Brazos River Basin Highlights Report 2009

TABLE OF CONTENTS

The Brazos River Authority, as a member of the Texas Clean Rivers Program, works to answer questions about the quality of our local streams, rivers and lakes in the *2008 Brazos River Basin Highlights Report*. This report contains the information needed to answer questions about water quality in the lakes and streams of the Brazos River basin. It also summarizes the results of the ongoing water quality assessment activities in the Brazos River basin under the Texas Clean Rivers Program.

The Authority wishes to thank both the Texas Commission on Environmental Quality's Clean Rivers Program staff and the Surface Water Quality Monitoring Team for their hard work and significant contributions to the water quality in the Brazos River basin. Thanks also go out to the hundreds of individuals and organizations that are not named on these lists who have attended public meetings and other outreach events sponsored by the Authority and the Clean Rivers Program. Their input is the foundation of the watershed management process.

INTRODUCTION

The principal goal of the Texas Clean Rivers Program (CRP) is to ensure safe, clean water supplies for the future of Texans' drinking water needs, industry, agriculture, healthy ecosystems, and recreation and for all other uses of this valuable state resource. The CRP meets its goal in the Brazos River Basin through an ongoing partnership involving the Texas Commission on Environmental Quality (TCEQ), the Brazos River Authority (BRA), regional entities, local governments, industry and citizens.

As the lead agency for the Brazos River Basin, the Authority oversees all aspects of the Clean Rivers Program process in the basin. This includes: serving as liaison between TCEQ and the stakeholders, participating in statewide CRP task forces; performing all administrative and project tasks; supporting the Brazos River Basin CRP Steering Committee and Technical Advisory Committee; and maintaining regular contacts with other planning agencies.

THIS YEARS HIGHLIGHTS

The water quality in the Brazos River Basin is generally good and the majority of the basin supports aquatic life and recreational uses. Two issues that commonly affect the water quality are drought conditions and excessive levels of chloride. Water quality can also be dramatically impacted by flooding, and although this occurs rarely, we did experience significant flooding in the spring and summer of 2007 which continued to affect the Brazos River basin in 2008.

Chloride

Chloride in the mainstem of the Brazos River Basin comes from natural brine springs in Stonewall, Kent and Garza counties that deposit highly concentrated groundwater into the watershed of the Salt Fork and Double Mountain Fork of the Brazos. Rainfall then flushes this residual salt into the rivers. The natural salt produced in the uppermost portion of the Brazos River Basin affects the mainstem throughout its entire reach.

Drought conditions frequently affect most of the State of Texas; such was the case from 2005 through early 2007. Over this period, chloride levels in mainstem lakes became even more concentrated than normal due to evaporation which reduced water levels while leaving chlorides in the remaining water. During this drought period, chloride levels in Lakes Possum Kingdom and Granbury reached high concentrations never previously observed in either lake. Water releases from both lakes caused abnormally high chloride levels to be observed in the entire mainstem of the Brazos River. Concentrating effects of chlorides and other minerals were also observed in other parts of the basin but were not as dramatic as those observed in the mainstem.

With significant rainfall events occurring in March, May and June of 2007, flooding occurred in almost all parts of the Brazos River basin. In the Upper

Basin, these rainfall events fortunately all occurred east of the salt producing area in the Brazos basin and had a diluting affect on chlorides in the mainstem. In just a few months time, the chloride levels in the mainstem went from the highest ever recorded to the lowest ever recorded. Chloride levels in mainstem lakes remain uncharacteristically low but have risen somewhat in 2008 as rainfall, although not at drought levels, was below average.

New Projects

In 2008, the BRA received funding from the Texas State Soil and Water Conservation Board to further assess water quality in the Little Brazos River Watershed in Robertson County. In 2004, five tributaries to the Little Brazos River were placed on the State's 303(d) List for having bacteria concentrations that exceed state water quality standards for contact recreation. The purpose of this project is to better characterize the bacteria impairment and to determine possible sources. For the project, the BRA added 8 new water quality monitoring sites throughout the watershed and started monitoring flow and collecting stormwater data in November 2008

Completion of the 2007 Basin Summary Report

The BRA was proud to present its 2007 Basin Summary Report. This report is completed once every five years. The report was in a completely different format from previous summary reports. After discussing what would be the most useable format for a report of this magnitude, and after considering usability, development and distribution costs, BRA decided to go with an all-electronic report format (interactive CD) with a companion booklet that included the Executive Summary and a user's guide for the CD.

Response to the report has been overwhelmingly positive. Users are saying it is the most user-friendly water quality report they have used. They like the fact that they can print any maps they want from the report. The data tables are easy to read and easily printed. BRA presented the 2008 and 2009 Basin Highlights Reports and plans to produce all future reports in this same type of format. A copy of the report is available online at: http://www.brazos.org/BasinSummary_2007.asp.

National Environmental Laboratory Accreditation Conference

In 2001, the 77th Texas Legislature passed HB 2912 requiring that all data used by TCEQ for commission decisions regarding permits or other authorizations, compliance matters, enforcement actions, or corrective actions be from an accredited environmental laboratory.

HB 2912 also transferred authority for environmental laboratory accreditation and drinking water certification from Texas Department of Health to the TCEQ, and required that the state's environmental testing laboratory accreditation program be consistent with National Environmental Laboratory Accreditation Conference (NELAC). This transfer of authority became effective on September 1, 2001.

Prior to NELAC, the existing state programs varied widely in scope and requirements. The NELAC Standard provides uniform requirements for accreditation of environmental laboratories to ensure that decisions being made are based on data that is scientifically accurate.

BRA's Environmental Services Laboratory received NELAC accreditation from TCEQ on September 11, 2008.

Texas Water Quality Inventory and 303(d) List

On March 19, 2008, the Texas Water Quality Inventory and 303(d) list, which is complied every two years, was approved by the United States Environmental Protection Agency (EPA). Several segments were added to this list while others were removed (Tables 1 and 2). For a more detailed description of the list and water quality evaluation, please see the **Evaluating Water Quality** chapter of this document. For a visual depiction of all water bodies in the Brazos River Basin that are impaired, on the 303(d) list, maps are provided in the **Basin Overview** chapter.

Table. 1 Brazos River Basin Water Bodies and Impairments Added to the 2008Texas 303(d) List

Water Body	*Segment*	*Use Impaired*	*Parameter*	*Action*
Lake Granbury	1205	General	elevated chloride	Additional data to be collected
Brazos River Below Possum Kingdom Lake	1206	Aquatic Life	impaired macrobenthic community	
Brazos River Above Possum Kingdom Lake	1208	Recreation	elevated bacteria	
Somerville Lake	1212	Aquatic Life	depressed dissolved oxygen	
San Gabriel River	1214	General	elevated chloride	
Leon River Below Leon Reservoir	1223	Aquatic Life	depressed dissolved oxygen	
Paluxy River/North Paluxy River	1229	General	elevated sulfate, total dissolved solids and chloride	Error - will be removed from list in 2010
Upper North Bosque River	1255	Aquatic Life	depressed dissolved oxygen	Additional data to be collected

Table. 2 Brazos River Basin Water Bodies and Impairments Removed from the 2008 Texas 303(d) List

Water Body	*Segment*	*Use Impaired*	*Parameter*	*Reason*
Big Creek	1202J	Aquatic Life	impaired habitat	Changed assessment procedure
Lampassas River Below Stillhouse Hollow Lake	1215	Recreation	elevated bacteria	Meets criteria
Lake Graham	1231	General	elevated bacteria	Meets criteria
White River Lake	1240	General	elevated sulfate	Meets criteria
Double Mountain Fork Brazos River	1241	General	elevated total dissolved solids	Meets criteria
Upper Oyster Creek	1245	Recreation	elevated bacteria	Completed TMDL

PUBLIC INVOLVEMENT AND OTHER INFORMATION

Brazos River Basin Clean Rivers Program Steering Committee

The size and diversity of issues across the Brazos River Watershed presents a challenge for the large group of stakeholders in our basin. The Brazos River Clean Rivers Program (CRP) Steering Committee participants represent diverse interests that are represented by government agencies, municipalities, industry, agriculture, organized local stakeholder groups, individuals, and environmental groups. For the 2008 fiscal year the Brazos River Authority made a concerted effort to encourage and increase participation at local levels within the basin. The Clean River Program Steering Committee meeting attendance in the Brazos River Basin more than doubled in 2008 from the previous year.

The BRA holds an annual meeting that provides the Steering Committee with an opportunity to hear results of water quality monitoring and CRP special studies and gives them a forum where they may voice opinions, make recommendations and interact with other stakeholder participants and BRA staff. Steering Committee members also participate by providing input into planning water quality monitoring activities, prioritizing problems within the basin for prospective CRP special studies, identifying problem areas and developing actions to address potential problem areas in the basin.

How to get involved with the Brazos Basin CRP?

BRA promotes communication and participation from the general public. If you are interested in serving on the Brazos River Basin CRP Steering Committee, send an email addressed to jbarrett@brazos.org. Please indicate what topics you are interested in and provide an email address so that you can receive electronic notices of meetings and reports. In addition, the information you provide will help us to develop more effective meetings and provide direction to the program. We highly encourage participation in our meetings and input on water quality issues in the basin.

Brazos Basin CRP Website

The BRA maintains both a river authority website (http://www.brazos.org) and a CRP website (http://www.brazos.org/crpHome.asp) as a mechanism to keep the public informed via the internet. These websites provide information on topics of interest in the basin. The websites provide links to a range of information, including:

Water quality data

Water quality data generated by the BRA is available in a searchable format and can be easily downloaded to an Excel file (http://crpdata.brazos.org/). A link to the TCEQ data website is also provided.

Special Studies Reports

Available for download in .pdf format.

Quality Assurance Information

The Quality Assurance Project Plan for CRP and Data Management Plan are available for download in .pdf format.

Schedule of Monitoring Activities

A link is provided to the coordinated monitoring website, which contains a list of the water quality monitoring locations in the state.

Information on Non-CRP Water Quality Projects

Information is provided on a variety of water quality related projects sponsored by the BRA that are not conducted as part of the CRP.

River and Reservoir Levels

An interactive map provides information on USGS Stations in the basin, flood stage at each station and current flow at each station.

Current Drought Status

An updated Palmer Drought Index map is provided along with copies of the BRA's Drought Contingency Plan and Water Conservation Plan.

Water Supply Data

Information is provided on reservoir locations, elevations, and capacities and surface area.

Technical Assistance Program

Information is provided on services offered by the BRA to municipalities and utility districts in the basin, including: Industrial Pretreatment Programs, Regulatory Reviews, and Operations Assistance.

SPECIAL PROJECTS

The Brazos River Authority's (BRA) public outreach activites include involving our stakeholders in planning water quality and watershed protection activities in the Brazos Basin as well as education and outreach programs.

Watershed Protection Plan for Lake Granbury

In May 2002, a study began to monitor and assess water quality in the canals and coves of Lake Granbury. The canals are backwater areas that have little or no circulation and mix slowly with the main body of the reservoir. The result can mean stagnant conditions where pollution problems have the potential to persist. The on-site sewage facilities located along the many canals and coves of Lake Granbury may be a significant source of bacteria and nutrients to the reservoir and may cause water quality concerns in many of the canals. The BRA and TCEQ are currently developing a Watershed Protection Plan (WPP) to address the concerns that these canals present. The Lake Granbury WPP has a large, active stakeholder group with representatives from government agencies, local, state and federal government, municipalities, and other locally interested parties. In addition, a Technical Advisory Group made up of agency representatives provides technical input to the plan development.

The Lake Granbury Watershed Protection Plan Stakeholders group continued their efforts to develop a Watershed Protection Plan to reduce bacterial impacts in the canals of Lake Granbury. During 2008, the stakeholders group completed source identification projects including: land use analysis, water quality modeling and bacterial source identification projects. The sources varied by location. In urban areas the bacteria in Lake Granbury canals appears to come mostly from domestic waste, pet waste, and wildlife. While in rural areas the source appears to be a combination of domestic waste, livestock, and wildlife. The Stakeholders Group is now working to select and analyze Best Management Practices. It is anticipated that the Watershed Protection Plan will be completed fiscal year 2010.

Watershed Protection Plan for Lake Granger and the San Gabriel River

The BRA, in coordination with the Little River-San Gabriel Soil and Water Conservation District (SWCD), has received grant funding from the Texas State Soil and Water Conservation Board to develop a Watershed Protection Plan (WPP) for Lake Granger and the San Gabriel River Watershed. The Little River-San Gabriel SWCD received a funding to provide technical and financial support to farmers and ranchers for the implementation of best management practices on agricultural lands.

Utilizing stakeholder input, the BRA has identified stream erosion and sedimentation as the primary concerns in the watershed. In addition, Mankins Branch and Willis Creek both are listed on the State's 303(d) List of Impaired

Waterbodies for having *E. coli* bacteria concentrations that exceed the state's contact recreation designation.

The BRA will continue to coordinate with stakeholder groups and project partners to develop a WPP that is holistic and includes the most appropriate management strategies to address water quality concerns.

Watershed Protection Plan for the Leon River

The Leon River was placed on the State's 303(d) List of impaired waters in 1997. In 2002 the TCEQ began developing a Total Maximum Daily Load on the portion of the river downstream of Lake Proctor and upstream of Hamilton. As a result, local stakeholders requested the BRA facilitate the development of a WPP for the Leon River that would assist the TCEQ is selecting implementation strategies for the TMDL. Additional bacteria listings and nutrient concerns on a number of the tributaries have resulted in the BRA expanding the project to address these concerns as well.

The BRA has met with stakeholders on numerous occasions to discuss the most appropriate and acceptable implementation measures. The next step for the project will be to model these scenarios to determine their potential impact on water quality. The WPP is expected to be complete in late 2009.

Little Brazos River Tributaries Bacteria Assessment

The BRA has received funding from the Texas State Soil and Water Conservation Board to further assess water quality in the Little Brazos River Watershed in Robertson County. In 2004, five tributaries to the Little Brazos River were placed on the State's 303(d) List for having bacteria concentrations that exceed state water quality standards for contact recreation. The purpose of this project is to better characterize the bacteria impairment and to determine possible sources. For the project, the BRA has added 8 new water quality monitoring sites throughout the watershed and started monitoring flow and collecting stormwater data in November 2008. The BRA will complete the assessment project in August of 2010.

Clean Texas Marina Program

The Clean Texas Marina Program was established in 2001 in partnership with the marina industry, federal and state agencies and civic organizations. The program is coordinated by the Small Business and Environmental Assistance Division of the Texas Commission on Environmental Quality through a collaborative partnership with the U.S. Environmental Protection Agency, Marina Association of Texas, Texas A&M University Sea Grant Program, Texas Parks and Wildlife Department, General Land Office (Coastal), U.S. Army Corps of Engineers, and other local agencies.

The goal of the Clean Texas Marina Program is to provide technical assistance to implement pollution prevention programs, improve compliance with environmental regulations and enhance water quality. The program also promotes clean boating

public education and outreach efforts to promote improved sewage handling and other environmental impacts.

The BRA has administered this program for TCEQ at Possum Kingdom Reservoir and Lake Granbury since 2004. To date, six marinas on Possum Kingdom Lake and two marinas on Lake Granbury have been certified as Clean Marinas. Currently, one additional marina on Lake Granbury has pledged to join the program and is in the process of making necessary repairs and upgrades. Upon completion of upgrades and repairs, they will have a confirmation inspection.

Clean Water Sticker Program

The Clean Water Sticker Program is a legislatively-mandated program aimed at reducing sewage inputs into freshwater lakes from boats and sewage pump-out facilities. In 2004, the TCEQ delegated authority to the BRA for performing annual inspection and certification activities for sewage pump-out facilities at marinas on Possum Kingdom Reservoir and Lake Granbury. Since the delegation, the BRA has inspected seven pump-out stations annually at Possum Kingdom Reservoir and two at Lake Granbury. During these inspections, Authority staff have identified compromised pump-out systems and provided technical assistance to the systems owners to bring them into compliance and eliminate the release of sewage from these systems.

Beginning in 2007, the BRA has also been designated authority by TCEQ to perform Clean Water Sticker inspections and certify that boats with onboard marine sanitation devices are not capable of discharging sewage into the environment. Boats subject to this program include: houseboats, boats longer than 26 feet with permanent sleeping quarters, and any boat with a permanently installed marine sanitation device. The goal of the boat inspection is similar to that for the pump-out stations, to reduce sewage discharged from boats that may degrade water quality and to ensure that designated vessels are in compliance with federal and state laws.

EVALUATING WATER QUALITY

The Texas Commission on Environmental Quality (TCEQ) evaluates the condition of the state's water bodies on a periodic basis under the Clean Water Act (CWA) Section 305(b). The results are contained within the Texas Water Quality Inventory and 303(d) List and are comprised of a complete listing of all water quality concerns in the state. As required by the Act, the inventory is updated every two years and includes the review of the past seven years' data collected by many organizations statewide, including the BRA. The 2008 Water Quality Inventory and 303(d) List, on which the following information is based, provides an assessment of water quality results using the most recent seven years of data. This inventory is available on the TCEQ Web site at http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/305_303.html.

The Texas Water Quality Inventory, 305(b) report, provides an overview of surface water quality throughout the state, including issues relating to public health, fitness for use by aquatic species and other wildlife, and specific pollutants and their possible sources. These water quality issues are identified by comparing concentrations in the water to numerical criteria that represent the state's water quality standards or screening levels to determine if the waterbody supports its designated uses, such as suitability for aquatic life, for contact recreation, or for public water supply. The report determines if fish and aquatic insects have adequate oxygen, if people swimming in the water are exposed to pathogens that may cause illness and if the water is fit to be used as a source for public drinking water. Waterbodies that do not meet established water quality standards are placed on the 303(d) List and are referred to as "impaired," "not supporting," or "NS." Once placed on the list the waterbody is targeted for special study and/or corrective action.

Water quality standards numerical criteria are used by TCEQ as the maximum or minimum instream concentrations that may result from permitted discharges and/or nonpoint sources and still meet designated uses. To resolve the issues of regional and geological diversity of the state, standards are developed for classified segments. Classified segments are defined segments of waterways that are unique from other segments. Appropriate water uses such as contact recreation, public water supply, and aquatic life are then applied to the segments. Specific water quality criteria has been developed for water temperature, dissolved oxygen, pH, bacteria, chloride, sulfate and total dissolved solids have been developed for classified segments. Many streams that are not classified segments are assessed throughout the state and are considered unclassified segments. These unclassified segments do not have specific water quality standards developed for them. For assessment purposes, unclassified streams are assessed using the numeric criteria developed for the classified segment into which the stream flows.

The TCEQ identifies segments where the data conditions are such that the waterbody is close to violating water quality standards as "concern for near nonattainment of standards" or "CN." These CN segments are then targeted for increased monitoring to better understand the conditions in the stream.

Numeric quality standards have not been developed for nutrients and chlorophyll *a*. Instead, the water quality standards for nutrients and chlorophyll *a* are expressed as narrative criteria. In the absence of segment-specific numeric water quality criteria, the state has developed screening levels for these parameters in order to identify areas where elevated concentrations may cause water quality concerns. These screening levels are applied to waterbodies statewide, and are based on the 85th percentile of nutrient values in the statewide water quality database. Waterbodies that exhibit frequent (>25% of the time) elevated concentrations of nutrients and chlorophyll *a* are referred to as a "concern for

screening level violations" or "CS" and are often targeted for continued and increased monitoring to better understand the effects of the elevated concentrations.

Descriptions of Water Quality Parameters

Field parameters are those water quality constituents that can be obtained on-site and generally include: dissolved oxygen (DO), specific conductance, pH, water temperature, stream flow (not in reservoirs) and transparency.

Dissolved oxygen indicates the amount of oxygen available in the stream or reservoir to support aquatic life. DO concentrations can be reduced by the decomposition of organic matter.

Specific Conductance is a measure of the waterbody's ability to conduct electricity and indicates the approximate levels of dissolved salts, such as chloride, sulfate and sodium in the water. Elevated concentrations of dissolved salts can reduce the waters usability as a drinking water source and as suitable aquatic habitat.

pH is a measure of the hydrogen ion concentration in an aqueous solution. It is a measure of the acidity or basic property of the water. Chemical and biological processes can be affected by pH. Dissolved constituents can influence pH, such as carbon dioxide and by point and nonpoint source contributions to the stream.

Water Temperature affects the ability of the water to hold dissolved oxygen. Warmer water temperatures decrease the oxygen solubility in water, causing stress in aquatic ecosystems.

Flow is an important parameter affecting water quality. Low flow conditions common in the warm summer months can create critical conditions of aquatic organisms. Under these conditions, streams also have lower assimilative capacities for waste inputs from point and nonpoint sources and are also subject to decreased oxygen availability.

Transparency is a measure of the depth to which light is transmitted through the water column and thus the depth to which aquatic plants can grow.

Conventional Parameters are typical water quality constituents that require laboratory analysis and generally include: chloride, sulfate, total dissolved solids (TDS), nutrients, Chlorophyll *a* (Chl *a*), total suspended solids (TSS), and turbidity.

Chloride is an essential element for maintaining normal physiological functions in all organisms. Elevated chloride concentrations can disrupt osmotic pressure, water balance, and acid/base balances in aquatic organisms which can

adversely affect survival, growth and/or reproduction. Elevated chloride content can also impact the usability of water for drinking water.

Sulfate is an essential element for maintaining normal physiological functions in all organisms. Effects of high sulfate levels in the environment have not been fully documented; however, sulfate contamination may be contributing to the declines of native plants by altering chemical conditions in the sediment. Elevated sulfate content can also impact the usability of water for drinking water.

Total Dissolved Solids is a measurement of minerals and other salts that are dissolved in water. High TDS may affect the aesthetic quality of the water, interfering with washing clothes and corroding plumbing fixtures. High TDS in the environment can also affect the permeability of ions in aquatic organisms. **Nutrients**, nitrogen and phosphorus compounds, increase plant and algae growth. When plants and algae die, the bacteria that decompose them use oxygen that is no longer available for fish and other organisms. The more dead plants in the water, the more bacteria are produced to decompose the dead leaves.

Chlorophyll *a* is a plant pigment whose concentration is an indicator of the amount of algal biomass and growth in the water.

Total Suspended Solids indicate the amount of particulate matter suspended in the water column, which can influence transparency.

Turbidity is a measure of water clarity or light transmitting capability of water. Increases in turbidity are caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms.

Bacteria, specifically *E. coli* and Enterococcus, are used as an indicator of the possible presence of disease-causing organisms.

Biological and Habitat assessment includes collection of fish community data, benthic macroinvertebrate data and measurement of physical habitat parameters. This information is used to determine whether the stream adequately supports a diverse and desirable biological community.

24-Hr Dissolved Oxygen studies perform measurements of DO in frequent intervals in a 24-hr period. This type of monitoring is conducted to measure the diurnal variation of DO and its impacts on the biological community. This monitoring is frequently paired with biological and habitat assessments.

Metals in water, such as mercury or lead, typically exist in low concentrations but can be toxic to aquatic life or human health when certain levels are exceeded.

Organics in water, such as pesticides or fuels, can be toxic to aquatic life or human health when certain levels are exceeded.

Monitoring in the Brazos River Basin

The Brazos River Basin can be divided into 14 major watersheds that fall within the 42,000 square miles and portions of 70 counties that make up the basin (MAP). The 14 major watersheds include:

- the Caprock watershed;
- the Double Mountain Fork/Salt Fork of the Brazos watershed;
- the Clear Fork of the Brazos watershed;
- the Upper Brazos River watershed;
- the Lampasas River watershed;
- the Leon River watershed;
- the Bosque River watershed;
- the Aquilla Creek watershed;
- the Little River watershed;
- the Central Brazos River watershed;
- the Navasota River watershed;
- the Yegua Creek watershed;
- the Lower Brazos River watershed; and
- the Oyster Creek watershed.

The Caprock watershed is a non-contributing watershed to the Brazos River Basin due to lack of rainfall and high evaporative rates in northwest Texas. Precipitation in this area is either absorbed by area soils or is contained in the hundreds of playa lakes in this part of the state. Playa lakes are shallow, round depressions that fill after storms then rapidly dry due to evaporation. These temporary lakes provide water for wildlife and flood control for municipalities. However, due to their ephemeral natures, these lakes are not monitored or assessed as part of the CRP.

One of the key roles of the CRP is fostering coordination and cooperation in monitoring efforts. Coordinated monitoring meetings are held once a year to bring all the monitoring agencies together to discuss streamlining and coordinating efforts, and to eliminate duplication of monitoring efforts in the watersheds of the Brazos River Basin.

Table 3 outlines the type, frequency and number of stations in the Brazos Basin monitored by various entities as part of the Brazos Basin CRP for FY 2008 (September 2007 through August 2008).

Table 3. FY 2008 Summary of Sampling for the Brazos River Basin (September 2007 through August 2008)							
Sampling Entity	**Field**	**Conventional**	**Bacteria**	**24-hr D.O.**	**Biological and Habitat**	**Metals in Water**	**Organics in Water**
BRA	76 monthly 72 quarterly 9 semi-annually			8 semi-annually	8 semi-annually		
TCEQ	65 quarterly			4 semi-annually	2 semi-annually	15 quarterly 3 semi-annually	2 semi-annually
		1 quarterly					
	1 quarterly		1 quarterly				
	6 semi-annually						
TIAER	20 semi-monthly						
	7 semi-monthly		7 monthly				
	1 bi-monthly						
TPWD				3 annually			
Abilene	1 semi-annually						

Information compiled from the Clean Rivers Program Coordinated Monitoring website (http://cms.lcra.org/)

Biological Assessments

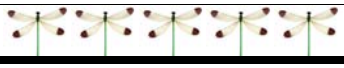
The Authority conducts biological assessments for individual, routine monitoring sites. They are conducted to provide baseline data on environmental conditions or to determine if the designated aquatic life use for the stream is being attained. Data collected as part of a biological assessment are used for the State of Texas Water Quality Inventory or CWA Section 305(b) assessment. The three components evaluated during a biological assessment include: the available habitat, the fish community and the microinvertebrate community. Each component, depending on the nature of a particular waterbody and its biota, is classified as having limited, intermediate, high, or exceptional aquatic life.

BASIN OVERVIEW

The Basin Overview section of this report contains water quality assessment information about each of the classified segments in the Brazos Basin Clean Rivers Program assessment area. This section is presented as a result of Texas Commission on Environmental Quality (TCEQ) and Brazos River Authority (BRA) screening. It is important to remember that the information presented represents a snapshot in time and that water quality conditions are dynamic and can change over time. Furthermore, segments identified as having "no known problems" are not necessarily without problem. Rather, there may have been limited or no data available and all uses may not have been assessed.

Each classified segment has been ranked according to the degree of water quality impairments or concerns and reflects the overall quality of each stream segment (Table 4).

Table 4. Ranking Key

Rank	NS[1]	CS[2]	CN[3]	Description
	0	0	0	No impairments or concerns.
	0	1	0	One concern for screening levels, or
	0	0	1	One concern for near non-attainment of standard
	1	0	0	One impairment, or
	0	1+	0	Multiple concerns for screening levels, or
	0	0	1+	Multiple concerns for near non-attainment of standard, or
	0	1	1	One concern for screening levels and one concern for near non-attainment of standard
	2	0	0	Two parameters impaired
	1	1	0	One impairment and one concern for screening levels, or
	1	0	1	One impairment and one concern for near non-attainment of standard, or
	0	1+	1+	Multiple concerns for screening levels and near non-attainment of standards, or
	1+	2+	2+	One or more impairements and multiple concerns for screening levels and near non-attainment of standards

[1]NS indicates a segment is non-supporting or impaired; does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants

[2]CS indicates a segment has a concern for water quality based on screening levels

[3]CN indicates a segment has concern for near-nonattainment of applicable water quality

standards

WATERSHED OF THE SALT FORK AND DOUBLE MOUNTAIN FORK OF THE BRAZOS RIVER (MAP)

The Watershed of the Salt and Double Mountain Forks of the Brazos River begins with the formation of the Double Mountain Fork of the Brazos River near Tahoka in Lynn County. The Salt Fork of the Brazos River is formed in southeastern Crosby County and flows approximately 175 miles before joining with the Double Mountain Fork in Stonewall County to form the main stem of the Brazos River. The Double Mountain Fork and Salt Fork both flow through rural areas with very little development. The land use is primarily agricultural and rangeland. The North Fork of the Double Mountain Fork does have limited perennial flow immediately below the City of Lubbock where several wastewater outfalls create a continuous flow of water. However, this wastewater driven flow typically does not reach the Double Mountain Fork due to high evaporative rates in this arid part of the state. Both the Double Mountain and Salt Forks are shallow streams that meander within the stream bed. This watershed is underlain by geologic formations that are very high in salt content and contribute to the high levels of dissolved solids and chlorides in this watershed and over much of the remaining Brazos River main stem.

Salt Fork of the Brazos River (Segment 1238) –

This segment is impaired for chloride. The source of chloride causing impairment in this segment is from underlying geologic formations that are very high in salt content and contribute to the high levels of dissolved solids and chlorides to the river via a series of brine springs. TCEQ is currently proposing to the United States Environmental Protection Agency (EPA) a revised chloride standard of 33,670 mg/L for this segment based on long-term data collection efforts. Should EPA approve the new standard, it is anticipated that the chloride impairment for this segment will be removed from the 2010 303(d) List.

The segment also has a concern for dissolved oxygen (DO) in the portion of the segment near Highway 83 and for high water temperature in the portion of the segment near Highway 380. Both of these concerns are most likely caused by low water levels and high ambient temperatures in the most arid part of the basin.

White River (Segment 1239) –

This segment has no impairments or concerns.

White River Lake (Segment 1240) –

White River Lake is listed as impaired for chloride and TDS. This segment was previously impaired for sulfates. This has been downgraded to a concern in the 2008 303(d) List. As with this entire watershed the source of dissolved solids are a result of the geology of the watershed. However, trend analysis indicates an

increasing trend in chloride and TDS. TCEQ is currently proposing to the EPA revised standards for chloride (210 mg/L), sulfate (110 mg/L) and TDS (870 mg/L) for this segment based on long-term data collection efforts. Should EPA approve these new standards, it is anticipated that the chloride and TDS impairments and the sulfate concern for this segment will be removed from the 2010 303(d) List.

Double Mountain Fork of the Brazos River (Segment 1241) – 
This segment is listed as not supporting for Chloride. The previous impairment for TDS was removed from the 2008 303(d) List but remains a concern. Like the Salt Fork of the Brazos River and White River Lake, this segment is impacted by naturally occurring salt deposits that result in non-attainment of standards. TCEQ is currently proposing to the EPA a revised standard for chloride (3,270 mg/L) for this segment based on long-term data collection efforts. Should EPA approve this new standard, it is anticipated that the chloride impairment will be removed from the 2010 303(d) List.

Unclassified sub-segment 1241A, the North Fork Double Mountain Fork of the Brazos River, is listed as not supporting for *E. coli* and has concern for ammonia, nitrate, and chlorophyll *a*. The most likely source of nitrogen loading and bacteria in this segment is from point source municipal discharges. The nitrogen loading in this segment in turn is most likely stimulating the algal growth and leading to elevated chlorophyll *a* levels.

Lake Alan Henry (1241B) is not listed for any impairment or concerns.

Buffalo Creek Reservoir (1241C) is listed as having a concern for chlorophyll *a*. The most likely cause of the nutrient loading is point source municipal discharges and residential runoff.

WATERSHED OF THE CLEAR FORK OF THE BRAZOS RIVER (MAP)

The Clear Fork Watershed begins in Fisher County and flows 284 miles east through Jones, Shackelford, Throckmorton, Stephens, and Young Counties, to its mouth on the Brazos River near South Bend in southern Young County. The predominant land use is agricultural with one major urban area, Abilene. Special studies on California Creek, Paint Creek, and Deadman Creek have identified agricultural non-point pollution and municipal discharges as possible sources of nutrient loadings.

Clear Fork of the Brazos River (Segment 1232) – 
The Clear Fork is listed as having concerns for chlorophyll *a*, nitrate nitrogen, orthophosphate phosphorus and total phosphorous for the portion of the segment

downstream from the confluence with Deadman Creek. Nutrient concentrations and concerns in the Clear Fork generally are higher near the inflow of Deadman Creek but decrease downstream of the inflow. Deadman Creek is an effluent dominated stream and municipal discharges are most likely the greatest contributor to the nutrient loading in the Clear Fork.

There is also a DO and chlorophyll *a* concern in the portion of the segment upstream from the Deadman Creek inflow. The flow in this portion of the river is highly intermittent and the concerns are most likely a function of low flows, seasonal ambient air temperatures and high evaporative rates.

California Creek (1232A) is listed as having concerns for nitrate and chlorophyll *a*. Potential contributors to the nutrient enrichment concerns include: municipal discharges, agricultural runoff and on-site sewage facilities.

Deadman Creek (1232B), is listed as not supporting for *E. coli* and has concerns for nitrate nitrogen and orthophosphate phosphorus. Deadman Creek is an effluent dominated stream and municipal discharges are most likely the greatest contributor to the nutrient loading in the stream.

Hubbard Creek Reservoir (Segment 1233) –
This segment is listed as having concerns for low DO against the grab sample screening level. Hubbard Creek Reservoir is frequently impacted by drought and low water levels which is most likely the cause of the DO concern.

The unclassified Big Sandy Creek (1233A) has a bacterial concern. Potential contributors to the bacteria concerns include: wildlife runoff, agricultural runoff and on-site sewage facilities.

Lake Cisco (Segment 1234) –
This segment has no listing for impairments or concerns.

Lake Stamford (Segment 1235) –
Lake Stamford is listed as having concerns for low DO against the grab sample screening. Like Hubbard Creek Reservoir, Lake Stamford frequently experiences drought conditions, low inflows, seasonal ambient air temperatures and high evaporative rate all of which contribute to the DO concern.

Fort Phantom Hill Reservoir (Segment 1236) –
Fort Phantom Hill has a concern based on screening level for increased water treatment due to dissolved solids in the reservoir.

Lake Sweetwater (Segment 1237) –

Lake Sweetwater has no impairments or concerns.

UPPER WATERSHED OF THE BRAZOS RIVER (MAP)

The Upper Watershed of the Brazos River drains approximately 4,725 square miles stretching from the Salt and Double Mountain Fork confluence to the impoundment at the Lake Whitney Dam. The river is generally wide with banks heavily vegetated with elm, willow, oak, and juniper trees. The land use is largely agricultural with row crops, rangeland, and pasture. There are three major urban areas in close proximity to the river.

Lake Graham (Segment 1231) –

Lake Graham has no concerns or impairments; TDS was removed from the 2008 303(d) List. The decline in TDS levels is most likely a result of the above normal precipitation observed in the watershed during in 2007 which had a diluting effect on TDS concentrations.

Brazos River above Possum Kingdom Reservoir (Segment 1208) –

The Brazos River above Possum Kingdom was placed on the 2008 303(d) List as non-supporting for bacteria. Elevated levels of bacteria are attributed to general non-point source pollution.

The lower portion of the segment upstream of Possum Kingdom to the confluence with Spring Creek and the uppermost portion between the confluences with Miller's Creek and Lake Creek both possess concerns chlorophyll *a* screening levels. The nutrient sources causing the excessive algal growth are unknown.

Millers Creek Reservoir (1208A) is listed as having a concern for DO and a concern for near non-attainment for *E. coli*. The DO concern is most likely a result of the shallow depths of the reservoir (ranging from 6 to 8 feet in depth) which leads to an insufficient quantity of water to buffer against high ambient air temperatures experienced in this region.

Possum Kingdom Lake (Segment 1207) –

PK is a large reservoir that is an important source of drinking water and recreation. The 2008 assessment found a concern for increased cost of treatment due to dissolved solids. TDS is a constant source of concern for Possum Kingdom Lake due the high saline conditions in the Watershed of the Salt Fork and Double Mountain Fork of the Brazos River. TDS in the reservoir fluctuates greatly with the drought/flood cycle and the reservoir is frequently being listed and de-listed due to this fluctuation. Due to the diluting effect of the 2007 flood on the reservoir is anticipated that the TDS concern will be removed in the 2010 assessment.

Brazos River below Possum Kingdom Reservoir (Segment 1206) –

The Brazos River below Possum Kingdom is listed as not supporting for chloride. The elevated chlorides in this segment are a result of the drought conditions observed from 2005 through early 2007 that resulted in chloride levels becoming even more concentrated than normal due to evaporation and reduced water levels. During the drought period, chloride levels in Possum Kingdom Reservoir reached unprecedented concentrations. As a result of these increased concentrations, abnormally high chloride levels were observed downstream of the Reservoir following water releases. Chloride in the segment fluctuates greatly with the drought/flood cycle and the segment is frequently being listed and de-listed due to this fluctuation. Due to the diluting effect of the 2007 flood on the segment is anticipated that the chloride impairment will be removed in the 2010 assessment. Additionally, TCEQ is currently proposing to the EPA a revised standard for chloride (1,0336 mg/L), sulfate (595 mg/L) and TDS (2,325 mg/L) for this segment based on long-term data collection efforts.

The segment is also listed as not supporting for the macrobenthic community and as having concerns for poor habitat. The Authority conducted biological assessments at three locations in this segment during fiscal years 2005 and 2006. At all three sites, dissolved oxygen criteria were achieved, but an intermediate aquatic life use was indicated by benthic macroinvertebrates and physical habitat. There were no obvious water quality factors which would account for aquatic life use nonattainment by benthic macroinvertebrates, suggesting that physical habitat limitations and hydrological characteristics may have been primarily responsible. Environmental attributes which create relatively harsh instream conditions for aquatic invertebrates include predominance of a shifting sand substrate, which is not conducive for invertebrate colonization, and frequent flow fluctuations resulting from hydroelectric releases from Possum Kingdom Lake.

Lake Palo Pinto (Segment 1230) –

Lake Palo Pinto has no surface water impairments or concerns.

Lake Granbury (Segment 1205) –

The lake is an important source of drinking water and recreation. Lake Granbury is impaired for chloride in the 2008 303(d) List. Lake Granbury serves as a sink for the high amount of dissolved solids that occur naturally in the upper reaches of the basin. Chloride in the segment fluctuates greatly with the drought/flood cycle and the segment is frequently being listed and de-listed due to this fluctuation. Due to the diluting effect of the 2007 flood on the segment is anticipated that the chloride impairment will be removed in the 2010 assessment.

Since May, 2002 there has been an ongoing study designed to monitor and assess water quality in the canals and coves of Lake Granbury. The canals are backwater areas that have little or no circulation and mix slowly with the main body of the reservoir. This data collection effort has identified bacteria impairments in many of these canals and concerns for dissolved oxygen and elevated nutrient levels in a few of the canals. This seems to be a result of the stagnant conditions in the canals and lack of mixing with the main body of the lake which are not observed in the main body of Lake Granbury. The on-site sewage facilities located along the many canals and coves of Lake Granbury may be a significant source of bacteria and nutrients to the reservoir. The sewage facility in combination with stormwater runoff, may be the cause of water quality concerns in many of the canals. To address the concerns that these canals present, the BRA, TCEQ and a dedicated stakeholder group are currently developing a Watershed Protection Plan (WPP) for Lake Granbury.

Brazos River below Lake Granbury (Segment 1204) –
The Brazos River below Lake Granbury is not listed as impaired or as having concerns.

Two biological assessments were conducted on the Brazos River at FM 200 northeast of Glen Rose in 2008, in response to public concerns over effects of golden algae and decline of the fishery in recent years. Despite less-than-optimal physical habitat, which scored intermediate, biological and dissolved oxygen components achieved the designated high aquatic life use, with one exception, when benthic macroinvertebrates rated intermediate in May. Predominance of a shifting sand substrate and frequent flow fluctuations create relatively harsh conditions for invertebrates. Fish scoring higher than invertebrates appears typical for the middle Brazos, as this pattern has previously been documented for sites in Segment 1206. Fish community characteristics indicated favorable water quality conditions during the study period, and did not reflect adverse effects from golden algae.

Paluxy River (Segment 1229) –
The Paluxy River is listed as not supporting for chloride, sulfate, and total dissolved solids. This listing was a result of an assessment error and will removed from the 2010 303(d) List if current conditions persist.

Squaw Creek Reservoir (1229A) has concerns for orthophosphate and total phosphorus. The source of elevated phosphorus in Squaw Creek Reservoir is currently unknown.

Lake Pat Cleburne (Segment 1228) –
Lake Pat Cleburne did not have any concerns or impairments identified during the 2008 assessment.

Nolan River (Segment 1227) –

Nolan River is listed as not supporting for dissolved solids, and has concerns for chlorophyll *a*, nitrate, orthophosphate and total phosphorous. Groundwater in the area contains high concentrations of dissolved solids. This brackish ground water is the primary source of water for industrial and municipal uses in this area. After use, this brackish water is passed to the local municipal waste water treatment plants, which are not equipped to remove the dissolved solids. Thus the TDS passes through the wastewater systems and is discharged to the Nolan River. In light of the impact of the groundwater on surface water, the TCEQ is proposing to the EPA a revised standard for chloride (372 mg/L), sulfate (320 mg/L) and TDS (1,383 mg/L) for this segment based on long-term data collection efforts. Should EPA approve this new standard, it is anticipated that the dissolved solids impairment will be removed from the 2010 303(d) List.

In August and October of 2006, the BRA conducted biological assessments at two locations in this segment, FM 916 and FM 933. The October dataset reflected the existence of near-optimal fish community integrity at both collecting sites. Greatly improved integrity at FM 933 compared to August evidently resulted from the effects of two intervening high flow events, which flushed silt and filamentous algae from the system. The portions of Nolan River downstream from Buffalo Creek where physical habitat and physicochemical conditions are favorable are capable of supporting near-optimal fish community integrity. Such a level of integrity likely would not occur without inflow from Buffalo Creek, as Segment 1227 probably would be dry during the summer. Fish community and water quality data collected prior to the two October high flow events indicate that summertime conditions in the lower portion of Segment 1227 become stressful to aquatic life, due largely to the effects of elevated nutrient concentrations that promote excessive algal growth, which through photosynthesis produces stressful pH levels and wide dissolved oxygen fluctuations. Such conditions could be ameliorated through a reduction in nutrient inputs to the river.

Lake Whitney (Segment 1203) –

Lake Whitney has a concern for nitrate and chlorophyll *a* in the Nolan River Arm and chlorophyll *a* in the Brazos River Arm. Potential non-point sources of nitrate in the watershed include municipal discharges, on-site sewage facilities and municipal and agricultural runoff.

There is also a concern for DO (24-hr average) near the dam. The current cause for low DO is unknown.

Brazos River below Lake Whitney (Segment 1257) –

The Brazos River below Lake Whitney is not listed for any impairments or concerns in the 2008 Assessment.

AQUILLA CREEK WATERSHED (MAP)

The Aquilla Creek Watershed covers about 466 square miles, begins in Johnson County flows through Hill County then discharges into the Brazos River in McLennan County. The Aquilla Reservoir is the major drinking water source for most of the estimated 35,424 residents in Hill County. A land-use analysis in the watershed showed approximately 21 percent of the land is used for pasture, hay and grassland; approximately 60 percent is used for row crops and small grains; approximately 13 percent is deciduous and evergreen forest; and approximately 6 percent is commercial, industrial, transportation, residential, and urban uses.

Aquilla Reservoir (Segment 1254) –

Aquilla Reservoir is the major drinking water source for Hill County. This segment has no impairments but continues to have concerns for atrazine in finished drinking water.

The Hackberry Creek portion of the segment has a concern for arsenic and nickel in sediment. It is suspected that the arsenic came from the arsenic acid cotton defoliant used for decades in the highly agricultural area around Aquilla Reservoir. The nickel is believed to be a historical remnant from industrial activities in the Hillsboro area.

Elevated nitrate concentrations are also a concern in Aquilla Reservoir; sources of elevated nutrients prevalent through much of the watershed have not been determined but may include permitted discharges, agricultural runoff and other non-point source runoff.

Brazos River/Lake Brazos (Segment 1256) –

The Lake Brazos portion of the segment is listed as having concern for elevated chlorophyll *a* on the 2008 assessment. Elevated chlorophyll a levels are most likely a result of municipal discharges and urban runoff, both which can transport high levels of nutrients to waterbodies.

BOSQUE RIVER WATERSHED (MAP)

The Bosque River begins in Erath County and drains 1,652 square miles before emptying into Lake Waco in McLennan County. The predominant land use is agricultural, rangeland, and pasture. A great deal of research has been done in this watershed to address the elevated nutrients and bacteria.

Upper North Bosque River (Segment 1255) –

The Upper North Bosque River is listed as not supporting for *E. coli*, DO, and nutrient enrichment. Wastewater treatment plant effluent, agricultural runoff and the confined animal feeding operations (CAFOs) located in the watershed are potential contributors to the elevated bacteria and nutrients.

Goose Branch (1255A), North Fork Upper North Bosque River (1255B), Scarborough Creek (1255C), Unnamed Tributary to Goose Creek (1255E), Unnamed Tributary to Scarborough Creek (1255F), and Woodhollow Branch (1255G) are all impaired due to elevated *E. coli*.

Sub-segments 1255A-D, Goose Branch Reservoir (1255J) and Scarborough Creek Reservoir (1255K) have concerns for nutrients and/or chlorophyll *a*.

The South Fork Upper North Bosque River Reservoir (1255H) unclassified sub-segment has a concern for DO.

There is one commonality between the Upper North Bosque River and all the sub-segment streams that may be a significant contributor to their impairments, which leads to questions about the appropriateness of monitoring such streams in Texas and the efficacy of applying water quality standards meant for large river segments to small, ephemeral streams. The Upper North Bosque River and all of these sub-segment streams are small, prairie streams with no flow to low flow for most of the year, so when water is present in these streams, it is a result of storm events. Stormwater is known to accumulate high levels of both bacteria and nutrients as it travels over land. These pollutants are then deposited in the small streams where they can cause impairment and also contribute to other concerns such as excessive algal growth and low DO levels. As a result of little to no consistent flow (e.g. flow contributed by springs or other streams), the stormwater and its associated pollutants tend to stay and accumulate in the stream. In contrast these pollutants would be diluted and distributed throughout the system in a larger stream with constant flow.

North Bosque River (Segment 1226) – 

The North Bosque River near Clifton is listed as impaired due to nutrient enrichment. There are also concerns in the portion of the segment near Meridian for near non-attainment of depressed dissolved oxygen and in the portion of the river upstream of Hico for chlorophyll *a* and orthophosphate. Wastewater treatment plant effluent, agricultural runoff and the confined animal feeding operations (CAFOs) located in the watershed are potential contributors to the elevated bacteria and nutrients.

The BRA conducted two biological assessments on the North Bosque River at Cooper's Crossing west of China Spring in 2008. The site is in the lower portion of the segment and should reflect cumulative impacts from most contaminant sources in the watershed upstream from Lake Waco. All components met, and generally exceeded, the designated high aquatic life use, indicating favorable environmental conditions. The 305(b) Assessment concerns for dissolved oxygen, orthophosphorus, chlorophyll *a*, and excessive algal growth did not translate to adverse effects on dissolved oxygen concentrations, fish, or benthic macroinvertebrates during the study period.

Duffau Creek (1226A), Meridian Creek (1226C), Neils Creek (1226D), Spring Creek (1226G), Alarm Creek (1226H), Gilmore Creek (1226I), Honey Creek (1226J), Spring Creek Reservoir (1226P) are all unclassified sub-segments with no impairments or concerns.

Green Creek (1226B) is not supporting for DO and has a concern for chlorophyll *a*.

Sims Creek (1226F) and Little Duffau Creek (1226K) are not supporting for *E. coli*. Little Duffau Creek also has a concern for phosphates.

Indian (1226E) and Little Green Creeks have a concern for *E. coli* with Indian Creek having an additional concern for nitrate and orthophosphate.

Indian Creek Reservoir (1226N) – this unclassified sub-segment has concerns for chlorophyll *a*, ammonia and phosphates.

Sims Creek Reservoir (1226O) has concerns for DO and chlorophyll *a*.

Like the unclassified tributary streams in Segment 1255, many of the impaired or concern sub-segments in 1226 are small, rural streams with little to no flow for most of the year whose water is primarily generated by storm events.

Middle Bosque / South Bosque River (Segment 1246) – 

The Middle Bosque/South Bosque River segment as well as two sub-segments, Tonk Creek (1246D) and Wasp Creek (1246E), are listed as having concern for nitrate. The area ranges from undeveloped to moderate development with a mix of commercial, industrial, residential, and agricultural uses. Potential sources of nitrates include point source discharges along with both urban and agricultural runoff.

Wasp Creek is on the 2008 303(d) List as impaired for *E. coli*. Potential sources of bacteria include on-site sewage systems and runoff from rangeland and agricultural lands.

Waco Lake (Segment 1225) – 

Waco Lake is listed as having concerns for nitrate and chlorophyll *a*. Along with nutrients provided by the North Bosque River and Middle/South Bosque Rivers, potential local sources of nutrients include: urban runoff and on-site sewage facilities.

LEON RIVER WATERSHED (MAP)

The Leon River Watershed drains approximately 3,750 square miles through Bell, Hamilton, Coryell, Comanche, and Eastland Counties. There are three impoundments within the watershed forming the Leon Reservoir, Proctor Lake, and Lake Belton, providing flood control, municipal water supply, and recreation. Land use in the watershed is primarily rangeland and improved pastureland with areas of mixed forestland. The watershed also hosts a number of municipalities, CAFOs, row crop agriculture and an emerging produce industry.

Leon Reservoir (Segment 1224) –

The Leon Reservoir currently has no impairments. There is a concern for manganese in the sediment although there is limited data and it is recommended that additional data be collected prior to the next assessment.

Leon River below Leon Reservoir (Segment 1223) –

In 2008, the Leon River below Leon Reservoir remains on the 303(d) List as impaired for recreational use due to elevated bacterial levels and added the listing for depressed dissolved oxygen. The 2008 assessment continues to show a concern for chlorophyll *a*. This segment frequently experiences low water levels which hinder its ability to buffer against high ambient air temperatures in the summer and fall and are the likely cause for depressed dissolved oxygen levels.

Armstrong Creek, segment 1223A, an unclassified tributary is also listed as impaired for bacteria. This creek is plagued by low flow and dominated by stormwater runoff, which is most likely the source of the bacteria.

Proctor Lake (Segment 1222) –

Proctor Lake possesses no impairments; however, four tributaries to Lake Proctor possess impairments for bacteria: Duncan Creek, Rush-Copperas Creek, Sabana River and Sweetwater Creek. As in the case of the small tributary streams afore mentioned in the Bosque River Watershed, the tributary streams of Proctor Lake are also dominated by stormwater runoff. These similarities bring to light the need for discussion on whether applying ambient criteria to these streams is appropriate and whether using the high aquatic life use as a default is the best option to assess the waterways when Use Attainability Analyses are not available.

Proctor Lake also has concerns for total phosphorus and chlorophyll *a*. There is also a concern for chlorophyll *a* in Duncan Creek. Elevated chlorophyll *a* levels are most likely caused by increased nutrient inputs to the stream and reservoir from runoff from rural lands.

Leon River Below Proctor Lake (Segment 1221) –

The Leon River below Lake Proctor was first placed on the State's 303(d) List for bacteria levels not supporting contact recreation use in 1998 and is still listed as having non-supporting bacterial levels with additional concerns noted for chlorophyll *a* and depressed dissolved oxygen. The bacteria impairment is a result of the contribution of multiple sources, including: confined animal feeding operations, municipal waste water discharge, and stormwater runoff from rural sources. The chlorophyll *a* concern occurs in the upper portion of Segment 1221 and is most likely a result of low flow during summer months that allows for a concentration of algal cells in the water column.

Biological assessments were conducted on the Leon River at FM 1829 southeast of Gatesville in 2008. Local conditions reflect cumulative impacts from most contaminant sources in the watershed upstream from Belton Lake. The objectives were to evaluate the current condition of aquatic life, in light of 305(b) assessment concerns for bacteria, chlorophyll *a*, dissolved oxygen, and excessive algal growth, and to provide a baseline for monitoring the effectiveness of water quality improvement projects. Physical habitat, benthic macroinvertebrates, and dissolved oxygen concentrations met or exceeded the designated high aquatic life use. The fish community was impaired, scoring intermediate during both events. None of the water quality variables measured accounted for depressed fish index scores. Several factors related to instream flow may have been involved, but the basic cause remains unknown.

Five of the tributaries to this segment are non-supporting for bacteria: Resley Creek (1221A), South Leon River (1221B), Pecan Creek (1221C), Indian Creek (1221D), and Walnut Creek (1221F). Resley Creek's 303(d) listing also includes an impairment for depressed dissolved oxygen. Nutrients, chlorophyll *a*, and depressed dissolved oxygen levels are concerns for several of these creeks. The Special Studies section provides more information regarding the TCEQ initiated Total Maximum Daily Load (TMDL) that began in 2002 and the development of the Leon Watershed Protection Plan.

Like the small tributary streams in the Bosque River Watershed, the tributary streams of the Leon Watershed are also dominated by stormwater runoff which brings to light the need for discussion on whether applying ambient criteria to these streams is appropriate and whether using the high aquatic life use as a default is the best option when Use Attainability Analyses are not available.

Belton Lake (Segment 1220) –

Water quality in Belton Lake is fully supporting of all uses assessed; however, an increasing trend in nutrient concentrations, specifically nitrate, is a concern.

An unclassified tributary to Belton Lake, Cowhouse Creek is impaired for bacteria. Potential sources of bacteria in this stream include: runoff from

agricultural land and range land, on-site sewage facilities and municipal discharges.

Leon River Below Belton Lake (Segment 1219) –
The Leon River below Belton Lake possesses concerns for nitrate and orthophosphorus, but is otherwise fully supporting of all assessed uses. The source of elevated nutrients in this segment is currently unknown but may be a result of point source discharge and urban runoff.

Nolan Creek/South Nolan Creek (Segment 1218) –
The Nolan Creek/South Nolan Creek segment possesses a bacterial impairment and water quality concerns for nitrate, orthophosphorus, and total phosphorus. Sources of bacteria and nutrients include municipal discharges, on-site sewage facilities and urban runoff.

LAMPASAS RIVER WATERSHED (MAP)

The Lampasas River Watershed drains approximately 1,502 square miles through Lampasas and portions of Mills, Burnet, Williamson and Bell Counties. Land use is predominantly agricultural, although development has increased around Stillhouse Hollow Lake. The majority of the Lampasas River watershed drains into Stillhouse Hollow Lake. Salado Creek drains into the Lampasas River below Stillhouse Hollow Lake before the confluence with the Leon River. Much of the Lampasas River has heavily vegetated banks and is characterized by low flow conditions much of the time.

Lampasas River Above Stillhouse Hollow Lake (Segment 1217) –
The portion of Segment 1217 from the crossing of FM 1690 up to the crossing of CR 117 remains listed as impaired for bacteria in the 2008 303(d) List. This portion of the river is strongly intermittent and only possesses flowing water immediately following a rain event, which is most likely the source of the bacteria.

The unclassified tributary of North Fork Rocky Creek possesses impairment for depressed dissolved oxygen. This DO impairment is caused by frequent low water levels which hinder its ability to buffer against high ambient air temperatures in the summer and fall reducing the water's capacity to maintain dissolved oxygen levels.

Stillhouse Hollow Lake (Segment 1216) –
Water quality in Lake Stillhouse Hollow currently meets all water quality standard criteria and nutrient screening levels and has no impairments or concerns at this time. However, Authority staff is becoming increasingly concerned about Trimmier Creek, an unclassified tributary to Stillhouse Hollow Lake. The creek

flows through an area experiencing rapid development and appears to be carrying a large sediment load caused by urban runoff into Stillhouse Hollow Lake. Because there are no State standards for sediment or suspended solids, assessing this issue is difficult but visual observations of the confluence of Trimmier Creek and the lake indicate that the lake is being impacted by the sediment load in the creek.

Lampasas River Below Stillhouse Hollow Lake (Segment 1215) –

The Lampasas River below Stillhouse Hollow Lake was removed from the 303(d) List as impaired for bacteria after the 2008 assessment.

Salado Creek (Segment 1243) –

Salado Creek possesses a concern for nitrate but no impairments. Likely sources of nitrate include runoff from urban and agricultural areas and on-site sewage facilities.

The Salado Creek Preservation Committee, a group of Salado residents concerned about bacteria levels in Salado Creek have actively participated with both the TCEQ and BRA in water quality monitoring efforts to characterize the concern. After several years of monitoring it appears that the bacteria issues in Salado Creek are localized to the area of the creek between the IH-35 frontage road and the low water dam just north of FM 2268. Water samples collected from upstream and downstream of this area do not indicate any concern for bacteria.

Two biological assessments were conducted on Salado Creek 418 m upstream of IH 35 near Salado in 2008. The purpose was to evaluate the current condition of aquatic life in the river, in relation to public concerns over the expansion of rock quarry operations in the watershed and the potential for instream impacts. Physical habitat achieved the designated high aquatic life use, while all biological and dissolved oxygen components achieved an exceptional aquatic life use, indicating healthy environmental conditions and lack of discernible impacts by rock quarries or other sources. The data identified the segment as a candidate for an aquatic life use upgrade.

LITTLE RIVER WATERSHED (MAP)

The Little River Watershed drains approximately 2,349 square miles through Williamson, Bell, Milam and portions of Burnet Counties. This watershed includes Lake Georgetown and Lake Granger. The western portion of this watershed is experiencing rapid urban development and is considered one of the fastest growing areas in the State of Texas while the eastern portion of the watershed remains fairly rural.

North Fork San Gabriel River (Segment 1251), and Lake Georgetown (Segment 1249) –

Both segments are in full support of all designated uses and possess no water quality concerns.

South Fork San Gabriel River (Segment 1250) –

The 2008 assessment revealed a concern for depressed dissolved oxygen from the Williamson CR 279 crossing to the upper end of the segment. This DO impairment is caused by frequent low water levels which hinder the water's ability to buffer against high ambient air temperatures in the summer and fall reducing the its' capacity to maintain dissolved oxygen levels.

Biological assessments were conducted on the South Fork San Gabriel River at the Weir Pit west of Georgetown during 2008 to evaluate the current condition of aquatic life in the river, in relation to concerns over the high rate of development and construction activities in the watershed and the potential for instream impacts. However, circumstances changed the focus to impacts of major sewer line installation activities along the streambed in the study area. Physical habitat, biological, and dissolved oxygen components achieved or exceeded the designated high aquatic life use, with the exception of habitat scoring intermediate in July. Whereas the early to middle installation phases, which coincided with the assessments, did not significantly impact the biota, habitat was affected. Effects included destruction of riparian vegetation, increased turbidity, deposition of large amounts of silt on the streambed, direct physical damage to the stream channel by trenching and heavy machinery traffic, and construction of low water dams used as vehicle crossings. Follow-up observations revealed progressive deterioration, and severe habitat disruption was evident by the end of September during advanced installation stages, with a high probability for significant aquatic life impacts. A follow-up is planned for 2010 to reassess environmental damage.

San Gabriel/North Fork San Gabriel River (Segment 1248) –

The San Gabriel/North Fork San Gabriel River is in full support of all of its designated uses and possesses no concerns. However, Authority staff is becoming increasingly concerned about this segment as well as segments 1249, 1250 and 1251 due to the high rate of development and construction activities occurring either in the river channel itself or immediately adjacent to the river. The river at times appears to be carrying a large sediment load caused by these construction activities. Due to a lack of State standards for sediment or suspended solids, assessing these issues are difficult but visual observations indicate that the river is being impacted by the sediment. Additionally, this segment is immediately upstream from Lake Granger which already possesses a

concern for increased sedimentation and additional sediment loading from the river will only hasten the rate of sedimentation.

Biological assessments were conducted twice during 2008 at three locations to evaluate the current condition of aquatic life in the river, in relation to concerns over the high rate of development and construction activities in the watershed and the potential for instream impacts. The first location sampled was the San Gabriel River at SH 29 east of Georgetown, which is upstream of the confluence with Mankins Branch. Despite less-than-optimal physical habitat, which scored intermediate, all biological and dissolved oxygen components achieved the designated high aquatic life use. A degree of nutrient enrichment was indicated by dense periphyton and filamentous algae growth, and fairly wide daily dissolved oxygen fluctuations. Currently, nutrient-associated effects were not severe enough to significantly degrade fish or benthic macroinvertebrate communities.

The second location was at the San Gabriel River at CR 366 east of Jonah, downstream of the confluence with Mankins Branch. All physical habitat, biological, and dissolved oxygen components met or exceeded the designated high aquatic life use, indicating favorable environmental conditions. In every instance, Index of Biotic Integrity scores were higher than at the SH 29 site. This was attributed to greater habitat suitability, flow augmentation from intervening springs and tributaries, and diminished nutrient effects with increased distance from primary sources in the Georgetown area, through dilution and assimilation.

The last set of biological assessments in the segment was conducted on Mankins Branch at CR 100 east of Georgetown. Despite less-than-optimal physical habitat, which scored intermediate, all biological and dissolved oxygen components achieved or exceeded a presumed high aquatic life use, indicating that present water quality conditions are favorable.

Huddleston Branch (1248B), an unclassified stream, possesses concerns for nitrate and bacteria. Mankins Branch (1248C), a tributary which flows into the Huddleston Branch above Lake Granger, is currently identified on the 2008 303(d) List for bacterial impairments. Concerns for elevated nitrate, orthophosphorus and total phosphorus also exist in Mankins Branch. Issues in these subsegments are most likely a combination of municipal discharges and urban runoff.

Granger Lake (Segment 1247) –

Lake Granger is in full support of all of its designated uses but a concern for elevated nitrate levels exists. Willis Creek, a tributary to Lake Granger, is currently identified on the 2008 303(d) List for bacterial impairments and recent data continues to support the impairment designation. Data collected also reveal a concern for nitrate. The watershed in the immediate vicinity of both Lake

Granger and Willis Creek is highly utilized for agriculture, and runoff from these fields is the most likely source of both bacteria and nutrients into the lake.

As segment 1248 flows into Lake Granger it deposits its large sediment load into the reservoir. Since there are no State standards for sediment or suspended solids, assessing this issue is difficult but Lake Granger is experiencing a reduction in storage capacity due to this accelerated sedimentation.

Brushy Creek (Segment 1244) – 

Brushy Creek is currently listed on the 2008 303(d) List for bacterial impairment. Concerns for elevated nutrients including nitrate, orthophosphate and total phosphorus exist in Brushy Creek. Two tributaries to Brushy Creek also possess concerns for nutrients: Brushy Creek above South Brushy Creek (1244A) and South Brushy Creek (1244D). Both elevated bacteria levels and nutrient levels in Brushy Creek are attributed to municipal discharges and urban runoff.

San Gabriel River (Segment 1214) – 

In 2008, the San Gabriel River was listed as impaired for bacteria, chloride, and sulfate with a concern for nitrate. Bacteria and nitrate issues are most likely caused by a combination of agricultural runoff, municipal discharges and on-site sewage facilities. The source of the dissolved solids impairment is currently unknown but may be a result of the high use of water softeners by residential properties in the upper portion of the San Gabriel's watershed. Most wastewater treatment systems in the state are not equipped to remove the high levels of dissolved solids generated by water softeners, so the when high levels of dissolved solids come to the treatment facility from residential properties they are passed through and discharged into lakes and streams.

Little River (Segment 1213) – 

The Little River is on the 2008 303(d) List for a bacterial impairment. The Little River also possesses a concern for nitrate and atrazine in finished drinking water. The immediate watershed to segment 1213 is dominated by agricultural activities. Runoff from the agricultural lands is the transport mechanism carrying atrazine to the river. Nitrogen concerns are most likely from a combination of localized agricultural runoff and inflow from the San Gabriel River and Brushy Creek which both have nutrient concerns. The elevated bacteria count is likely a result of runoff from agricultural lands, wildlife waste, and municipal discharges.

CENTRAL WATERSHED (MAP)

The Central Brazos River Watershed drains approximately 2,710 square miles from Lake Brazos Dam in Waco to the mouth of the Navasota River southeast of College Station through Falls, Burleson, Robertson, and portions of McLennan

and Brazos Counties. Land usage is primarily agricultural, with two sizeable urban areas, Waco and Bryan/College Station.

Brazos River above Navasota (Segment 1242) –

There is a concern for the Public Water Supply use on this segment of the Brazos River above Navasota due to the possibility of incurring a higher cost for water treatment in the form of demineralizing the water. If chloride concentrations continue to increase in this segment, there will be a need for more advanced and costlier water treatment. Similar to the upper basin mainstem segments, the chloride concentrations in Segment 1242 are highly dependent on rainfall patterns in the upper basin. The elevated chlorides in this segment are a result of the drought conditions observed from 2005 through early 2007 that resulted in chloride levels becoming even more concentrated than normal due to evaporation, which reduced water levels while leaving chlorides in the remaining water. During this drought period, chloride levels in Possum Kingdom Lake reached high concentrations never previously observed in either lake. Water releases from Possum Kingdom then caused abnormally high chloride levels to be observed in the entire main stem. Due to the diluting effect of the 2007 flood on the segment and recent data that indicates that the segment has returned to normal concentrations it is anticipated that the chloride impairment will be removed in the 2010 assessment.

Segment 1242 is also listed as being impaired for bacteria. More recent data indicates that bacteria are no longer a concern for this segment and it is anticipated that the impairment will be removed during the 2010 assessment.

Eleven tributaries to the Brazos above Navasota possess bacterial impairments, including: Cottonwood Branch (1242B), Still Creek (1242C), Thompson Creek (1242D) (also with depressed dissolved oxygen impairment), Campbell's Creek (1242I), Deer Creek (1242J), Mud Creek (1242K), Pin Oak Creek (1242L), Spring Creek (1242M), Tehuacana Creek (1242N), Walnut Creek (1242O) and Big Creek (12421242P). Nutrient enrichment is a concern for Cottonwood Branch, Still Creek, Thompson Creek, Pond Creek (1242F) and Deer Creek. As in the case of the unclassified tributary streams in the Bosque and Leon Watersheds, many of the impaired or concern sub-segments in 1242 are small, rural streams with little to no flow for most of the year whose water is primarily generated by storm events and the associated runoff.

For the Marlin City Lake System, total phosphorus and elevated chlorophyll *a* pose concerns. Currently, the source of phosphorus is unknown; however, the elevated phosphorous levels are likely influencing chlorophyll *a* concentrations.

NAVASOTA RIVER WATERSHED (MAP)

The Navasota River Watershed drains approximately 2,235 square miles through Limestone, Robertson, Brazos, Grimes and portions of Madison, Leon and

Freestone Counties. The main stem of the river is impounded in three places in Limestone County creating Lake Mexia, Lake Springfield and Lake Limestone. Land use in this watershed is primarily agricultural with one growing urban area, Bryan/College Station.

Lake Mexia (Segment 1210) – 

Lake Mexia is listed as having concerns for chlorophyll *a*, orthophosphorus and total phosphorus. Nutrient concerns are attributable to runoff from wildlife and agricultural lands.

The Navasota River above Lake Mexia (1210A), which is highly intermittent, is listed as impaired due to bacteria. Potential sources of bacteria include: on-site sewage facilities, wildlife wastes, and runoff from residential areas and agricultural lands.

Navasota River Below Lake Mexia (Segment 1253) – 

There are concerns for chlorophyll *a* and depressed DO on the Navasota River from the headwaters of Springfield Lake to the Lake Mexia Dam. This DO impairment is caused by frequent low water levels which hinder its ability to buffer against high ambient air temperatures in the summer and fall reducing the water's capacity to maintain dissolved oxygen levels. The cause of elevated chlorophyll *a* levels is currently unknown, but may be a result of nutrient rich runoff entering the river and lake.

The unclassified Springfield Lake (1253A) is in full support of all of its uses, but there is a concern for elevated levels of chlorophyll *a* and depressed DO. The cause of elevated chlorophyll *a* levels is currently unknown, but may be a result of nutrient rich runoff entering the river and lake.

Lake Limestone (Segment 1252) – 

This lake possesses concerns for depressed DO and chlorophyll *a*. The cause of the depressed DO is currently unknown and needs to be investigated further. The concern for chlorophyll a is most likely a result of elevated nitrate concentrations in the reservoir. However, the concern for nitrate was removed during the 2008 assessment.

Navasota River Below Lake Limestone (Segment 1209) – 

The Navasota River below Lake Limestone is listed on the 2008 303(d) List as impaired for contact recreation due to elevated bacteria levels. Sources of bacteria may include stormwater inflow from tributary streams, runoff from agricultural lands, municipal discharges, wildlife runoff and on-site sewage facilities. Concerns also exist for nitrate and orthphosphorus, which are likely caused by runoff from agricultural lands and municipal discharges.

There are nine tributaries that likely contribute to this segment's impairments. Carter's Creek (1209C), Country Club Branch (1209D), Wickson (1209E), Cedar (1209G), Duck (1209H), Gibbons (1209I), Shepherd (1209J), Steele (1209K), and Burton (1209L) Creeks all have impairments for their recreation use designation due to elevated bacteria levels. Carter's Creek and Burton Creek both have concerns for nutrients, while Cedar, Duck and Shepherd Creeks have concerns for depressed dissolved oxygen. Carter's Creek and Burton Creek are both strongly influenced by municipal discharges that are most likely the source of both elevated bacteria and nutrients.

Country Club Branch, Wickson, Cedar, Duck, Gibbons, Shepherd, and Steele Creeks all have one commonality that may be a significant contributor to their impairments and leads to questions about the appropriateness of monitoring such streams in Texas. These creeks are small, prairie streams with no flow to low flow for most of the year, so when water is present in these streams it is a result of storm events. Stormwater is known to accumulate high levels of both bacteria and nutrients as it travels over land. These pollutants are then deposited in the small streams where they can cause impairment and also contribute to other concerns such as excessive algal growth and low DO levels. Since the streams have little to no consistent flow (e.g. flow contributed by springs), the stormwater and its associated pollutants tend to stay in the stream and accumulate, where in a larger stream with constant flow the pollutants would be diluted and distributed throughout the stream system.

Country Club (1209A) and Fin Feather Lake (1209B) both have impairments for their aquatic use designation due to toxic sediments. These impairments are mostly a remnant from historically poor industrial practices. Country Club Lake also possesses concerns for phosphates while Fin Feather Lake possesses an additional concern for ammonia.

YEGUA CREEK WATERSHED (MAP)

The Yegua Creek Watershed drains approximately 1316 square miles through Milam, Lee, Burleson and Washington Counties. Land usage in the watershed is primarily agricultural. Oil and gas production has been, and is currently, a major operation in the watershed. Additionally, there is a large lignite mining operation located in the upper area near the City of Rockdale. Rockdale, along with four other small, rural communities (Caldwell, Lexington, Somerville, and Giddings) are the largest in the watershed.

Somerville Lake (Segment 1212) –

Somerville Lake is on the 2008 303(d) List as being impaired for depressed DO and has a concern for high pH levels at the eastern end of the reservoir near the dam. There is also concern for increased chlorophyll *a* concentrations. The extremes in pH are most likely a result of algal activity; the observed high concentrations of chlorophyll *a* may be a potential cause for fluctuations in pH.

Photosynthesis and respiration are two major factors that influence the amounts of carbon dioxide in the lake, which in turn affects pH levels and dissolved oxygen levels.

One tributary to the lake, East Yegua Creek, remains on the 2008 303(d) List as impaired for recreational use due to elevated bacteria levels. Sources of bacteria may include municipal discharges and runoff from agricultural lands and wildlife.

Yegua Creek (Segment 1211) – 
Yegua Creek is in full support of all of its designated uses and exhibits no concerns. The unclassified tributary to Yegua Creek, Davidson Creek (1211A), is impaired due to elevated bacteria levels. Reminiscent of the unclassified tributary streams in the Central Brazos and Navasota Watersheds, Davidson Creek is a small, rural stream with little to no flow for most of the year whose water is primarily generated by storm events and the associated runoff.

LOWER WATERSHED (MAP)

The Lower Brazos Watershed drains approximately 2,077 square miles through Washington, Grimes, Waller, Austin, Fort Bend, and Brazoria Counties before discharging into the Gulf of Mexico. Land uses include agriculture, oil and gas retrieval, chemical industry, and municipalities. Agricultural interests include row crops such as cotton, corn, and sorghum in the northern counties of the watershed, and rice and sorghum in Brazoria County with cattle and chicken farming throughout the watershed. Surface mining operations can be found in Grimes County. There is also a concentration of chemical industry activity in Brazoria County. Fort Bend County has experienced an explosion of growth with the sprawl of the Houston metropolitan area.

Brazos River Below Navasota River (Segment 1202) – 
The Brazos River below Navasota River is in full support of all of its designated uses.

Allen's Creek (1202H) is non-supporting for contact recreation use due to bacteria and also possesses a concern for depressed dissolved oxygen and orthophosphate. These issues are most likely a function of the creeks size; it is a small, shallow stream with little flow except for immediately after rain events.

The upper portion of Big Creek (1202J) continues to be non-supporting for contact recreation use due to bacteria and concerns for phosphate and chlorophyll *a*. The bacteria and nutrient concerns in this portion of Big Creek are most likely a result of agricultural and wildlife runoff. Big Creek also is impaired for the fish community and has concern for habitat in the upper portion of the creek. The poor diversity in the fish community is a result of the poor habitat available. This section of the creek is shallow, with muddy bottoms and low

sloping banks. There is little variety in this portion of the creek which leads to low diversity in the fish community.

Mill Creek has a concern for an impaired fish community. Like Big Creek, Mill Creek most likely has an impaired fish community due to poor available habitat to support a large and diverse fish population.

Brazos River Tidal (Segment 1201) – 
The Brazos River tidal segment differs from the rest of the Brazos River in that the Gulf of Mexico can have an effect on the water quality of that portion of the river. This segment does not have any water quality impairments, but there is a concern for nitrate. Potential sources of nitrates may include: industrial and municipal discharges, and stormwater runoff from urban and residential lands.

UPPER OYSTER CREEK WATERSHED (MAP)

The Upper Oyster Creek Watershed drains approximately 127 square miles in Fort Bend County. This segment varies from a natural stream course to a highly modified system of canals and dams, which create impoundments that maintain nearly constant water levels for industrial, residential, recreational and drinking water supply. The canal system was dredged to serve as a conveyance for water pumped from the Brazos River into Jones Creek to be diverted into Upper Oyster Creek.

Upper Oyster Creek (Segment 1245) – 
Upper Oyster Creek was originally listed on the 2000 303(d) List for dissolved oxygen and bacterial impairments and remains on the 2008 303(d) List. In response to these issues, a total maximum daily load (TMDL) project has been initiated to determine the pollution controls necessary to restore and maintain water quality in Upper Oyster Creek. The TMDL for bacteria was approved by the U.S. Environmental Protection Agency in September 2007 and recommended a 73 percent reduction in bacteria loading in each section to meet the contact recreation use. Currently the TCEQ and its stakeholders are developing an implementation plan that will outline the management strategies needed to restore water quality to Upper Oyster Creek. The TCEQ continues to work with stakeholders in developing a TMDL for dissolved oxygen.

Additional concerns that have been identified in Upper Oyster Creek include nutrients and chlorophyll *a*. The elevated nutrient levels are most likely stimulating algal growth and the elevated chlorophyll *a* concentrations. Potential sources of nitrates in the watershed include municipal and industrial discharges, wildlife contributions and urban runoff.

Bullhead Bayou (1245C) and an associated unnamed tributary (1245D) are also impaired due to elevated bacteria levels with Brown's Bayou (1245B) having a concern for bacteria.

CONCLUSIONS

The primary water quality concern throughout the basin continues to be the elevated chloride and total dissolved solids concentrations. Elevated chloride and associated TDS concentrations increase the drinking water treatment costs, stress aquatic ecosystems and also creates a suitable environment for golden algae.

A recurring theme throughout the Basin Overview section of this report is that elevated levels of bacteria also continue to be an issue of concern and are the cause of the majority of stream impairments in the Brazos Basin. Most of the streams that are impaired are unclassified segments that are small, rural, prairie streams which are characterized by low to intermittent flows. The task of addressing bacteria in the Brazos River Basin is particularly daunting because current water quality standards mandate that all waterbodies meet primary contact recreation criteria (e.g. swimming and divining). It has long been debated at the state level about the appropriateness of designating contact recreation use for small, rural streams with low to intermittent flow because it is usually not possible for submersion recreational activities to occur due to low water levels. In many of these small, rural streams compliance with the primary contact recreation standard is hindered by the natural features of the microwatershed.

To address the inability of small, rural streams to meet primary contact recreation criteria, the Texas Commission on Environmental Quality (TCEQ) is proposing to the U.S. Environmental Protection Agency (EPA) a revision to state water quality bacteria standards. If approved by EPA, TCEQ's proposal will create a four-tiered bacteria standard consisting of primary contact recreation, secondary contact recreation 1, secondary contact recreation 2 and noncontact recreation. This tiered-structure, if approved by EPA, will eliminate 79 waterbodies from the 303(d) List and would result in less stringent bacteria criteria for 246 waterbodies statewide.

Each tier will have unique bacteria criteria. A streams flow characteristics and recreational potential will determine which standard it is evaluated against. Waterbodies where water recreation activities involve a significant risk of ingestion of water, such as wading by children, swimming, water skiing, diving, tubing, surfing and whitewater kayaking, canoeing and rafting, will be evaluated using the primary contact recreation standard. Waterbodies where water recreation activities do not involve a significant risk of ingestion of water, such as fishing, commercial and recreational boating, and limited body contact incidental to shoreline activity, will be evaluated using the secondary contact recreation 1

standard. Waterbodies where water recreation activities do not involve a significant risk of ingestion of water and risk of ingestion occurs less frequently than secondary contact recreation1 due to physical characteristics of the waterbody or limited public access, will be evaluated using the secondary contact recreation 2 standard. The noncontact recreation standard will be applied to waterbodies where primary and secondary contact recreation should not occur because of unsafe conditions, such as areas used for ship and barge traffic.

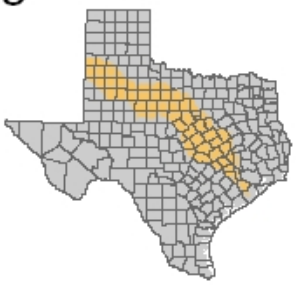
Routine monitoring continues to be conducted to document other water quality issues, including low dissolved oxygen levels that have been measured in many small tributaries throughout the basin.

Expanded ambient monitoring over the past decade has given water quality managers data to conduct better and more efficient assessments. Monitoring in watersheds that previously had limited data has improved the knowledge of water quality conditions in rural areas. The combination of data collection, analysis, education, stakeholder involvement, and reasonable implementation strategies are key factors in watershed management and the understanding of aquatic ecological systems.

The Authority will continue to monitor sites, analyze data, determine trends, and assist in the development of Best Management Practices to maintain the water quality in the Brazos River Basin. However, this effort has become increasingly difficult because Authority operational costs for CRP have increased steadily while the level of funding received by the Texas Clean Rivers Program (CRP) has not since the programs inception in 1991. This has forced CRP partner agencies to reduce sampling events and parameters collected, while the number of monitoring sites and parameters needed to meet the CRP goals are ever increasing. An increase in program funds is recommended to provide a constant, reliable source of water quality data. It is the BRA's opinion that the greatest attention should go to waterbodies with the greatest risk of not attaining water quality standards.

As an agency of the state, and in compliance with its mission, the BRA provides financial assistance as much as possible to alleviate some of the budget shortfalls, and also contributes to the CRP funding by payment of fees assessed to fund TCEQ's water programs. The Authority supports itself through contractual agreements with governmental and non-governmental entities, limiting the additional funding required to adequately monitor the basin's many water resources. Nevertheless, the BRA will continue to work toward full attainment of the Clean Rivers Program goals.

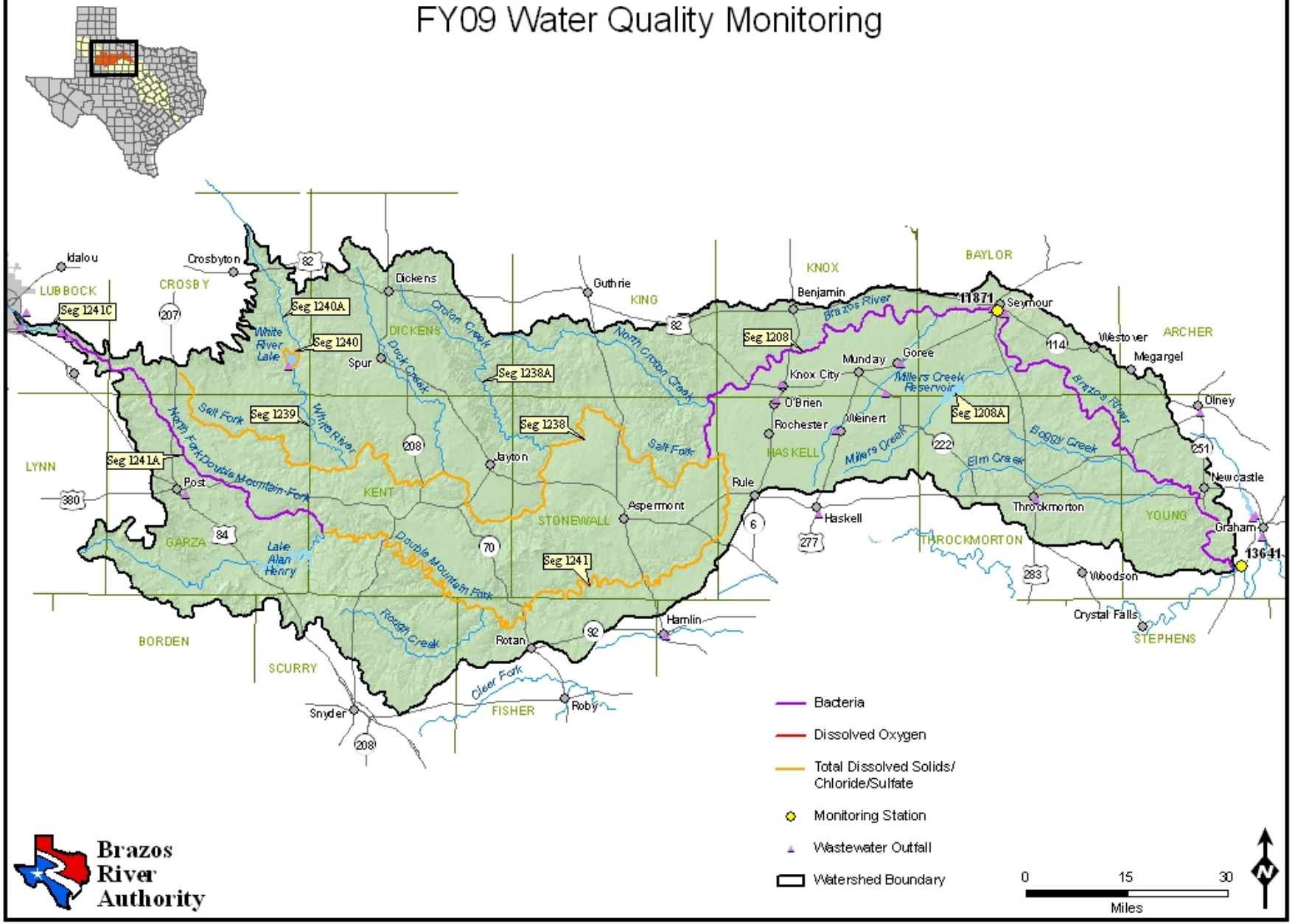
Watersheds of the Brazos River Basin
FY09 Water Quality Monitoring

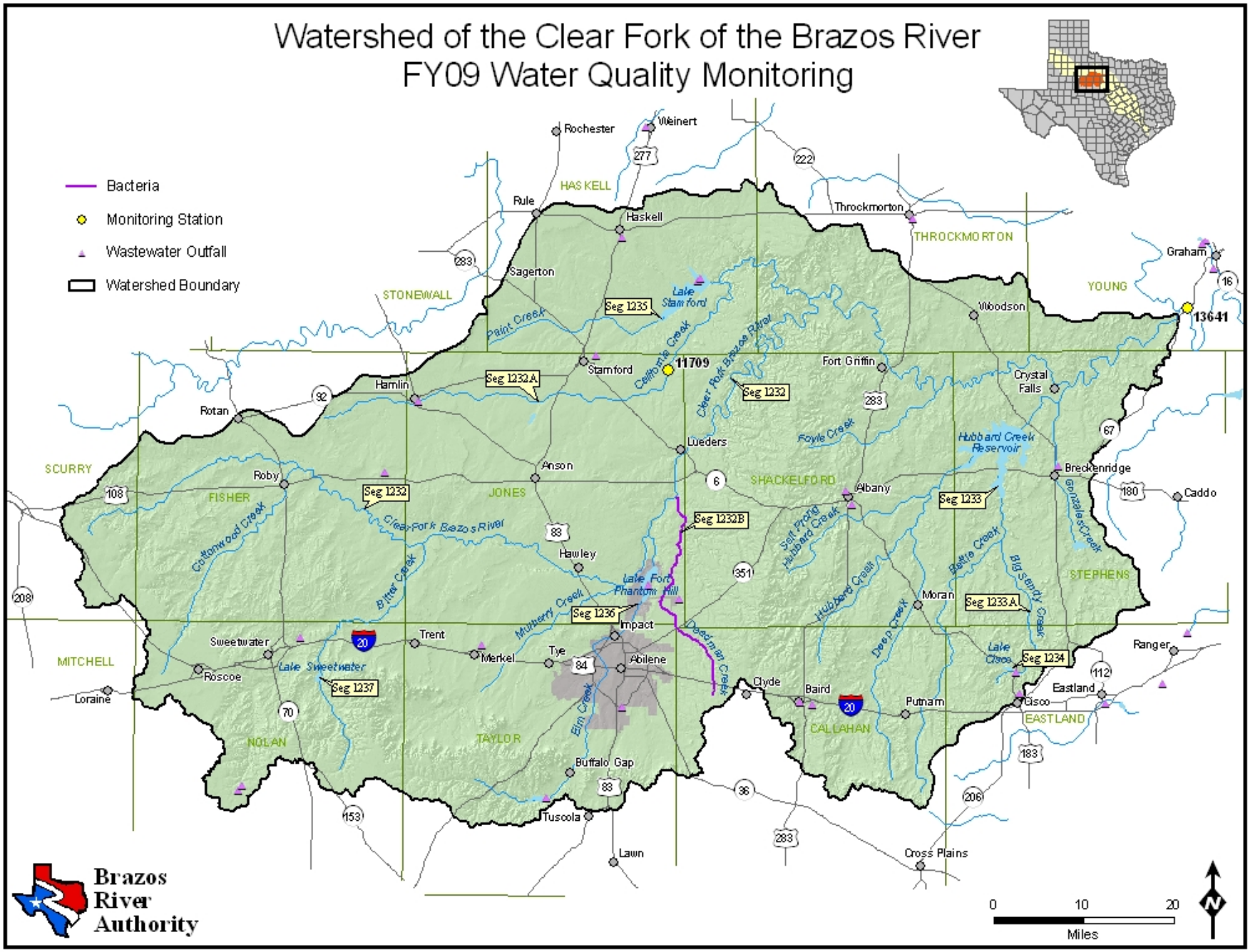


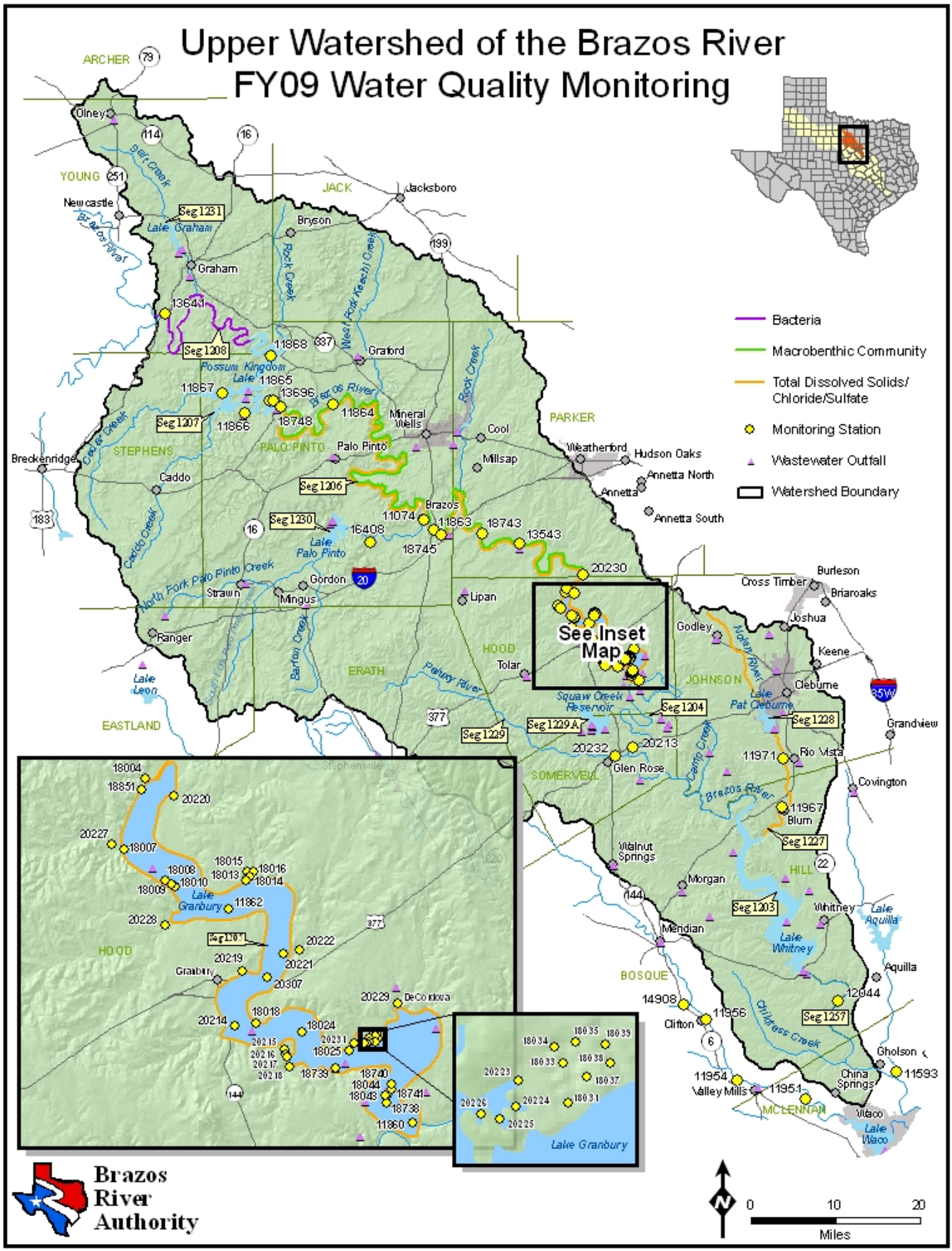
Brazos River Authority

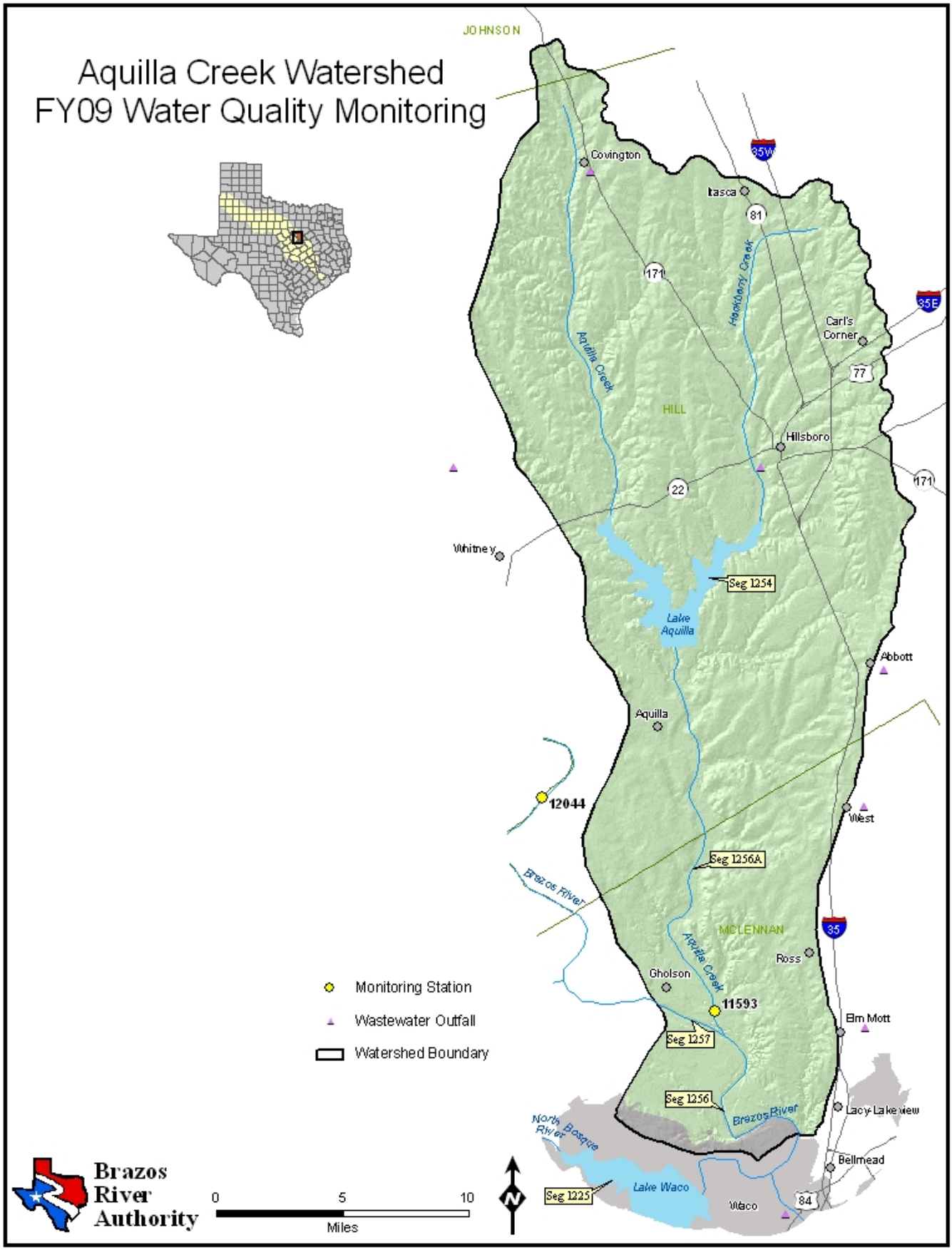
0 50 100
Miles

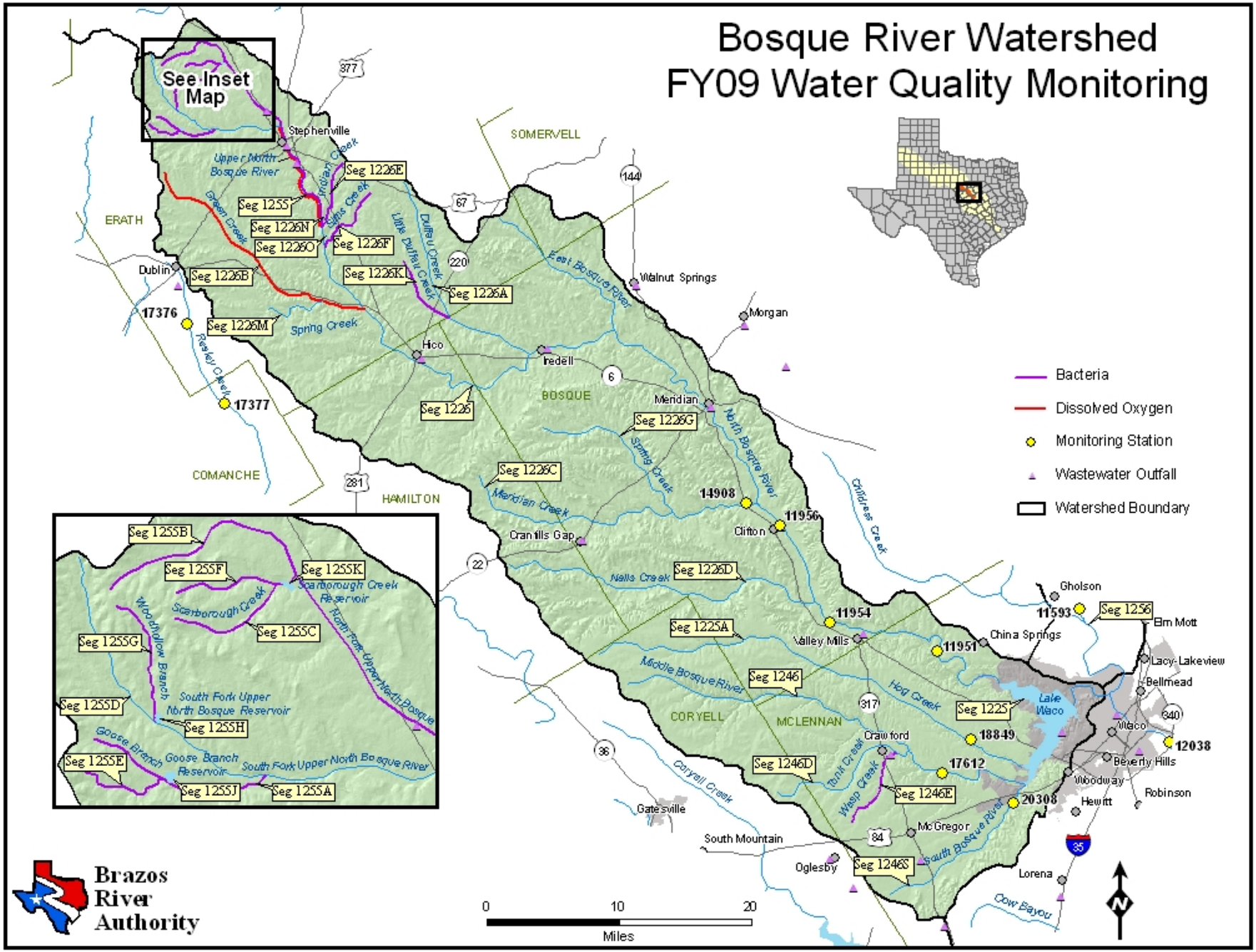
Watershed of the Salt and Double Mountain Forks of the Brazos River
FY09 Water Quality Monitoring

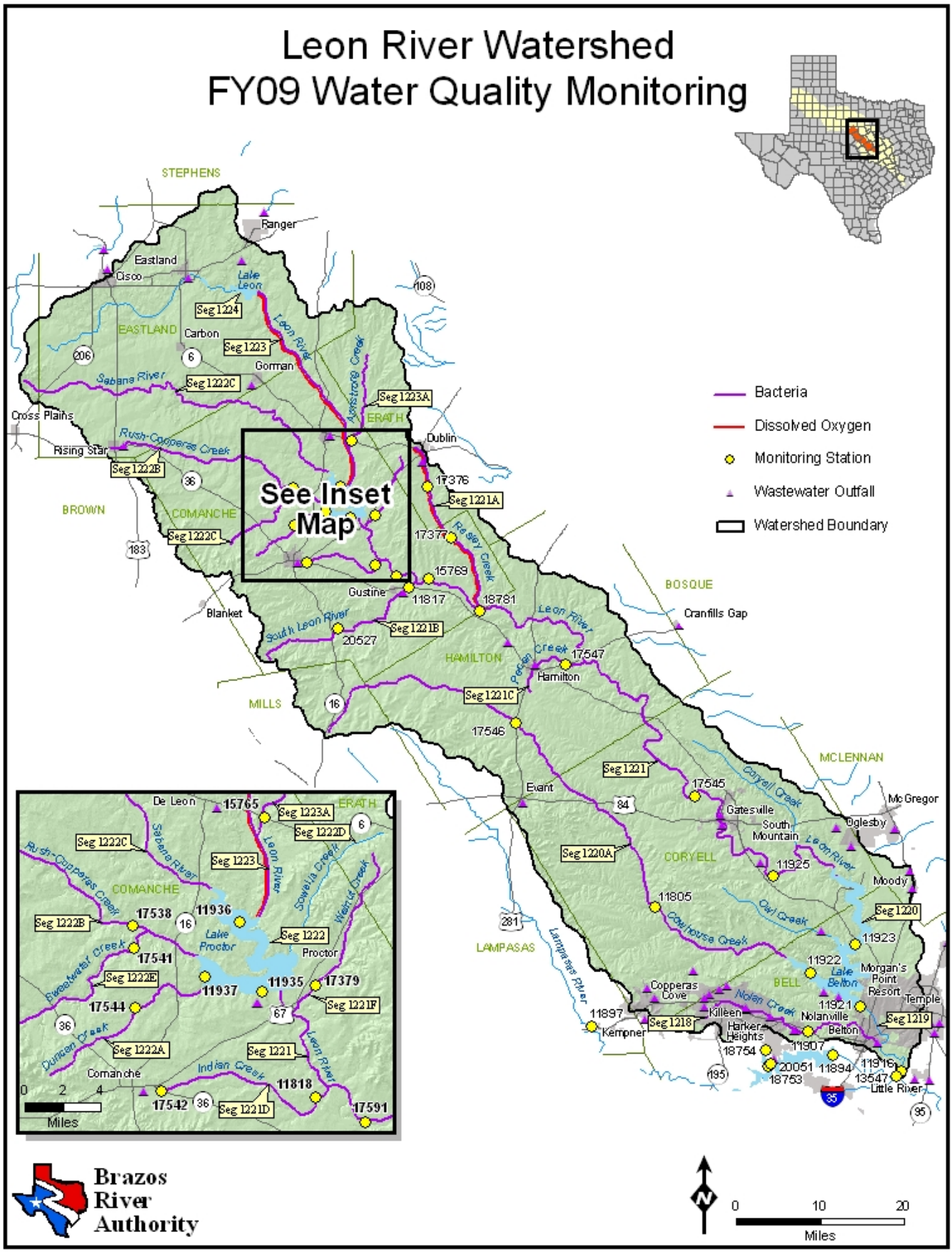


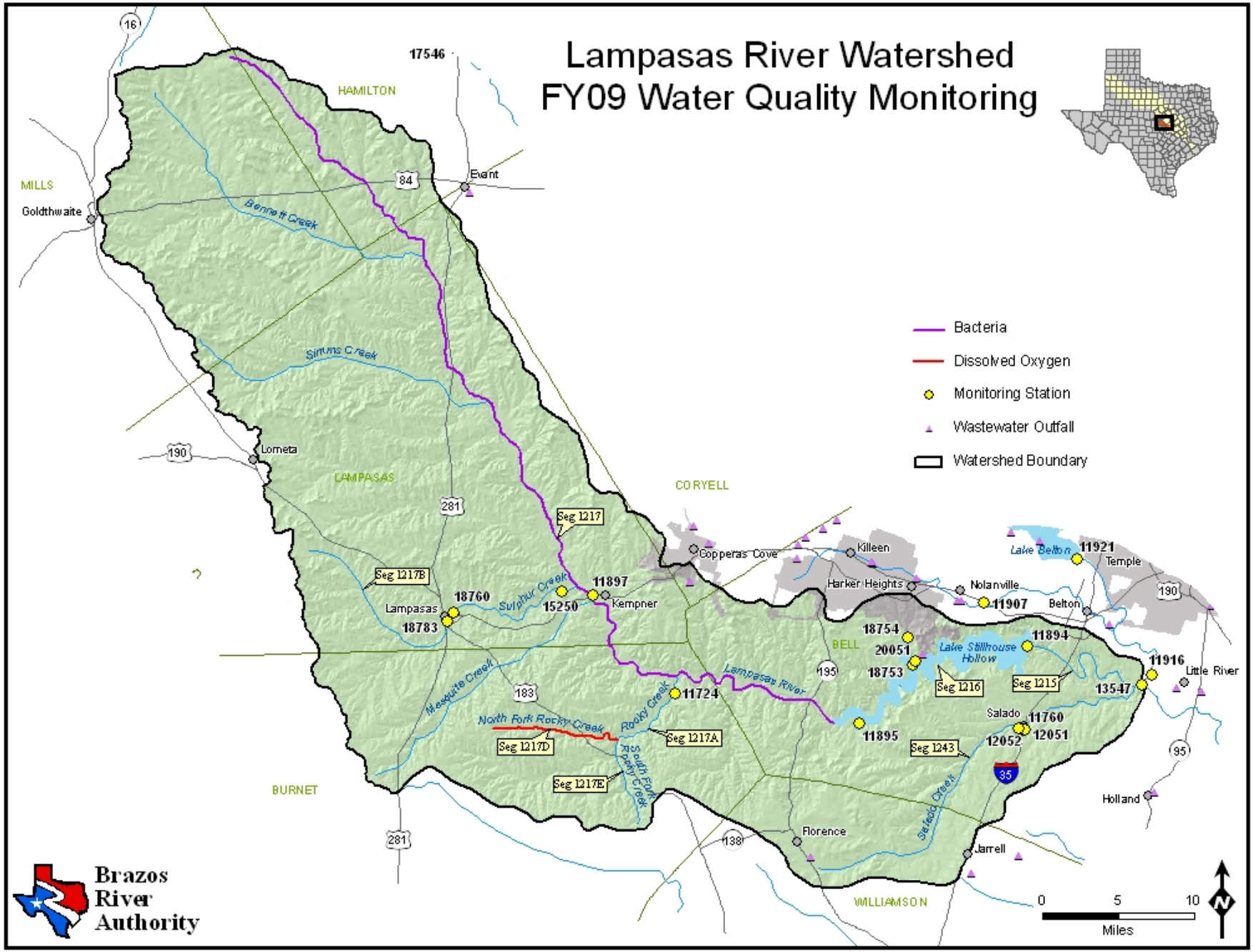

Watershed of the Clear Fork of the Brazos River
FY09 Water Quality Monitoring
Bacteria
Monitoring Station
Wastewater Outfall
Watershed Boundary
Rochester
Weinert
Rule
HASKELL
Haskell
Throckmorton
THROCKMORTON
Graham
YOUNG
Sagerton
STONEWALL
Lake Stamford
Seg 1235
Paint Creek
Clear Fork Brazos River
Croton Creek
11709
Stamford
Woodson
13641
Fort Griffin
Crystal Falls
Seg 1232A
Hamlin
Seg 1232
Rotan
Foyle Creek
Hubbard Creek Reservoir
Lueders
SCURRY
Roby
Anson
SHACKELFORD
Albany
Breckenridge
Caddo
FISHER
JONES
Seg 1232
Clear Fork Brazos River
Seg 1233
Cottonwood Creek
Seg 1232B
Self Prong Hubbard Creek
Gonzales Creek
Hawley
Bitter Creek
Lake Fort Phantom Hill
Mulberry Creek
Seg 1236
Impact
Deadman Creek
Hubbard Creek
Battle Creek
Big Sandy Creek
STEPHENS
Moran
Seg 1233A
Sweetwater
Trent
Merkel
Tye
Abilene
Lake Sweetwater
Seg 1237
Roscoe
MITCHELL
Loraine
Elm Creek
Clyde
Baird
Putnam
Lake Cisco
Seg 1234
Ranger
Eastland
Cisco
EASTLAND
CALLAHAN
NOLAN
TAYLOR
Buffalo Gap
Tuscola
Lawn
Cross Plains
Brazos River Authority
0
10
20
Miles
N

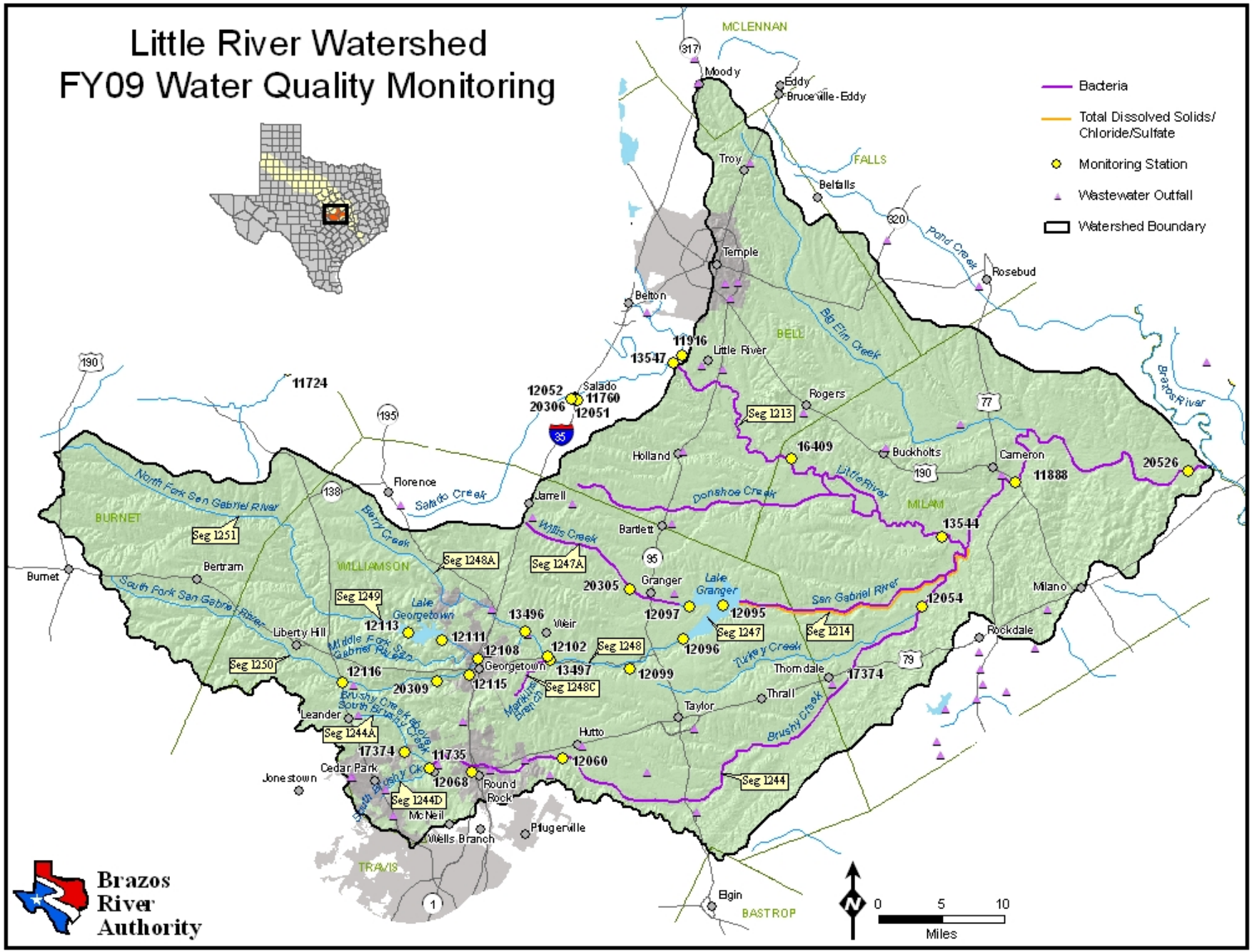

Upper Watershed of the Brazos River
FY09 Water Quality Monitoring
Bacteria
Macrobenthic Community
Total Dissolved Solids/ Chloride/Sulfate
Monitoring Station
Wastewater Outfall
Watershed Boundary
See Inset Map
Brazos River Authority
0 10 20
Miles

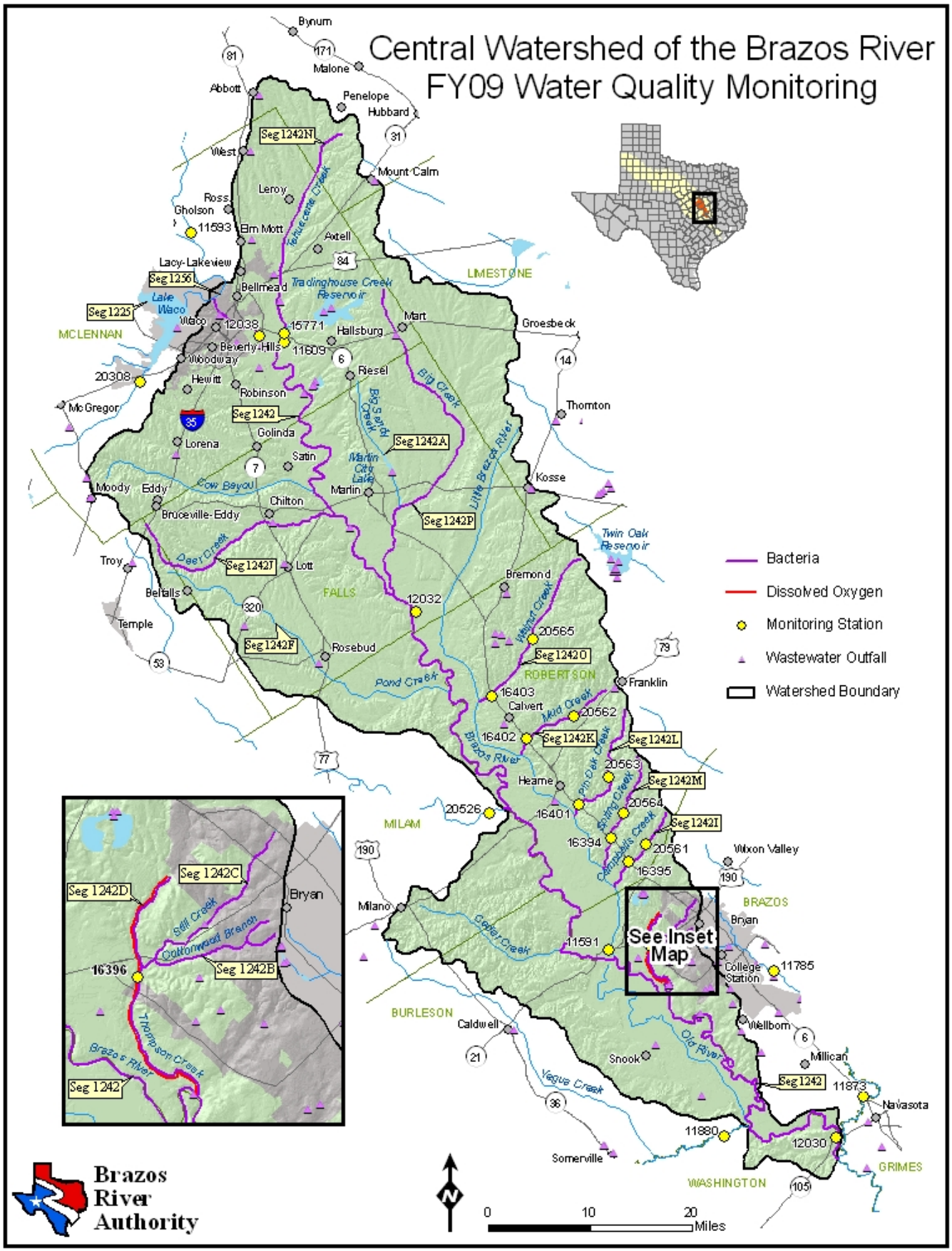

Aquilla Creek Watershed
FY09 Water Quality Monitoring
JOHNSON
Covington
Itasca
35W
81
171
Hackberry Creek
35E
Carl's Corner
77
Aquilla Creek
HILL
Hillsboro
171
22
Whitney
Seg 1254
Lake Aquilla
Abbott
Aquilla
12044
West
Seg 1256A
Brazos River
MCLENNAN
35
Ross
Gholson
Aquilla Creek
11593
Elm Mott
Seg 1257
Seg 1256
Brazos River
Lacy-Lakeview
North Bosque River
Bellmead
Lake Waco
Seg 1225
Waco
84
Monitoring Station
Wastewater Outfall
Watershed Boundary
Brazos River Authority
0
5
10
Miles
N

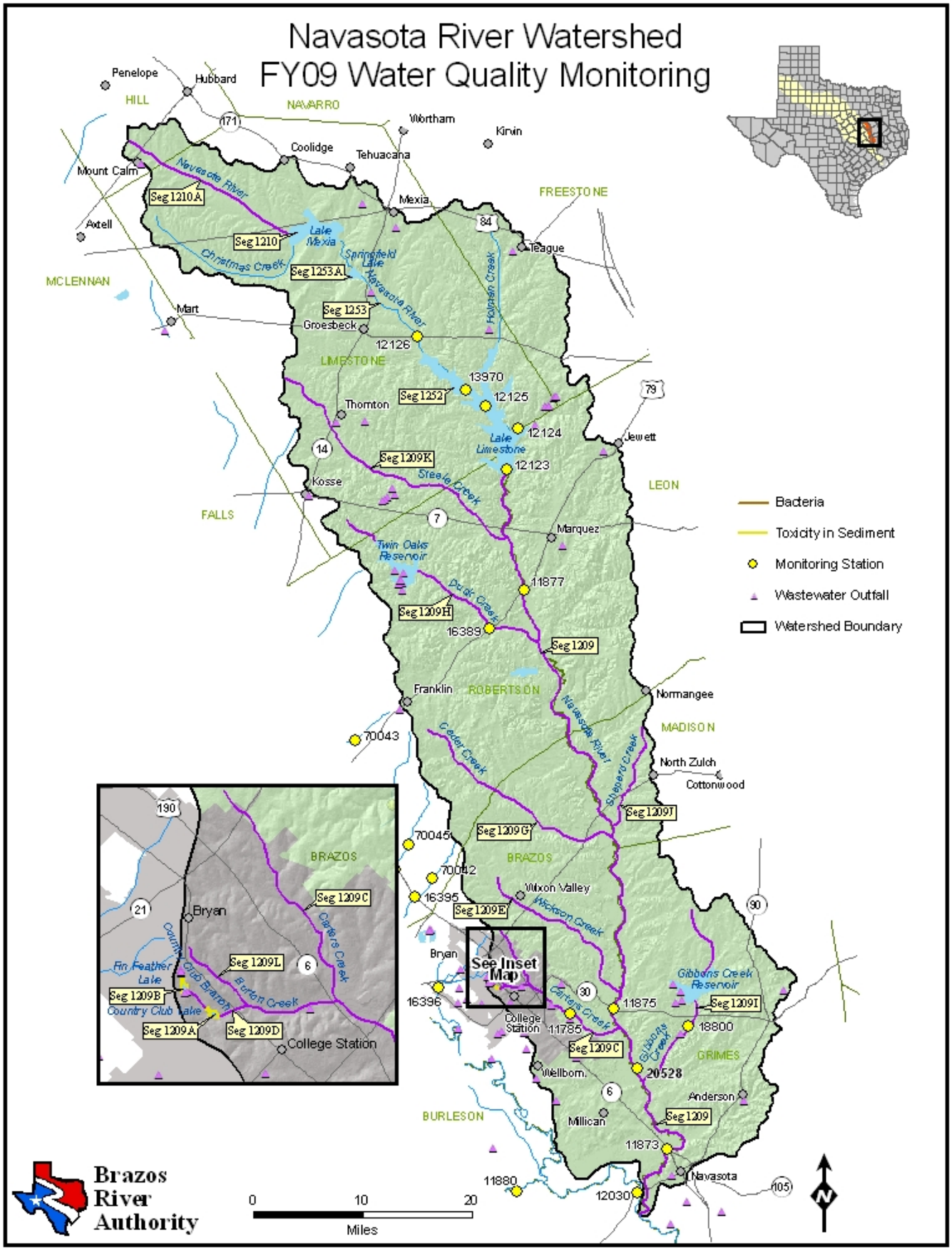

Bosque River Watershed
FY09 Water Quality Monitoring
See Inset Map
Stephenville
SOMERVELL
ERATH
Dublin
Walnut Springs
Morgan
Hico
Iredell
Meridian
BOSQUE
COMANCHE
HAMILTON
CORYELL
MCLENNAN
Cranfills Gap
Clifton
Valley Mills
China Springs
Gholson
Elm Mott
Lacy-Lakeview
Bellmead
Waco
Lake Waco
Crawford
Beverly Hills
Woodway
Robinson
Hewitt
McGregor
Gatesville
South Mountain
Oglesby
Lorena
Upper North Bosque River
Green Creek
Spring Creek
Rocky Creek
Meridian Creek
Duffau Creek
Little Duffau Creek
East Bosque River
North Bosque River
Nails Creek
Hog Creek
Middle Bosque River
Tonk Creek
Wasp Creek
Cowell Creek
South Bosque River
Cow Bayou
Childress Creek
Seg 1226E
Seg 1255
Seg 1226N
Seg 1226O
Seg 1226F
Seg 1226K
Seg 1226B
Seg 1226A
Seg 1226M
Seg 1226
Seg 1226G
Seg 1226C
Seg 1226D
Seg 1225A
Seg 1246
Seg 1225
Seg 1246D
Seg 1246E
Seg 1246S
Seg 1256
17376
17377
14908
11956
11954
11951
11593
18849
17612
20308
12038
Bacteria
Dissolved Oxygen
Monitoring Station
Wastewater Outfall
Watershed Boundary
Seg 1255B
Seg 1255F
Seg 1255K
Scarborough Creek Reservoir
Scarborough Creek
Seg 1255C
Seg 1255G
Mud Shallow Branch
North Fork Upper North Bosque
Seg 1255D
South Fork Upper North Bosque Reservoir
Seg 1255H
Goose Branch
Seg 1255E
Goose Branch Reservoir
South Fork Upper North Bosque River
Seg 1255J
Seg 1255A
Brazos River Authority
0
10
20
Miles
N

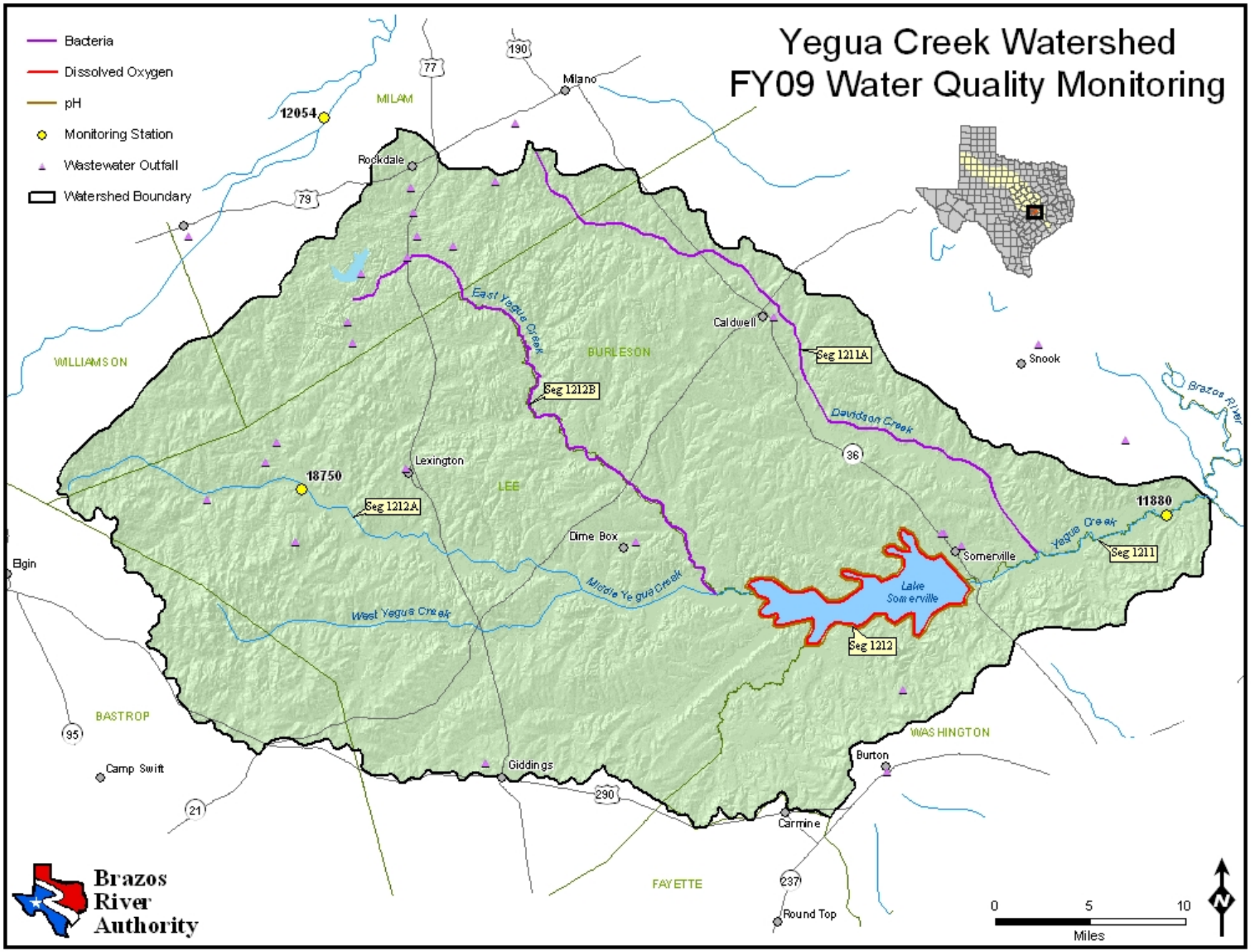

Leon River Watershed
FY09 Water Quality Monitoring
STEPHENS
Ranger
Eastland
Cisco
Lake Leon
Seg 1224
EASTLAND
Carbon
Seg 1223
Leon River
Armstrong Creek
Sabana River
Seg 1222C
Gorman
Seg 1223A
ERATH
Cross Plains
Rising Star
Rush-Copperas Creek
Seg 1222B
Dublin
17376
Seg 1221A
See Inset Map
BROWN
COMANCHE
Seg 1222C
17377
Resley Creek
15769
Gustine
11817
18781
Blanket
South Leon River
20527
Seg 1221B
BOSQUE
Cranfills Gap
Leon River
HAMILTON
Pecan Creek
17547
Hamilton
MILLS
Seg 1221C
17546
Seg 1221
Evant
17545
MCLENNAN
Coryell Creek
Gatesville
South Mountain
Leon River
Uglesby
McGregor
Seg 1220A
CORYELL
11925
Moody
11805
Owl Creek
Seg 1220
Cowhouse Creek
11923
LAMPASAS
Lampasas River
11922
Lake Belton
Morgan's Point Resort
Copperas Cove
BELL
Nolan Creek
11921
Temple
Killeen
Nolanville
Seg 1219
11897
Seg 1218
Kempner
Harker Heights
Belton
18754
11907
20051
11894
11916
18753
13547
Little River
Bacteria
Dissolved Oxygen
Monitoring Station
Wastewater Outfall
Watershed Boundary
De Leon
15765
Seg 1223A
Seg 1222D
ERATH
Seg 1222C
Sabana River
Rush-Copperas Creek
Seg 1223
Leon River
Sowell Creek
West Fk Creek
COMANCHE
17538
11936
Seg 1222B
Lake Proctor
Seg 1222
Proctor
Sweetwater Creek
17541
Seg 1222E
11937
11935
17379
17544
Seg 1221F
Duncan Creek
Seg 1222A
Seg 1221
Indian Creek
Leon River
Comanche
11818
17542
Seg 1221D
17591
0 2 4
Miles
Brazos River Authority
N
0 10 20
Miles

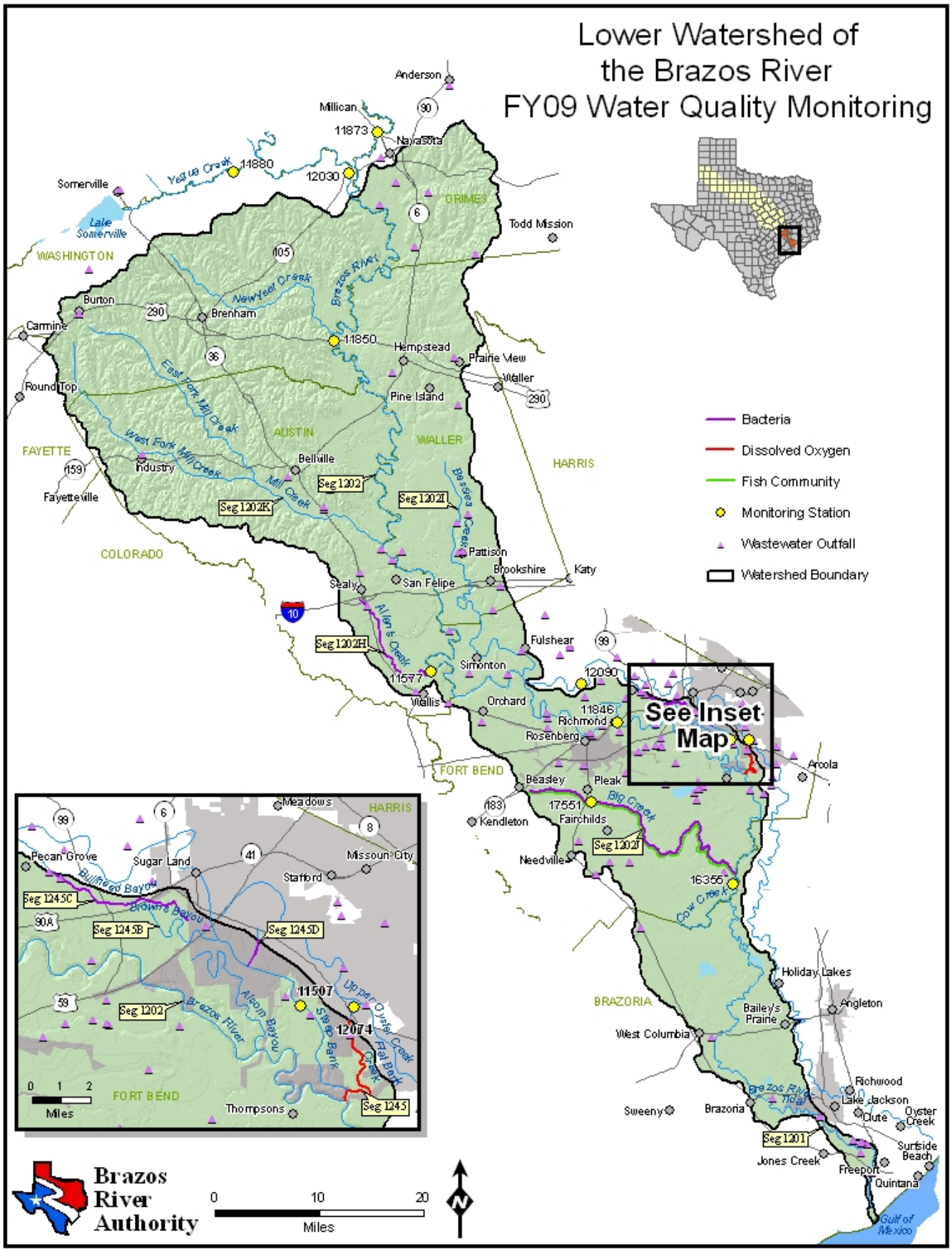

Lampasas River Watershed
FY09 Water Quality Monitoring
Bacteria
Dissolved Oxygen
Monitoring Station
Wastewater Outfall
Watershed Boundary
HAMILTON
MILLS
CORYELL
LAMPASAS
BURNET
BELL
WILLIAMSON
Goldthwaite
Evant
Lometa
Copperas Cove
Killeen
Harker Heights
Nolanville
Belton
Temple
Little River
Holland
Florence
Jarrell
Salado
Lampasas
Kempner
Bennett Creek
Simms Creek
Sulphur Creek
Mesquite Creek
North Fork Rocky Creek
Rocky Creek
South Fork Rocky Creek
Lampasas River
Lake Belton
Lake Stillhouse Hollow
Stiles Creek
Seg 1217
Seg 1217B
Seg 1217D
Seg 1217A
Seg 1217E
Seg 1216
Seg 1215
Seg 1243
17546
18760
18783
15250
11897
11724
18754
20051
18753
11895
11894
11907
11921
11916
13547
11760
12051
12052
0
5
10
Miles
Brazos River Authority

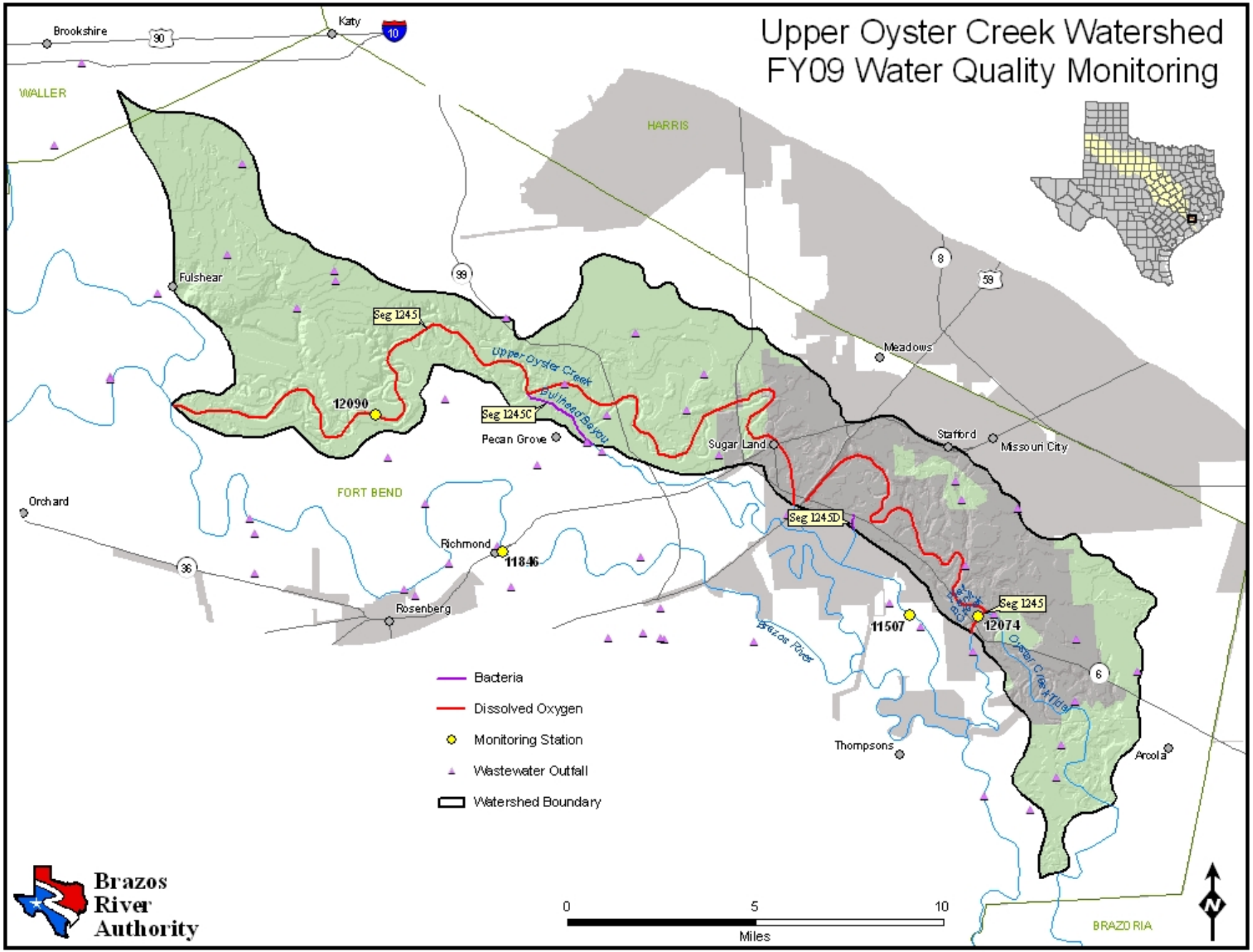

Little River Watershed
FY09 Water Quality Monitoring
Bacteria
Total Dissolved Solids/ Chloride/Sulfate
Monitoring Station
Wastewater Outfall
Watershed Boundary
MCLENNAN
BELL
FALLS
WILLIAMSON
BURNET
MILAM
TRAVIS
BASTROP
Moody
Eddy
Bruceville-Eddy
Troy
Belfalls
Temple
Rosebud
Belton
Little River
Rogers
Holland
Buckholts
Cameron
Florence
Salado
Jarrell
Bartlett
Granger
Lake Granger
Georgetown
Lake Georgetown
Weir
Liberty Hill
Bertram
Burnet
Leander
Cedar Park
Jonestown
Round Rock
McNeil
Wells Branch
Pflugerville
Hutto
Taylor
Thrall
Thorndale
Rockdale
Milano
Elgin
Big Elm Creek
Pond Creek
Little River
Ponshoe Creek
Willis Creek
Berry Creek
Salado Creek
North Fork San Gabriel River
South Fork San Gabriel River
Middle Fork San Gabriel River
San Gabriel River
Turkey Creek
Brushy Creek
Markum Branch
South Brushy Creek
South Brushy Ck
Brushy Creek Below
Brazos River
11916
13547
11724
12052
20306
11760
12051
16409
11888
20526
13544
12054
12095
12097
20305
12096
12099
17374
13496
12113
12111
12108
12102
13497
12116
20309
12115
11735
12060
12068
Seg 1213
Seg 1214
Seg 1247
Seg 1247A
Seg 1248
Seg 1248A
Seg 1248C
Seg 1249
Seg 1250
Seg 1251
Seg 1244
Seg 1244A
Seg 1244D
0
5
10
Miles
Brazos River Authority


Central Watershed of the Brazos River
FY09 Water Quality Monitoring
Bacteria
Dissolved Oxygen
Monitoring Station
Wastewater Outfall
Watershed Boundary
See Inset Map
Brazos River Authority
0
10
20
Miles
Seg 1242N
Seg 1225
Seg 1256
Seg 1242
Seg 1242A
Seg 1242P
Seg 1242T
Seg 1242F
Seg 1242O
Seg 1242K
Seg 1242L
Seg 1242M
Seg 1242I
Seg 1242C
Seg 1242D
Seg 1242B
11593
12038
15771
11609
20308
12032
20565
16403
20562
16402
20563
20564
16401
16394
20561
16395
20526
11591
11785
11873
11880
12030
16396
MCLENNAN
LIMESTONE
FALLS
ROBERTSON
MILAM
BRAZOS
BURLESON
WASHINGTON
GRIMES
Bynum
Malone
Abbott
Penelope
Hubbard
West
Mount Calm
Leroy
Ross
Gholson
Elm Mott
Axtell
Lacy-Lakeview
Bellmead
Waco
Lake Waco
Tradinghouse Creek Reservoir
Hallsburg
Mart
Groesbeck
Beverly Hills
Woodway
Riesel
Hewitt
Robinson
McGregor
Lorena
Golinda
Satin
Marlin
Marlin City Lake
Big Creek
Big Sandy Creek
Little Brazos River
Thornton
Kosse
Twin Oak Reservoir
Moody
Eddy
Cow Bayou
Chilton
Bruceville-Eddy
Troy
Belfalls
Temple
Deer Creek
Lott
Rosebud
Bremond
Hilliard Creek
Franklin
Pond Creek
Calvert
Mud Creek
Brazos River
Pin Oak Creek
Hearne
Spring Creek
Campbells Creek
Wixon Valley
Milano
Cedar Creek
Bryan
College Station
Caldwell
Wellborn
Millican
Snook
Old River
Vegue Creek
Navasota
Somerville
Self Creek
Cottonwood Branch
Thompson Creek
Brazos River


Navasota River Watershed
FY09 Water Quality Monitoring
Penelope
Hubbard
HILL
NAVARRO
Wortham
Kirvin
Coolidge
Tehuacana
Mount Calm
Axtell
Navasota River
Seg 1210A
Seg 1210
Lake Mexia
Springfield Lake
Christmas Creek
Seg 1253A
Mexia
FREESTONE
84
Teague
Hilpsm Creek
MCLENNAN
Mart
Seg 1253
Groesbeck
12126
LIMESTONE
13970
Seg 1252
12125
Thornton
12124
Jewett
79
Lake Limestone
14
Seg 1209K
12123
Steele Creek
Kosse
LEON
FALLS
7
Marquez
Twin Oaks Reservoir
11877
Duck Creek
Seg 1209H
16389
Seg 1209
Franklin
ROBERTSON
Normangee
MADISON
70043
Navasota River
Cedar Creek
Shepherd Creek
North Zulch
Cottonwood
Seg 1209J
70045
Seg 1209G
BRAZOS
70042
Wixon Valley
16395
Seg 1209E
Mickson Creek
90
Bryan
See Inset Map
Gibbons Creek Reservoir
16396
30
11875
Seg 1209I
Carters Creek
College Station
11785
18800
Seg 1209C
GRIMES
Gibbons Creek
Wellborn
20528
6
Anderson
BURLESON
Millican
Seg 1209
11873
11880
12030
Navasota
105
Bacteria
Toxicity in Sediment
Monitoring Station
Wastewater Outfall
Watershed Boundary
190
21
BRAZOS
Seg 1209C
Bryan
Carters Creek
Country Club Branch
Fin Feather Lake
Seg 1209L
6
Seg 1209B
Burton Creek
Country Club Lake
Seg 1209A
Seg 1209D
College Station
Brazos River Authority
0
10
20
Miles


Yegua Creek Watershed
FY09 Water Quality Monitoring
Bacteria
Dissolved Oxygen
pH
Monitoring Station
Wastewater Outfall
Watershed Boundary
12054
18750
11880
Seg 1211A
Seg 1212B
Seg 1212A
Seg 1211
Seg 1212
East Yegua Creek
Middle Yegua Creek
West Yegua Creek
Davidson Creek
Yegua Creek
Brazos River
Lake Somerville
Milano
Rockdale
Caldwell
Snook
Lexington
Dime Box
Somerville
Elgin
Giddings
Burton
Carmine
Round Top
Camp Swift
MILAM
WILLIAMSON
BURLESON
LEE
BASTROP
FAYETTE
WASHINGTON
77
190
79
36
95
21
290
237
Brazos River Authority
0
5
10
Miles
N


Lower Watershed of
the Brazos River
FY09 Water Quality Monitoring
Bacteria
Dissolved Oxygen
Fish Community
Monitoring Station
Wastewater Outfall
Watershed Boundary
See Inset Map
Anderson
Millican
Navasota
Somerville
Lake Somerville
Yegua Creek
Todd Mission
GRIMES
WASHINGTON
Burton
Brenham
Carmine
Round Top
Hempstead
Prairie View
Waller
Pine Island
AUSTIN
WALLER
HARRIS
FAYETTE
Industry
Bellville
Fayetteville
Seg 1202
Seg 1202K
Seg 1202I
Mill Creek
East Fork Mill Creek
West Fork Mill Creek
Bessies Creek
COLORADO
Pattison
Brookshire
Katy
Sealy
San Felipe
Allen's Creek
Seg 1202H
Fulshear
Simonton
Wallis
Orchard
Richmond
Rosenberg
FORT BEND
Beasley
Pleak
Kendleton
Fairchilds
Big Creek
Seg 1202F
Needville
Arcola
Holiday Lakes
Angleton
Bailey's Prairie
West Columbia
BRAZORIA
Sweeny
Brazoria
Richwood
Lake Jackson
Clute
Oyster Creek
Surfside Beach
Freeport
Quintana
Jones Creek
Seg 1201
Gulf of Mexico
Meadows
Pecan Grove
Sugar Land
Missouri City
Stafford
Bullhead Bayou
Brown's Bayou
Seg 1245C
Seg 1245B
Seg 1245D
Seg 1202
Alcorn Bayou
Upper Oyster Creek
Flat Bank Creek
Seg 1245
Thompsons
Miles
Brazos River Authority
Miles


Upper Oyster Creek Watershed
FY09 Water Quality Monitoring
Brookshire
Katy
WALLER
HARRIS
Fulshear
Seg 1245
Upper Oyster Creek
Bullhead Bayou
12090
Seg 1245C
Pecan Grove
Meadows
Sugar Land
Stafford
Missouri City
FORT BEND
Orchard
Richmond
11846
Seg 1245D
Rosenberg
Brazos River
11507
Seg 1245
12074
Thompsons
Arcola
BRAZORIA
Bacteria
Dissolved Oxygen
Monitoring Station
Wastewater Outfall
Watershed Boundary
Brazos River Authority
0
5
10
Miles
N