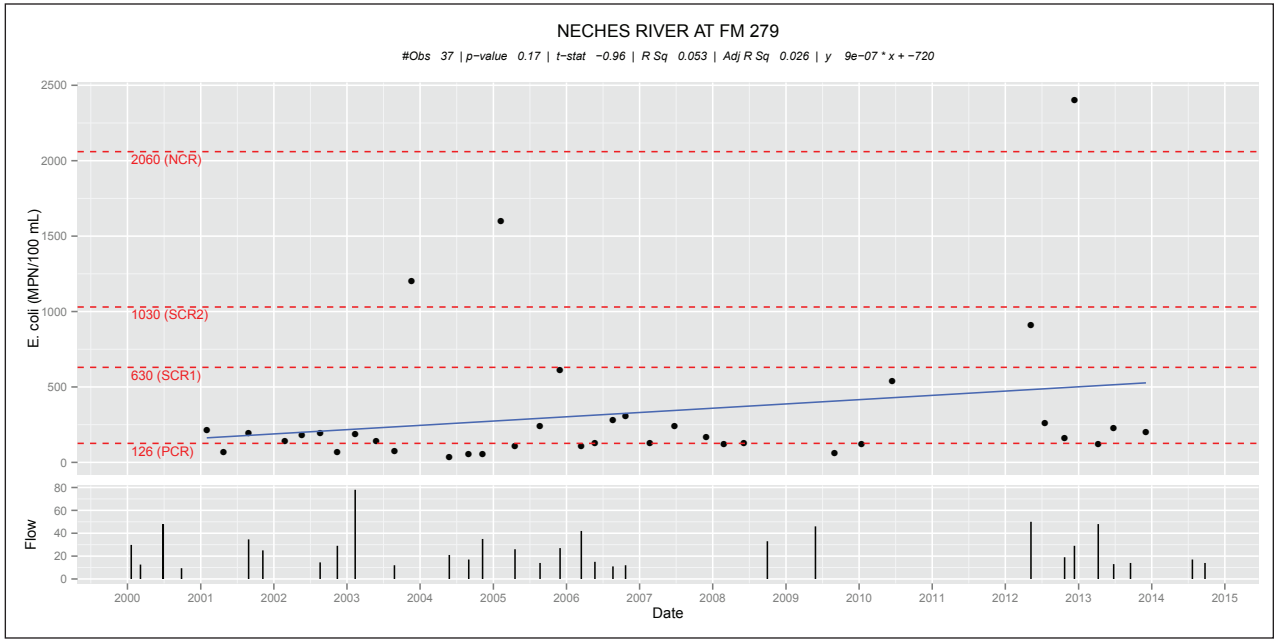
Monitoring Station 10596 - Neches River at FM 279

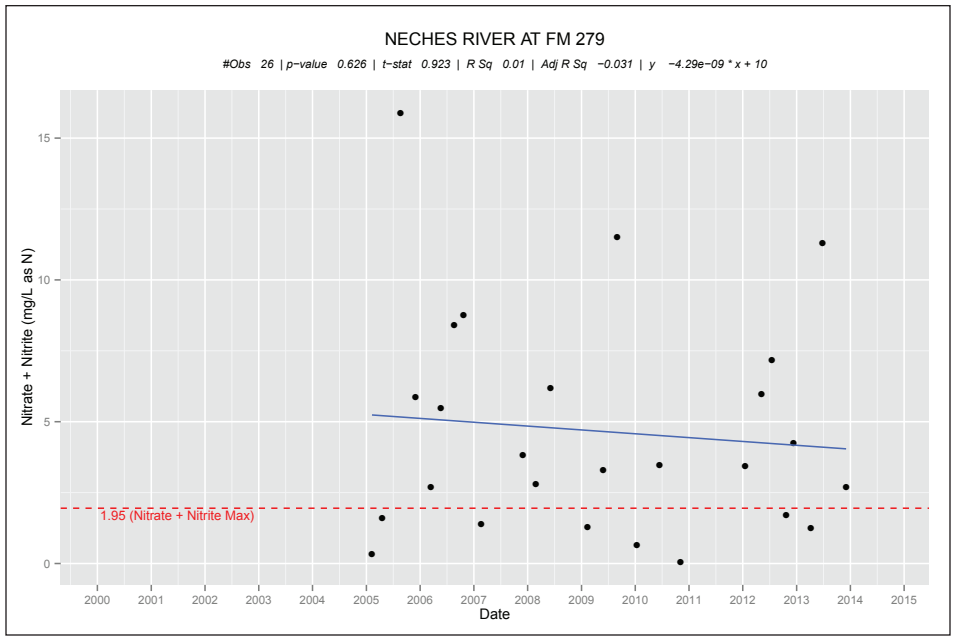
Monitoring Station 10596 is west of Tyler and northeast of Chandler and is located in AU 0606_01. This station is monitored quarterly by TCEQ Region 5 personnel for conventional parameters, field parameters, flow, and *E. coli* bacteria.

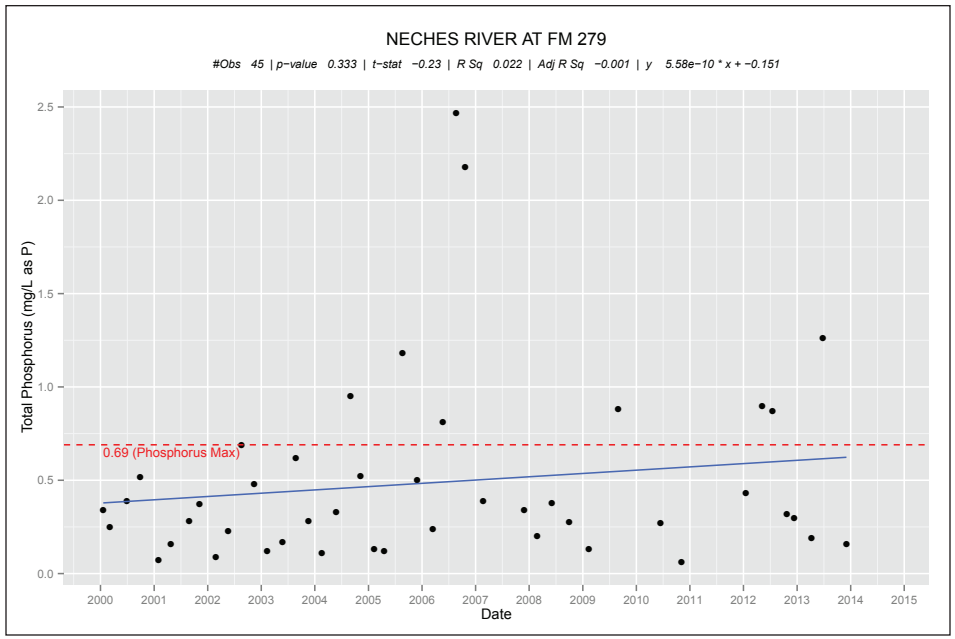
This assessment unit is listed in the Draft 2014 Integrated Report as impaired for *E. coli* bacteria.

Nutrient concerns are listed for Nitrate+Nitrite and Total Phosphorus. There is an increasing trend for Ammonia-Nitrogen, but this trend is not statistically significant. A decreasing trend for Chlorophyll-*a* is due to a change in the limit of quantitation.

Numerous Total Dissolved Solids results exceeded the criteria of 300 mg/L.

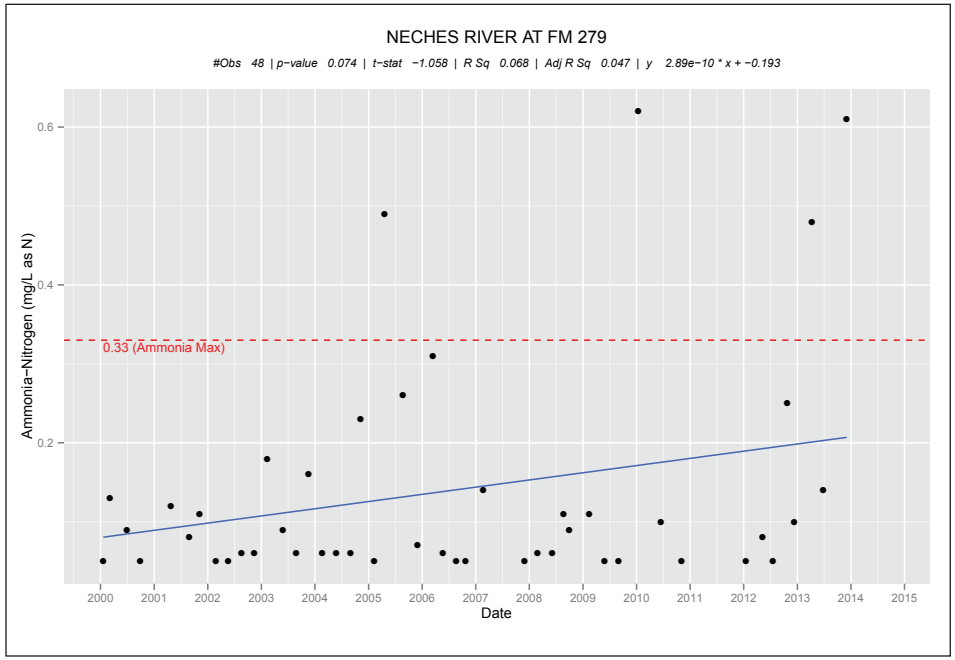


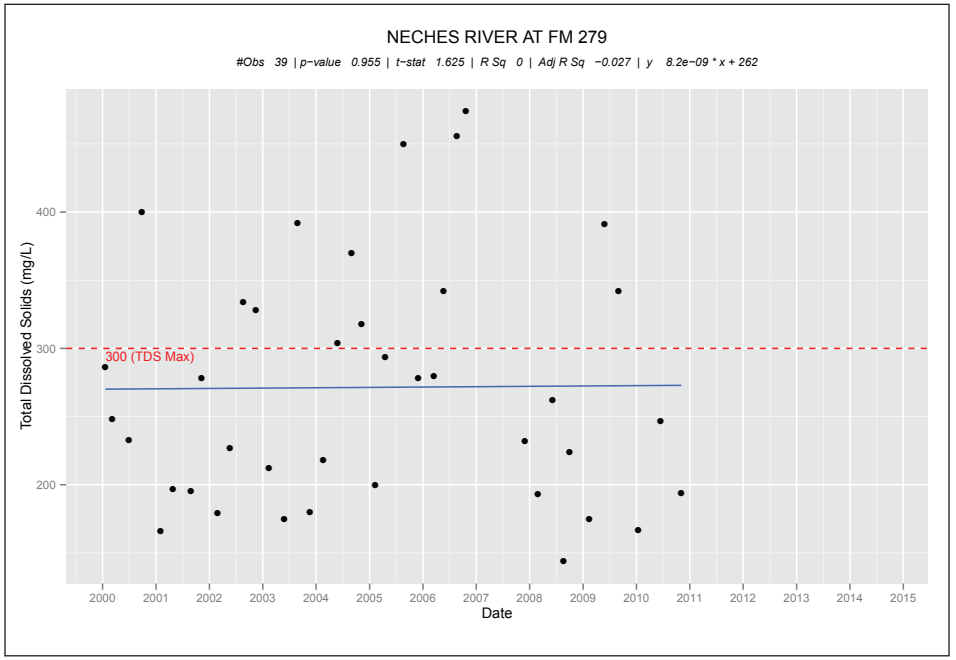




Segment 0606 - Neches River Above Lake Palestine

Monitoring Station 10596 - Neches River at FM 279





Water Quality Monitoring Results for Station 10596 - Neches River at FM 279

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	52	0	170	798	425.52		1.3434	0.3724	
00300	Dissolved Oxygen (mg/L)	52	0	5.1	11.6	7.51		4.5318	0.7312	
00400	pH (S.U.)	52	1	5.9	7.6	6.96		16.8025	0.1351	
00530	Total Suspended Solids (mg/L)	48	0	4	68	13.08		-0.2820	0.2216	
00610	Ammonia-Nitrogen (mg/L as N)	48	4	0.05	0.62	0.14		-1.0580	0.0740	
00630	Nitrate + Nitrite (mg/L as N)	26	18	0.04	15.9	4.67		0.9226	0.6264	
00665	Total Phosphorus (mg/L as P)	45	9	0.06	2.47	0.49		-0.2298	0.3330	
00940	Chloride (mg/L)	48	4	18	132	56.05		2.4086	0.4934	
00945	Sulfate (mg/L)	48	13	13	71	41.38		0.5949	0.1120	
31699	*E. coli* (MPN/100 mL)	37	25	35	2400		36.12	-0.9602	0.1704	
32211+70953	Chlorophyll-*a* (µg/L)	48	0	0.7	10	6.30		7.5798	0.0000	
70300	Total Dissolved Solids (mg/L)	39	13	144	474	271.41		1.6246	0.9552	

Segment 0606 - Neches River Above Lake Palestine

Monitoring Station 10597 - Neches River at SH 64

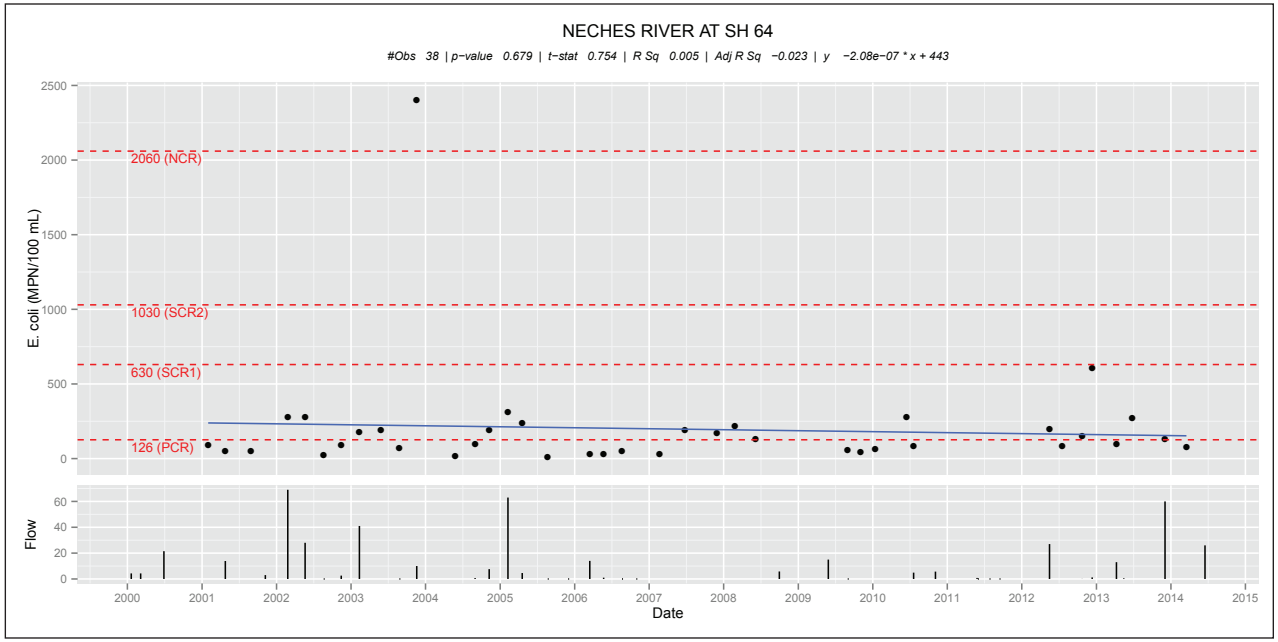
Monitoring Station 10597 is west of Tyler at the SH 64 crossing and is located in AU 0606_02. This station is monitored quarterly by TCEQ Region 5 personnel for conventional parameters, field parameters, flow, and *E. coli* bacteria.

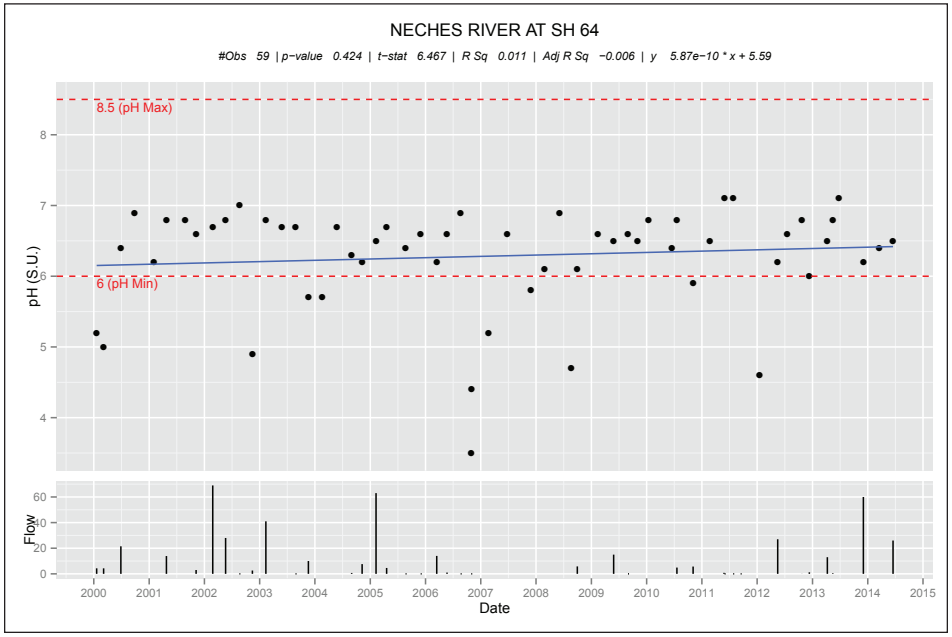
This assessment unit is listed in the Draft 2014 Integrated Report for near non-attainment for *E. coli* bacteria.

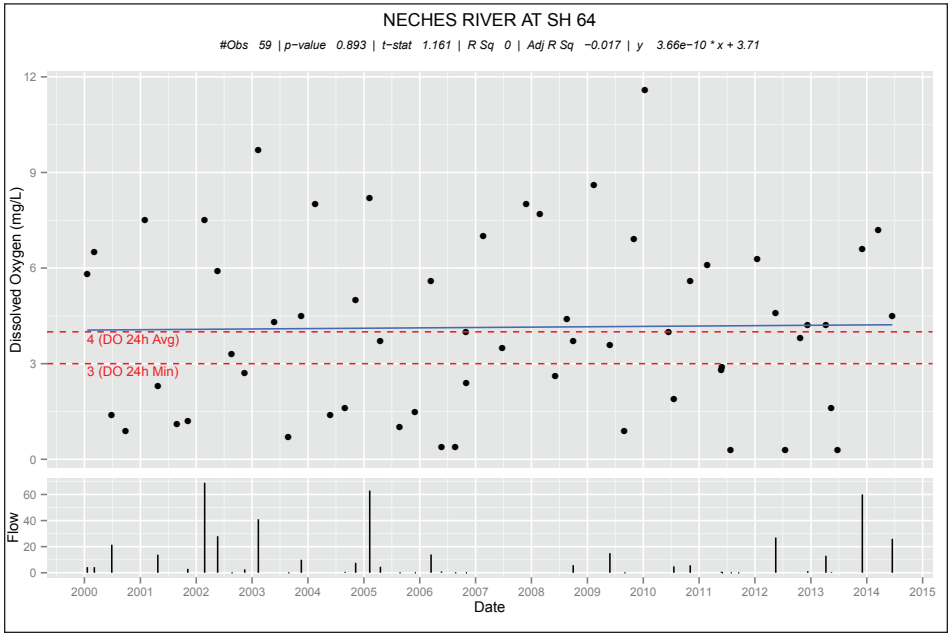
This assessment unit is listed as not supporting its designated Aquatic Life Use due to low pH and depressed Dissolved Oxygen.

Although there are no nutrient concerns for this AU, there were several Ammonia-Nitrogen and Chlorophyll-*a* values that exceeded the screening levels.

There is a statistically significant decreasing trend for Chloride, although all values are well below the criteria.

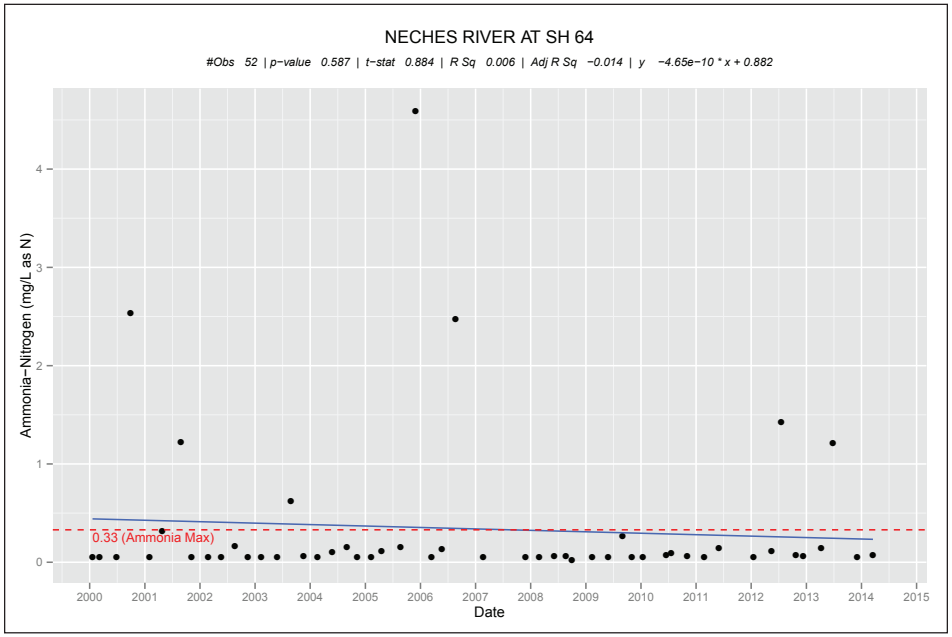


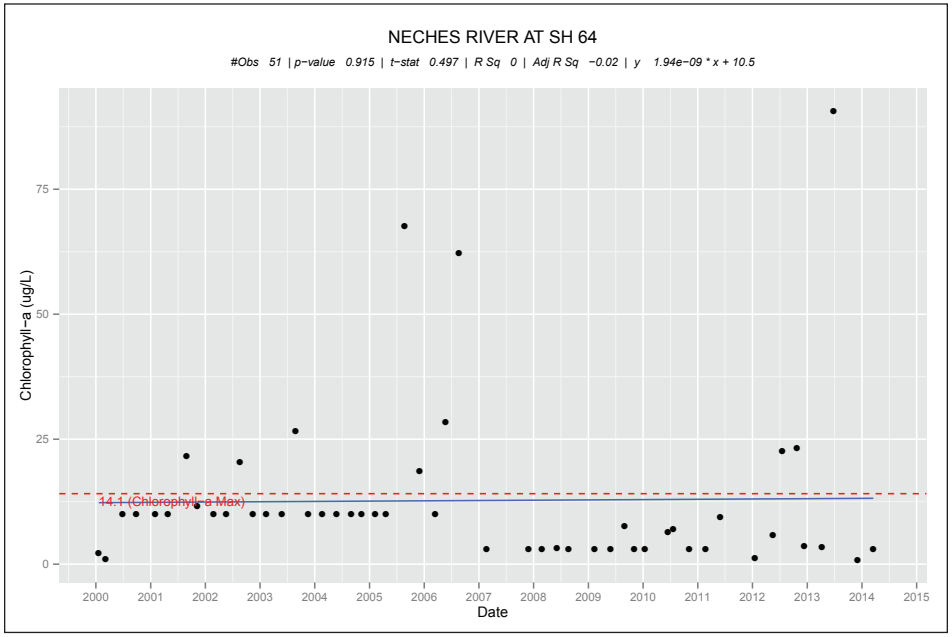




Segment 0606 - Neches River Above Lake Palestine

Monitoring Station 10597 - Neches River at SH 64





Water Quality Monitoring Results for Station 10597 - Neches River at SH 64

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	59	0	120	1840	310.64		1.7552	0.5694	
00300	Dissolved Oxygen (mg/L)	59	23	0.3	11.6	4.14		1.1610	0.8925	
00400	pH (S.U.)	59	12	3.5	7.1	6.29		6.4673	0.4242	
00530	Total Suspended Solids (mg/L)	52	0	1	236	20.88		1.5756	0.2490	
00610	Ammonia-Nitrogen (mg/L as N)	52	7	0.02	4.59	0.34		0.8835	0.5874	
00630	Nitrate + Nitrite (mg/L as N)	30	1	0.04	2.69	0.14		-0.3085	0.6787	
00665	Total Phosphorus (mg/L as P)	48	1	0.02	0.7	0.15		2.0157	0.2453	
00940	Chloride (mg/L)	52	0	13	52	30.91		4.6701	0.0890	↓
00945	Sulfate (mg/L)	52	15	1	166	41.33		1.1803	0.7521	
31699	*E. coli* (MPN/100 mL)	38	18	10	2400		19.13	0.7541	0.6786	
32211+70953	Chlorophyll-*a* (µg/L)	51	10	0.85	90.7	12.72		0.4969	0.9147	
70300	Total Dissolved Solids (mg/L)	42	5	110	408	214.55		3.6165	0.1063	

Segment 0606 - Neches River Above Lake Palestine

Summary of Water Quality Trends

There were no statistically significant trends for assessment unit 0606_01. For AU 0606_02, the only statistically significant trend was a decreasing trend for Chloride.

Trend Analysis Summary for Segment 0606 - Neches River Above Lake Palestine

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Neches River Above Lake Palestine	0606_01	10596	Neches River at FM 279	No trends were statistically significant.											
	0606_02	10597	Neches River at SH 64				↓								

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

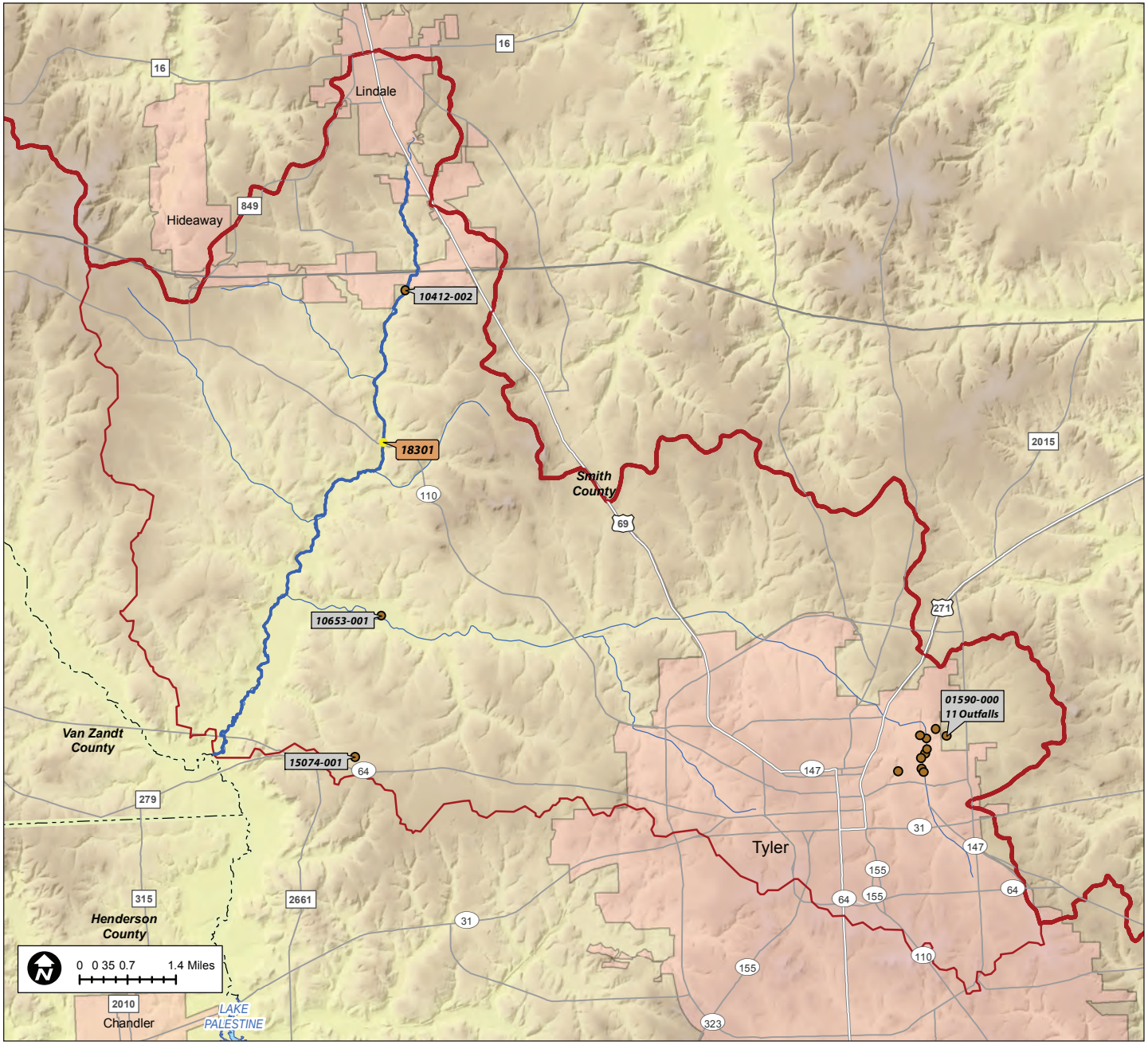
Water Quality Issues Summary for Segment 0606 - Neches River Above Lake Palestine

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment for *E. coli* bacteria	Entire segment	• Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A RUAA is being conducted on this water body to determine if the most appropriate contact recreation standard is being applied
Depressed Dissolved Oxygen	AU 0606_02 (upper assessment unit)	• Nonpoint source pollution • Aquatic vegetation • Nutrient loading into the water body	• Detrimental effect on aquatic biological community	• Continue monitoring • Conduct 24-hour DO measurements • Conduct Aquatic Life UAA
Concern for Low pH	AU 0606_02 (upper assessment unit)	• Natural causes • Acidic groundwater infiltration	• Detrimental effect on aquatic biological community	• Continue monitoring
Concern for Nitrate-Nitrogen	AU 0606_01 (lower assessment unit)	• Municipal wastewater discharge • Nonpoint sources of pollution • Stormwater runoff	• Detrimental effect on aquatic biological community	• Continue monitoring • Evaluate wastewater effluent permit limits
Concern for Total Phosphorus	AU 0606_01 (lower assessment unit)	• Municipal wastewater discharge • Nonpoint sources of pollution • Stormwater runoff	• Can increase production of algae • Algae production can cause swings in dissolved oxygen, which can be detrimental to the aquatic biological community	• Continue monitoring • Evaluate wastewater effluent permit limits

Segment 0606A - Prairie Creek

Segment Profile

This freshwater stream includes a 13-mile length perennial stream from the confluence of the Neches River west of Tyler in Smith County to a point immediately upstream of the confluence of Caney Creek. Designated uses for this segment are general, contact recreation, and high aquatic life use.



Segment 0606A - Prairie Creek

Assessment Units

Assessment Units in Segment 0606A - Prairie Creek	
AU ID	**Description**
0606A_01	From the confluence with Neches River (0606), per WQS App. D first entry for Prairie Creek at NHD RC 12020001000071 in Smith County upstream to the confluence with Black Fork Creek (0606D) at NHD RC 12020001000071
0606A_02	From the confluence with Black Fork Creek (0606D) upstream to a point immediately upstream of confluence with Caney Creek in Smith County at NHD RC 12020001000074, per WQS App. D first entry for Prairie Creek
0606A_03	From the confluence with Caney Creek upstream to confluence with unnamed tributary appx. 0.6 km downstream of the US 69 bridge crossing, which is located appx. 0.6 km south of the City of Lindale, per App. D second line entry

Monitoring Stations

Monitoring Stations in Segment 0606A - Prairie Creek										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0606A_03	18301	PRAIRIE CREEK AT SH 110 6.5 MI NORTHWEST OF TYLER AND 3.5 MI SOUTHWEST OF LINDALE	4	4	4	4			TCEQ-5

Description of Water Quality Issues

Impairments and Concerns

For Prairie Creek, two assessment units (AU 0606A_01 and AU 0606A_03) are listed as impaired for *E. coli* bacteria. For AU 0606A_01, the listing is for a geometric mean of 164.87 MPN/100 mL (based on 22 samples). In AU 0606A_03, the geometric mean is 170.98 MPN/100 mL (based on 24 samples).

Assessment Summary for Segment 0606A - Prairie Creek as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	75 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.2**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0606A_01										**NS**				
0606A_03										**NS**				

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

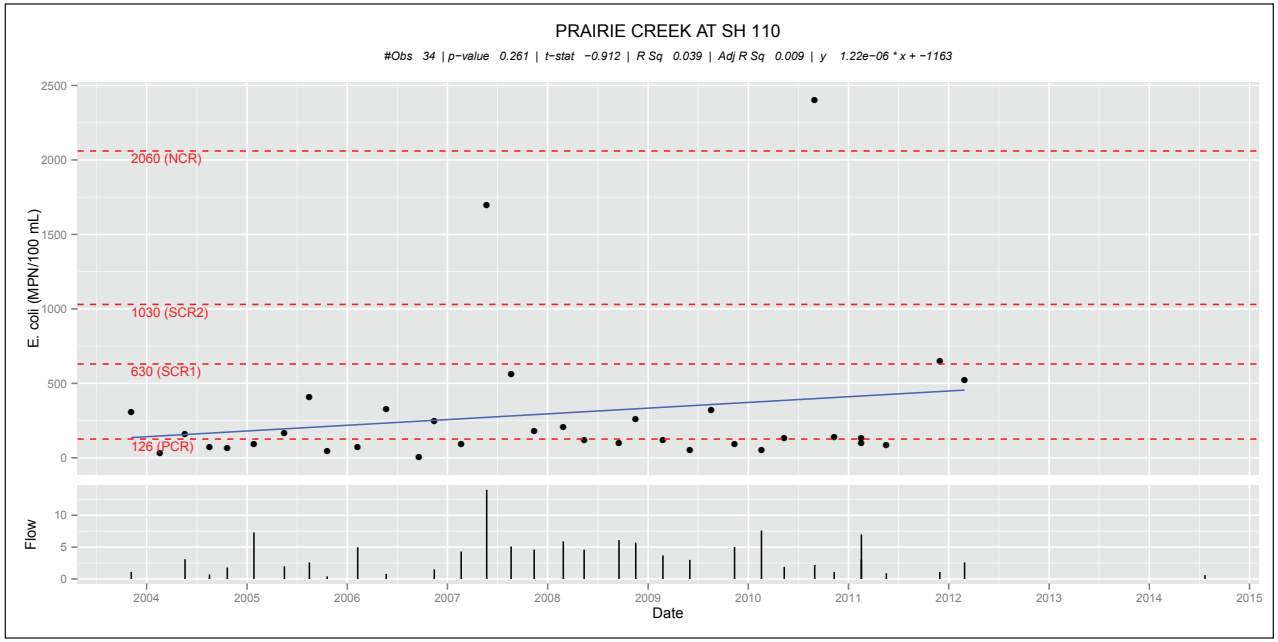
Segment 0606A - Prairie Creek

Monitoring Station 18301 - Prairie Creek at SH 110

Monitoring Station 18301 is located west of Tyler and southwest of Lindale at the SH 100 crossing, and is found in AU 0606A_03. This station is monitored quarterly by TCEQ Region 5 personnel for conventional parameters, field parameters, flow, and *E. coli* bacteria.

This assessment unit is listed in the Draft 2014 Integrated Report as impaired for *E. coli* bacteria.

A decreasing trend for Chlorophyll-*a* is due to a change in the limit of quantitation.



Water Quality Monitoring Results for Station 18301 - Prairie Creek at SH 110

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	35	0	110	462	152.23		-0.6723	0.0780	
00300	Dissolved Oxygen (mg/L)	35	0	3.8	10.31	6.48		2.1953	0.7022	
00400	pH (S.U.)	34	0	6.3	8.1	7.10		5.3556	0.1434	
00530	Total Suspended Solids (mg/L)	34	0	2.3	34	6.92		-0.8153	0.2191	
00610	Ammonia-Nitrogen (mg/L as N)	34	9	0.1	2.3	0.31		0.3954	0.9088	
00630	Nitrate + Nitrite (mg/L as N)	34	0	0.04	1.2	0.36		-0.0156	0.6289	
00665	Total Phosphorus (mg/L as P)	33	1	0.06	1.08	0.14		0.3414	0.9398	
00940	Chloride (mg/L)	34	0	5.7	43	13.03		0.2196	0.5692	
00945	Sulfate (mg/L)	34	1	10	669	37.49		1.5615	0.1604	
31699	*E. coli* (MPN/100 mL)	34	18	5	2400		130.26	-0.9117	0.2606	
32211+70953	Chlorophyll-*a* (µg/L)	32	1	2	15.7	4.17		4.1619	0.0013	
70300	Total Dissolved Solids (mg/L)	32	0	76	160	105.33		0.7447	0.1099	

Segment 0606A - Prairie Creek

Summary of Water Quality Trends

There were no statistically significant trends for Prairie Creek.

Trend Analysis Summary for Segment 0606A - Prairie Creek														
Segment Name	**AU**	**Station ID**	**Station Description**	**PARAMETERS**										
				E. coli	**pH**	**DO**	**Cl**	**SO4**	**Spec Cond**	**TDS**	**TSS**	**Chl-*a***	**NH3**	**NO3/ NO2**	**Total P**
Prairie Creek	0606A_03	18301	Prairie Creek at SH 110	No trends were statistically significant.											
↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1														

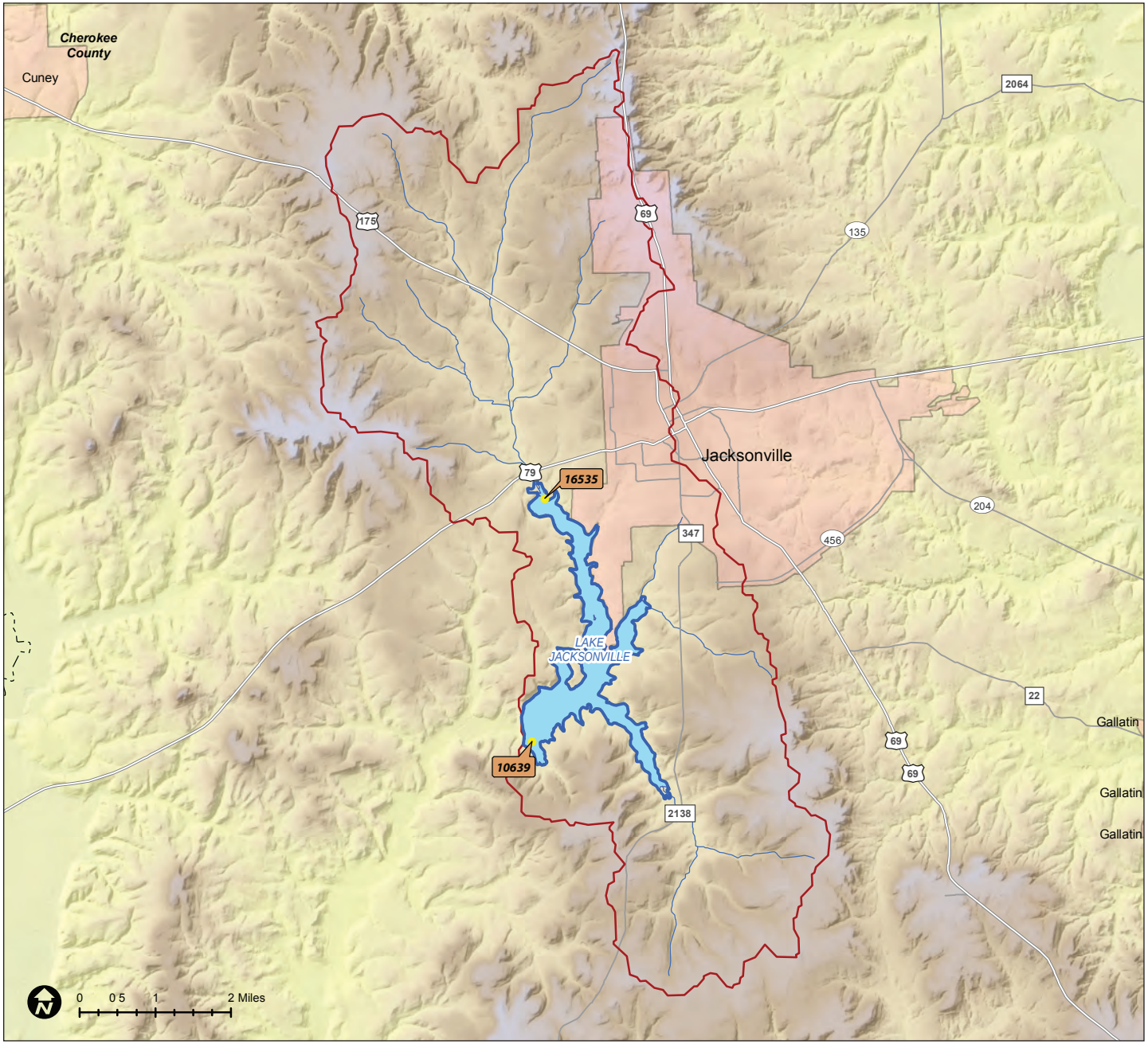
Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0606A - Prairie Creek				
Water Quality Issue	**Affected Area**	**Possible Influences/Causes**	**Possible Effects**	**Possible Solutions / Actions Taken**
Impairment for *E. coli* bacteria	Entire water body	• Municipal wastewater discharge • Sanitary sewer overflow (SSO) and Combined sewer overflow (CSO) • Stormwater runoff • Nonpoint sources of pollution • Domestic animals and wildlife	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A RUAA is being conducted on this water body to determine if the most appropriate contact recreation standard is being applied

Segment 0614 - Lake Jacksonville

Segment Profile

Segment 0614 is designated as a classified reservoir, Lake Jacksonville. The description of this lake includes from an area from Buckner Dam in Cherokee county up to a normal pool elevation of 422 feet (impounds Gum Creek). The reservoir is classified for public water supply use, high aquatic life use, general use, and contact recreation use.



Segment 0614 - Lake Jacksonville

Assessment Units

Assessment Units in Segment 0614 - Lake Jacksonville	
AU ID	**Description**
0614_01	Lower reservoir
0614_02	Upper reservoir

Monitoring Stations

Monitoring Stations in Segment 0614 - Lake Jacksonville									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0614_01	10639	LAKE JACKSONVILLE AT DAM	4	4	4	4			TCEQ-5
0614_02	16535	LAKE JACKSONVILLE UPPER LAKE	4	4	4	4			TCEQ-5

Description of Water Quality Issues

Impairments and Concerns

There are no impairments or concerns listed for Segment 0614 (Lake Jacksonville) in the Draft 2014 Integrated Report.

Assessment Summary for Segment 0614 - Lake Jacksonville as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**75 mg/L**	**750 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 9.0 SU**	**33.9**	**126 MPN /100 mL**	**0.11 mg/L**	**0.37 mg/L**	**0.20 mg/L**	**26.7 µg/L**
0614_01	FS	FS	FS	NC	FS			FS	FS	NC	NC	NC	NC	NC
0614_02	FS	FS	FS	NC	FS			FS	FS	NC	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0614 - Lake Jacksonville

Monitoring Station 10639 - Lake Jacksonville at Dam

Monitoring Station 10639 is located in the southwest corner of the lake approximately 100 m upstream of the dam and equidistant to both shorelines. This station is monitored quarterly by TCEQ Region 5 personnel for conventional parameters, field parameters, and *E. coli* bacteria.

There are no impairments or concerns identified for this AU. Decreasing trends for Total Phosphorus, Total Suspended Solids, and Chlorophyll-*a* are due to changes in the limit of quantitation. There is a statistically significant increasing trend for Sulfate, but all values are low, with results ranging from 4 to 11 mg/L.

Water Quality Monitoring Results for Station 10639 - Lake Jacksonville at Dam

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	57	0	67	116	84.09		6.6238	0.4914	
00300	Dissolved Oxygen (mg/L)	57	0	6.1	10.8	8.37		5.5556	0.6926	
00400	pH (S.U.)	57	0	6.6	8	7.39		17.0217	0.9045	
00530	Total Suspended Solids (mg/L)	53	0	1	5	3.21		-4.8168	0.0000	
00610	Ammonia-Nitrogen (mg/L as N)	54	1	0.05	0.2	0.06		1.3440	0.5135	
00630	Nitrate + Nitrite (mg/L as N)	34	0	0.04	0.18	0.06		0.4099	0.8079	
00665	Total Phosphorus (mg/L as P)	49	0	0.02	0.06	0.05		7.4610	0.0000	
00940	Chloride (mg/L)	55	0	5	10	7.73		0.0972	0.0000	
00945	Sulfate (mg/L)	55	0	4	11	6.58		-3.7088	0.0000	↑
31699	*E. coli* (MPN/100 mL)	40	0	1	70		2.21	-0.8536	0.2442	
32211+70953	Chlorophyll-*a* (µg/L)	53	0	1	15.1	6.45		8.9511	0.0000	
70300	Total Dissolved Solids (mg/L)	44	0	18	81	60.80		2.5021	0.1615	

Monitoring Station 16535 - Lake Jacksonville Upper Lake

Monitoring Station 16535 is located in the upper lake near the raw water intake structure. This station is monitored quarterly by TCEQ Region 5 personnel for conventional parameters, field parameters, and *E. coli* bacteria.

Trends at this station are very similar to those observed at station 10639 and are affected by changes to the limit of quantitation for the methods. There is a significant decreasing trend for pH at this station.

Water Quality Monitoring Results for Station 16535 - Lake Jacksonville Upper Lake

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	56	0	69	110	85.89		6.7895	0.6263	
00300	Dissolved Oxygen (mg/L)	56	0	6	11.9	8.66		5.2564	0.9674	
00400	pH (S.U.)	56	3	6.7	9.7	7.68		10.9604	0.0678	↓
00530	Total Suspended Solids (mg/L)	55	0	1	7	3.60		-1.9855	0.0000	
00610	Ammonia-Nitrogen (mg/L as N)	51	1	0.05	0.14	0.05		2.8723	0.6942	
00630	Nitrate + Nitrite (mg/L as N)	34	0	0.04	0.17	0.06		0.2030	0.6126	
00665	Total Phosphorus (mg/L as P)	48	0	0.02	0.06	0.05		7.2684	0.0001	
00940	Chloride (mg/L)	55	1	5	69	8.93		-0.6580	0.1304	
00945	Sulfate (mg/L)	55	0	4	15	6.85		-3.0183	0.0000	↑
31699	*E. coli* (MPN/100 mL)	40	3	1	410		3.23	0.3546	0.8972	
32211+70953	Chlorophyll-*a* (µg/L)	51	1	1.33	46.4	8.09		3.1780	0.0327	
70300	Total Dissolved Solids (mg/L)	44	0	50	99	65.07		1.4922	0.0016	

Segment 0614 - Lake Jacksonville

Summary of Water Quality Trends

An increasing trend was identified for Sulfate in both assessment units. However, the results for this parameter were very low, so this is not an issue or concern. A decreasing trend was seen for pH in the upper portion of the lake. Higher pH values were recorded between 2003 and 2008, with values typically being between 7.0 - 8.0 S.U. since that time.

Trend Analysis Summary for Segment 0614 - Lake Jacksonville

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Lake Jacksonville	0614_01	10639	Lake Jacksonville at Dam					↑							
	0614_02	16535	Lake Jacksonville Upper Lake		↓			↑							

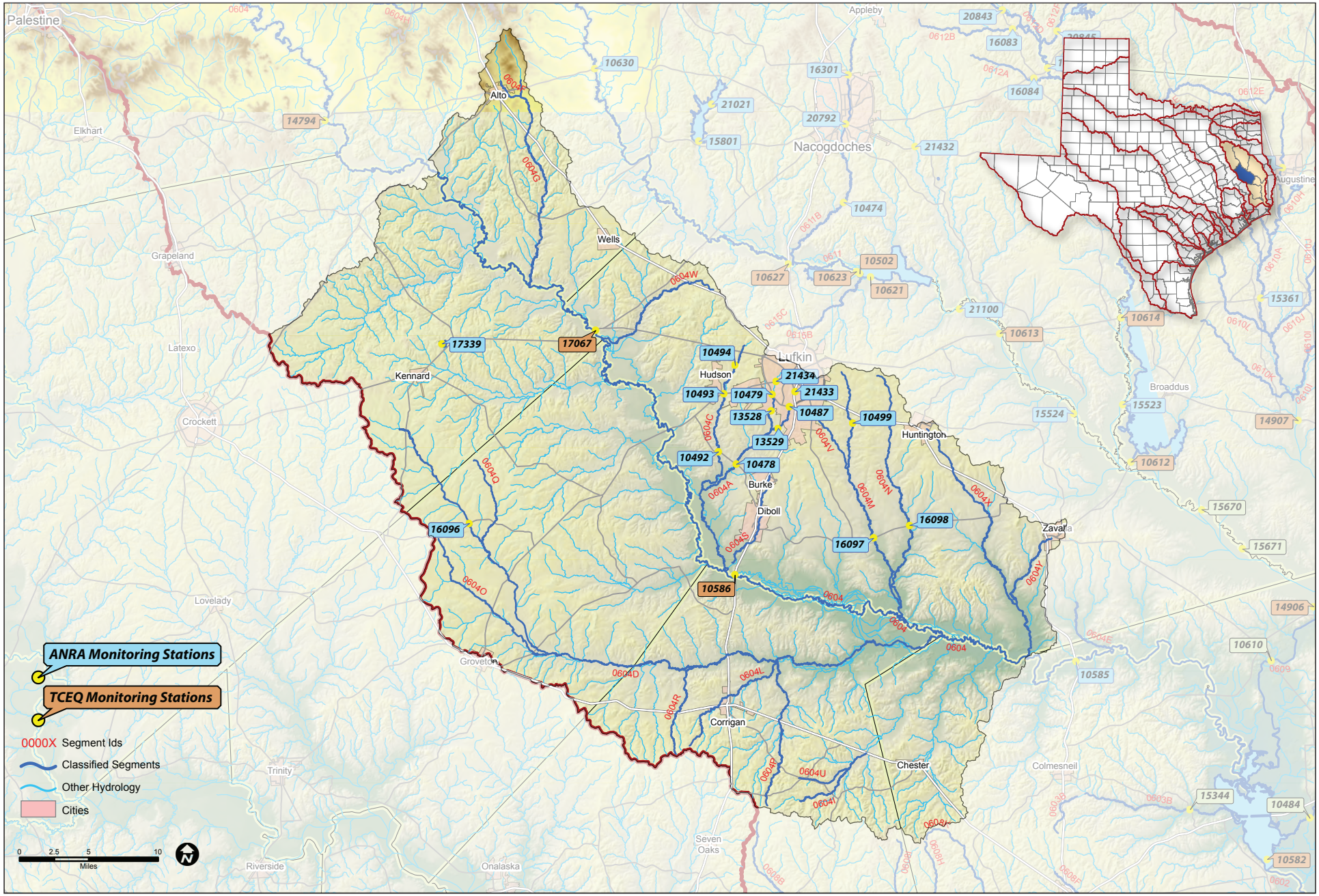
↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0614 - Lake Jacksonville

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
No impairments or concerns identified				

Middle Neches Overview Map



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Profile of the Middle Neches Sub-Basin

Population

Cherokee, Angelina, Houston, Trinity, Polk, and Tyler counties are included within the sub-basin. The following cities which lie partially or wholly within the sub-basin are as follows: Lufkin, Hudson, Burke, Diboll, Huntington, Zavalla, Chester, Corrigan, Wells, Alto, Kennard, and Groveton. As of the 2010 census, there are an estimated 33,243 households, including 79,176 individuals residing within the sub-basin.

Land Characteristics and Use

There are numerous farms within this sub-basin, with the poultry industry being particularly prevalent.

The South Central Plains ecoregion includes floodplains, tertiary uplands, and southern tertiary uplands. Carrizo-Wilcox, Yegua Jackson, and Gulf Coast are the aquifers supplying this region.

Segments in the Middle Neches Sub-Basin	
Segment ID	**Segment Name**
0604	Neches River Below Lake Palestine
0604A	Cedar Creek
0604B	Hurricane Creek
0604C	Jack Creek
0604D	Piney Creek
0604M	Biloxi Creek
0604N	Buck Creek
0604T	Lake Ratcliff

10478 - Cedar Creek at FM 2497

Profile of the Middle Neches Sub-Basin

Permitted Discharges in the Middle Neches Sub-Basin

A total of twenty-five permitted discharges are within the Middle Neches sub-basin.

Permitted Discharges in the Middle Neches Sub-Basin

First Segment in Drainage Path	Segment ID as identified in Permit	Permit Number	Outfall Number	NPDES Number	Permittee	County	TCEQ Region	Map Locations
0604	0604	10191-001	001	053422	CITY OF HUNTINGTON	Angelina	10 - Beaumont	Page 226
0604	0604	11474-001	001	056596	CITY OF KENNARD	Houston	10 - Beaumont	Page 226
0604	0604	13871-001	001	118991	CITY OF ZAVALLA	Angelina	10 - Beaumont	Page 226
0604	0604	14086-001	001	118966	APPLE SPRINGS ISD	Trinity	10 - Beaumont	Page 226
0604A	0604	01153-000	001	001201	TIN INC	Angelina	10 - Beaumont	Pages 226 & 231
0604A	0604	01153-000	001	001201	TIN INC	Angelina	10 - Beaumont	Pages 226 & 231
0604A	0604	01153-000	004	001201	TIN INC	Angelina	10 - Beaumont	Pages 226 & 231
0604B	0604	01737-000	001	082261	GEORGIA-PACIFIC CHEMICALS LLC	Angelina	10 - Beaumont	Pages 226, 231 & 241
0604B	0604	10214-001	001	024309	CITY OF LUFKIN	Angelina	10 - Beaumont	Pages 226, 231 & 241
0604C	0604	11826-001	001	068985	CITY OF HUDSON	Angelina	10 - Beaumont	Pages 226, 231 & 248
0604G	0604	10546-001	001	025020	CITY OF ALTO	Cherokee	05 - Tyler	Page 226
0604L	0604	01902-000	001	064491	GEORGIA-PACIFIC WOOD PRODUCTS SOUTH LLC	Polk	10 - Beaumont	Pages 226 & 255
0604L	0604	01902-000	002	064491	GEORGIA-PACIFIC WOOD PRODUCTS SOUTH LLC	Polk	10 - Beaumont	Pages 226 & 255
0604L	0604	15057-001	001	133787	CITY OF CORRIGAN	Polk	10 - Beaumont	Pages 226 & 255
0604N	0604	01268-000	001	065412	LUFKIN INDUSTRIES LLC	Angelina	10 - Beaumont	Pages 226, 260 & 268
0604N	0604	01268-000	002	065412	LUFKIN INDUSTRIES INC	Angelina	10 - Beaumont	Pages 226, 260 & 268
0604N	0604	14128-001	001	119679	ANGELINA WSC	Angelina	10 - Beaumont	Pages 226, 260 & 268
0604P	0604	11139-001	001	075701	MOSCOW WSC	Polk	10 - Beaumont	Pages 226 & 255
0604S	0604	01153-000	003	001201	TIN INC	Angelina	10 - Beaumont	Pages 226 & 231
0604S	0604	01153-000	006	001201	TIN INC	Angelina	10 - Beaumont	Pages 226 & 231
0604S	0604	10288-001	001	024872	CITY OF DIBOLL	Angelina	10 - Beaumont	Pages 226 & 231
0604U	0604	01598-000	001	006076	GEORGIA-PACIFIC WOOD PRODUCTS SOUTH LLC	Polk	10 - Beaumont	Page 226
0604U	0604	01598-000	002	006076	GEORGIA-PACIFIC WOOD PRODUCTS SOUTH LLC	Polk	10 - Beaumont	Page 226
0604U	0604	01598-000	004	006076	GEORGIA-PACIFIC WOOD PRODUCTS SOUTH LLC	Polk	10 - Beaumont	Page 226
0604W	0604	11196-001	001	071021	CITY OF WELLS	Cherokee	05 - Tyler	Page 226

Profile of the Middle Neches Sub-Basin

Texas Surface Water Quality Standards for the Middle Neches Sub-Basin

Site-Specific Uses and Numeric Criteria for Classified Segments in the Middle Neches Sub-Basin

Segment ID	Segment Name	DESIGNATED USES				CRITERIA*						
		Recreation	Aquatic Life	Domestic Water Supply	Other	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	Dissolved Oxygen (mg/L	pH Range (S.U.)	*E. coli* Bacteria #/100 mL	Temp (°F)
0604	Neches River Below Lake Palestine	PCR	H	PS		50	50	200	5.0	6.0 - 8.5	126	91

PCR = Primary Contact Recreation SCR1 = Secondary Contact Recreation 1 SCR2 = Secondary Contact Recreation 2 NCR = Noncontact Recreation
H = High Aquatic Life Use I = Intermediate Aquatic Life Use
PS = Public Supply

* The criteria for Chloride, Sulfate, and TDS are listed as the maximum annual averages for the segment. Dissolved Oxygen criteria are listed as minimum 24-hour means at any site within the segment. The pH criteria are listed as minimum and maximum values expressed in standard units at any site within the segment. The criteria for Temperature are listed as maximum values at any site within the segment.

Segment 0604 - Neches River Below Lake Palestine

Segment Profile

This freshwater segment is 231 miles long and extends from a point immediately upstream of the confluence of Hopson Mill Creek in Jasper/Tyler County to Blackburn Crossing Dam in Anderson/Cherokee County. Contact recreation, public water supply, general, and high aquatic life use are the designated uses for this segment. Segment 0604 spans the Upper, Middle, and Lower Neches Sub-Basins.

Segment 0604 - Neches River Below Lake Palestine

Assessment Units

Assessment Units in Segment 0604 - Neches River Below Lake Palestine (Middle Neches Sub-Basin Portion)	
AU ID	**Description**
0604_02	From the confluence of Biloxi Creek (0604M) upstream to the upper confluence of Old River at NHD RC 12020002000037
0604_03	From the upper confluence of Old River upstream to the confluence with Cedar Creek in Cherokee County at NHD RC 12020002000085 near Hargrove Lake

Monitoring Stations

Monitoring Stations in Segment 0604 - Neches River Below Lake Palestine (Middle Neches Sub-Basin Portion)									
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604_02	10586	NECHES RIVER AT US 59	4	4	4	4			TCEQ-10
0604_03	17067	NECHES RIVER AT SH 7	4	4	4				TCEQ-10

Description of Water Quality Issues

Impairments and Concerns

Assessment units 0604_02 and 0604_03 are listed in the Draft 2014 Integrated Report as impaired for Dioxin in edible tissue and Mercury in edible tissue. Both of these are covered under the same Texas Department of State Health Services fish consumption advisory that applies to Sam Rayburn Reservoir.

No other impairments or concerns have been identified for this portion of the segment.

Assessment Summary for Segment 0604 - Neches River Below Lake Palestine (Middle Neches Sub-Basin Portion) as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604_02				NC	FS			FS	FS	FS	NC	NC	NC	NC
0604_03				NC	FS			FS	FS	FS	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0604 - Neches River Below Lake Palestine

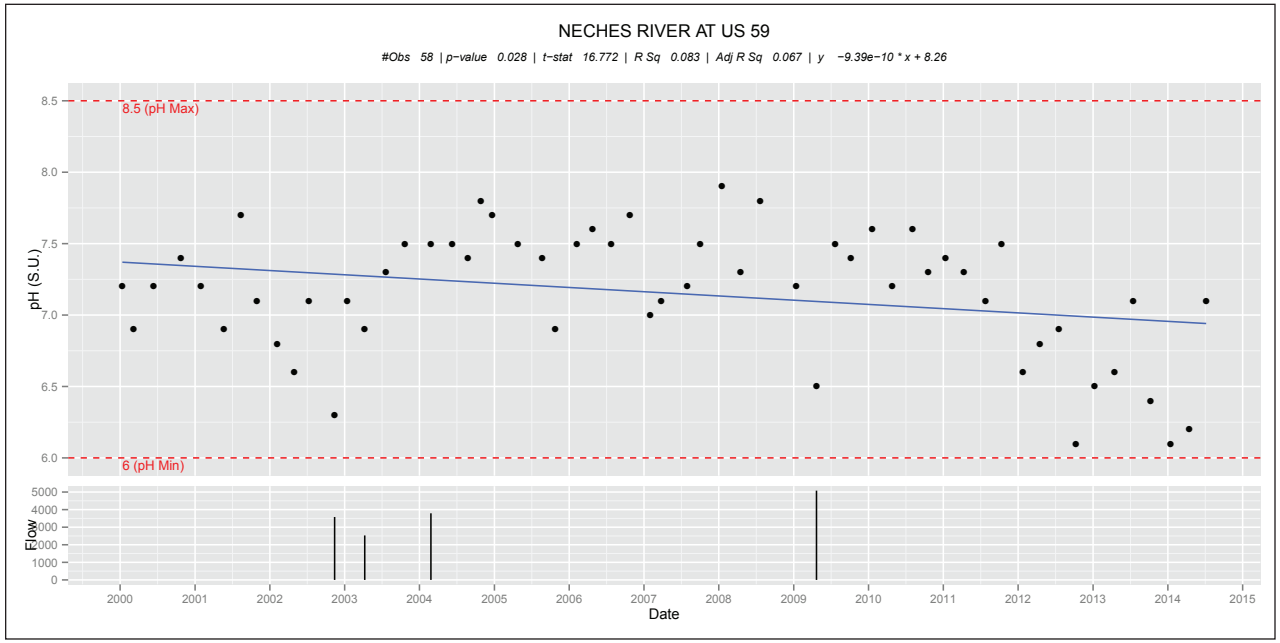
Monitoring Station 10586- Neches River at US 59

Located in AU 0604_02, Monitoring Station ID 10586 is monitored quarterly for field and conventional parameters, flow, and *E. coli* bacteria. This monitoring station is located 6.3 km south of Diboll in Angelina County. It is the southernmost monitoring station on the Neches River in the Middle Neches Sub-Basin.

This assessment unit is listed as impaired for Dioxin in edible tissue and Mercury in edible tissue. No other impairments or concerns have been identified for this assessment unit.

There is a statistically significant decreasing trend for pH observed at this monitoring station. With this trend, there are numerous lower pH values clustered in recent years. However, none of the values are below the lower pH criteria of 6.0 S.U.

Increasing trends are observed for Specific Conductance, Total Dissolved Solids, Chloride, and Sulfate, but none of these trends are considered to be statistically significant.



Water Quality Monitoring Results for Station 10586 - Neches River at US 59

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	58	0	130	338	215.45		0.7285	0.0001	
00300	Dissolved Oxygen (mg/L)	58	0	4	12.1	7.69		3.0748	0.7007	
00400	pH (S.U.)	58	0	6.1	7.9	7.16		16.7717	0.0278	↓
00530	Total Suspended Solids (mg/L)	54	0	4	92	34.56		3.1113	0.1012	
00610	Ammonia-Nitrogen (mg/L as N)	55	0	0.05	0.27	0.06		2.2342	0.4953	
00630	Nitrate + Nitrite (mg/L as N)	35	0	0.04	1.32	0.27		-0.7042	0.2715	
00665	Total Phosphorus (mg/L as P)	50	0	0.05	0.28	0.15		1.6108	0.8678	
00940	Chloride (mg/L)	56	0	12	37	24.23		1.2082	0.0254	
00945	Sulfate (mg/L)	56	2	8	59	26.66		0.2449	0.0231	
31699	*E. coli* (MPN/100 mL)	44	10	8	4838		68.60	2.2072	0.0485	
32211+70953	Chlorophyll-*a* (µg/L)	55	7	1.78	24.6	9.53		3.0191	0.1700	
70300	Total Dissolved Solids (mg/L)	43	2	98	203	156.88		1.4317	0.0087	

Segment 0604 - Neches River Below Lake Palestine

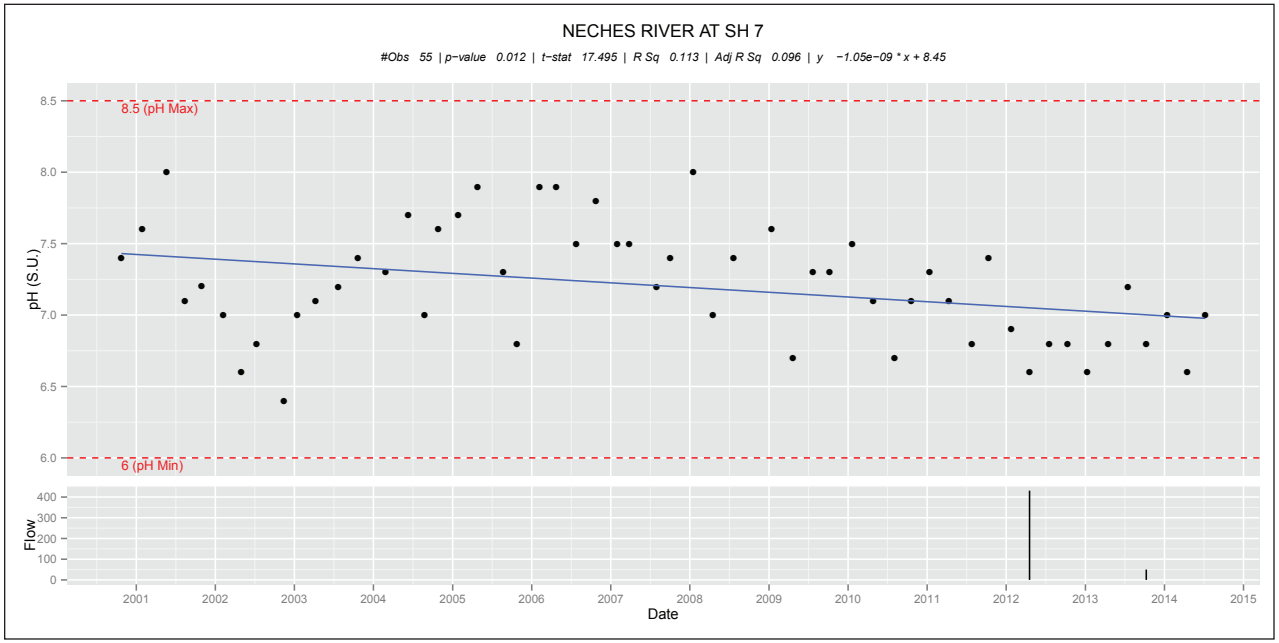
Monitoring Station 17067- Neches River at SH 7

Monitoring Station 17067, located at the SH 7 bridge crossing, is the northernmost monitoring station on the Neches River in the Middle Neches Sub-Basin, and the only station in assessment unit 0604_03. This station is monitored quarterly by TCEQ Region 10 personnel for field parameters, conventional parameters, flow, and *E. coli* bacteria.

At this monitoring station, there is a statistically significant decreasing trend for pH. All values reported are within the criteria of 6.0 – 8.5 S.U.

Increasing trends are found for Specific Conductance, Chloride, and Sulfate; however, none of these trends are statistically significant. A statistically significant increasing trend does exist for Total Dissolved Solids, but there is no data for this parameter in recent years, so ANRA is not classifying this trend as significant.

For nutrient parameters, there is a statistically significant decreasing trend for Total Phosphorus. It should be noted that this trend is being influenced by a lower laboratory limit of quantitation in recent years. Because of the change in the LOQ, ANRA is not considering this trend to be of significance. Results ranged from <0.02 – 0.19 mg/L as P, with no values exceeding the nutrient screening level.



Water Quality Monitoring Results for Station 17067 - Neches River at SH 7

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	55	0	114	267	188.76		0.7266	0.0000	
00300	Dissolved Oxygen (mg/L)	55	0	4.7	12.8	7.99		2.8279	0.6060	
00400	pH (S.U.)	55	0	6.4	8	7.20		17.4948	0.0122	↓
00530	Total Suspended Solids (mg/L)	51	0	4	82	30.33		1.6793	0.7473	
00610	Ammonia-Nitrogen (mg/L as N)	52	0	0.05	0.11	0.06		3.3372	0.9337	
00630	Nitrate + Nitrite (mg/L as N)	36	0	0.04	0.62	0.20		0.4027	0.8435	
00665	Total Phosphorus (mg/L as P)	47	0	0.02	0.19	0.09		3.7499	0.0565	
00940	Chloride (mg/L)	53	0	12	31	21.92		0.2654	0.0005	
00945	Sulfate (mg/L)	53	0	9	50	22.64		-1.5781	0.0001	
31699	*E. coli* (MPN/100 mL)	44	11	10	4800		68.82	0.0195	0.8478	
32211+70953	Chlorophyll-*a* (µg/L)	52	9	2.84	27.8	10.63		1.3234	0.9957	
70300	Total Dissolved Solids (mg/L)	40	0	99	168	137.65		2.6051	0.0423	

Segment 0604 - Neches River Below Lake Palestine

Summary of Water Quality Trends

The only trends that ANRA considered to be of significance in assessment units 0604_02 and 0604_03 was a decreasing trend for pH. For both AUs, there were no values that fell below the criteria for this parameter.

Trend Analysis Summary for Segment 0604 - Neches River Below Lake Palestine (Middle Neches Sub-Basin Portion)

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Neches River Below Lake Palestine	0604_02	10586	Neches River at US 59		↓										
	0604_03	17067	Neches River at SH 7		↓										

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

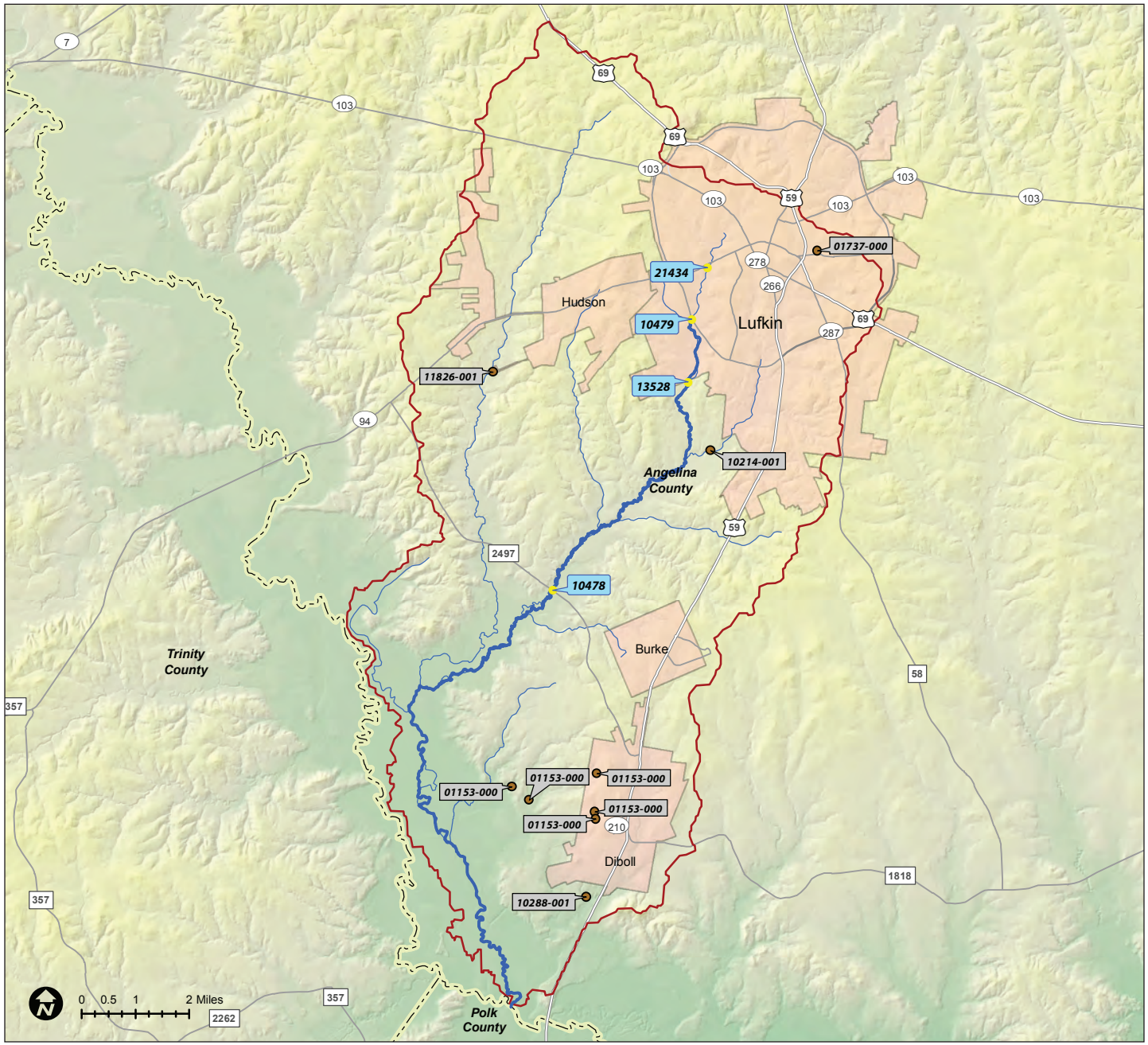
Water Quality Issues Summary for Segment 0604 - Neches River Below Lake Palestine (Middle Neches Sub-Basin Portion)

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Mercury in Edible Tissue	The Neches River (Segment 0604) and all contiguous waters from the SH 7 bridge west of Lufkin, TX downstream to the US 96 bridge near Evadale, TX including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir	• Pulp and paper bleaching processes	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for six species of fish • ADV-51 issued on January 24, 2014
Dioxin in Edible Tissue	The Neches River (Segment 0604) and all contiguous waters from the SH 7 bridge west of Lufkin, TX downstream to the US 96 bridge near Evadale, TX including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir	• Atmospheric deposition from coal-fired power plants, large boilers and heaters, steel production, and incinerators	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for six species of fish • ADV-51 issued on January 24, 2014

Segment 0604A - Cedar Creek

Segment Profile

Cedar Creek is a 24-mile length freshwater stream that extends from the confluence of the Neches River southwest of Lufkin to the upstream perennial portion of the stream in Lufkin in Angelina County. This segment is designated for contact recreation, general use, and aquatic life use.



Segment 0604A - Cedar Creek

Assessment Units

Assessment Units in Segment 0604A - Cedar Creek	
AU ID	**Description**
0604A_01	From the confluence with the Neches River upstream to the confluence with Jack Creek (0604C)
0604A_02	From the confluence with Jack Creek (0604C) upstream to confluence with unnamed tributary adjacent to State Loop 287, per App. D in WQS, at NHD RC 12020002000436

Monitoring Stations

Monitoring Stations in Segment 0604A - Cedar Creek										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604A_02	13528	CEDAR CREEK AT FM 1336	4	4	4	4			ANRA
0604A_02	10478	CEDAR CREEK AT FM 2497	4	4	4	4			ANRA
0604A_02	21434	CEDAR CREEK AT ELLIS AVE IN LUFKIN	4	4	4	4			ANRA
0604A_02	10479	CEDAR CREEK AT LOOP 287	4	4	4	4			ANRA

Description of Water Quality Issues

Impairments and Concerns

Cedar Creek is listed in the Draft 2014 Integrated Report with an impairment due to *E. coli* bacteria. The AU is listed with a geometric mean of 134.38 MPN/100 mL based on 52 samples assessed from 12/1/2005 to 11/30/2012.

Nutrient concerns are also present in Cedar Creek, with the segment listed with concerns for Ammonia-Nitrogen, Nitrate+Nitrite, and Total Phosphorus.

Beginning in 2013, three additional monitoring stations were added to help identify potential sources of the nutrients and *E. coli* .

Assessment Summary for Segment 0604A - Cedar Creek as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**4.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604A_02				NC	FS					**NS**	CS	CS	CS	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0604A - Cedar Creek

Monitoring Station 13528 - Cedar Creek at FM 1336

Monitoring Station 13528 is located at the FM 1336 crossing of Cedar Creek in southwest Lufkin. This station is monitored quarterly by ANRA personnel for field parameters, conventional parameters, flow, and *E. coli* bacteria.

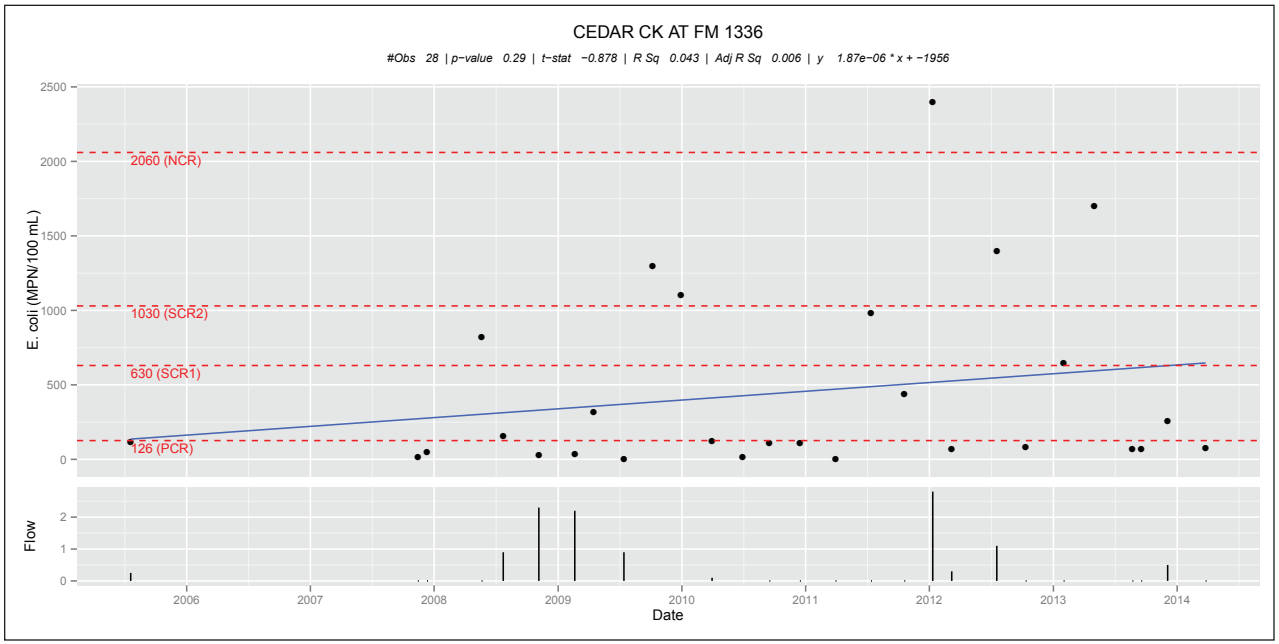
At this station, there is an increasing trend for Dissolved Oxygen, although this trend is not statistically significant. Results at this station ranged from 2.9 to 10.5 mg/L.

Chloride and Sulfate both show increasing trends, although neither trend is considered significant. For both parameters, there are numerous results which exceed the criteria. For Chloride, 15 of 28 values exceeded 50 mg/L, with a range of 12.8 – 120 mg/L, and a mean of 52.1 mg/L. For Sulfate, the range was <5 to 240 mg/L, with a mean of 99.5 mg/L, and 24 of 28 samples exceeding 50 mg/L. Related to the increased levels of Chloride and Sulfate, elevated Total Dissolved Solids were also seen at this station, with results ranging from 198 to 627 mg/L, with a mean of 389 mg/L.

For *E. coli* bacteria, results ranged from 3 to >2400 MPN/100 mL, with a geometric mean for the samples of 143.14 MPN/100 mL. This geometric mean exceeds the standard for Primary Contact Recreation.

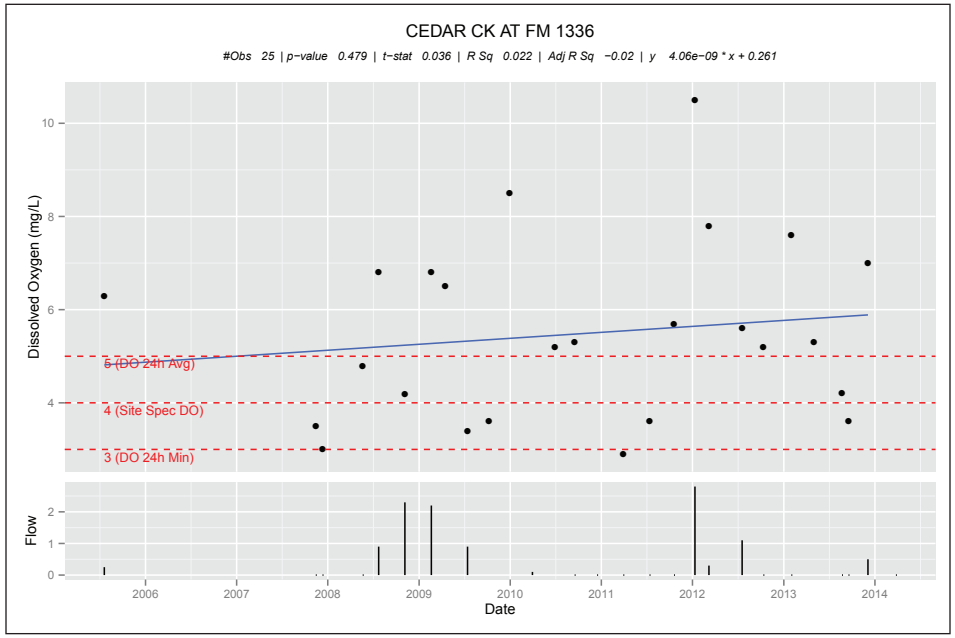
For nutrient parameters, there is a decreasing trend for Total Phosphorus, although this trend is not statistically significant. There were no values reported at this site during the period that exceeded the nutrient screening level of 0.69 mg/L.

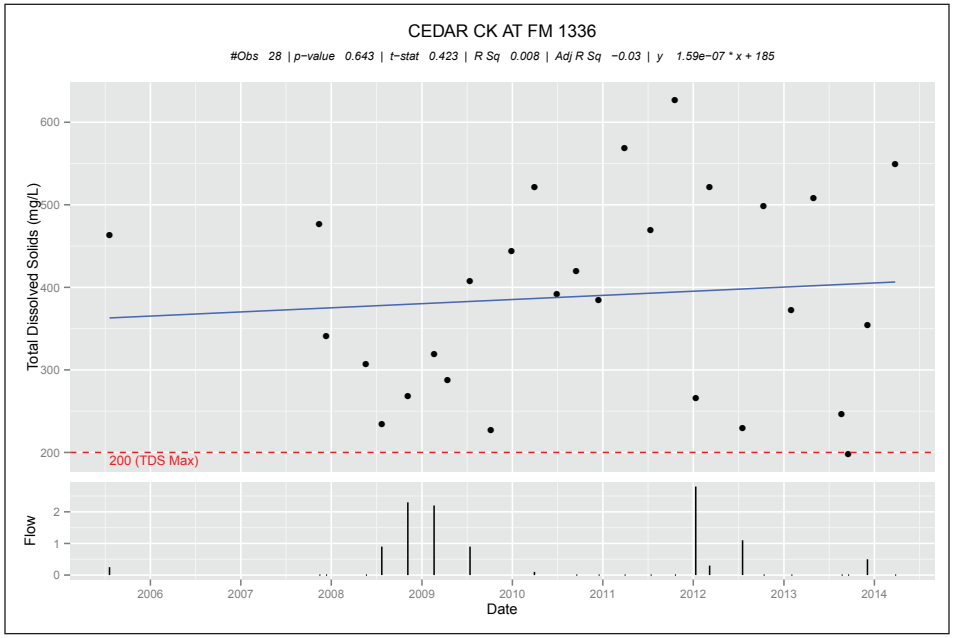
13528 - Cedar Creek at FM 1336



Segment 0604A - Cedar Creek

Monitoring Station 13528 - Cedar Creek at FM 1336





Water Quality Monitoring Results for Station 13528 - Cedar Creek at FM 1336										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	28	0	294	1030	606.11		0.1139	0.5101	
00300	Dissolved Oxygen (mg/L)	25	1	2.9	10.5	5.48		0.0360	0.4789	
00400	pH (S.U.)	26	0	7	7.9	7.48		10.9770	0.1486	
00530	Total Suspended Solids (mg/L)	28	0	1.3	46	10.67		1.0835	0.4355	
00610	Ammonia-Nitrogen (mg/L as N)	28	2	0.1	1.6	0.20		-0.3986	0.5653	
00630	Nitrate + Nitrite (mg/L as N)	28	0	0.04	1.28	0.17		1.2535	0.2870	
00665	Total Phosphorus (mg/L as P)	28	0	0.06	0.52	0.20		2.2747	0.1121	
00940	Chloride (mg/L)	28	15	12.8	120	52.11		-0.2518	0.4322	
00945	Sulfate (mg/L)	28	24	5	240	99.50		0.2108	0.7736	
31699	*E. coli* (MPN/100 mL)	28	12	3	2400		143.14	-0.8784	0.2898	
32211+70953	Chlorophyll-*a* (µg/L)	28	1	2	28.5	5.48		0.3352	0.9397	
70300	Total Dissolved Solids (mg/L)	28	27	198	627	389.43		0.4227	0.6426	

Segment 0604A - Cedar Creek

Monitoring Station 10478 - Cedar Creek at FM 2497

Monitoring Station 10478 is located on Cedar Creek at the FM 2497 crossing. This station is monitored quarterly by ANRA personnel for field parameters, conventional parameters, flow, and *E. coli* bacteria.

The majority of *E. coli* bacteria results at this station (40 of 54 samples) exceed the standard for Primary Contact Recreation. Results ranged from 48 to <2400 MPN/100 mL, with a geometric mean of 196 MPN/100 mL.

There is a statistically significant increasing trend for pH at this station. However, no values exceed the pH maximum of 8.5 S.U.

Chloride and Sulfate both demonstrate increasing trends, but neither is statistically significant. As seen at station 13528, the majority of values for Chloride and Sulfate exceed the standard of 50 mg/L. Chloride results ranged from 22.6 to 165.5 mg/L, with 48 of 53 samples exceeding the standard. For Sulfate, results ranged from <5 to 198 mg/L, with a mean of 122 mg/L, and 52 of 56 samples exceeding 50 mg/L. Total Dissolved Solids results ranged from 42 to 780 mg/L, with a mean of 573 mg/L. Specific Conductance values are much higher than what is normally seen in the basin.

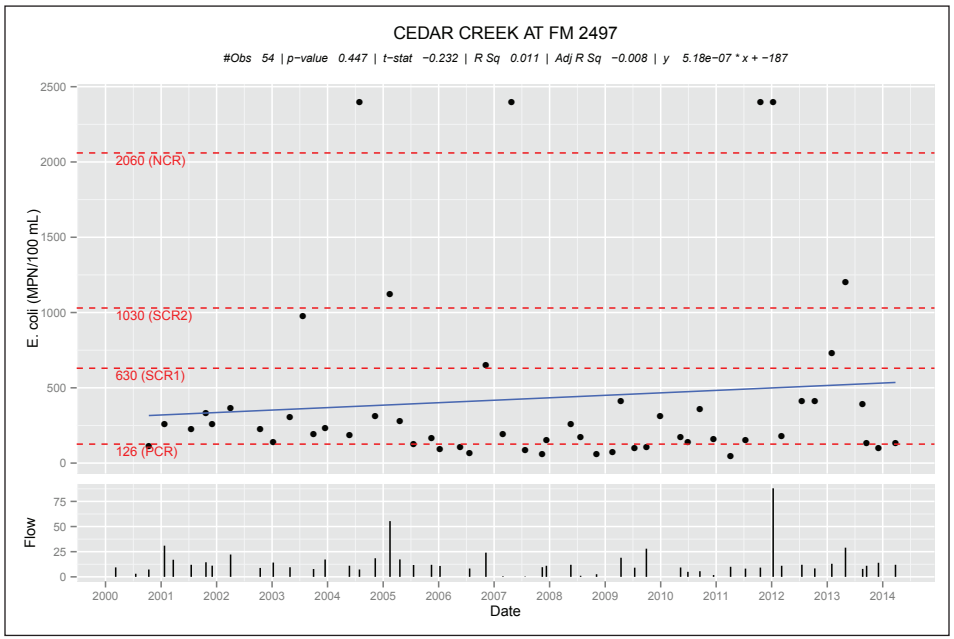
This stream segment has concerns for Ammonia-Nitrogen, Nitrate+Nitrite, and Total Phosphorus. At this station, 21 of 54 Ammonia-Nitrogen values exceeded the 0.33 mg/L screening level, particularly during the period of 2004 – 2008. Results ranged from <0.02 to 3.9 mg/L as N.

There is an increasing trend for Nitrate+Nitrite, but it is not statistically significant. There are numerous elevated Nitrate+Nitrite results at this station, including many values that exceed 10 mg/L as N. Results ranged from <0.04 to 26.6 mg/L as N, with a mean of 7.82 mg/L as N, and 43 of 56 samples exceeded the nutrient screening level.

For Total Phosphorus, there is a statistically significant decreasing trend. The majority of the Total Phosphorus results exceed the 0.69 mg/L as P screening level, with several results reported above 5 mg/L as P. Results ranged from 0.27 to 15.8 mg/L as P, with a mean of 3.19 mg/L as P. Of the samples evaluated, 46 of 56 exceeded the nutrient screening level for Total Phosphorus.

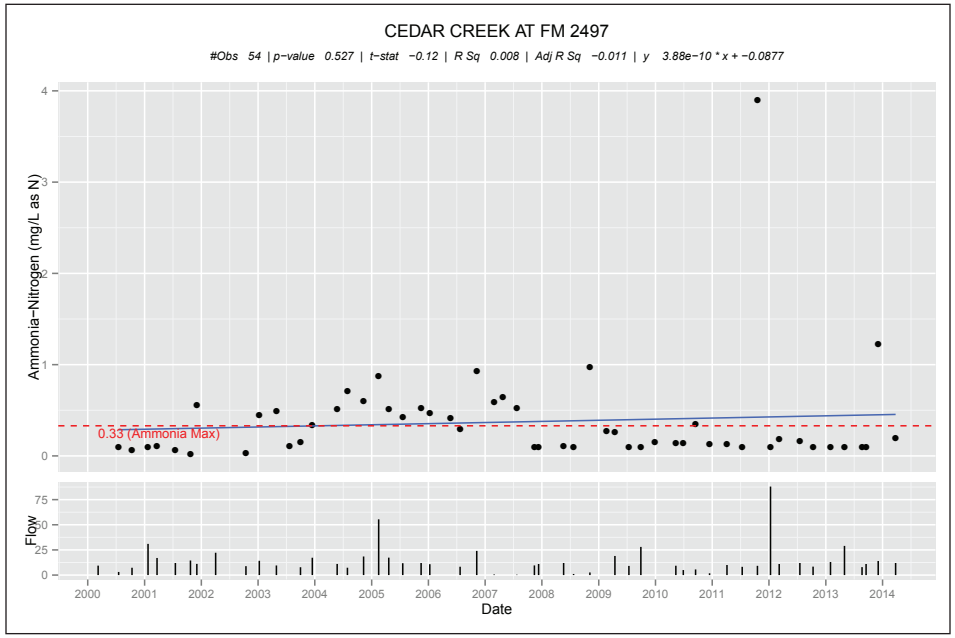
A decreasing trend for Chlorophyll-*a* is due to a change to a lower limit of quantitation in recent years.

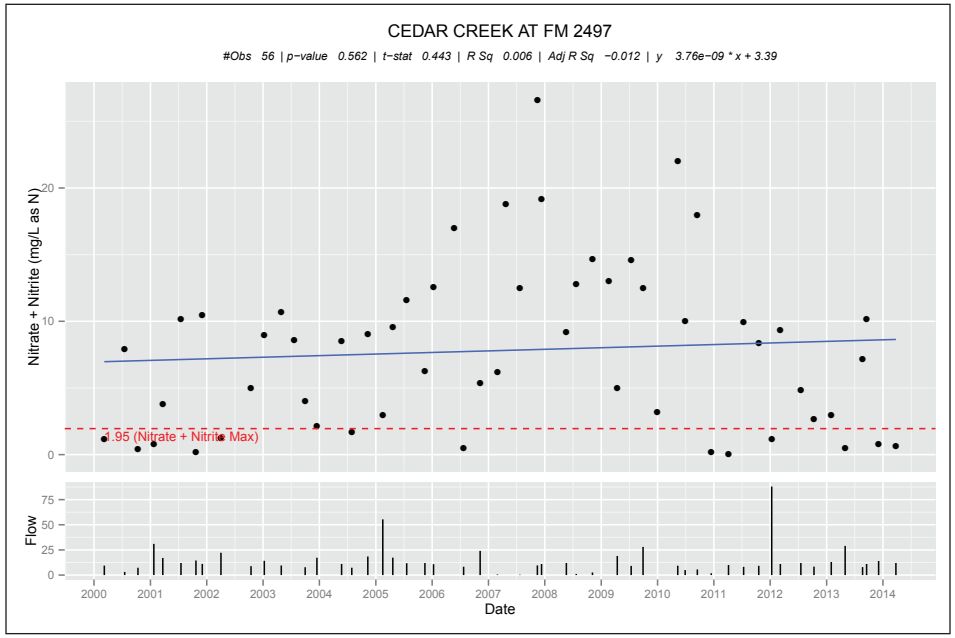
Flow measurements at 10478 - Cedar Creek at FM 2497

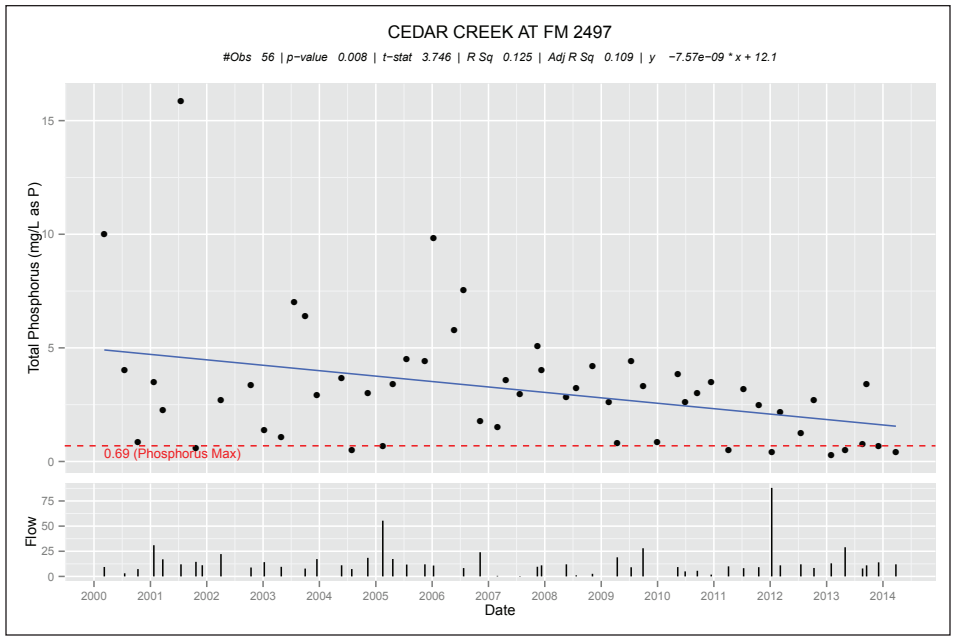


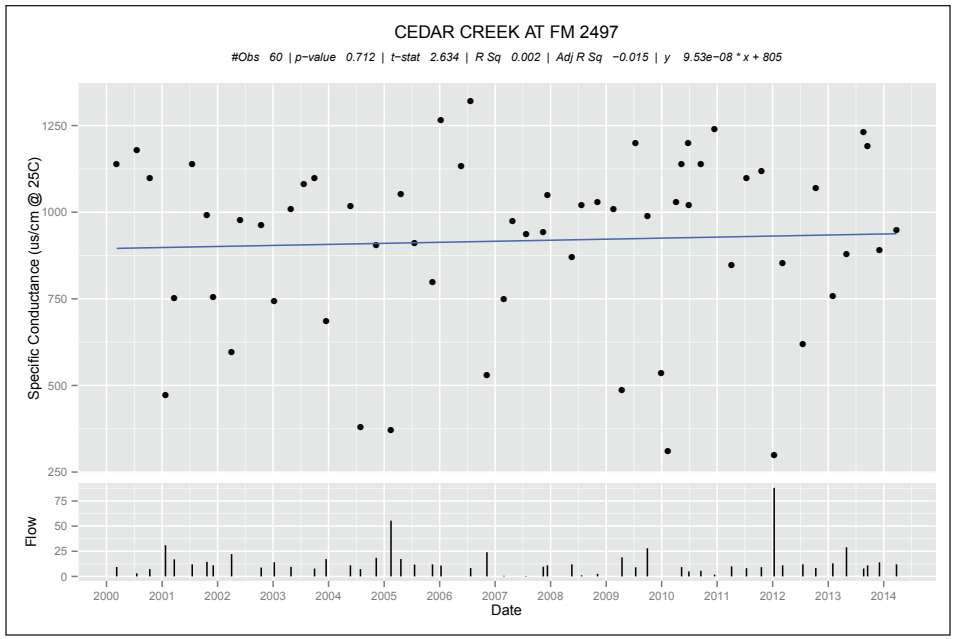
Segment 0604A - Cedar Creek

Monitoring Station 10478 - Cedar Creek at FM 2497









Segment 0604A - Cedar Creek

Monitoring Station 10478 - Cedar Creek at FM 2497

Water Quality Monitoring Results for Station 10478 - Cedar Creek at FM 2497										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	60	0	298	1320	917.42		2.6340	0.7123	
00300	Dissolved Oxygen (mg/L)	58	0	4.3	11.4	7.56		5.2091	0.4389	
00400	pH (S.U.)	58	0	6.7	8.1	7.61		17.2876	0.0169	↑
00530	Total Suspended Solids (mg/L)	56	0	3	77.2	17.31		1.2402	0.7162	
00610	Ammonia-Nitrogen (mg/L as N)	54	21	0.02	3.9	0.37		-0.1204	0.5272	
00630	Nitrate + Nitrite (mg/L as N)	56	43	0.04	26.6	7.82		0.4426	0.5623	
00665	Total Phosphorus (mg/L as P)	56	46	0.266	15.85	3.19		3.7463	0.0075	↓
00940	Chloride (mg/L)	53	48	22.6	165.5	88.77		1.8025	0.3907	
00945	Sulfate (mg/L)	56	52	5	198	122.13		1.1059	0.2945	
31699	*E. coli* (MPN/100 mL)	54	40	48	2400		196.04	-0.2317	0.4469	
32211+70953	Chlorophyll-*a* (µg/L)	42	0	2	11.4	3.64		5.9342	0.0000	
70300	Total Dissolved Solids (mg/L)	55	54	42	780	573.47		3.0755	0.9034	

10478 - Cedar Creek at FM 2497

Segment 0604A - Cedar Creek

New Monitoring Stations on Segment 0604A - Cedar Creek

To help identify possible sources of the *E. coli* bacteria and nutrient concerns in Cedar Creek, two additional monitoring stations were added on this segment beginning in FY 2014. Both of the new monitoring stations are located within the city limits of the City of Lufkin. There is not enough monitoring data to present in the Basin Summary Report. Monitoring Station 21434 is located at the Ellis Avenue crossing. Monitoring Station 10479 is located at the South Loop 287 crossing. ANRA monitors both stations quarterly for conventional parameters, field parameters, flow, and *E. coli* bacteria.

21434 - Cedar Creek at Ellis Avenue

10479 - Cedar Creek at South Loop 287

Segment 0604A - Cedar Creek

Summary of Water Quality Trends

At the Cedar Creek at FM 2497 station (10478), there is a statistically significant increasing trend for pH. For Total Phosphorus, there is a statistically significant decreasing trend. Although the trend is decreasing, the majority of values still exceed the nutrient screening level.

For the station at Cedar Creek at FM 1336, there are no statistically significant trends. At the two newly added stations (21434 and 10479), there is not a sufficient amount of data to perform statistical analysis.

Trend Analysis Summary for Segment 0604A - Cedar Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Cedar Creek	0604A_02	13528	Cedar Creek at FM 1336	No statistically significant trends at this station.											
	0604A_02	10478	Cedar Creek at FM 2497		↑										↓
	0604A_02	21434	Cedar Creek at Ellis Avenue in Lufkin	Trend analysis not performed due to insufficient data (sampling began FY 2014).											
	0604A_02	10479	Cedar Creek at Loop 287	Trend analysis not performed due to insufficient data (sampling began FY 2014).											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Segment 0604A - Cedar Creek

Summary of Water Quality Issues

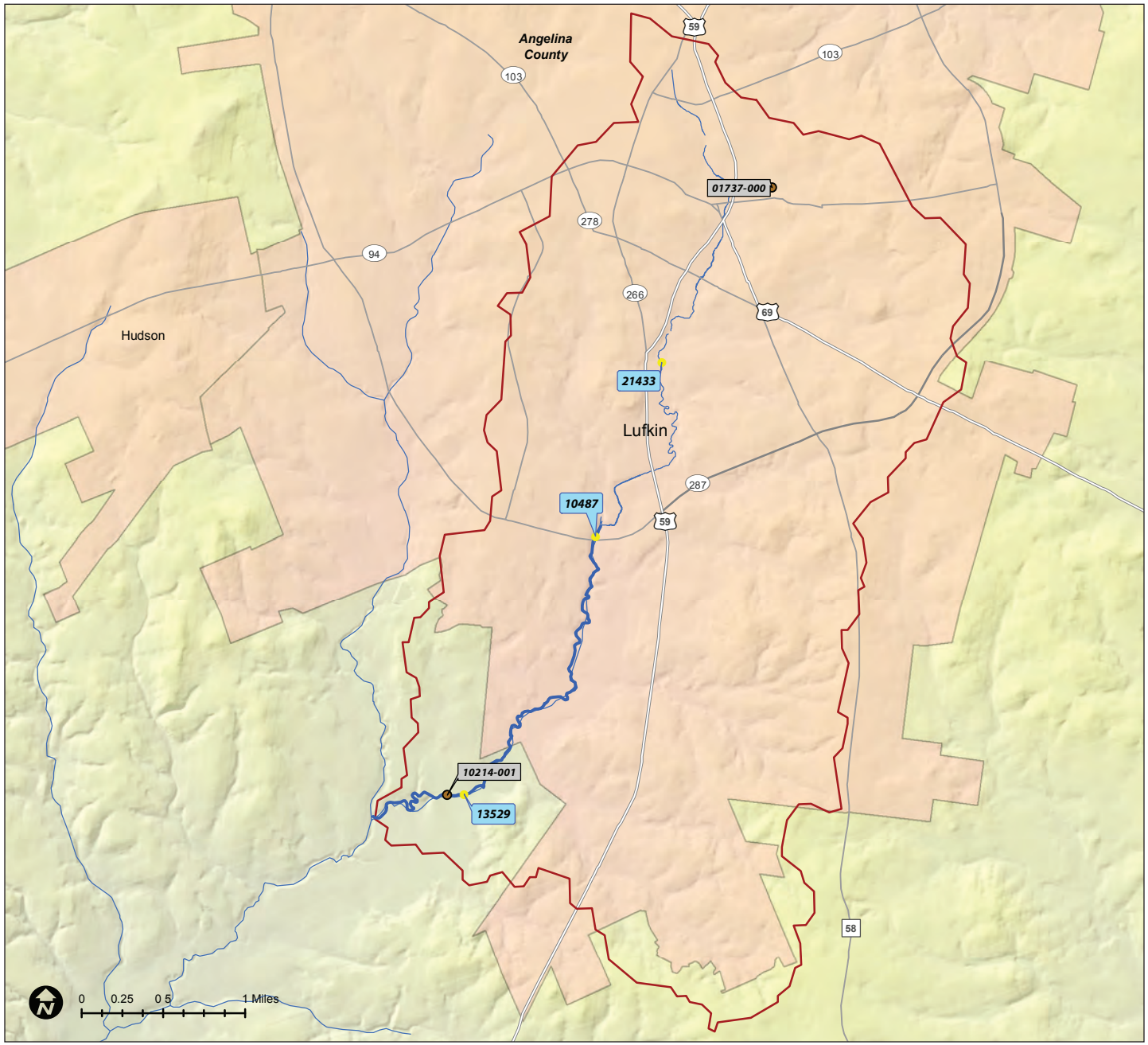
Water Quality Issues Summary for Segment 0604A - Cedar Creek				
Water Quality Issue	**Affected Area**	**Possible Influences/Causes**	**Possible Effects**	**Possible Solutions / Actions Taken**
Impairment for *E. coli* bacteria	Entire water body	• Urbanization in upper portion of segment • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff • Illegal dumping	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • Additional monitoring stations added in FY 2014 within the city limits of Lufkin to help identify sources
Concern for Ammonia-Nitrogen	Entire water body	• Urbanization in upper portion of segment • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff • Illegal dumping	• Detrimental effect on aquatic biological community	• Continue monitoring • Additional monitoring stations added in FY 2014 within the city limits of Lufkin to help identify sources
Concern for Nitrate-Nitrogen	Entire water body	• Urbanization in upper portion of segment • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff • Illegal dumping	• Detrimental effect on aquatic biological community	• Continue monitoring • Additional monitoring stations added in FY 2014 within the city limits of Lufkin to help identify sources
Concern for Total Phosphorus	Entire water body	• Urbanization in upper portion of segment • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff • Illegal dumping	• Can increase production of algae • Algae production can cause swings in dissolved oxygen, which can be detrimental to the aquatic biological community	• Continued monitoring • Additional monitoring stations added in FY 2014 within the city limits of Lufkin to help identify sources

Segment 0604B - Hurricane Creek

Segment Profile

Covering a length of 3.3 miles, this water body stretches from the confluence of Cedar Creek south of Lufkin to the upstream perennial portion of the stream in Lufkin in Angelina County. General and recreation use are designated uses for this segment.

The City of Lufkin's wastewater treatment facility discharges to Hurricane Creek.



Segment 0604B - Hurricane Creek

Assessment Units

Assessment Units in Segment 0604B - Hurricane Creek	
AU ID	**Description**
0604B_01	From the confluence with Cedar Creek (0604A) upstream to confluence with unnamed tributary 100m above State Loop 287 in Lufkin, per WQS App. D, at NHD RC 12020002000043

Monitoring Stations

Monitoring Stations in Segment 0604B - Hurricane Creek										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604B_01	13529	HURRICANE CREEK AT FM 324	4	4	4	4			ANRA
0604B_01	21433	HURRICANE CREEK 38 METERS DOWNSTREAM OF KIWANIS PARK DRIVE	4	4	4	4			ANRA
0604B_01	10487	HURRICANE CREEK AT LOOP 287	4	4	4	4			ANRA

Description of Water Quality Issues

Impairments and Concerns

Hurricane Creek is listed in the Draft 2014 Integrated Report as impaired due to *E. coli* bacteria. There is also a nutrient concern for Ammonia-Nitrogen.

Assessment Summary for Segment 0604B - Hurricane Creek as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**4.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604B_01				NC	FS					**NS**	CS	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0604B - Hurricane Creek

Monitoring Station 13529 - Hurricane Creek at FM 324

Monitoring Station 13529 is located on Hurricane Creek at the FM 324 crossing. This monitoring station is downstream of the City of Lufkin wastewater treatment plant discharge. There is a large quantity of discarded trash and tires at this location. This station is monitored quarterly by ANRA personnel for field parameters, conventional parameters, flow, and *E. coli* bacteria.

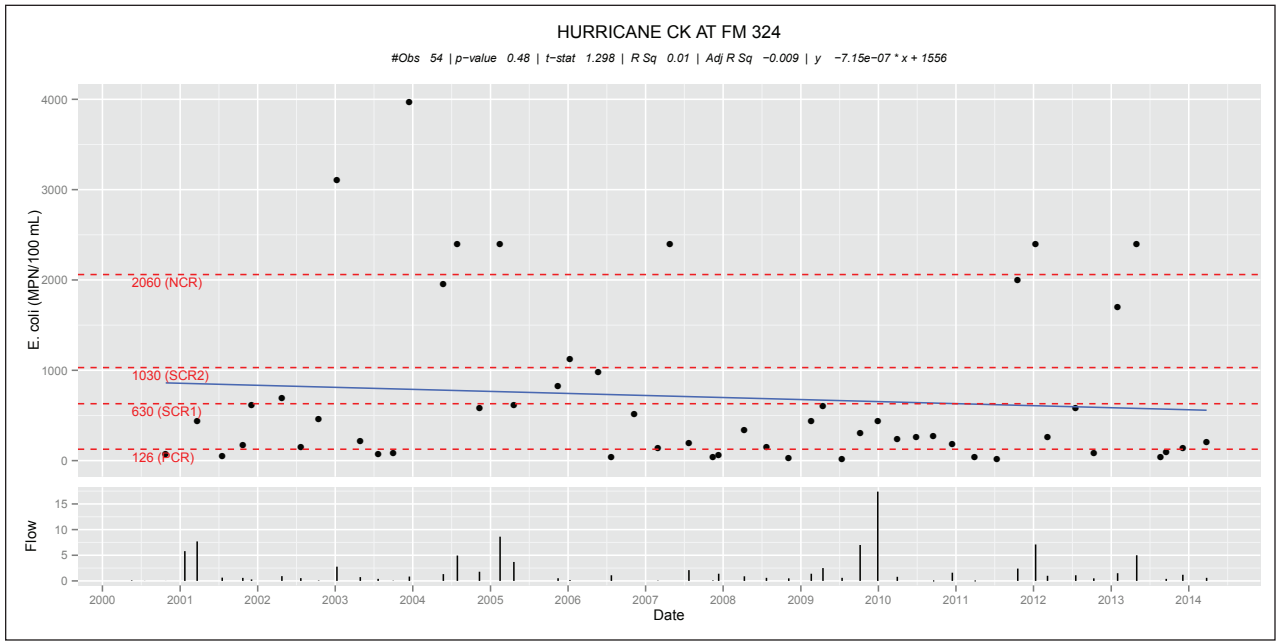
The majority of *E. coli* bacteria results at this station exceed the standard for Primary Contact Recreation, with results ranging from 19 to 3970 MPN/100 mL. The geometric mean was 246.06 MPN/100 mL.

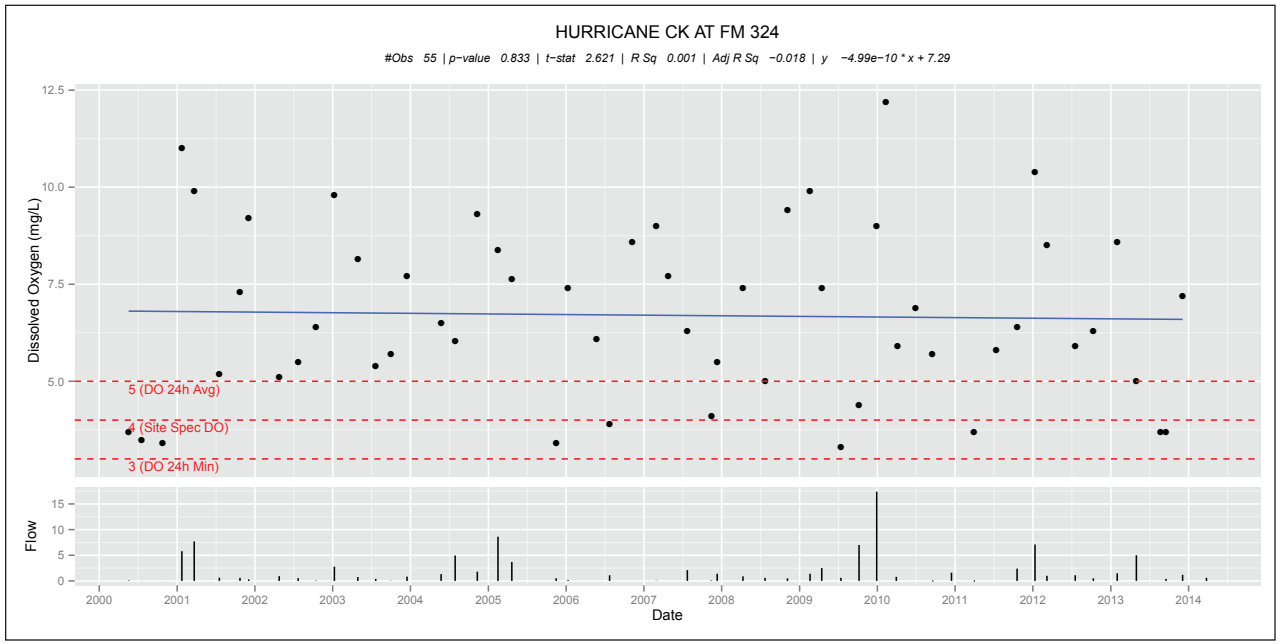
At this station, pH values show a statistically significant increasing trend, although no values are exceeding the maximum pH criteria of 8.5 S.U. For Dissolved Oxygen, there is no significant trend, but there are several values that fall below the site-specific criteria of 4.0 mg/L.

Chloride and Sulfate results both show numerous values above 50 mg/L. Total Dissolved Solids results ranged from 189 to 759 mg/L, with a mean of 409 mg/L.

For nutrient parameters, Ammonia-Nitrogen results show numerous elevated values, particularly from 2004 – 2008. The majority of values reported since 2008 have been below the 0.33 mg/L screening level. Results ranged from <0.01 to 1.5 mg/L as N, with a mean of 0.29 mg/L as N. 16 of 56 results exceeded the nutrient screening level.

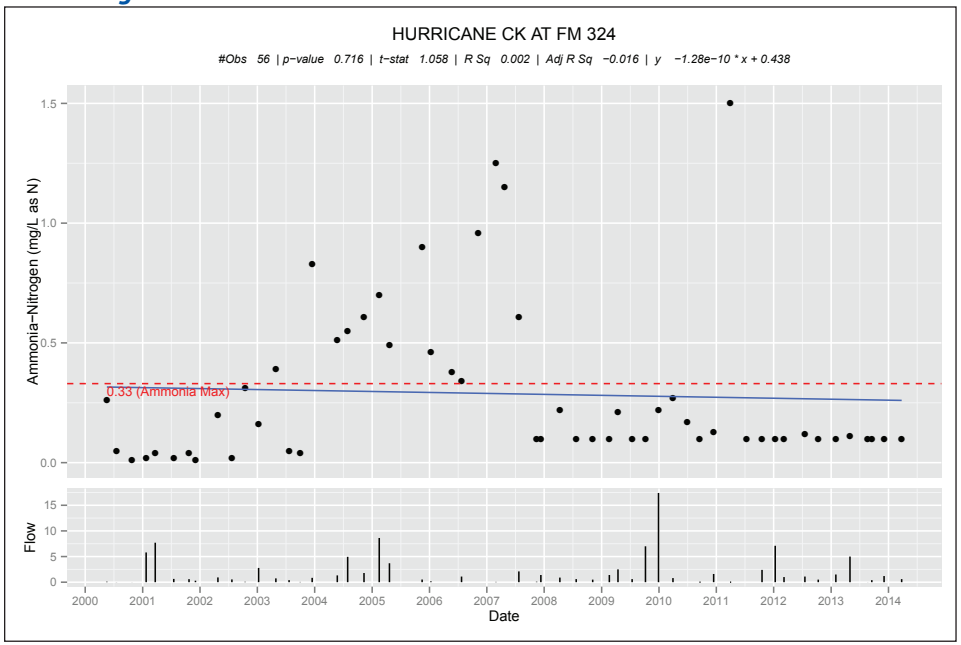
There are statistically significant decreasing trends for both Nitrate+Nitrite and Total Phosphorus.

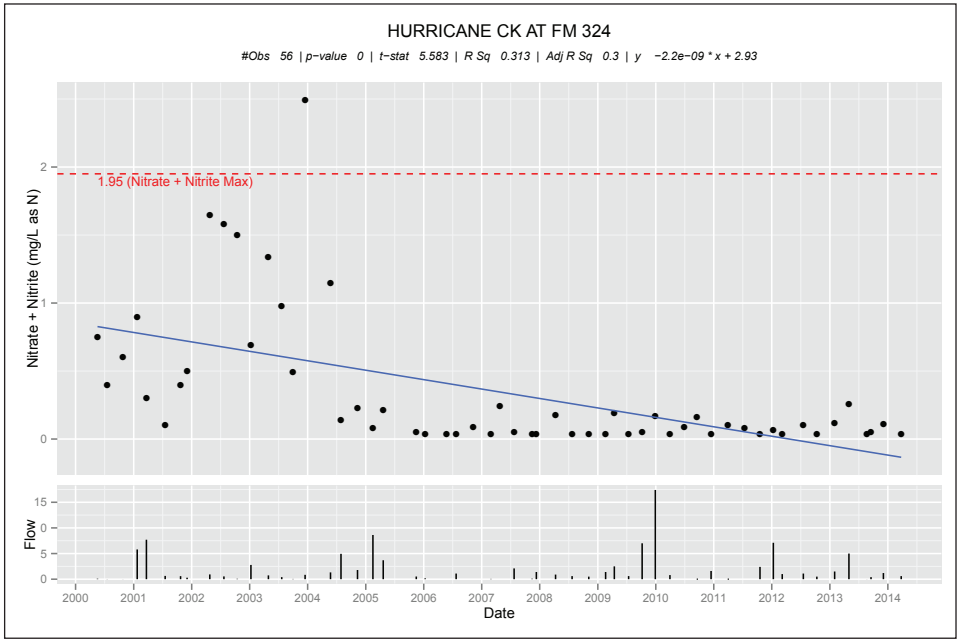


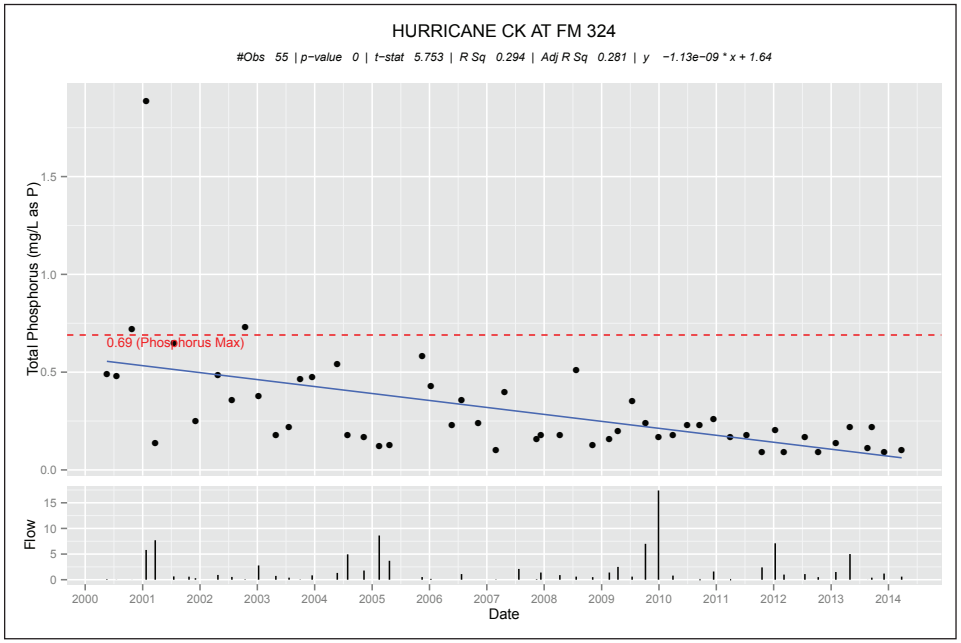


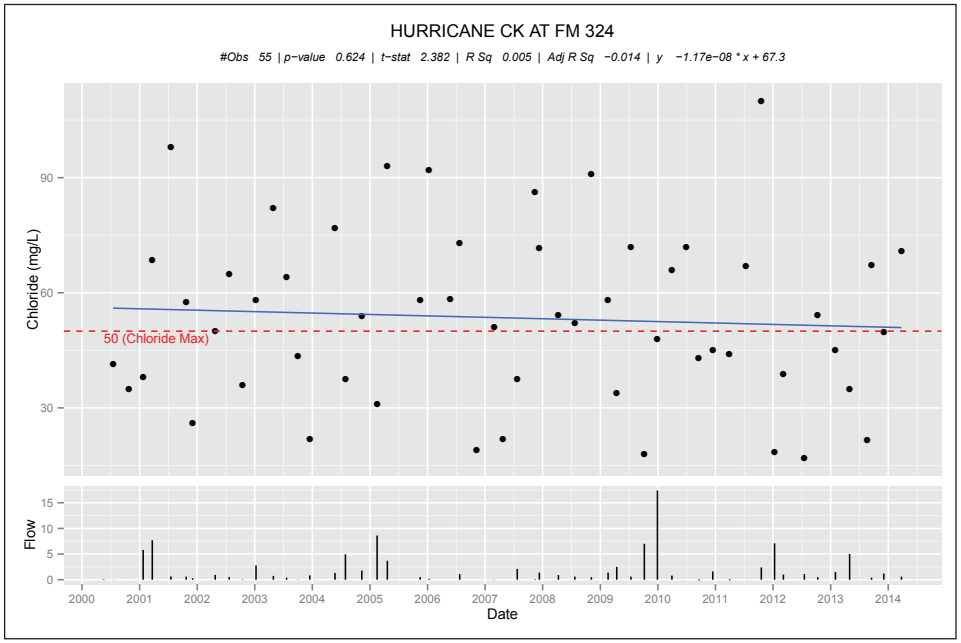
Segment 0604B - Hurricane Creek

Monitoring Station 13529 - Hurricane Creek at FM 324









Segment 0604B - Hurricane Creek

Monitoring Station 13529 - Hurricane Creek at FM 324

Pollution at Monitoring Station 13529 - Hurricane Creek at FM 324

Water Quality Monitoring Results for Station 13529 - Hurricane Creek at FM 324

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	57	0	267	1170	629.74		1.5019	0.5704	
00300	Dissolved Oxygen (mg/L)	55	0	3.3	12.2	6.70		2.6210	0.8331	
00400	pH (S.U.)	56	0	6.8	8.2	7.40		17.8152	0.0118	↑
00530	Total Suspended Solids (mg/L)	56	0	1.33	152.4	20.09		0.9845	0.6395	
00610	Ammonia-Nitrogen (mg/L as N)	56	16	0.01	1.5	0.29		1.0576	0.7164	
00630	Nitrate + Nitrite (mg/L as N)	56	1	0.04	2.49	0.35		5.5828	0.0000	↓
00665	Total Phosphorus (mg/L as P)	55	3	0.09	1.887	0.31		5.7533	0.0000	↓
00940	Chloride (mg/L)	55	29	17	110	53.44		2.3817	0.6239	
00945	Sulfate (mg/L)	56	50	5	2600	150.93		-0.4137	0.4360	
31699	*E. coli* (MPN/100 mL)	54	40	19	3972.6		246.06	1.2977	0.4802	
32211+70953	Chlorophyll-*a* (µg/L)	41	2	2	29.8	6.29		0.3102	0.7982	
70300	Total Dissolved Solids (mg/L)	56	53	189.3	759	409.43		1.7597	0.5348	

Segment 0604B - Hurricane Creek

New Monitoring Stations on Segment 0604B - Hurricane Creek

To help identify possible sources of the *E. coli* bacteria in Hurricane Creek, two additional monitoring stations were added on this segment beginning in FY 2014. Both of the new monitoring stations are located within the city limits of the City of Lufkin. There is not enough monitoring data to present in the Basin Summary Report. Monitoring Station 21433 is located downstream of Kiwanis Park Drive. Monitoring Station 10487 is located at the South Loop 287 crossing. ANRA monitors both stations quarterly for conventional parameters, field parameters, flow, and *E. coli* bacteria,

Bridge Crossing above 21433 - Hurricane Creek downstream of Kiwanis Park Drive

10487 - Hurricane Creek at South Loop 287

Segment 0604B - Hurricane Creek

Summary of Water Quality Trends

At station 13529 - Hurricane Creek at FM 324 located in AU 0604B_01, there are statistically significant decreasing trends for both Total Phosphorus and Nitrate+Nitrite. There is also a decreasing trend for Ammonia-Nitrogen, although this trend is not statistically significant. There is a concern for Ammonia-Nitrogen for this segment, with numerous elevated values reported between 2004 - 2008. Results observed since 2008 show an improvement in water quality related to this parameter.

There is a statistically significant increasing trend for pH at station 13529, but no values exceed the criteria.

For the new stations added in FY 2014 (21433 - Hurricane Creek Downstream of Kiwanis Park Drive and 10487 - Hurricane Creek at Loop 287), there is not enough data to perform statistical analysis or determine trends.

Trend Analysis Summary for Segment 0604B - Hurricane Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Hurricane Creek	0604B_01	13529	Hurricane Creek at FM 324		↑									↓	↓
	0604B_01	21433	Hurricane Creek Downstream Of Kiwanis Park Drive	Trend analysis not performed due to insufficient data (sampling began FY 2014).											
	0604B_01	10487	Hurricane Creek at Loop 287	Trend analysis not performed due to insufficient data (sampling began FY 2014).											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0604B - Hurricane Creek

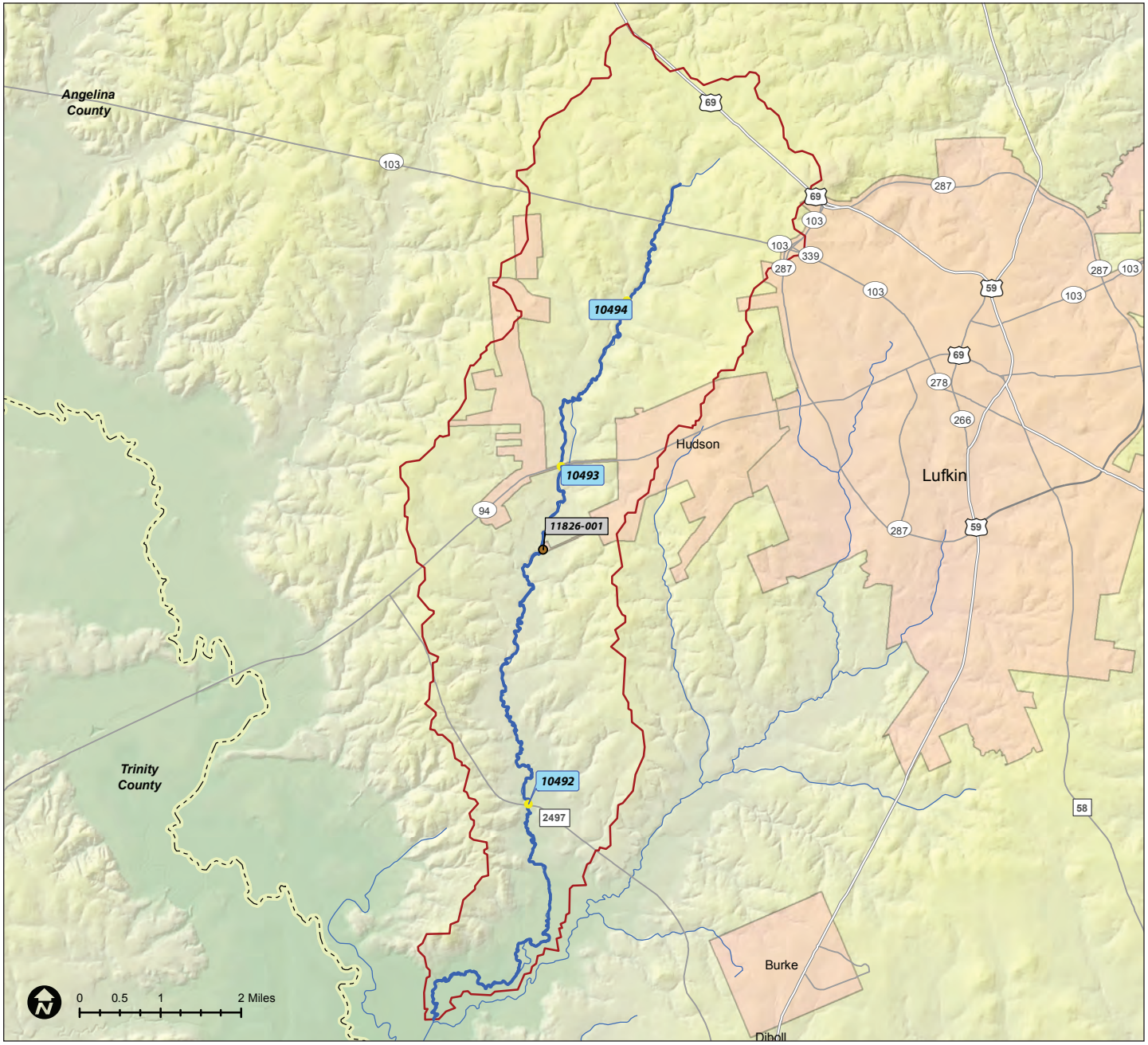
Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment for *E. coli* bacteria	Entire water body	• Urbanization in upper portion of segment • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff • Illegal dumping	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • Additional monitoring stations added in FY 2014 within the city limits of Lufkin to help identify sources
Concern for Ammonia-Nitrogen	Entire water body	• Urbanization in upper portion of segment • Point-source pollution from wastewater discharges, sewer line breaks, overflows, etc. • Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff • Illegal dumping	• Detrimental effect on aquatic biological community	• Continue monitoring • Additional monitoring stations added in FY 2014 within the city limits of Lufkin to help identify sources

Segment 0604C - Jack Creek

Segment Profile

This freshwater stream extends 16 miles from the confluence of Cedar Creek southwest of Lufkin in Angelina County to the upstream perennial portion of the stream in northeast Lufkin in Angelina County. This segment is designated for contact recreation, general use, and aquatic life use.

The City of Hudson's wastewater treatment facility discharges to Jack Creek.



Segment 0604C - Jack Creek

Assessment Units

Assessment Units in Segment 0604C - Jack Creek	
AU ID	**Description**
0604C_01	From the confluence with Cedar Creek (0604A) upstream to confluence with unnamed tributary 1.6km SW of US Hwy 69 NW of Lufkin at NHD RC 12020002012470

Monitoring Stations

Monitoring Stations in Segment 0604C - Jack Creek										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604C_01	10492	JACK CREEK AT FM 2497	4	4	4	4			ANRA
0604C_01	10493	JACK CREEK AT SH 94	4	4	4	4			ANRA
0604C_01	10494	JACK CREEK AT FM 3150	4	4	4	4			ANRA

Description of Water Quality Issues

Impairments and Concerns

Jack Creek is listed in the Draft 2014 Integrated Report with a concern for depressed Dissolved Oxygen, with 9 of 31 samples assessed for the period of 12/1/2005 to 11/30/2012 falling below the 5.0 mg/L grab screening level.

Concerns for Ammonia-Nitrogen and Total Phosphorus were also identified for this segment.

Assessment Summary for Segment 0604C - Jack Creek as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604C_01				CS						FS	CS	NC	CS	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0604C - Jack Creek

Monitoring Station 10492 - Jack Creek at FM 2497

Monitoring Station 10492 is located on Jack Creek at the FM 2497 crossing. This station is located downstream of the City of Hudson wastewater treatment plant effluent discharge. This station is monitored quarterly by ANRA personnel for field parameters, conventional parameters, flow, and *E. coli* bacteria.

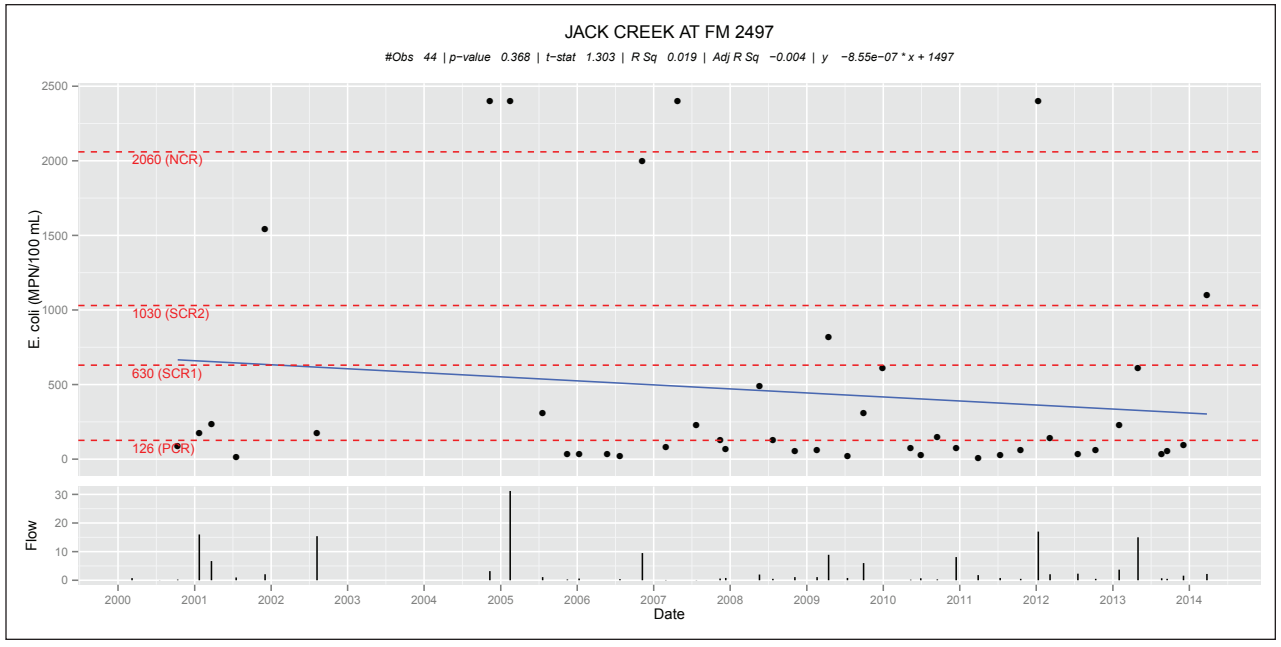
Values for pH measured at this station show a statistically significant increasing trend, with results ranging from 6.6 to 8.3 S.U. No values exceeded the criteria.

For Dissolved Oxygen, there is a decreasing trend, but it is not considered significant. There are numerous Dissolved Oxygen results that are below the 5.0 mg/L grab screening level. This segment has a concern for depressed Dissolved Oxygen. Results for this parameter ranged from 2.6 to 12.4 mg/L.

There are concerns for Ammonia-Nitrogen and Total Phosphorus for Jack Creek. Ammonia-Nitrogen, Total Phosphorus, and Nitrate+Nitrite all show decreasing trends, with the trends for Nitrate+Nitrite and Total Phosphorus being statistically significant. For Ammonia-Nitrogen, there were numerous elevated values reported during the period of 2005 -2009, with results ranging from <0.01 to 4.93 mg/L as N, with a mean of 0.53 mg/L as N and 18 of 44 results exceeding the nutrient screening level. The range of results for Nitrate+Nitrite at this station was <0.04 to 10.4 mg/L as N, with a mean of 1.54 mg/L as N. Total Phosphorus results ranged from 0.18 to 11.4 mg/L as P, with a mean of 1.74 mg/L as P. Of the 45 samples analyzed, 32 exceeded the nutrient screening level.

The trend for Chlorophyll-*a* is being influenced by a change in the limit of quantitation and is therefore not considered to be significant.

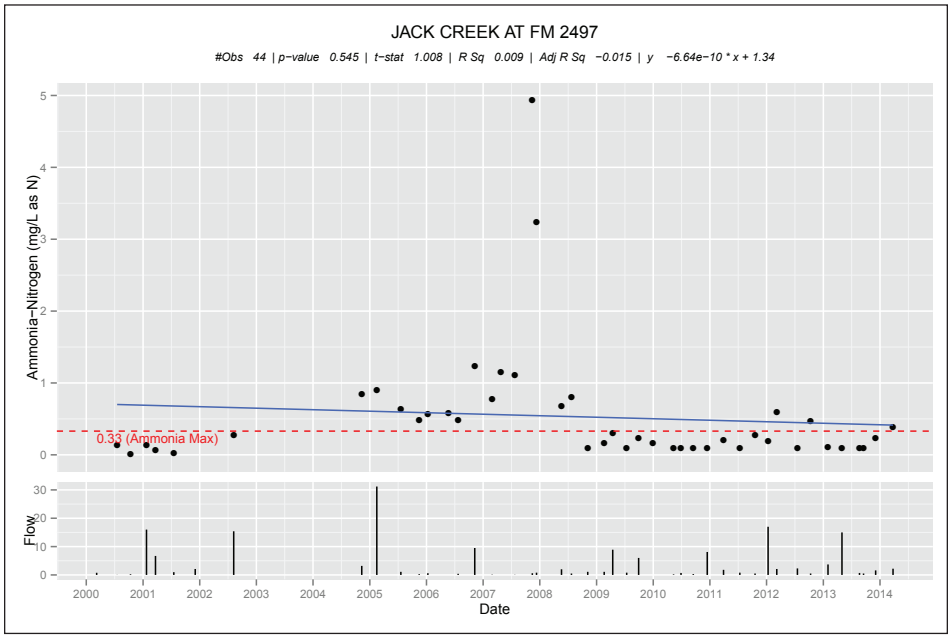
Jack Creek was delisted for *E. coli* bacteria in the Draft 2014 Integrated Report.

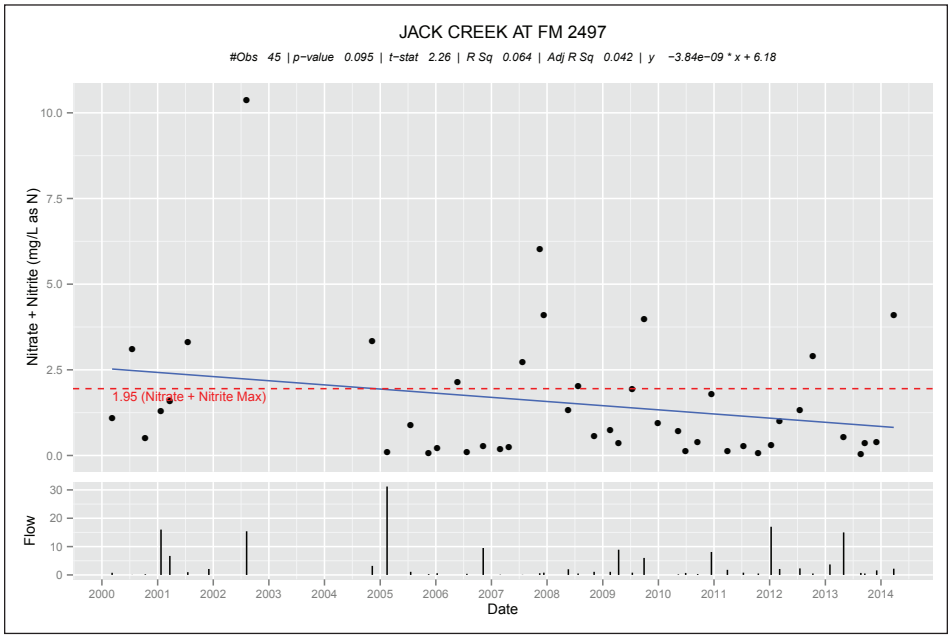


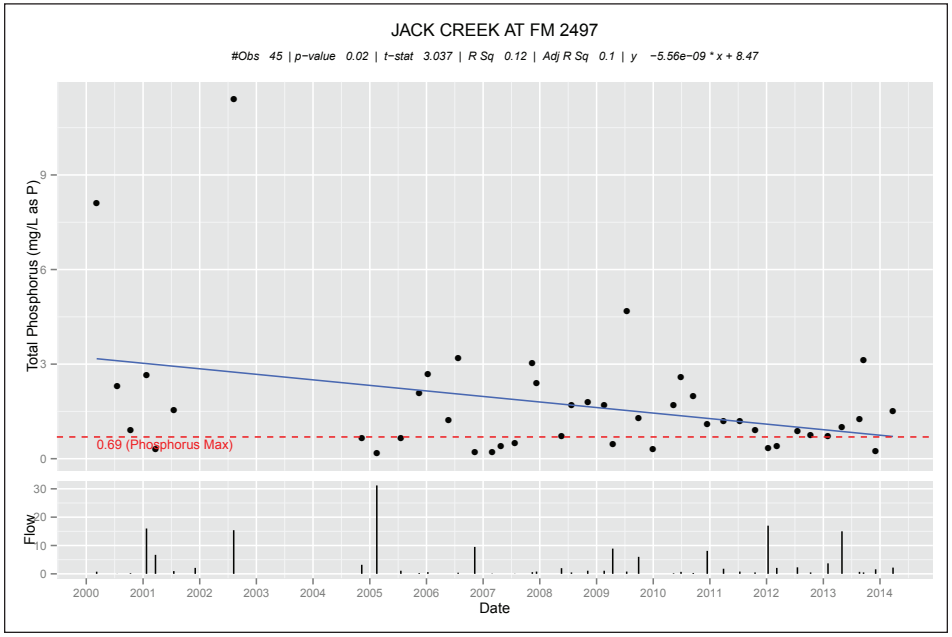
10492 - Jack Creek at FM 2497

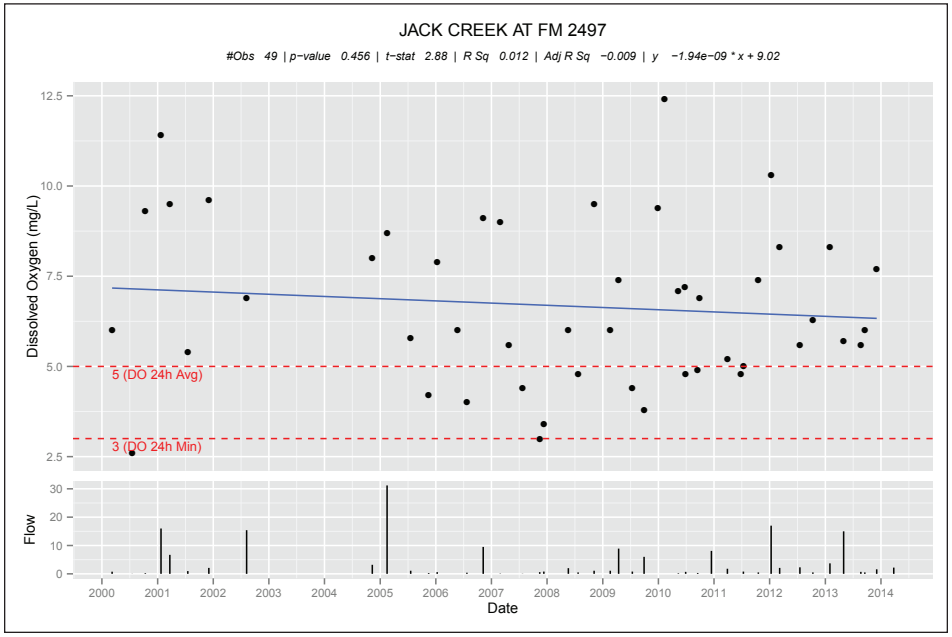
Segment 0604C - Jack Creek

Monitoring Station 10492 - Jack Creek at FM 2497





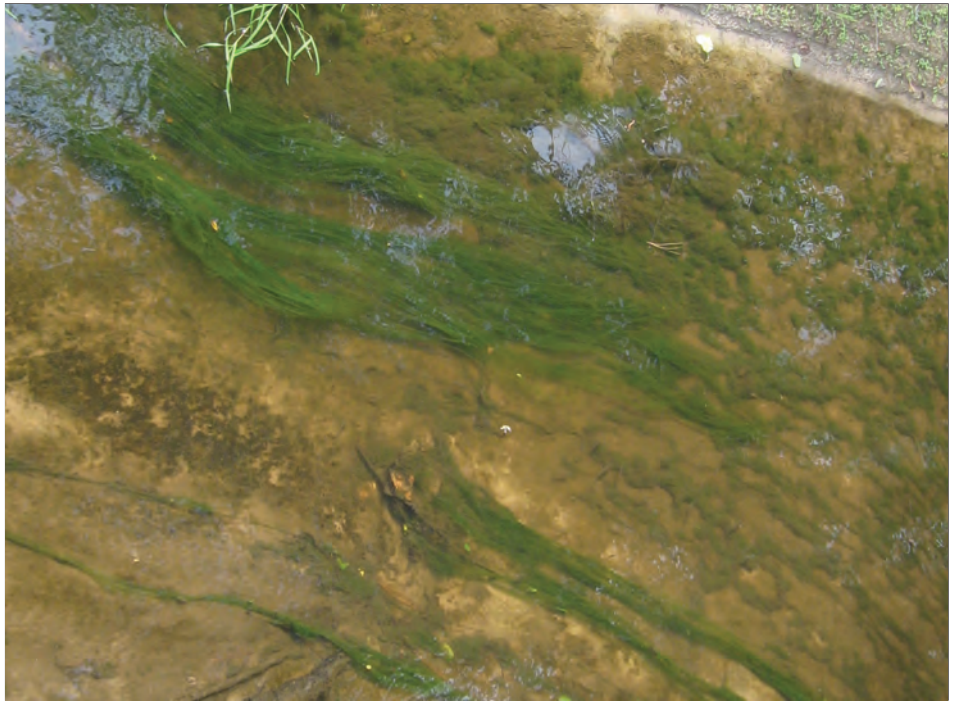




Segment 0604C - Jack Creek

Monitoring Station 10492 - Jack Creek at FM 2497

Water Quality Monitoring Results for Station 10492 - Jack Creek at FM 2497										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	53	0	185	1590	859.13		0.6481	0.3614	
00300	Dissolved Oxygen (mg/L)	49	1	2.6	12.4	6.68		2.8802	0.4563	
00400	pH (S.U.)	51	0	6.6	8.3	7.69		13.9056	0.0450	↑
00530	Total Suspended Solids (mg/L)	44	0	1	143	13.23		0.3684	0.9717	
00610	Ammonia-Nitrogen (mg/L as N)	44	18	0.01	4.93	0.53		1.0078	0.5452	
00630	Nitrate + Nitrite (mg/L as N)	45	12	0.04	10.36	1.53		2.2598	0.0948	↓
00665	Total Phosphorus (mg/L as P)	45	32	0.18	11.396	1.74		3.0369	0.0195	↓
00940	Chloride (mg/L)	45	36	14.5	174	98.92		0.9070	0.6173	
00945	Sulfate (mg/L)	45	29	23.8	184.85	59.83		2.8414	0.1501	
31699	*E. coli* (MPN/100 mL)	44	22	6	2400		115.30	1.3030	0.3678	
32211+70953	Chlorophyll-*a* (µg/L)	37	0	2	10.6	4.09		3.6701	0.0083	
70300	Total Dissolved Solids (mg/L)	44	42	156	983	545.69		0.7764	0.4260	



Filamentous Algae at 10492 - Jack Creek at FM 2497

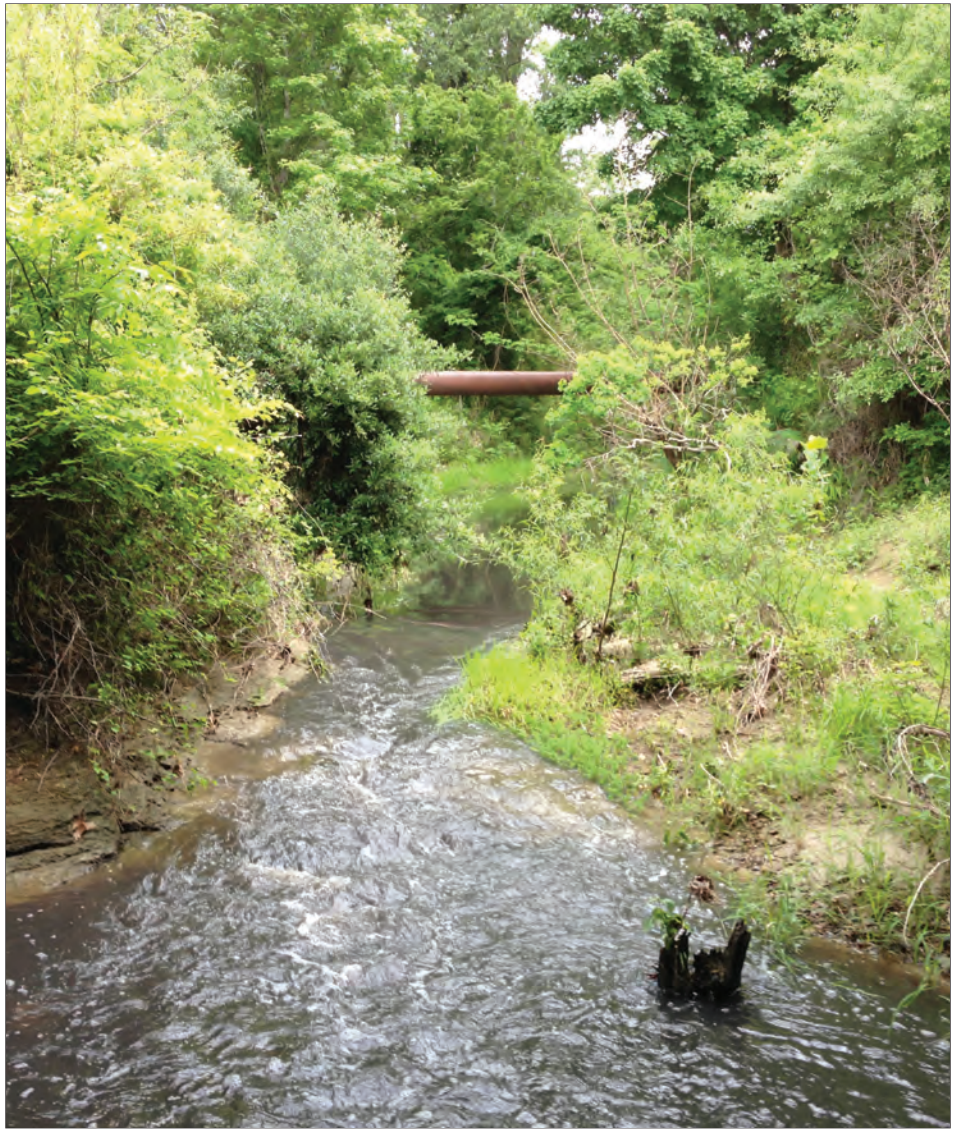
Flow Measurements at 10492 - Jack Creek at FM 2497

Segment 0604C - Jack Creek

New Monitoring Stations on Segment 0604C - Jack Creek

To help identify possible sources of the nutrient concerns on Jack Creek, two additional monitoring stations were added on this segment beginning in FY 2014. There is not enough monitoring data to present in the Basin Summary Report.

Monitoring Station 10493 is located on Jack Creek at the SH 94 crossing. Monitoring Station 10494 is located at the FM 3150 crossing. ANRA monitors both stations quarterly for conventional parameters, field parameters, flow, and *E. coli* bacteria.



10493 - Jack Creek at SH 94

10494 - Jack Creek at FM 3150

Segment 0604C - Jack Creek

Summary of Water Quality Trends

There are statistically significant decreasing trends for both Total Phosphorus and Nitrate+Nitrite at station 10492 - Jack Creek at FM 2497. Concerns for both parameters are listed in the Draft 2014 Integrated Report. A statistically significant increasing trend is seen for pH, but no values exceed the criteria for this parameter.

Due to limited data, statistical analysis was not performed for stations 10493 - Jack Creek at SH 94 and 10494 - Jack Creek at FM 3150. Monitoring at these stations began in FY 2014.

Trend Analysis Summary for Segment 0604C - Jack Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Jack Creek	0604C_01	10492	Jack Creek at FM 2497		↑									↓	↓
	0604C_01	10493	Jack Creek at SH 94	Trend analysis not performed due to insufficient data (sampling began FY 2014).											
	0604C_01	10494	Jack Creek at FM 3150	Trend analysis not performed due to insufficient data (sampling began FY 2014).											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

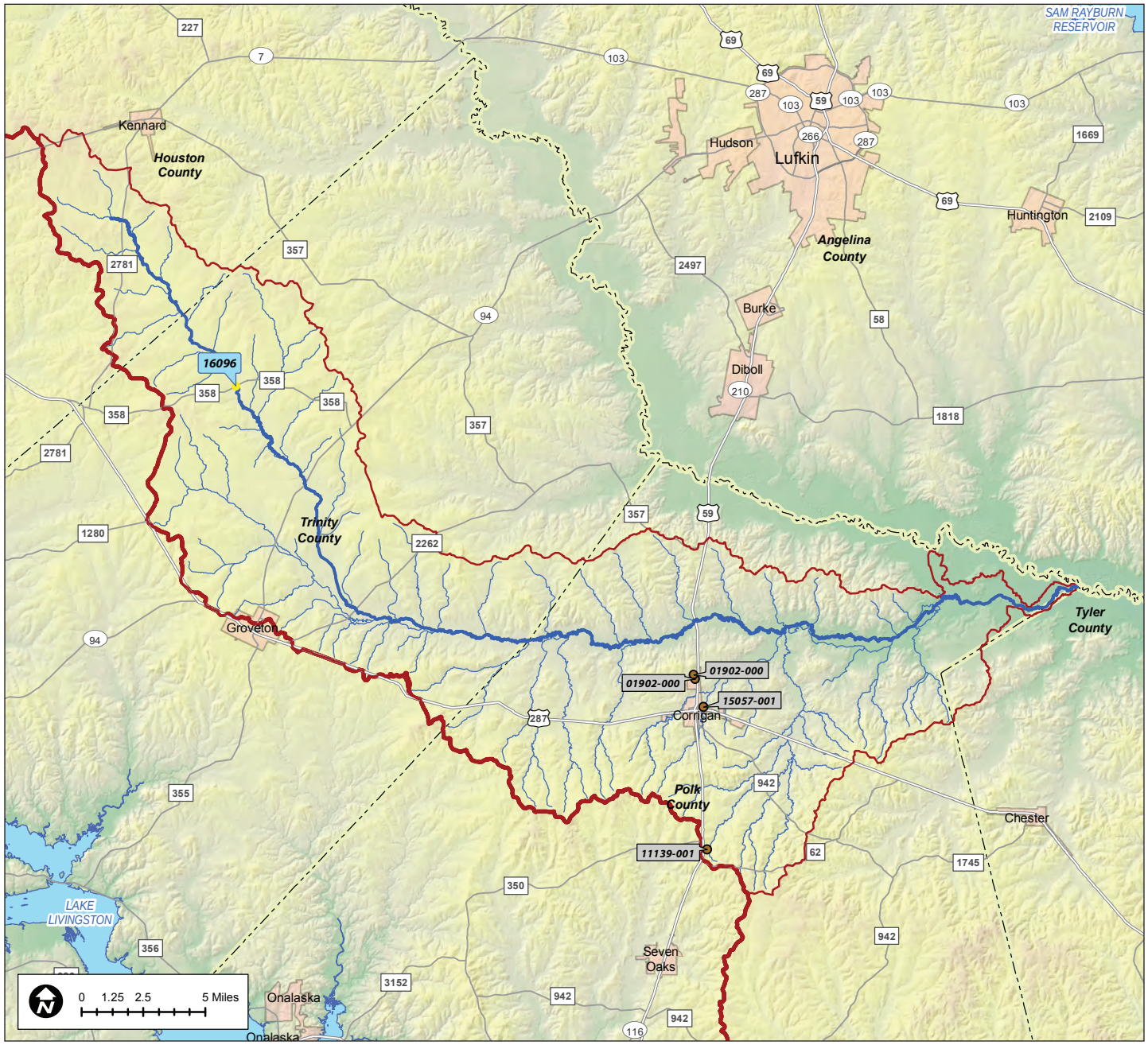
Water Quality Issues Summary for Segment 0604C - Jack Creek

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
E. coli bacteria	Entire water body	• Jack Creek was previously listed as impaired for *E. coli* bacteria, but was de-listed in the Draft 2014 Integrated Report	• The water body now meets the standard for Primary Contact Recreation and has been de-listed	• Continue monitoring • A RUAA is being conducted by TCEQ on this water body to determine if the most appropriate contact recreation standard is being applied
Depressed Dissolved Oxygen	Entire water body	• Municipal wastewater discharge • Nonpoint source pollution • Aquatic vegetation • Nutrient loading into the water body	• Detrimental effect on aquatic biological community	• Continue monitoring • Conduct 24-hour DO measurements
Concern for Ammonia-Nitrogen	Entire water body	• Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff	• Detrimental effect on aquatic biological community	• Continue monitoring • Additional monitoring stations added in FY 2014 to help identify sources
Concern for Total Phosphorus	Entire water body	• Municipal wastewater discharge • Nonpoint sources of pollution • Domestic animals and wildlife • Stormwater runoff	• Can increase production of algae • Algae production can cause swings in dissolved oxygen, which can be detrimental to the aquatic biological community	• Continue monitoring • Additional monitoring stations added in FY 2014 to help identify sources

Segment 0604D - Piney Creek

Segment Profile

This freshwater stream encompasses 70 miles in stream length from the confluence of the Neches River at the Polk/Tyler/Angelina County lines east of Corrigan to the upstream perennial portion of the stream east of Crockett in Houston County. This segment is designated for contact recreation, general use, and aquatic life use.



Segment 0604D - Piney Creek

Assessment Units

Assessment Units in Segment 0604D - Piney Creek	
AU ID	**Description**
0604D_01	Middle portion of the stream from the confluence with Bear Creek (0604L) in Polk County upstream to the confluence with Caney Creek (0604O) in Trinity County at NHD RC 12020002000163
0604D_02	Upper portion of stream from the confluence with Caney Creek (0604O) in Trinity County upstream to confluence with unnamed tributary at NHD RC 12020002000181 in Houston County 0.75km west of FM 2781
0604D_03	Lower portion of stream from the confluence with the Neches River (0604) upstream to the confluence with Bear Creek (0604L) in Polk County at NHD RC 12020002000145

Monitoring Stations

Monitoring Stations in Segment 0604D - Piney Creek										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604D_01	16081	PINEY CREEK AT FM 1987	Station is no longer being monitored.						
0604D_02	16096	PINEY CREEK AT FM 358 EAST OF PENNINGTON	4	4	4	4			ANRA

Description of Water Quality Issues

Impairments and Concerns

Piney Creek is listed in the Draft 2014 Integrated Report as impaired due to depressed Dissolved Oxygen. In AU 0604D_01, there is a concern based upon samples below the Dissolved Oxygen grab screening level, as well as a listing for not supporting its designated aquatic life use due to results below the Dissolved Oxygen grab minimum. There is also a listing of not supporting due to the 24-hour average and 24-hour minimum measurements. Assessment Unit 0604D_02 is shown to be fully supporting for this parameter.

There are nutrient concerns in Piney Creek as well, with AU 0604D_01 having a concern for Ammonia-Nitrogen and AU 0604D_02 having a concern for Chlorophyll-*a*.

Assessment Summary for Segment 0604D - Piney Creek as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**	**5.00 mg/L**	**3.00 mg/L**	**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604D_01				CS	**NS**	**NS**	**NS**			NC	CS	NC	NC	NC
0604D_02				NC	FS					FS	NC	NC	NC	CS

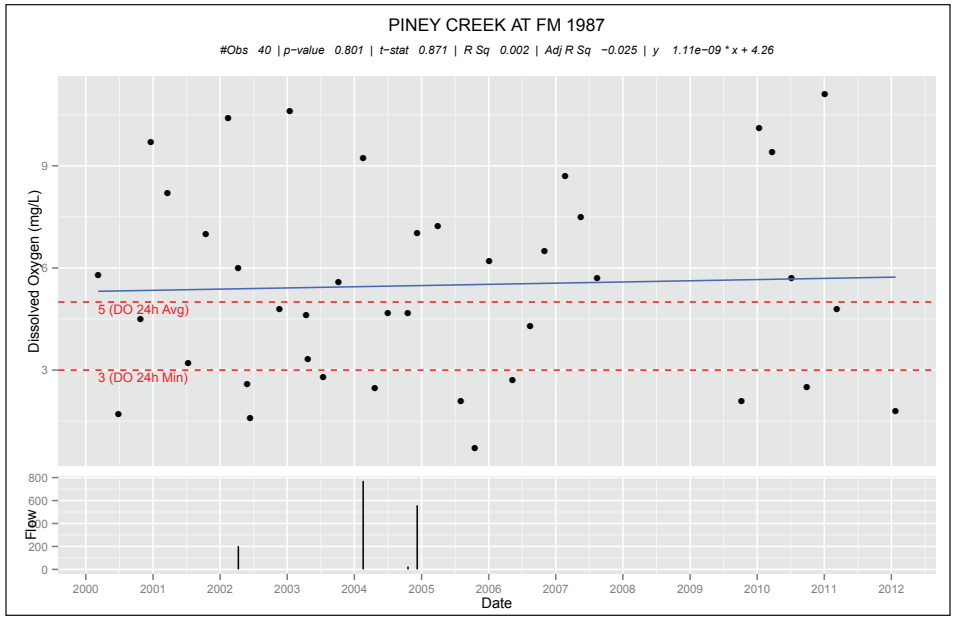
FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

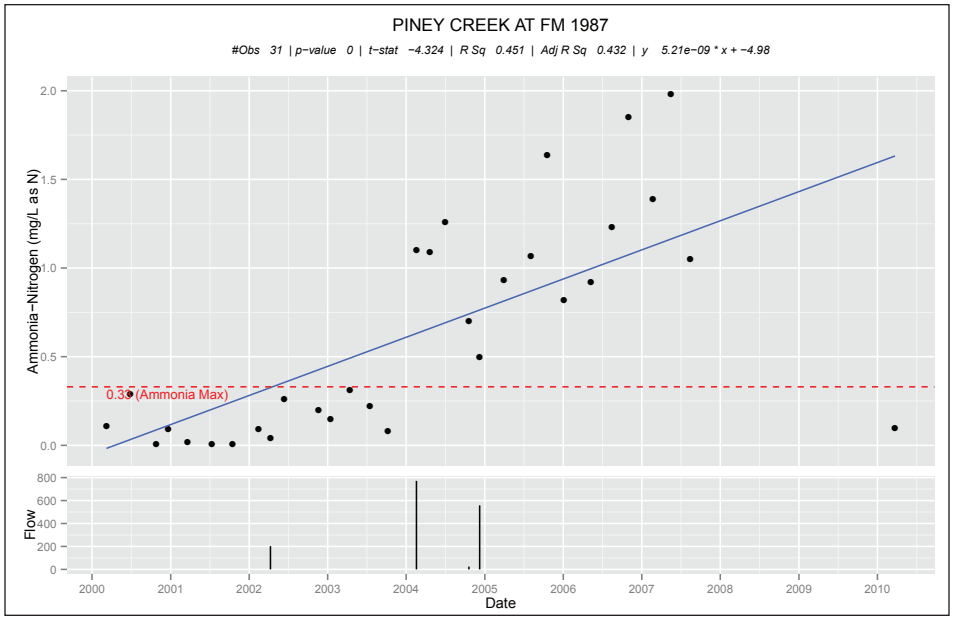
Segment 0604D - Piney Creek

Monitoring Station 16081 - Piney Creek at FM 1987

Monitoring Station 16081 is located at the FM 1987 crossing of Piney Creek. This station is no longer monitored due to difficulty obtaining samples during the drought, when this portion of the stream would frequently go dry. The depressed Dissolved Oxygen impairments and Ammonia-Nitrogen concern for this segment are based upon the data collected at station 16081, which is located in AU 0604D_01.

Because of the lack of recent data, ANRA is not considering the trends at this station to be statistically significant, as they may not represent current water quality conditions.





Water Quality Monitoring Results for Station 16081 - Piney Creek at FM 1987

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	40	0	68	475	237.33		-0.0966	0.1580	
00300	Dissolved Oxygen (mg/L)	40	11	0.7	11.1	5.49		0.8711	0.8012	
00400	pH (S.U.)	40	5	5.4	7.7	6.66		5.1262	0.0297	
00530	Total Suspended Solids (mg/L)	31	0	4.67	26.3	12.92		0.0408	0.4782	
00610	Ammonia-Nitrogen (mg/L as N)	31	15	0.01	1.98	0.63		-4.3236	0.0000	
00630	Nitrate + Nitrite (mg/L as N)	31	1	0.04	2	0.53		4.5150	0.0004	
00665	Total Phosphorus (mg/L as P)	31	5	0.07	3.95	0.42		1.5206	0.2083	
00940	Chloride (mg/L)	31	4	8.5	143	30.57		-0.9684	0.1536	
00945	Sulfate (mg/L)	31	17	10	140.5	57.35		-0.5757	0.1895	
31699	*E. coli* (MPN/100 mL)	29	13	6	1990		114.42	0.9226	0.4714	
32211+70953	Chlorophyll-*a* (µg/L)	16	2	2	44.6	9.16		0.2112	0.9472	
70300	Total Dissolved Solids (mg/L)	31	13	80	345	184.43		-0.6217	0.0961	

Segment 0604D - Piney Creek

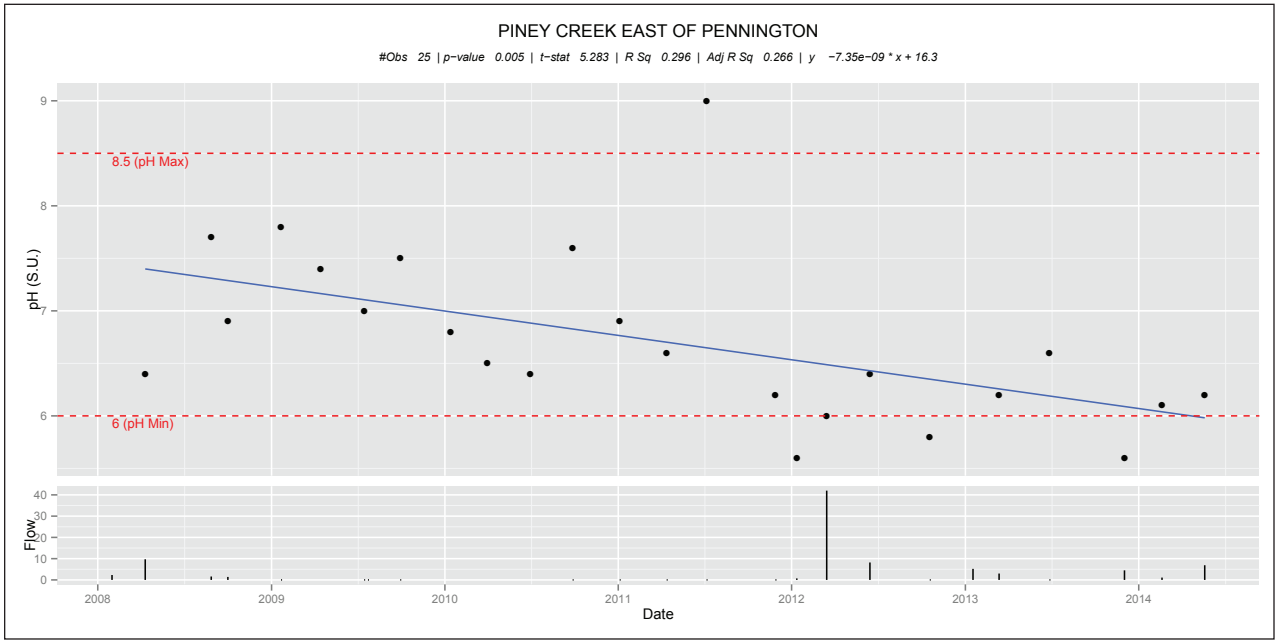
Monitoring Station 16096 - Piney Creek at FM 358

Monitoring Station 16096 is located on Piney Creek at the FM 358 crossing in assessment unit 0604D_02. This station is monitored quarterly by ANRA personnel for field parameters, conventional parameters, flow and *E. coli* bacteria.

For Dissolved Oxygen at this station, there is a decreasing trend, although it is not statistically significant. Results at this station ranged from 2.5 to 14.1 mg/L. This assessment unit is listed as fully supporting for Dissolved Oxygen in the Draft 2014 Integrated Report.

At this station, there is a decreasing trend for pH, with results ranging from 5.6 to 9.0 S.U. Because there is less than 10 years worth of data, ANRA is not considering this trend to be significant.

There is a concern for Chlorophyll-*a* for this assessment unit, but this listing is based upon one value that is skewing the mean of results at this station.



Water Quality Monitoring Results for Station 16096 - Piney Creek at FM 358

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	27	0	65	824	196.11		2.2246	0.0704	
00300	Dissolved Oxygen (mg/L)	23	2	2.5	14.1	6.75		1.0619	0.5946	
00400	pH (S.U.)	25	4	5.6	9	6.70		5.2825	0.0049	
00530	Total Suspended Solids (mg/L)	27	0	3.2	72	19.39		-0.3651	0.5152	
00610	Ammonia-Nitrogen (mg/L as N)	27	1	0.1	0.36	0.12		1.7770	0.2269	
00630	Nitrate + Nitrite (mg/L as N)	27	0	0.04	0.54	0.08		-0.6747	0.4000	
00665	Total Phosphorus (mg/L as P)	26	1	0.02	0.87	0.25		0.0478	0.7928	
00940	Chloride (mg/L)	27	2	5	52	18.28		1.8879	0.1383	
00945	Sulfate (mg/L)	27	2	5	86.9	21.88		1.7262	0.1621	
31699	*E. coli* (MPN/100 mL)	26	15	2	1400		80.96	-0.9328	0.2724	
32211+70953	Chlorophyll-*a* (µg/L)	26	7	2	727	43.45		-0.1268	0.8457	
70300	Total Dissolved Solids (mg/L)	27	6	84	307	164.27		0.8878	0.9011	

Segment 0604D - Piney Creek

Summary of Water Quality Trends

Trend analysis was not conducted for Piney Creek. In the case of assessment unit 0604D_01, monitoring station 16081 is no longer being monitored. Due to the lack of data in the past several years, ANRA does not consider any trends seen to be significant, as they may not reflect current water quality conditions in the waterbody. For assessment unit 0604D_02, trends are not considered to be statistically significant since there is less than 10 years of monitoring data.

Trend Analysis Summary for Segment 0604D - Piney Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Piney Creek	0604D_01	16081	Piney Creek at FM 1987	Trend analysis not performed due to insufficient data (no recent data).											
	0604D_02	16096	Piney Creek at FM 358 East Of Pennington	Trend analysis not performed due to insufficient data (<10 years).											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

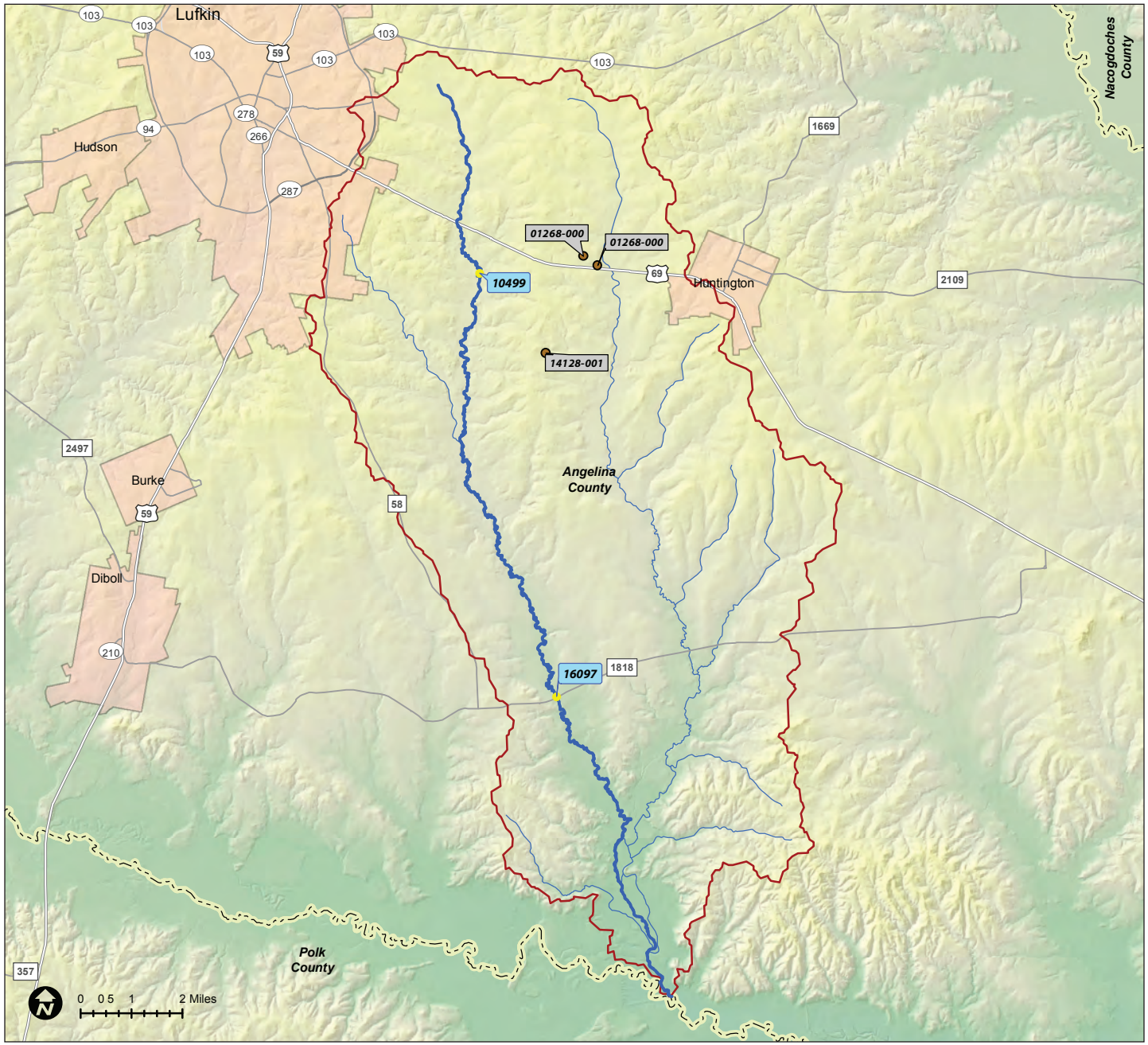
Water Quality Issues Summary for Segment 0604D - Piney Creek

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Depressed Dissolved Oxygen	0604D_01 (lower assessment unit)	• Municipal wastewater discharge • Nonpoint sources of pollution • Aquatic vegetation • Nutrient loading into the water body • Low flow • Intermittent nature of water body	• Detrimental effect on aquatic biological community	• Continue monitoring • Conduct 24-hour DO measurements
Concern for Ammonia-Nitrogen	0604D_01 (lower assessment unit)	• Municipal wastewater discharges • Nonpoint sources of pollution • Stormwater runoff • Domestic animals and wildlife • Improper use of fertilizers	• Detrimental effect on aquatic biological community	• Continue monitoring
Concern for Chlorophyll-*a*	0604D_02 (upper assessment unit)	• Nonpoint sources of pollution • Stormwater runoff • Improper use of fertilizers	• Aesthetic issues • Effect on dissolved oxygen levels	• Continue monitoring

Segment 0604M - Biloxi Creek

Segment Profile

Biloxi Creek is 28.3 miles in length and is from the confluence with the Neches River southeast of Diboll to FM 325 east of Lufkin in Angelina County. This segment is designated for contact recreation, general use, and aquatic life use.



Segment 0604M - Biloxi Creek

Assessment Units

Assessment Units in Segment 0604M - Biloxi Creek	
AU ID	**Description**
0604M_02	From the confluence with Neches River (0604) upstream to confluence with One Eye Creek in Angelina County SE of Lufkin
0604M_03	From the confluence with One Eye Creek in Angelina County SE of Lufkin upstream to FM 325 east of Lufkin

Monitoring Stations

Monitoring Stations in Segment 0604M - Biloxi Creek										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604M_02	16097	BILOXI CREEK AT FM 1818	4	4	4	4			ANRA
0604M_03	10499	BILOXI CREEK AT ANGELINA CR 216	6		6	6			ANRA

Description of Water Quality Issues

Impairments and Concerns

For Biloxi Creek, there is a listing in the Draft 2014 Integrated Report for depressed Dissolved Oxygen, with data showing that the waterbody is not supporting its designated use due to values below the Dissolved Oxygen grab screening level, 24-hour average, and 24-hour minimum criteria in assessment unit 0604M_03. AU 0604M_03 is also listed as impaired due to *E. coli* bacteria.

Nutrient concerns are present in both assessment units, with a concern for Total Phosphorus in AU 0604M_03 and a concern for Ammonia-Nitrogen in both AU 0604M_02 and 0604M_03.

Assessment Summary for Segment 0604M - Biloxi Creek as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**3.00 mg/L**	**2.00 mg/L**	**3.00 mg/L**	**2.00 mg/L**	**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604M_02				NC	FS					FS	CS	NC	NC	NC
0604M_03				CS	FS	**NS**	**NS**			**NS**	CS	NC	CS	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0604M - Biloxi Creek

Monitoring Station 16097 - Biloxi Creek at FM 1818

Monitoring Station 16097 is located on Biloxi Creek at the FM 1818 crossing. This station is in AU 0604M_02. Station 16097 is monitored quarterly by ANRA personnel for field parameters, conventional parameters, flow, and *E. coli* bacteria.

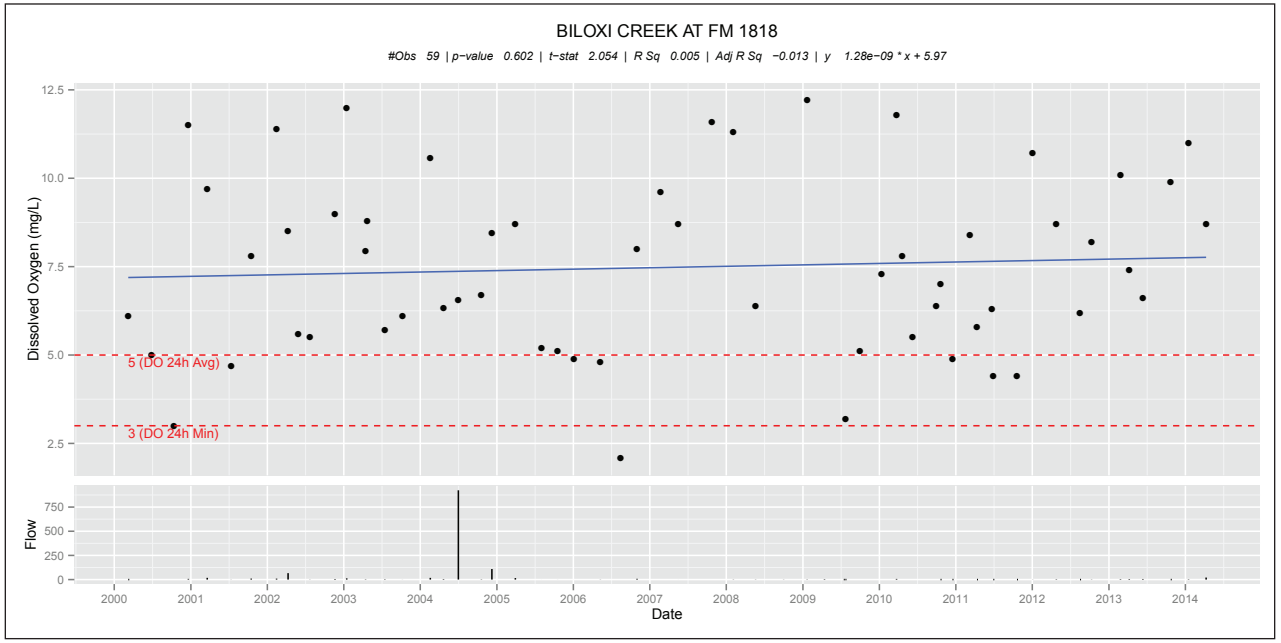
There are no Dissolved Oxygen impairments at this site. There are some values that fall below the water quality standard, but the majority of results are above the standard. Results ranged from 2.1 mg/L to 12.2 mg/L. There is a slight increasing trend, but it is not statistically significant.

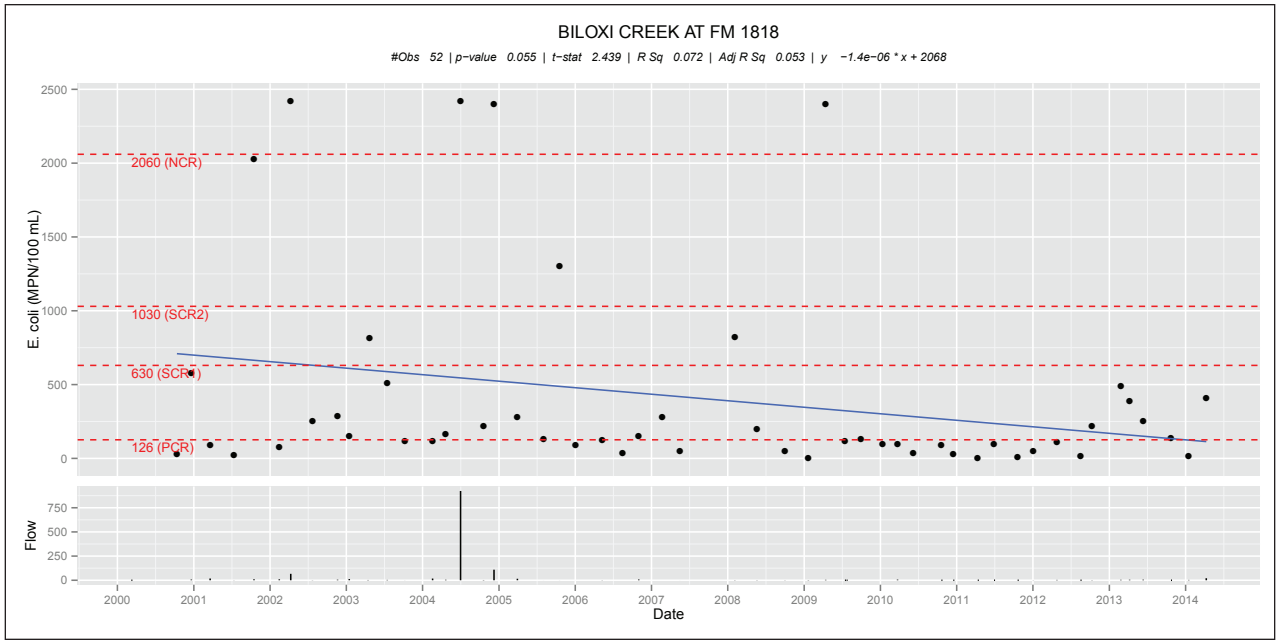
Chloride, Sulfate, and Total Dissolved Solids results are elevated at this site. For Chloride and Sulfate, there are numerous values above 50 mg/L, and for Total Dissolved Solids, the majority of values (49 of 55) are greater than 200 mg/L. Total Dissolved Solids results ranged from 112 to 557 mg/L, with a mean value of 313 mg/L.

For nutrient parameters, there is a concern for Ammonia-Nitrogen for this AU. The trend for Ammonia-Nitrogen is decreasing at this site, but the decrease is not statistically significant. There are numerous elevated values reported in 2004 – 2008, but the results seem to have improved since that time. Ammonia-Nitrogen results at this station ranged from a minimum of <0.01 mg/L as N to a maximum of 1.24 mg/L as N, with 15 of 54 samples exceeding the nutrient screening level.

There are statistically significant decreasing trends for both Nitrate+Nitrite and Total Phosphorus. Higher Nitrate+Nitrite values were observed prior to 2004.

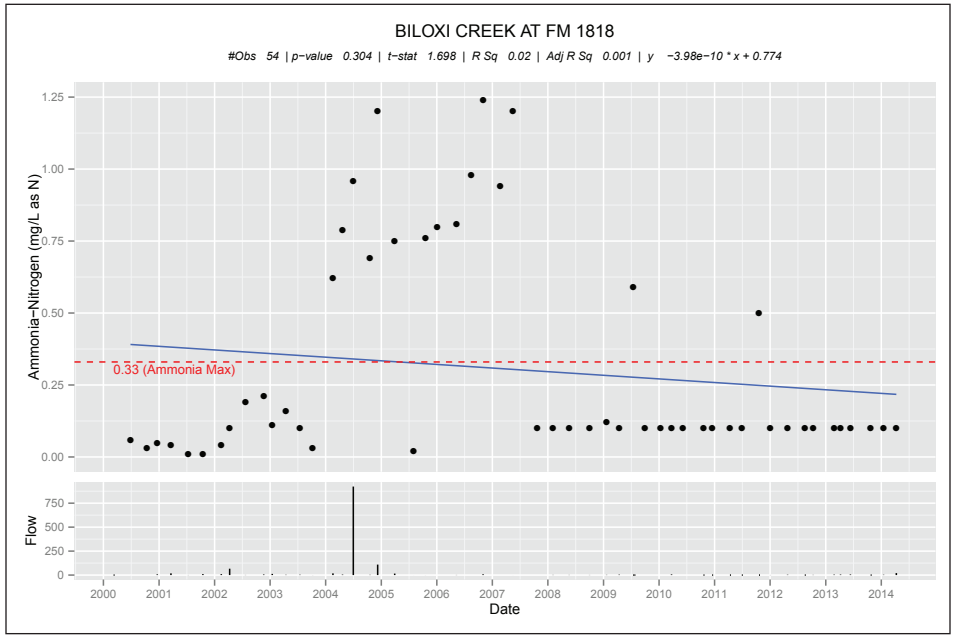
Based upon results for *E. coli* bacteria, this assessment unit has been delisted for bacterial impairment in the Draft 2014 Integrated Report.

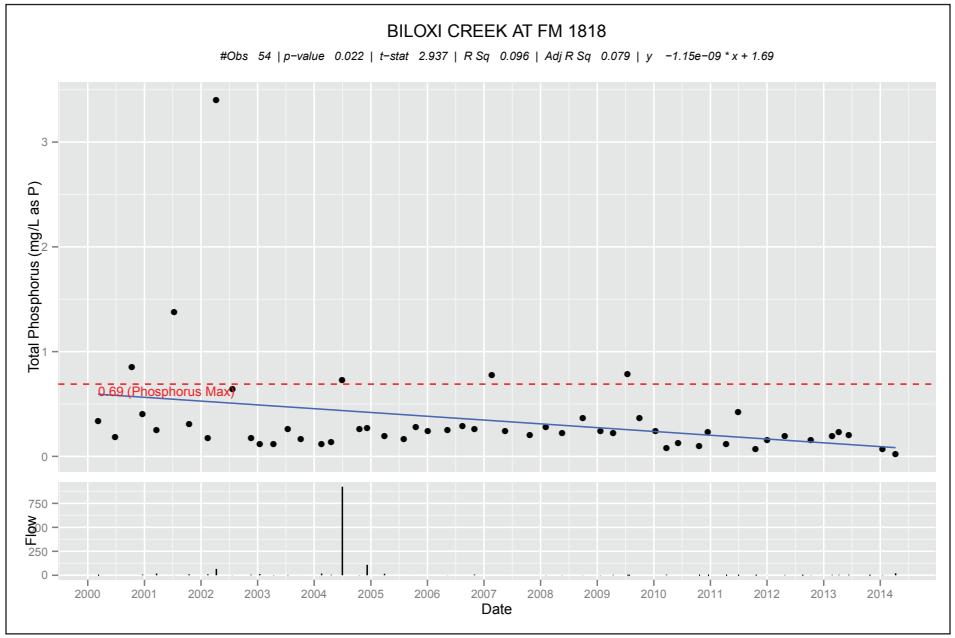


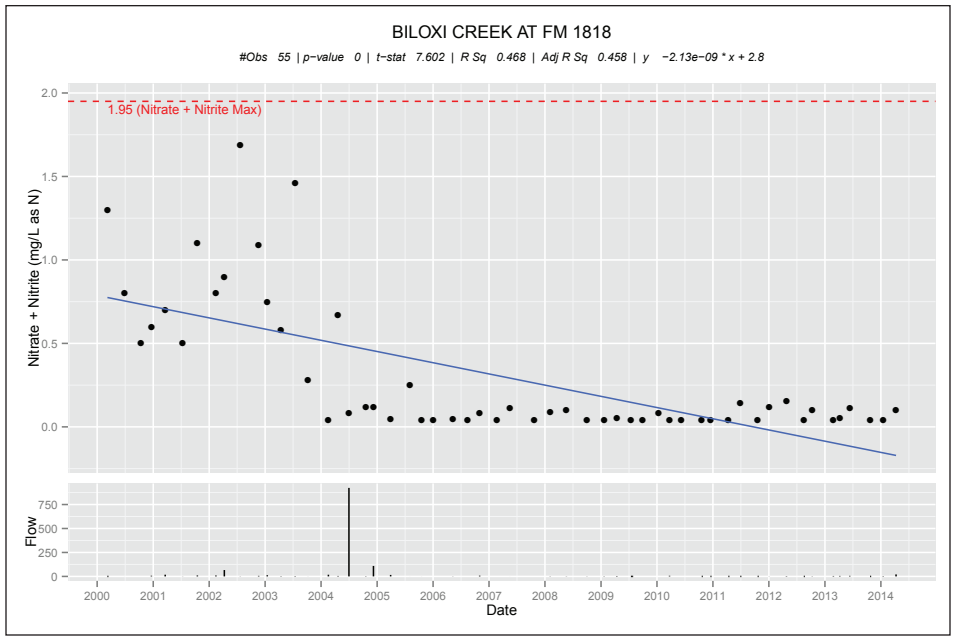


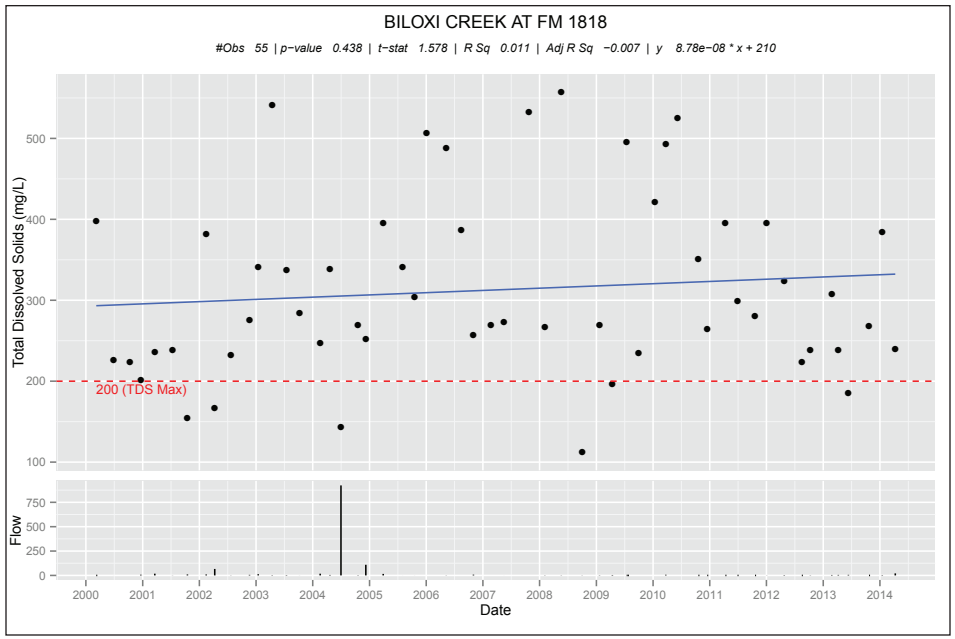
Segment 0604M - Biloxi Creek

Monitoring Station 16097 - Biloxi Creek at FM 1818







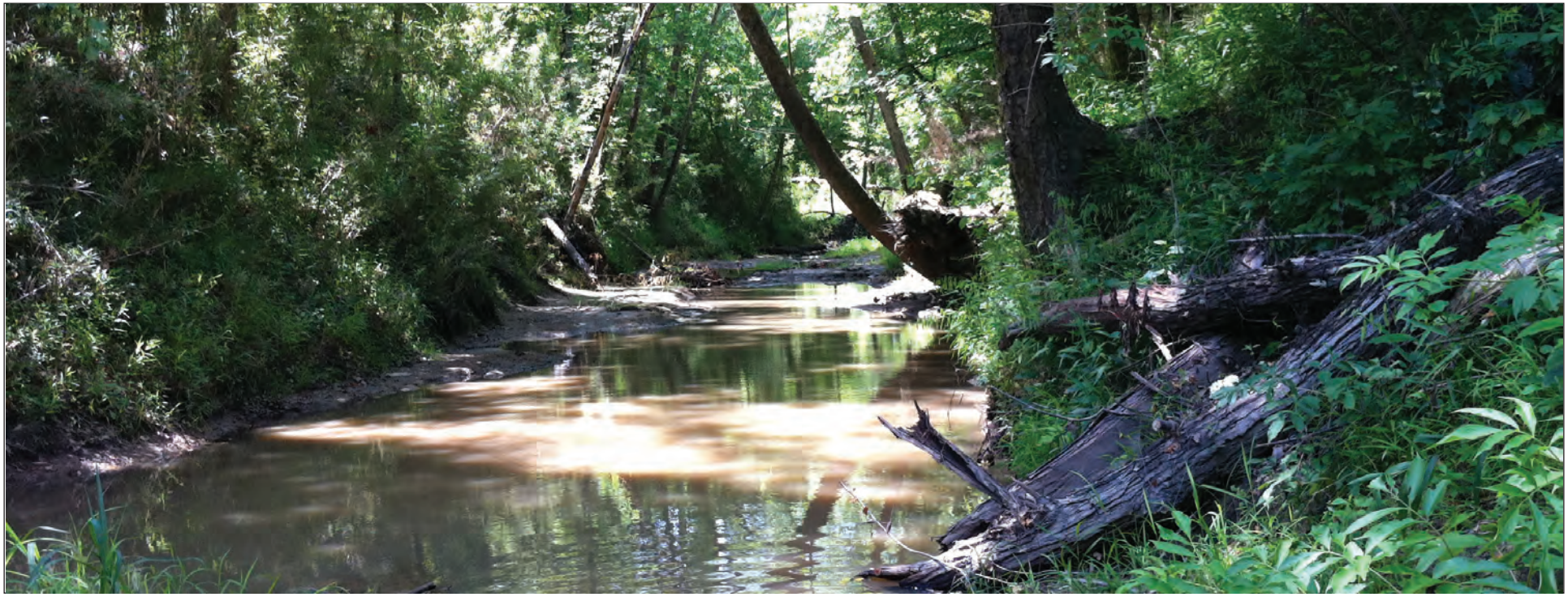


Segment 0604M - Biloxi Creek

Monitoring Station 16097 - Biloxi Creek at FM 1818

Water Quality Monitoring Results for Station 16097 - Biloxi Creek at FM 1818

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	62	0	101	902	464.90		1.5534	0.6874	
00300	Dissolved Oxygen (mg/L)	59	1	2.1	12.2	7.48		2.0544	0.6025	
00400	pH (S.U.)	60	0	6.1	8	6.99		16.0996	0.5572	
00530	Total Suspended Solids (mg/L)	55	0	2	314	24.76		1.0425	0.5426	
00610	Ammonia-Nitrogen (mg/L as N)	54	15	0.01	1.24	0.30		1.6981	0.3043	
00630	Nitrate + Nitrite (mg/L as N)	55	0	0.04	1.69	0.30		7.6018	0.0000	↓
00665	Total Phosphorus (mg/L as P)	54	6	0.02	3.4	0.34		2.9372	0.0222	↓
00940	Chloride (mg/L)	55	22	10	120	51.68		1.5688	0.8671	
00945	Sulfate (mg/L)	55	48	22	260	100.76		1.2833	0.7278	
31699	*E. coli* (MPN/100 mL)	52	27	1	2420		99.12	2.4389	0.0550	
32211+70953	Chlorophyll-*a* (µg/L)	40	5	2	54.3	8.27		0.6446	0.8010	
70300	Total Dissolved Solids (mg/L)	55	49	112	557	312.87		1.5778	0.4378	



16097 - Biloxi Creek at FM 1818

Segment 0604M - Biloxi Creek

Monitoring Station 10499 - Biloxi Creek at CR 216

Monitoring Station 10499 (Biloxi Creek at CR 216) is located in the uppermost assessment unit (AU 0604M_03) of Biloxi Creek. This monitoring station is monitored 6 times per year by ANRA personnel for field parameters, *E. coli* bacteria, and flow. Conventional parameters are no longer monitored at this station.

At this station, there is an impairment for depressed Dissolved Oxygen. Biloxi Creek has a designated Limited Aquatic Life Use. The Dissolved Oxygen levels at station 10499 show an increasing trend, although this trend is not considered to be statistically significant (t-stat = -1.117, p-value = 0.13). The minimum Dissolved Oxygen value recorded was 1.2 mg/L, with a maximum value of 9.7 mg/L.

There are decreasing trends for pH and Specific Conductance, but neither trend is considered to be significant due to there being less than 10 years of monitoring data.

This AU is listed for concerns for nutrient screening levels for Ammonia-Nitrogen and Total Phosphorus, but these listings are based upon historic data.

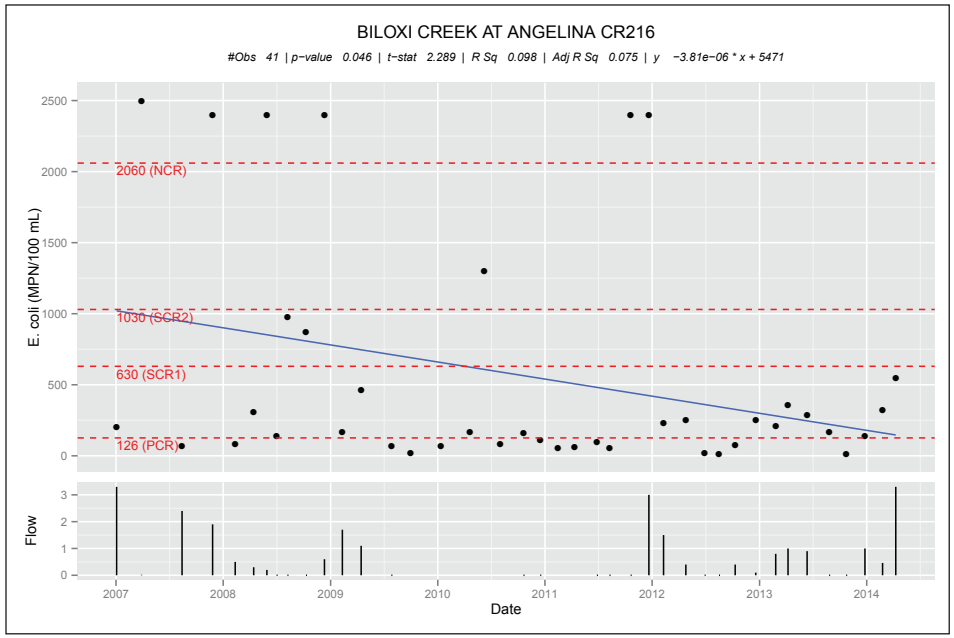
This assessment unit is listed as impaired for *E. coli* bacteria in the Draft 2014 Integrated Report.

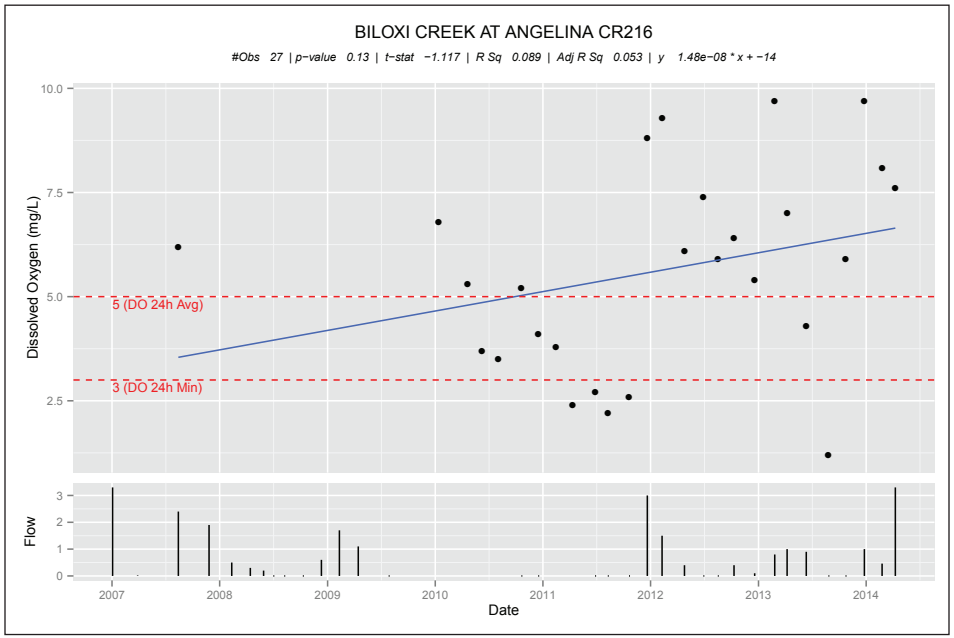
Pollution is a significant issue at this station, with numerous discarded tires present. During hunting season, animal carcasses are commonly found by water quality monitoring staff.

Pollution in Biloxi Creek at Monitoring Station 10499, including an animal carcass and discarded tires

Segment 0604M - Biloxi Creek

Monitoring Station 10499 - Biloxi Creek at CR 216





Water Quality Monitoring Results for Station 10499 - Biloxi Creek at CR 216

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	27	0	230	1520	548.07		2.4519	0.0424	
00300	Dissolved Oxygen (mg/L)	27	5	1.2	9.7	5.60		-1.1175	0.1298	
00400	pH (S.U.)	27	0	6.3	7.6	6.96		9.1766	0.0002	
00530	Total Suspended Solids (mg/L)	1	0	NA	NA	NA		NA	NA	
00610	Ammonia-Nitrogen (mg/L as N)	1	1	NA	NA	NA		NA	NA	
00630	Nitrate + Nitrite (mg/L as N)	1	0	NA	NA	NA		NA	NA	
00665	Total Phosphorus (mg/L as P)	1	0	NA	NA	NA		NA	NA	
00940	Chloride (mg/L)	1	0	NA	NA	NA		NA	NA	
00945	Sulfate (mg/L)	1	1	NA	NA	NA		NA	NA	
31699	*E. coli* (MPN/100 mL)	41	26	10	2500		208.40	2.2892	0.0463	
32211+70953	Chlorophyll-*a* (µg/L)	1	0	NA	NA	NA		NA	NA	
70300	Total Dissolved Solids (mg/L)	1	1	NA	NA	NA		NA	NA	

Segment 0604M - Biloxi Creek

Summary of Water Quality Trends

In assessment unit 0604M_02, there are statistically significant decreasing trends for Ammonia-Nitrogen and Nitrate+Nitrite.

In assessment unit 0604M_03, there is insufficient data to perform statistical analysis.

Trend Analysis Summary for Segment 0604M - Biloxi Creek

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Biloxi Creek	0604M_02	16097	Biloxi Creek at FM 1818										↓	↓	
	0604M_03	10499	Biloxi Creek at Angelina CR 216	Trend analysis not performed due to insufficient data (<10 years).											

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0604M - Biloxi Creek

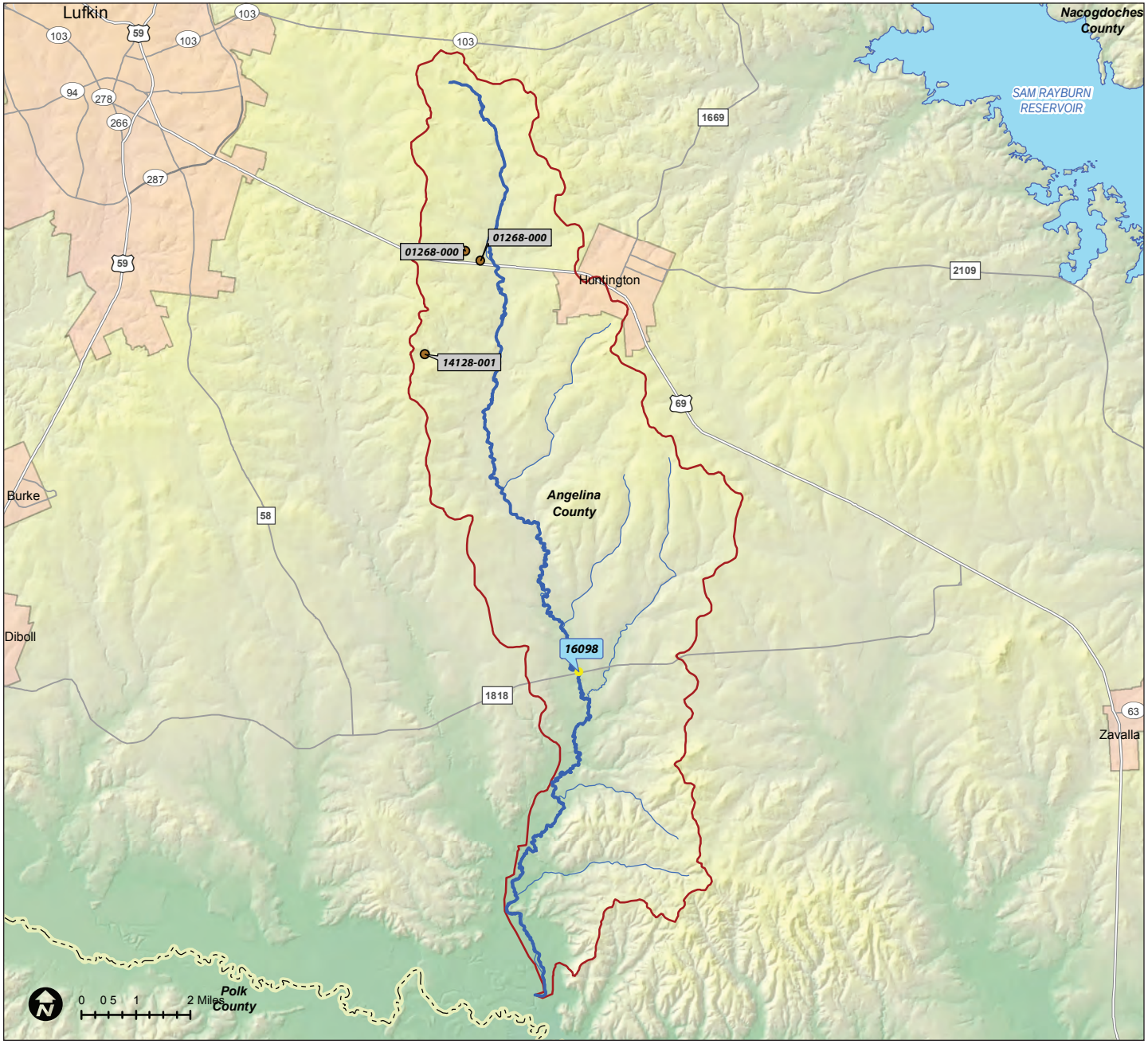
Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Impairment for *E. coli* bacteria	0604M_03 (upper assessment unit)	• Nonpoint sources of pollution • Stormwater runoff • Domestic animals and wildlife • Illegal dumping	• Water body does not meet the water quality standard for Primary Contact Recreation • Primary Contact Recreation in the water body has an increased risk of gastrointestinal illness	• Continue monitoring • A RUAA is being conducted by TCEQ on this water body to determine if the most appropriate contact recreation standard is being applied
Depressed dissolved oxygen	0604M_03 (upper assessment unit)	• Nonpoint sources of pollution • Aquatic vegetation • Nutrient loading into the water body • Low flow	• Detrimental effect on aquatic biological community	• Continue monitoring • Conduct 24-hour DO measurements
Concern for Ammonia-Nitrogen	Entire segment	• Nonpoint sources of pollution • Stormwater runoff • Domestic animals and wildlife • Improper use of fertilizers • Illegal dumping	• Detrimental effect on aquatic biological community	• Continue monitoring
Concern for Total Phosphorus	0604M_03 (upper assessment unit)	• Nonpoint sources of pollution • Stormwater runoff • Domestic animals and wildlife • Improper use of fertilizers • Illegal dumping	• Aesthetic issues • Effect on dissolved oxygen levels	• Continue monitoring

Segment 0604N - Buck Creek

Segment Profile

Buck Creek includes 23 miles of freshwater stream from its confluence with Biloxi Creek south of Huntington to a point 2.1 miles upstream of FM 1475, northwest of Huntington in Angelina County. This segment is designated for contact recreation, general use, and aquatic life use.

The City of Huntington's wastewater treatment facility discharges to Buck Creek. There is also an industrial wastewater treatment facility that discharges to this segment.



Segment 0604N - Buck Creek

Assessment Units

Assessment Units in Segment 0604N - Buck Creek	
AU ID	**Description**
0604N_01	From the confluence with Biloxi Creek (0604M) upstream to the confluence with Graham Creek (0604E) SW of City of Huntington at NHD RC 12020002000417
0604N_02	From the confluence with Graham Creek (0604E) SW of City of Huntington upstream to 0.23km south of Old Ewing Rd east of Lufkin at NHD RC 12020002000418

Monitoring Stations

Monitoring Stations in Segment 0604N - Buck Creek										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604N_01	16098	BUCK CREEK AT FM 1818	4	4	4	4			ANRA

Description of Water Quality Issues

Impairments and Concerns

There are no impairments or concerns listed for Buck Creek in the Draft 2014 Integrated Report.

Assessment Summary for Segment 0604N - Buck Creek as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604N_01										FS	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0604N - Buck Creek

Monitoring Station 16098 - Buck Creek at FM 1818

Monitoring Station 16098 is located on Buck Creek at the FM 1818 crossing. Sampling at this station is conducted quarterly by ANRA personnel, who monitor for field parameters, conventional parameters, flow, and *E. coli* bacteria.

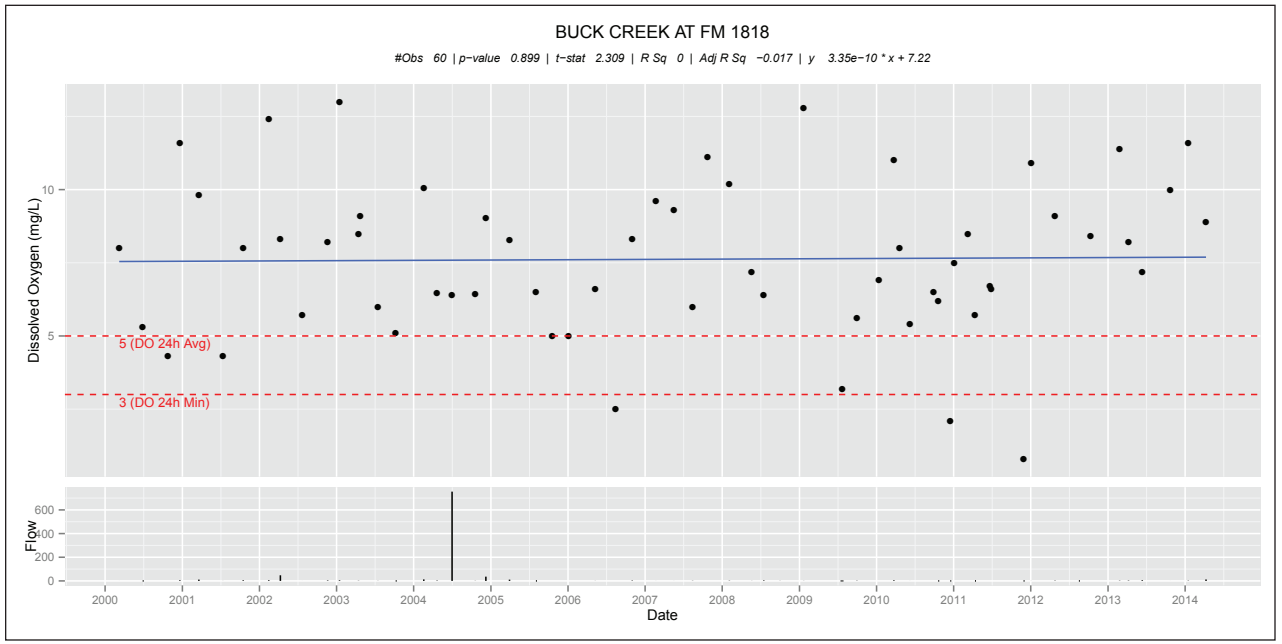
For Dissolved Oxygen, there were three values which were below the grab screening level of 3.0 mg/L, with results ranging from a minimum of 0.8 mg/L to a maximum of 13.0 mg/L. However, there was no Dissolved Oxygen impairment listed for this stream segment.

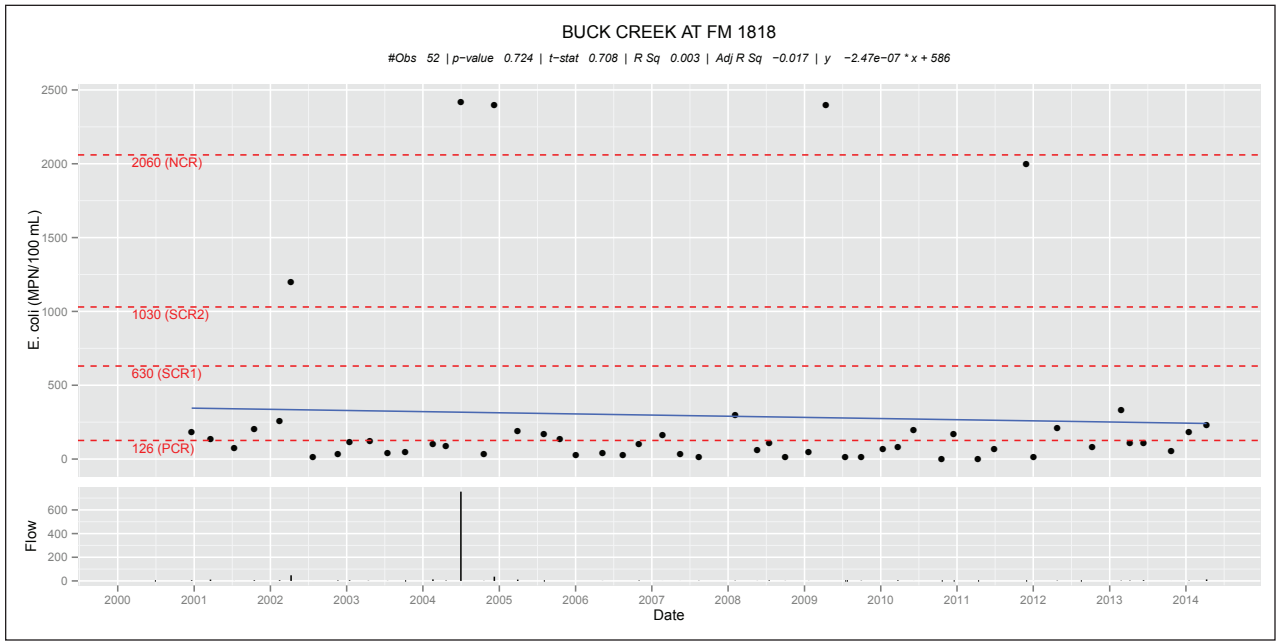
Chloride, Sulfate, and Total Dissolved Solids results all showed elevated results, with numerous Chloride and Sulfate values exceeding 50 mg/L, and the majority (46 of 55 samples) of Total Dissolved Solids being higher than 200 mg/L. Total Dissolved Solids results ranged from 133 to 1350 mg/L, with a mean of 375 mg/L.

Decreasing nutrient levels are seen for Ammonia-Nitrogen, Nitrate+Nitrite, and Total Phosphorus. For Ammonia-Nitrogen, the trend is not considered to be significant. There were numerous elevated results in the 2004 – 2008 time frame, with more recent results being below the nutrient screening level of 0.33 mg/L as N. Statistically significant decreasing trends were present for Nitrate+Nitrite and Total Phosphorus. For Nitrate+Nitrite, results appear to be elevated prior to 2004 and returning to values at or slightly above the limit of quantitation in recent years. A decreasing trend for Chlorophyll-*a* is being affected by changes to the limit of quantitation and is therefore not considered to be of statistical significance.

For *E. coli* bacteria, there is no impairment listed for Buck Creek, which has a designated use of Primary Contact Recreation.

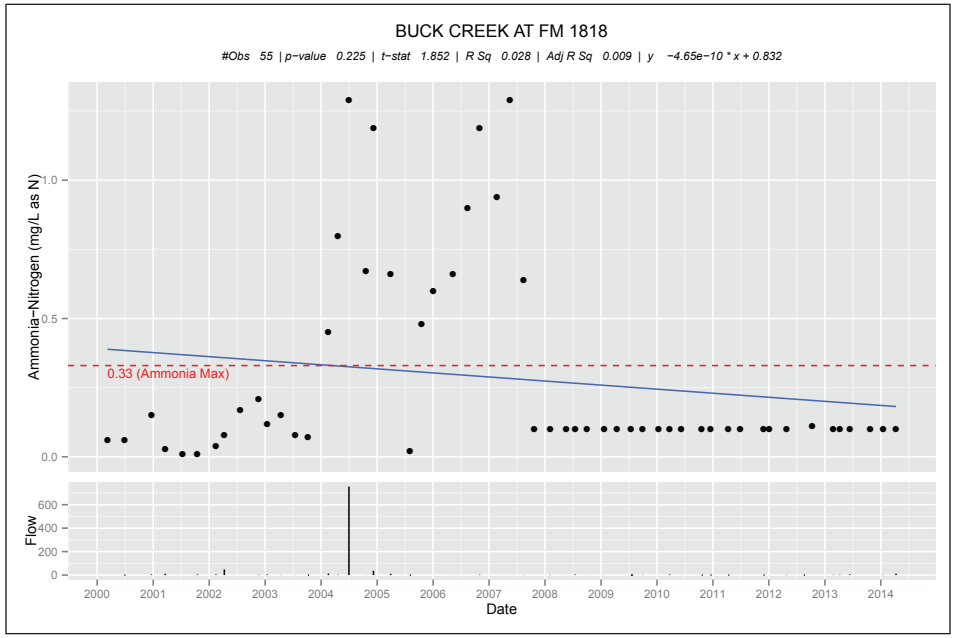
The site on Buck Creek at FM 1818 is used frequently for illegal dumping.

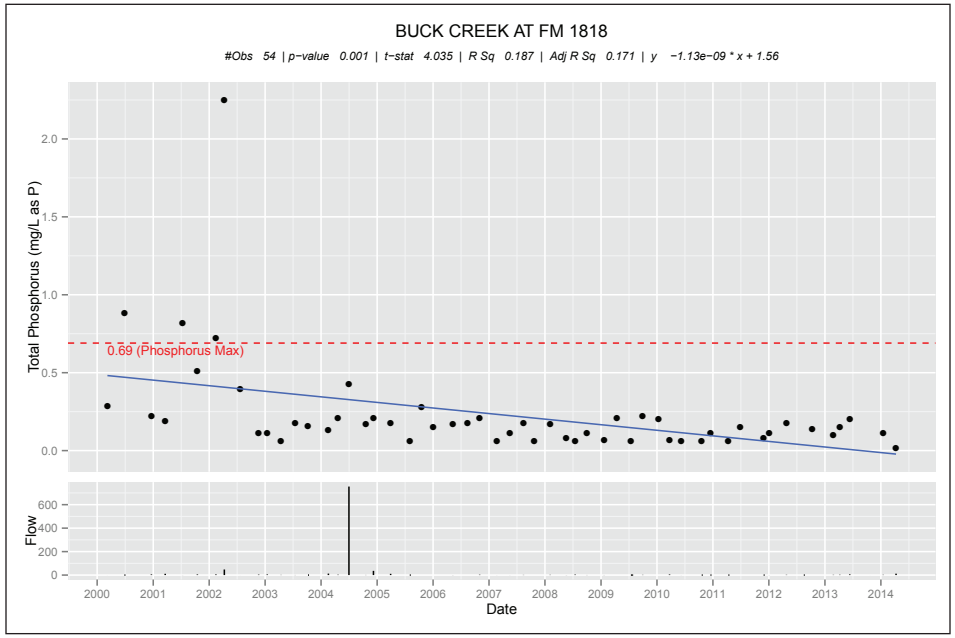


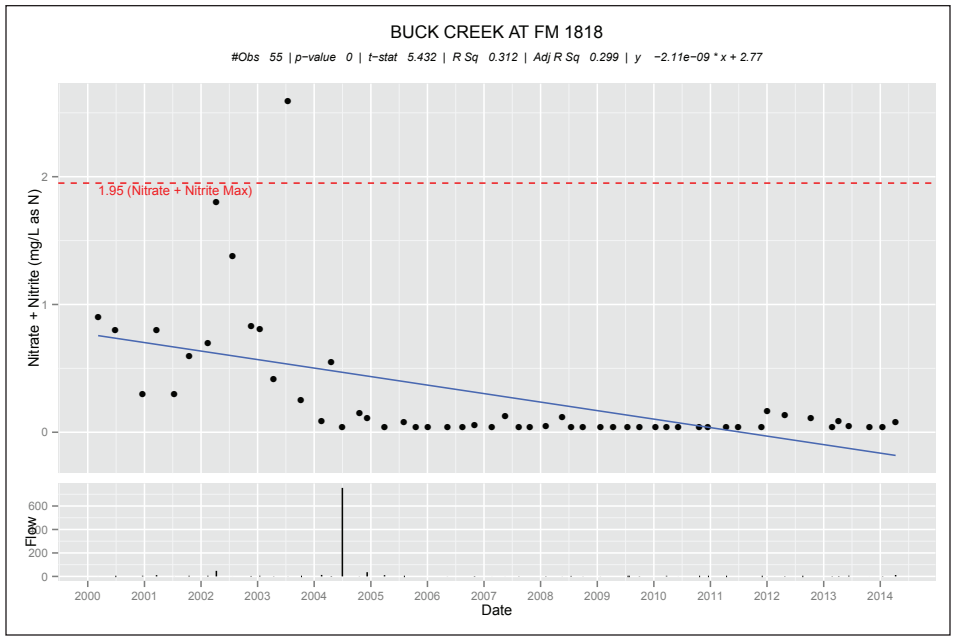


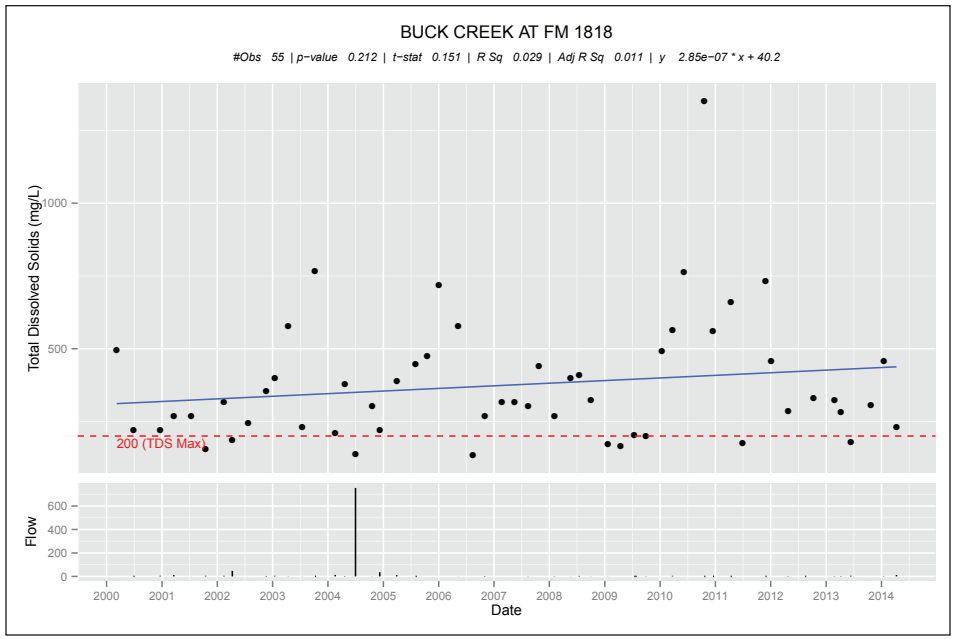
Segment 0604N - Buck Creek

Monitoring Station 16098 - Buck Creek at FM 1818









Segment 0604N - Buck Creek

Monitoring Station 16098 - Buck Creek at FM 1818

Water Quality Monitoring Results for Station 16098 - Buck Creek at FM 1818										
Parameter Code	**Parameter**	**Number of Samples**	**Number of Exceedances**	**MIN**	**MAX**	**MEAN**	**Geometric Mean**	**t-stat**	**p-value**	**Trend**
00094	Specific Conductance (µS/cm @ 25C)	62	0	104	4660	647.39		-0.7111	0.1219	
00300	Dissolved Oxygen (mg/L)	60	3	0.8	13	7.62		2.3090	0.8994	
00400	pH (S.U.)	60	3	4.7	7.8	6.90		11.4577	0.4768	
00530	Total Suspended Solids (mg/L)	55	0	1	172	20.60		1.5500	0.2778	
00610	Ammonia-Nitrogen (mg/L as N)	55	14	0.01	1.29	0.28		1.8519	0.2254	
00630	Nitrate + Nitrite (mg/L as N)	55	1	0.04	2.59	0.28		5.4324	0.0000	↓
00665	Total Phosphorus (mg/L as P)	54	4	0.02	2.25	0.23		4.0347	0.0011	↓
00940	Chloride (mg/L)	55	27	10	250	62.79		0.3266	0.4372	
00945	Sulfate (mg/L)	55	44	13	620	138.44		-0.4415	0.1472	
31699	*E. coli* (MPN/100 mL)	52	20	1	2419.6		60.34	0.7077	0.7237	
32211+70953	Chlorophyll-*a* (µg/L)	41	1	2	16.2	5.06		2.7335	0.0670	
70300	Total Dissolved Solids (mg/L)	55	46	133.3	1350	375.33		0.1506	0.2119	

Discarded tires and computer equipment in Buck Creek near Station 16098

Segment 0604N - Buck Creek

Summary of Water Quality Trends

There are statistically significant decreasing trends for Total Phosphorus and Nitrate+Nitrite for assessment unit 0604N_01.

Trend Analysis Summary for Segment 0604N - Buck Creek																
Segment Name	**AU**	**Station ID**	**Station Description**	**PARAMETERS**												
				E. coli	**pH**	**DO**	**Cl**	**SO4**	**Spec Cond**	**TDS**	**TSS**	**Chl-*a***	**NH3**	**NO3/ NO2**	**Total P**
Buck Creek	0604N_01	16098	Buck Creek at FM 1818											↓	↓
↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1																

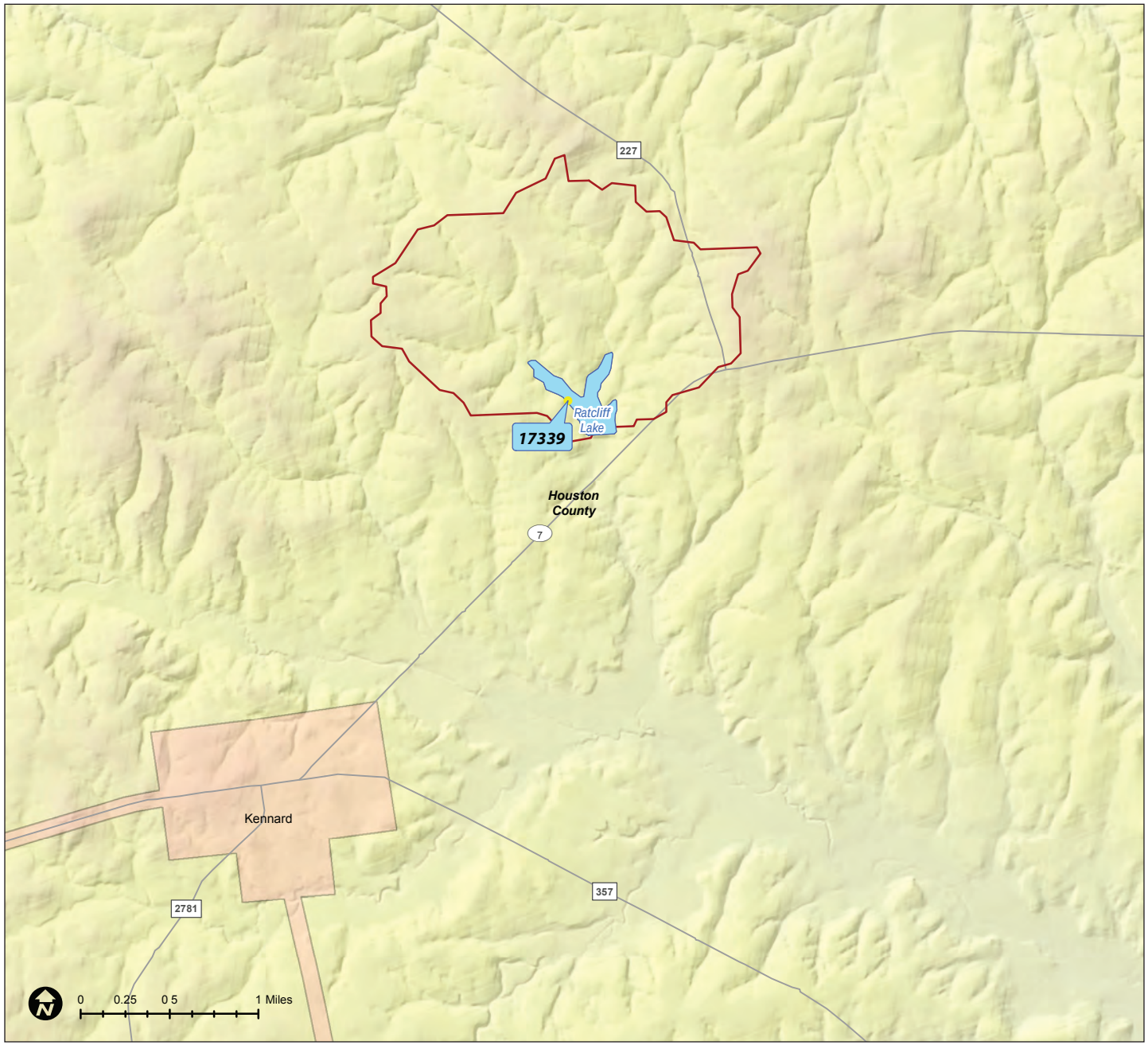
Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0604N - Buck Creek				
Water Quality Issue	**Affected Area**	**Possible Influences/Causes**	**Possible Effects**	**Possible Solutions / Actions Taken**
No impairments or concerns identified				

Segment 0604T - Lake Ratcliff

Segment Profile

The 53-acre reservoir is located within Houston County, 3.4 miles northeast of Kennard. This segment is designated for contact recreation, general use, and aquatic life use. The lake has a designated camping area, swimming area, and a concession area for summer visitors.



Segment 0604T - Lake Ratcliff

Assessment Units

Assessment Units in Segment 0604T - Lake Ratcliff	
AU ID	**Description**
0604T_01	Entire lake

Monitoring Stations

Monitoring Stations in Segment 0604T - Lake Ratcliff										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604T_01	17339	LAKE RATCLIFF NORTHWEST ARM	4	4	4	4			ANRA

Description of Water Quality Issues

Impairments and Concerns

Lake Ratcliff is listed in the Draft 2014 Integrated Report for Mercury in edible tissue. There is a fish consumption advisory for this lake.

No other impairments or concerns were identified for this waterbody.

Assessment Summary for Segment 0604T - Lake Ratcliff as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.11 mg/L**	**0.37 mg/L**	**0.20 mg/L**	**26.7 µg/L**
0604T_01				NC	FS					NC	NC	NC	NC	NC
FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed														

Segment 0604T - Lake Ratcliff

Monitoring Station 17339 - Lake Ratcliff Northwest Arm

Monitoring Station 17339 is located on Lake Ratcliff where the northwest arm joins the main body of the lake. This station is monitored quarterly by ANRA for conventional parameters, field parameters and *E. coli* bacteria. This monitoring station was added in FY 2010, so there is limited data available for assessment.

Decreasing trends are present for pH and Total Suspended Solids. There is less than 10 years of data for this station, so ANRA does not consider any trend to be of statistical significance.

17339 - Lake Ratcliff Northwest Arm

Water Quality Monitoring Results for Station 17339 - Lake Ratcliff Northwest Arm

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	19	0	63	208	108.26		2.7579	0.0317	
00300	Dissolved Oxygen (mg/L)	17	0	3.6	13.4	8.12		0.0732	0.7221	
00400	pH (S.U.)	19	1	5.9	8.1	7.12		4.9754	0.0073	
00530	Total Suspended Solids (mg/L)	19	0	2.5	13	5.78		3.2737	0.0084	
00610	Ammonia-Nitrogen (mg/L as N)	19	3	0.1	0.32	0.12		1.2714	0.3548	
00630	Nitrate + Nitrite (mg/L as N)	19	0	0.04	0.16	0.06		1.1899	0.3515	
00665	Total Phosphorus (mg/L as P)	18	0	0.02	0.08	0.06		3.3928	0.0112	
00940	Chloride (mg/L)	19	0	4.25	18	9.18		0.7648	0.7127	
00945	Sulfate (mg/L)	19	0	5	39.3	9.69		0.1068	0.9517	
31699	*E. coli* (MPN/100 mL)	19	0	1	42		4.61	-0.3369	0.6558	
32211+70953	Chlorophyll-*a* (µg/L)	19	4	2.4	44.8	13.96		1.3832	0.2364	
70300	Total Dissolved Solids (mg/L)	19	0	50	166	84.00		1.4573	0.3358	

Segment 0604T - Lake Ratcliff

Summary of Water Quality Trends

There is less than 10 years of monitoring data for Lake Ratcliff, so trend analysis has not been performed.

Trend Analysis Summary for Segment 0604T - Lake Ratcliff														
Segment Name	**AU**	**Station ID**	**Station Description**	**PARAMETERS**										
				E. coli	**pH**	**DO**	**Cl**	**SO4**	**Spec Cond**	**TDS**	**TSS**	**Chl-*a***	**NH3**	**NO3/ NO2**	**Total P**
Lake Ratcliff	0604T_01	17339	Lake Ratcliff Northwest Arm	Trend analysis not performed due to insufficient data (<10 years).										
↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1														

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0604T - Lake Ratcliff				
Water Quality Issue	**Affected Area**	**Possible Influences/Causes**	**Possible Effects**	**Possible Solutions / Actions Taken**
Mercury in Edible Tissue	Entire Lake	• Atmospheric deposition from coal-fired power plants, large boilers and heaters, steel production, and incinerators	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for largemouth bass • ADV-23 issued on May 10, 2002

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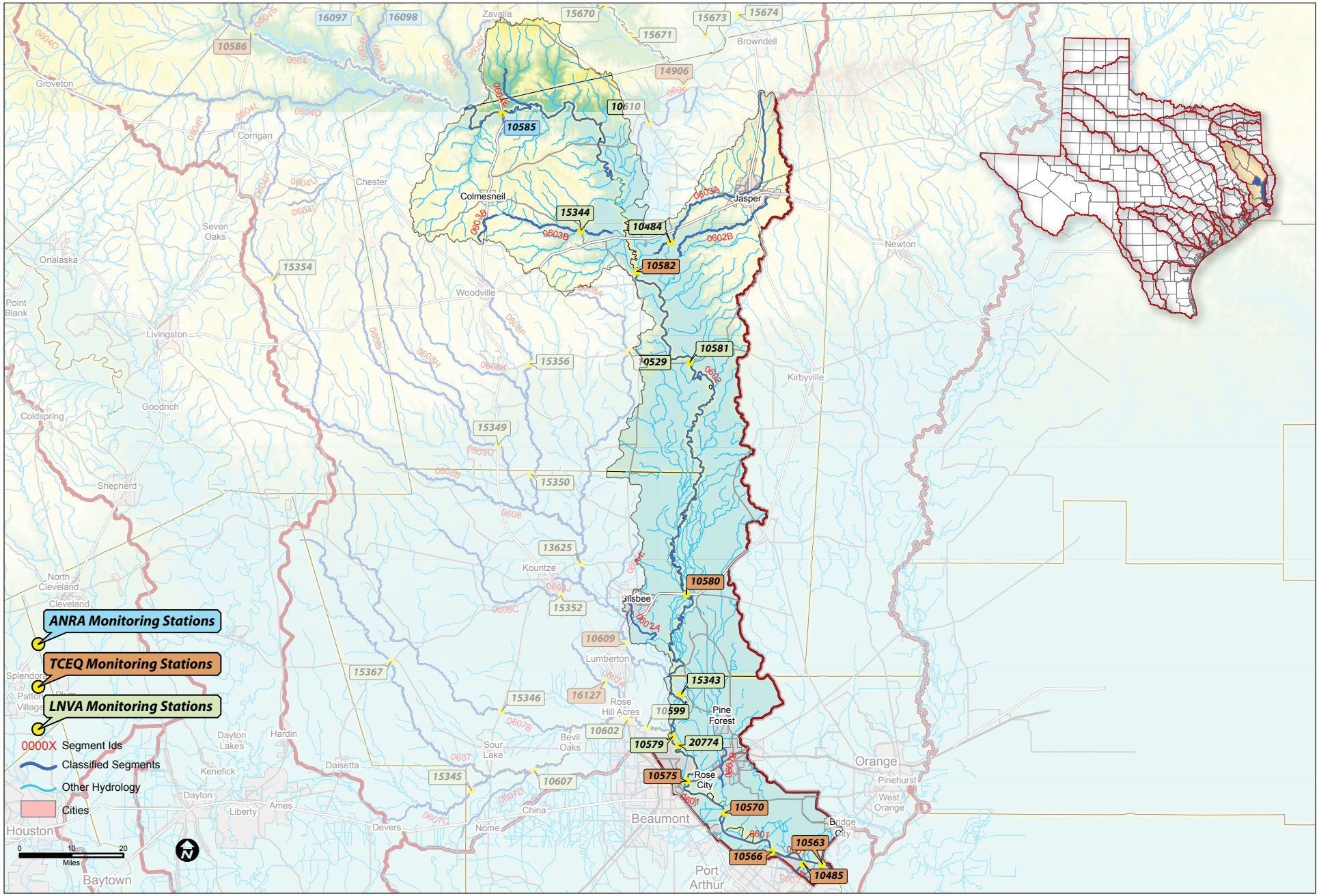
Lower Neches Overview Map



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Profile of the Lower Neches Sub-Basin

Clean Rivers Program monitoring conducted by ANRA in the Lower Neches Sub-Basin includes only one station on Segment 0604 (Neches River Below Lake Palestine). This segment spans the Upper, Middle, and Lower Neches Sub-Basins. While the sub-basin is within ANRA's jurisdictional service area, the majority of the CRP monitoring in the sub-basin (B.A. Steinhagen Reservoir and below) is performed by TCEQ and LNVA. For more information on the water quality in this portion of the basin, please refer to the 2015 Basin Summary Report produced by the Lower Neches Valley Authority.

Segments in the Lower Neches Sub-Basin	
Segment ID	**Segment Name**
0604	Neches River Below Lake Palestine

Permitted Discharges in the Lower Neches Sub-Basin

A total of eighty-five permitted discharges are within the Lower Neches sub-basin, but only one in the area of interest for this report. See LNVA's 2015 Basin Summary Report for details about others.

Neches River at US 69

Permitted Discharges in the Lower Neches Sub-Basin								
First Segment in Drainage Path	**Segment ID as identified in Permit**	**Permit Number**	**Outfall Number**	**NPDES Number**	**Permittee**	**County**	**TCEQ Region**	**Map Locations**
0604	0604	11295-001	001	100692	CITY OF COLMESNEIL	Tyler	10 - Beaumont	Page 282

Texas Surface Water Quality Standards for the Lower Neches Sub-Basin

Site-Specific Uses and Numeric Criteria for Classified Segments in the Lower Neches Sub-Basin													
Segment ID	**Segment Name**	**DESIGNATED USES**				**CRITERIA***							
		Recreation	**Aquatic Life**	**Domestic Water Supply**	**Other**	**Chloride (mg/L)**	**Sulfate (mg/L)**	**TDS (mg/L)**	**Dissolved Oxygen (mg/L**	**pH Range (S.U.)**	***E. coli* Bacteria #/100 mL**	**Temp (°F)**
0604	Neches River Below Lake Palestine	PCR	H	PS		50	50	200	5.0	6.0 - 8.5	126	91

PCR = Primary Contact Recreation SCR1 = Secondary Contact Recreation 1 SCR2 = Secondary Contact Recreation 2 NCR = Noncontact Recreation
H = High Aquatic Life Use I = Intermediate Aquatic Life Use
PS = Public Supply

* The criteria for Chloride, Sulfate, and TDS are listed as the maximum annual averages for the segment. Dissolved Oxygen criteria are listed as minimum 24-hour means at any site within the segment. The pH criteria are listed as minimum and maximum values expressed in standard units at any site within the segment. The criteria for Temperature are listed as maximum values at any site within the segment.

Segment 0604 - Neches River Below Lake Palestine

Segment Profile

This 231 miles-long freshwater stream extends from a point immediately upstream of the confluence of Hopson Mill Creek in Jasper/Tyler County to Blackburn Crossing Dam in Anderson/ Cherokee County. Contact recreation, public water supply, general, and high aquatic life use are the designated uses for this segment. Segment 0604 spans the Upper, Middle, and Lower Neches Sub-Basins.

Segment 0604 - Neches River Below Lake Palestine

Assessment Units

Assessment Units in Segment 0604 - Neches River Below Lake Palestine (Lower Neches Sub-Basin Portion)	
AU ID	**Description**
0604_01	Lower boundary to a point immediately upstream of confluence of Biloxi Creek 0604M at NHD RC 12020002001061

Monitoring Stations

Monitoring Stations in Segment 0604 - Neches River Below Lake Palestine (Lower Neches Sub-Basin Portion)										
Assessment Unit	**Monitoring Station ID**	**Description**	**Annual Frequency**						**Monitoring Entity**
			Field	**Conv**	**Bacteria**	**Flow**	**Metals in Water**	**Metals in Sediment**	
0604_01	10585	NECHES RIVER AT US 69	4	4	4	4			ANRA

Description of Water Quality Issues

Impairments and Concerns

Assessment unit 0604_01 is listed in the Draft 2014 Integrated Report as impaired for Dioxin in edible tissue and Mercury in edible tissue. Both of these are covered under the same Texas Department of State Health Services fish consumption advisory that applies to Sam Rayburn Reservoir.

No other impairments or concerns have been identified for this portion of the segment.

Assessment Summary for Segment 0604 - Neches River Below Lake Palestine (Middle Neches Sub-Basin Portion) as listed in the Draft 2014 Texas Integrated Report														
AU	**Chloride**	**Sulfate**	**TDS**	**DO Grab Screening Level**	**DO Grab Minimum**	**24 Hour DO Average**	**24 Hour DO Minimum**	**pH**	**Temp (C)**	***E. coli* geomean**	**Ammonia Nitrogen**	**Nitrate Nitrogen**	**Total Phosphorus**	**Chl-*a***
	50 mg/L	**50 mg/L**	**200 mg/L**	**5.00 mg/L**	**3.00 mg/L**			**6.0 - 8.5 SU**	**32.8**	**126 MPN /100 mL**	**0.33 mg/L**	**1.95 mg/L**	**0.69 mg/L**	**14.1 µg/L**
0604_01				NC	FS			FS	FS	FS	NC	NC	NC	NC

FS = Fully Supporting NC = No Concern CN = Concern for Near Non-Attainment CS = Concern for Screening Level NS = Not Supporting NA = Not Assessed

Segment 0604 - Neches River Below Lake Palestine

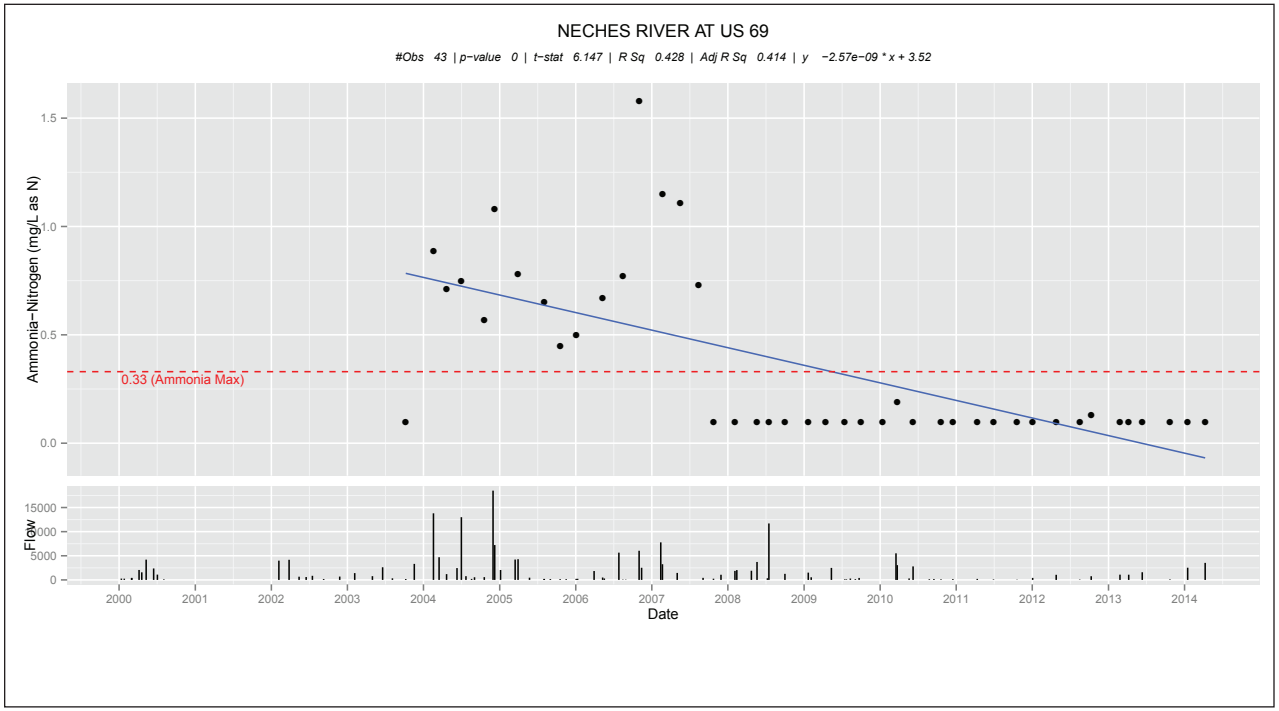
Monitoring Station 10585- Neches River at US 69

Located in AU 0604_01, Monitoring Station ID 10585 is monitored quarterly for field and conventional parameters, flow, and *E. coli* bacteria. This monitoring station is is the only station monitored by ANRA in the Lower Neches Sub-Basin.

This assessment unit is listed as impaired for Dioxin in edible tissue and Mercury in edible tissue. No other impairments or concerns have been identified for this assessment unit.

There is a statistically significant decreasing trend for Anmmonia-Nitrogen observed at this monitoring station. Numerous elevated values were reported prior to 2008, but since that time, most results are at or below the limit of quantitation.

There is a statistically significant decreasing trend for Chlorophyll-*a* at this station.



Water Quality Monitoring Results for Station 10585 - Neches River at US 69

Parameter Code	Parameter	Number of Samples	Number of Exceedances	MIN	MAX	MEAN	Geometric Mean	t-stat	p-value	Trend
00094	Specific Conductance (µS/cm @ 25C)	86	0	5	356	213.21		1.5731	0.1231	
00300	Dissolved Oxygen (mg/L)	91	0	4.6	12.9	7.62		4.0543	0.6289	
00400	pH (S.U.)	93	3	5.86	8.7	7.07		10.9617	0.3253	
00530	Total Suspended Solids (mg/L)	54	0	6	118	31.09		1.6353	0.6113	
00610	Ammonia-Nitrogen (mg/L as N)	43	15	0.1	1.58	0.36		6.1465	0.0000	↓
00630	Nitrate + Nitrite (mg/L as N)	43	0	0.04	0.45	0.15		1.4850	0.3959	
00665	Total Phosphorus (mg/L as P)	41	2	0.05	1.9	0.21		0.6035	0.7777	
00940	Chloride (mg/L)	81	1	2.19	54.5	26.03		0.7485	0.0747	
00945	Sulfate (mg/L)	81	2	1.63	87.5	30.11		-1.9500	0.0000	
31699	*E. coli* (MPN/100 mL)	42	8	2	2400		4.94	1.4233	0.2272	
32211+70953	Chlorophyll-*a* (µg/L)	42	8	2	34.9	9.58		2.8559	0.0370	↓
70300	Total Dissolved Solids (mg/L)	57	8	56	248	157.84		0.2798	0.0053	

Segment 0604 - Neches River Below Lake Palestine

Summary of Water Quality Trends

There are statistically significant decreasing trends in AU 0604_01 for Ammonia-Nitrogen and Chlorophyll-*a*.

Trend Analysis Summary for Segment 0604 - Neches River Below Lake Palestine (Lower Neches Sub-Basin Portion)

Segment Name	AU	Station ID	Station Description	PARAMETERS											
				E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/ NO2	Total P
Neches River Below Lake Palestine	0604_01	10585	Neches River at US 69									↓	↓		

↑ = Statistically significant increasing trend ↓ = Statistically significant decreasing trend Trends are considered significant if *t-stat* ≥ |2| and *p-value* < 0.1

Summary of Water Quality Issues

Water Quality Issues Summary for Segment 0604 - Neches River Below Lake Palestine (Lower Neches Sub-Basin Portion)

Water Quality Issue	Affected Area	Possible Influences/Causes	Possible Effects	Possible Solutions / Actions Taken
Dioxin in Edible Tissue	The Neches River (Segment 0604) and all contiguous waters from the SH 7 bridge west of Lufkin, TX downstream to the US 96 bridge near Evadale, TX including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir	• Pulp and paper bleaching processes	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for six species of fish • ADV-51 issued on January 24, 2014
Mercury in Edible Tissue	The Neches River (Segment 0604) and all contiguous waters from the SH 7 bridge west of Lufkin, TX downstream to the US 96 bridge near Evadale, TX including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir	• Atmospheric deposition from coal-fired power plants, large boilers and heaters, steel production, and incinerators	• The Texas DSHS has concluded that consuming fish from this water body poses an apparent hazard to public health	• A comprehensive Fish Consumption Advisory issued by the Texas DSHS recommends consumption advice for six species of fish • ADV-51 issued on January 24, 2014

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Recommendations & Conclusions

Water Moccasin in Hurricane Creek at Loop 287

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Basin-Wide Water Quality Findings

Impairments and Concerns

Bacterial Impairments

Bacterial impairments are the most common reason for water bodies in the upper and middle portions of the Neches River Basin to be listed on the 303(d) List. Three classified segments (Neches River Above Lake Palestine, Angelina River Above Sam Rayburn Reservoir, and Attoyac Bayou) have a bacterial impairment listed in the Draft 2014 Integrated Report. Additionally, thirteen unclassified segments have impairments or concerns for *E. coli* bacteria. Generally, most bacterial impairments are due to nonpoint sources of pollution.

In many cases, the geometric mean of sample results are above the criteria for Primary Contact Recreation, but below the criteria for Secondary Contact Recreation. Many of the stream segments in this portion of the state are very turbid and slow moving, with limited public access. Because of these factors, as well as the overall level of bacteria observed, many stream segments in the basin may be ideal candidates for a RUAA to determine if Primary Contact Recreation is the most appropriate designated use. RUAAs have already been conducted on several segments within the basin.

Impairments and Concerns in the Upper Neches Basin - Classified Segments (as listed in the Draft 2014 Texas Integrated Report)

Segment ID	Segment Name	Impairment(s)	Concern(s)
0604	Neches River Below Lake Palestine	Mercury in Edible Tissue Dioxin in Edible Tissue	Chlorophyll-*a*
0605	Lake Palestine	pH	Depressed Dissolved Oxygen Chlorophyll-*a* pH (High)
0606	Neches River Above Lake Palestine	*E. coli* Depressed Dissolved Oxygen pH (Low)	*E. coli* Depressed Dissolved Oxygen Nitrate-Nitrogen Total Phosphorus Zinc in Water
0609	Angelina River Below Sam Rayburn Reservoir	Mercury in Edible Tissue Dioxin in Edible Tissue	No Concerns
0610	Sam Rayburn Reservoir	Mercury in Edible Tissue Dioxin in Edible Tissue	Depressed Dissolved Oxygen Ammonia-Nitrogen pH Iron in Sediment Manganese in Sediment Mercury in Edible Tissue
0611	Angelina River Above Sam Rayburn Reservoir	*E. coli* Aluminum in Water	Lead in Water
0612	Attoyac Bayou	*E. coli*	Depressed Dissolved Oxygen Ammonia-Nitrogen
0615	Angelina River/Sam Rayburn Reservoir	Depressed Dissolved Oxygen Impaired Fish Community Mercury in Edible Tissue Dioxin in Edible Tissue	Nitrate-Nitrogen Total Phosphorus

Concerns for Nutrient Levels

Numerous segments had concerns for nutrients, particularly Ammonia-Nitrogen and Total Phosphorus. However, decreasing trends for these parameters were often observed.

Depressed Dissolved Oxygen

Depressed Dissolved Oxygen levels were common in the basin. These impairments and concerns are most likely due to a combination of low flows and elevated nutrient levels.

Impairments and Concerns in the Upper Neches Basin - Unclassified Segments (as listed in the Draft 2014 Texas Integrated Report)

Segment ID	Segment Name	Impairment(s)	Concern(s)
0604A	Cedar Creek	*E. coli*	Ammonia-Nitrogen Nitrate-Nitrogen Total Phosphorus
0604B	Hurricane Creek	*E. coli*	Ammonia-Nitrogem
0604C	Jack Creek	No Impairments	Depressed Dissolved Oxygen Ammonia-Nitrogen Total Phosphorus
0604D	Piney Creek	Depressed Dissolved Oxygen	Depressed Dissolved Oxygen Ammonia-Nitrogen
0604M	Biloxi Creek	*E. coli* Depressed Dissolved Oxygen	Depressed Dissolved Oxygen Ammonia-Nitrogen Total Phosphorus
0604N	Buck Creek	No Impairments	Ammonia-Nitrogen
0604T	Lake Ratcliff	Mercury In Edible Tissue	No Concerns
0605A	Kickapoo Creek	*E. coli* Depressed Dissolved Oxygen	Depressed Dissolved Oxygen Ammonia-Nitrogen
0606A	Prairie Creek	*E. coli*	No Concerns
0606D	Black Fork Creek	*E. coli*	Ammonia-Nitrogen
0610A	Ayish Bayou	*E. coli*	No Concerns
0611A	East Fork Angelina River	*E. coli*	*E. coli*
0611B	La Nana Bayou	*E. coli*	*E. coli* Ammonia-Nitrogen Nitrate-Nitrogen Total Phosphorus
0611C	Mud Creek	*E. coli* Aluminum in Water	*E. coli* Depressed Dissolved Oxygen
0611D	West Mud Creek	*E. coli*	Ammonia-Nitrogen Nitrate-Nitrogen
0611Q	Lake Nacogdoches	No Impairments	Ammonia-Nitrogen
0611R	Lake Striker	No Impairments	Ammonia-Nitrogen
0615A	Paper Mill Creek	*E. coli* Aluminum in Water	No Concerns

Basin-Wide Water Quality Findings

Water Quality Trends

Nutrients

Throughout the basin, statistically significant decreasing trends were observed for nutrient parameters. For Ammonia-Nitrogen, there were decreasing trends at 11 monitoring stations. Significant decreasing trends for Nitrate-Nitrogen were observed at 19 monitoring stations. For Total Phosphorus, decreasing trends were observed at 14 monitoring stations. Chlorophyll-*a* trends were decreasing at 4 monitoring stations.

No statistically significant increasing trends were seen for nutrient parameters at any monitoring station reviewed as part of the Basin Summary Report.

Dissolved Solids

At numerous monitoring stations within the basin, increasing trends were observed for Specific Conductance and Total Dissolved Solids. Chloride and Sulfate, which typically comprise the majority of the Total Dissolved Solids, also had increasing trends at several monitoring stations. In most cases, the trends were due to elevated values which were observed beginning in 2011. This time frame coincides with the statewide drought. Although East Texas was spared from the worst of the drought, there were still numerous instances of low (and no) flow in streams and diminished reservoir levels due to the drought. These conditions almost certainly played a role in the elevated dissolved solids levels seen throughout the basin.

The one exception to this trend was observed in Sam Rayburn Reservoir, which showed statistically significant decreasing trends for Specific Conductance, Total Dissolved Solids, Chloride, and Sulfate. In this case, these decreasing trends were the result of the elimination of a point source of pollution following the closure of the paper mill in Lufkin which discharged to Paper Mill Creek, which ultimately flowed to Sam Rayburn.

Summary of Statistically Significant Trends in the Upper Neches River Basin

Segment ID	Segment Name	AU	PARAMETERS											
			E. coli	pH	DO	Cl	SO4	Spec Cond	TDS	TSS	Chl-*a*	NH3	NO3/NO2	Total P
0604	Neches River Below Lake Palestine	0604_01									↓	↓		
		0604_02		↓										
		0604_03		↓										
		0604_05						↑	↑					
0604A	Cedar Creek	0604A_02		↑										↓
0604B	Hurricane Creek	0604B_01		↑									↓	↓
0604C	Jack Creek	0604C_01		↑									↓	↓
0604M	Biloxi Creek	0604M_02										↓	↓	
0604N	Buck Creek	0604N_01											↓	↓
0605	Lake Palestine	0605_01		↑										
		0605_03		↑										
0606	Neches River Above Lake Palestine	0606_02				↓								
0610	Sam Rayburn Reservoir	0610_01						↑					↓	
		0610_03						↑					↓	
		0610_04		↑	↑								↓	↓
		0610_06											↓	
		0610_07												↓
		0610_10						↑						
0610A	Ayish Bayou	0610A_01		↓									↓	↓
0611	Angelina River Above Sam Rayburn Reservoir	0611_01												
		0611_02				↑								
		0611_03											↓	↓
		0611_04		↑		↑	↑	↑					↓	
0611A	East Fork Angelina River	0611A_02											↓	
0611C	Mud Creek	0611C_01										↓	↓	↓
		0611C_01											↓	↓
0611D	West Mud Creek	0611D_01			↓									↓
		0611D_01										↓	↓	
0611Q	Lake Nacogdoches	0611Q_01					↑	↑	↑			↓		
		0611Q_01					↑	↑			↓	↓		
0611R	Lake Striker	0611R_01		↓			↑	↑		↑	↓	↓	↓	↓
		0611R_01		↓			↑	↑		↑	↓	↓	↓	
0612	Attoyac Bayou	0612_02		↑								↓	↓	↓
		0612_03		↑	↓								↓	
0613	Lake Tyler/Lake Tyler East	0613_02		↑										
		0613_03				↑			↑					
		0613_04					↑							
0614	Lake Jacksonville	0614_01					↑							
		0614_02		↓			↑							
0615	Sam Rayburn/Angelina River	0615_01				↓	↓	↓	↓			↓		
0615A	Paper Mill Creek	0615A_01		↓		↓	↓	↓	↓			↓		↓

Recommendations

Funding for the Texas Clean Rivers Program

Supporting Statewide Water Quality Monitoring Efforts

The Clean Rivers Program partners generate a substantial amount of water quality data in support of TCEQ's water quality programs and decision making processes. All data generated by ANRA in support of the Clean Rivers Program is submitted to TCEQ's Surface Water Quality Monitoring Information System for the commission to use in its assessments.

Funding for the Clean Rivers Program remained unchanged for over two decades following the program's inception in 1991. For the FY 2014/2015 biennium, funding for the program was reduced by 10% statewide. As costs increase every year, monitoring activities may have to be decreased in order to fund fixed costs such as salaries, as well as variable costs including travel, supplies and equipment.

So far, ANRA has been able to increase its number of monitoring locations in the basin in response to stakeholder concerns, but it has only been able to do so by reallocating salaries to other departments and acquiring additional automated laboratory equipment. This equipment was purchased through numerous funding sources, including Clean Water Act Section 319 grants. In FY 2015, the TCEQ funded a Clean Rivers Program contract amendment to provide ANRA with an additional $10,957 to purchase laboratory equipment. Since 2008, the ANRA Environmental Laboratory has invested over $100,000 in new equipment. While the additional equipment is beneficial to laboratory operations, the limited resources for personnel expenses, particularly for additional field monitoring staff, make this approach difficult to sustain long-term.

ANRA is hopeful that dedicated Clean Rivers Program funding can be reinstated in the future in order to maintain statewide monitoring efforts that are crucial to TCEQ's water quality programs.

Basin Goals and Priorities

The following priorities are based upon the evaluation of water quality presented in this Basin Summary Report, as well as recommendations from stakeholders and Steering Committee members.

Implementing the Attoyac Bayou WPP

With the approval of the Attoyac Bayou Watershed Protection Plan by the EPA, a concerted effort can now be made to address water quality impairments in the Attoyac Bayou watershed. ANRA has already implemented some of the suggestions in the WPP to address failing and non-existent OSSFs. Through a TCEQ-funded Clean Water Act Section 319 grant, ANRA is replacing failing septic systems within the four counties of the watershed to address one of the potential sources of *E. coli*.

ANRA is working closely with the Texas Water Resources Institute, Stephen F. Austin State University, Castilaw Environmental, and the Pineywoods Resource Conservation & Development program to develop additional project proposals to address public education, water quality monitoring, and OSSF replacement in the watershed.

On-Site Septic Facility Database and Mapping

As part of ANRA's Clean Water Act Section 319 grant to replace failing septic facilities in the Attoyac Bayou watershed, ANRA is also creating a database of all permitted OSSFs in the Sam Rayburn Reservoir Control Zone (the 2000 ft buffer zone around the reservoir), as well as the unincorporated portions of San Augustine County. ANRA is the Authorized Agent for OSSF permitting in both areas. ANRA is very interested in working with other Authorized Agents in the basin to share data and create a clearinghouse of OSSF permit data that can be used to map septic systems throughout the basin.

Recreational Use Attainability Analyses

Numerous segments in the basin are listed as impaired based upon their failure to meet the standard set for Primary Contact Recreation. Many of these segments are not likely used for Primary Contact Recreation due to numerous factors, such as limited access, bank characteristics, etc. By conducting RUAAs on these segments, the actual use of the streams can be determined to see if the most appropriate contact recreation standard is being applied.

RUAAs have either been completed or are underway on the Attoyac Bayou, Neches River above Lake Palestine, Prairie Creek, Mud Creek, West Mud Creek, Ayish Bayou, East Fork Angelina River, Biloxi Creek, Jack Creek, and Paper Mill Creek.

Support of the Texas Stream Team

ANRA continues to support the Texas Stream Team and the volunteer monitoring program of the Greater Lake Palestine Council, including the facilitation of a training program for new monitors in 2014. In the future, ANRA would like to participate in additional training opportunities and expand volunteer monitoring programs to other areas of the basin.

Watershed-Specific Monitoring Activities

ANRA has implemented additional monitoring in certain watersheds to address stakeholder concerns.

For Cedar and Hurricane Creeks, ANRA has added additional monitoring stations within the Lufkin city limits to help identify potential sources of the elevated *E. coli* and nutrient levels observed in these segments. ANRA worked closely with the City of Lufkin to select these additional monitoring stations.

In the Lake Striker watershed, unusually low pH values have been recorded. Working with the TPWD Kills and Spills Team, ANRA instituted additional monitoring on streams which flow into Lake Striker in order help identify potential causes of the low pH issues in the lake.

Conclusions

The Angelina and Neches River Authority's jurisdictional service area consists of approximately 8,500 square miles that lie wholly or in part of 17 counties. ANRA has a robust surface water quality monitoring program in the basin, monitoring 40 stations on a quarterly basis for the Clean Rivers Program, as well as additional monitoring for other grant projects.

Bacterial levels which do not support contact recreational use are the most common issues found in this portion of East Texas. With much of this area being rural and sparsely populated, non-point sources are the most likely cause of bacterial contamination of streams. Other areas have shown a recent improvement in water quality, particularly Paper Mill Creek and portions of Sam Rayburn Reservoir following the closure of the paper mill in Lufkin. There are several areas of concern for nutrients throughout the basin, and routine monitoring activities should be continued in order to better to assess these areas.

As the competing interests for water increase, the water in East Texas will continue to be one of the state's greatest natural resources. As the population of Texas is expected to increase over the next 50 year planning horizon, it is of critical importance that this valuable resource be monitored, maintained, and enhanced in order to meet the growing demands of the State of Texas.

Appendices

Flooded road near the confluence of Big Iron Ore Creek and the Attoyac Bayou

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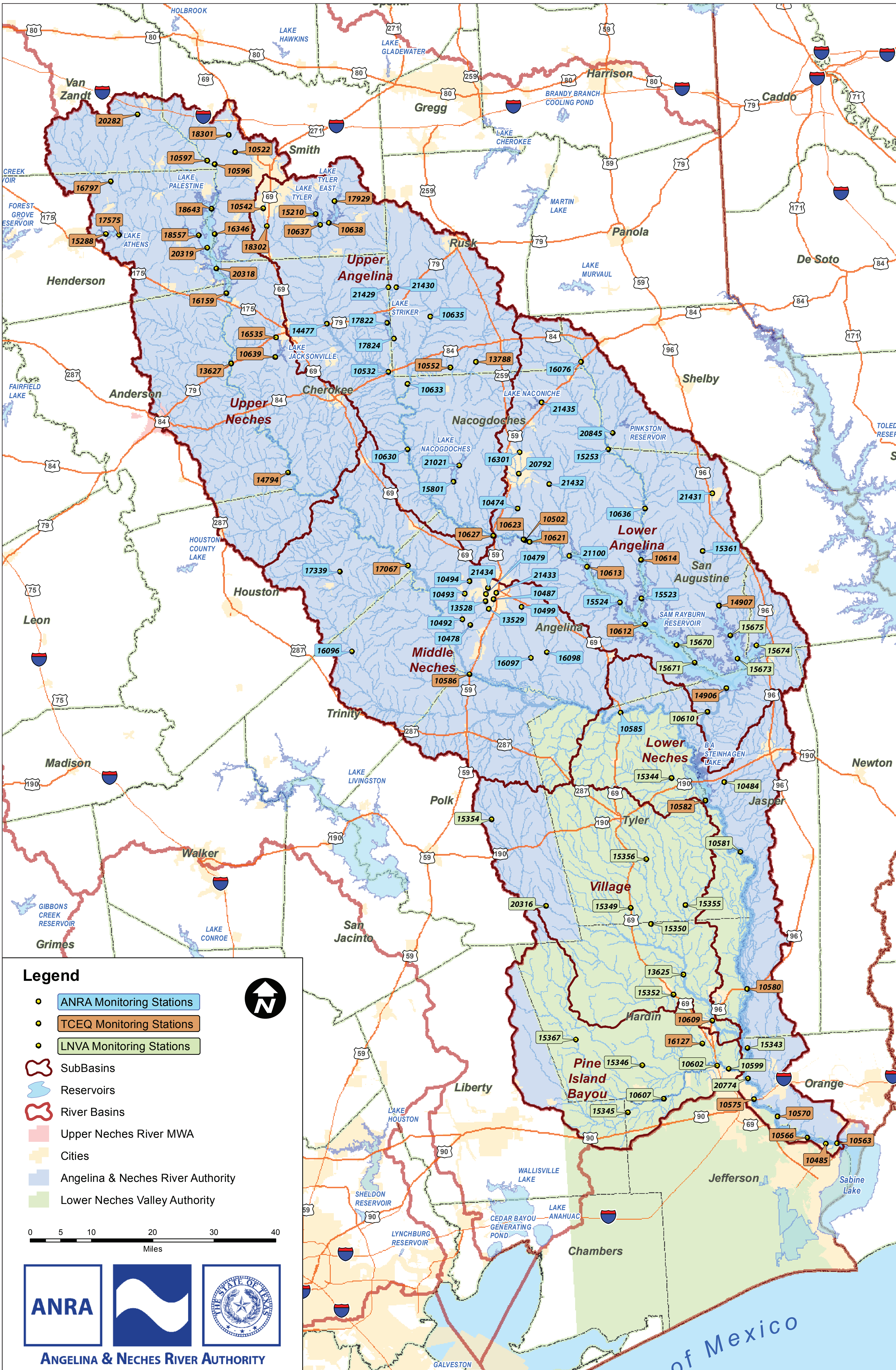
List of Acronyms

ALU	Aquatic Life Use
ANRA	Angelina and Neches River Authority
AU	Assessment Unit
Ave	Avenue
Avg	Average
BMP	Best Management Practice
C	Celsius
cfs	cubic feet per second
Chl-*a*	Chlorophyll-*a*
Cl	Chloride
CMS	Coordinated Monitoring Schedule
CR	County Road
CRP	Clean Rivers Program
CS	Concern for Screening
CWA	Clean Water Act
CZR	Control Zone Rayburn
DO	Dissolved Oxygen
DSHS	Department of State Health Services
EPA	Environmental Protection Agency
F	Fahrenheit
FM	Farm-to-Market Road
FS	Fully Supporting
FWSD	Freshwater Supply District
FY	Fiscal Year
GIS	Geographical Information System
hr	Hour
HUC	Hydrologic Unit Code
HWY	Highway
ISD	Independent School District
km	Kilometer
LNVA	Lower Neches Valley Authority
m	Meter
MAX	Maximum
mg/L	milligrams per liter
mi	Mile
MIN	Minimum
MPN	most probable number
MSW	Municipal Solid Waste
MUD	Municipal Utility District
N	Nitrogen
NA	Not Assessed
NCR	Non-Contact Recreation
NELAP	National Environmental Laboratory Accreditation Program
NH3	Ammonia-Nitrogen
NHD	National Hydrography Dataset
NO3/NO2	Nitrate+Nitite-Nitrogen
NPDES	National Pollution Discharge Elimination System
NPS	Nonpoint Source
NS	Not Supporting
OSSF	On-Site Sewage Facility
P	Total Phosphorus
PCR	Primary Contact Recreation
PWS	Public Water System
QAPP	Quality Assurance Project Plan
RC	Reach Code
RUAA	Recreational Use Attainability Analysis
RWA	Receiving Water Assessment
SCR1	Secondary Contact Recreation 1
SCR2	Secondary Contact Recreation 2
SFASU	Stephen F. Austin State University
SH	State Highway
SO4	Sulfate
Spec Cond	Specific Conductance
SU	Standard Units
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System

List of Acronyms

TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TIAER	Texas Institute for Applied Environmental Research
TMDL	Total Maximum Daily Load
TPDES	Texas Pollution Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
TWDB	Texas Water Development Board
TWRI	Texas Water Resources Institute
UAA	Use Attainability Analysis
µg/L	micrograms per liter
US	United States Highway
µs/cm	microseiemens per centimeter
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WAP	Watershed Action Planning
WCID	Water Control and Improvement District
WLE	Wasteload Evaluation
WPP	Watershed Protection Plan
WQS	Water Quality Standards
WSC	Water Supply Corporation
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

Map of Monitoring Stations in the Neches River Basin for FY 2015



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2015 Upper Neches Basin Summary Report

The 2015 Basin Summary Report was prepared by the Angelina & Neches River Authority
in cooperation with the Texas Commission on Environmental Quality (TCEQ)
under the authorization of the Texas Clean Rivers Act.