Brazos River Basin Highlights Report

2011

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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 *Brazos River Basin Highlights Report 2011*. 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

This report highlights the activities that occurred in Fiscal Year 2010 and what is coming up in Fiscal Year 2011 in the Brazos River Basin under the Clean Rivers Program (CRP). The CRP is managed by the Texas Commission on Environmental Quality (TCEQ), and funded entirely by fees assessed to wastewater discharge and water rights permit holders. The Brazos River Authority (BRA) carries out the water quality management efforts in the basin under contract with TCEQ. The activities described in this report include water quality monitoring results, a review of the draft 2010 Integrated Report (IR), a status update of proposed changes to surface water quality standards, a summary of significant events affecting water quality and a summary of other water quality studies being conducted in the Brazos River Basin.

The digital version of this report is imbedded with hyperlinks so that you can easily access more detailed information on projects in the Brazos River Basin. So wherever you see a word that looks like this, just click and see where it takes you. You can also click the Table of Contents to navigate to your desired page. If you want to return to where you were in the document either close the web page or press Alt+← if you were taken to another page in the document. There are also links to watershed maps in each watershed chapter, just click on (Map) next to the watershed name.

THIS YEARS HIGHLIGHTS

Bacterial impairments remain the primary reason for impairments in the Brazos River Basin. 16 of the 57 classified segments and 65 unclassified segments in the Brazos River basin do not meet State water quality standards. Of those 81 water quality impairments, 69 of them are bacteria-related. The one commonality to be found between most of the bacteria-impaired waterbodies in the Brazos River basin is that they 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 dissolved oxygen 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.

There has been a long-standing concern 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 bacteria standards are designed to protect the safety of contact recreation in state waters; however, this standard has been applied to all

waterbodies in the state regardless of whether they are classified or unclassified or even hold the potential to support contact recreational activities.

Fortunately, there may be relief on the horizon from applying contact recreation standards to all waterbodies regardless of size or function. The amended Texas Surface Water Quality Standards were adopted by the Commission on June 30, 2010 and submitted to the United States Environmental Protection Agency (EPA) on August 4, 2010. The two largest changes that will have the largest impact on the Brazos River basin are the revisions to bacteria standards and the creation of four categories of recreational use and the addition of nutrient standards for reservoirs. Below we will briefly discuss these proposed changes. Please click here if you would like more detail on the 2010 Texas Surface Water Quality Standards.

Revisions to Contact Recreation Standards

The contact recreation portion is revised to include four categories of recreational use: primary contact recreation (PCR), secondary contact recreation 1 (SCR1), secondary contact recreation 2 (SCR2), and non-contact recreation (NCR) waters. The proposed *E. coli* standards for each category can be found in Table 1. The revisions to the bacteria standards also propose that classified segments are designated for primary contact recreation, unless site-specific information, such as a Recreational Use Attainability Analysis (RUAA) demonstrates that different recreational uses and/or criteria may be justified. PCR will remain the presumed use for all waterbodies; however, SCR1 may be the presumed use for certain types of unclassified waters if primary contact recreation does not occur and if certain depth characteristics are met. Changes also include descriptions for SCR2 and NCR and that no waterbodies are presumed to have these two uses. To have a waterbody classified as SCR2 will require the completion of an RUAA study. There are no waterbodies in the Brazos River basin that would qualify for the NCR designation.

Table 1. Proposed *E. coli* Standards for Freshwater for Each Category of Recreational Use

Use Category	**Geometric Mean (colonies/100mL)**
Primary Contact Recreation (PCR)	206
Secondary Contact Recreation 1 (SCR1)	630
Secondary Contact Recreation 2 (SCR2)	1,030
Non-contact Recreation (NCR)	2,060

Based on new calculations using updated information and to be more consistent with national standards, the TCEQ is recommending that the PCR standard be raised from a concentration of 126 colonies/100mL to 206 colonies/100mL. If

this proposed change is accepted by EPA, it would eliminate 14 of the Brazos River basin's 69 bacteria impairments. Most of the unclassified waterbodies impaired for bacteria would be eligible for a SCR1 categorization, which would eliminate most of those impairments. Studies are under way across the basin to gather the data necessary for TCEQ to make category determination for the impaired, unclassified.

Nutrient Standards for Reservoirs

New criteria are proposed to protect numerous reservoirs from excessive growth of aquatic vegetation related to nutrients. The proposed standards contain median chlorophyll *a* criteria. Standards attainment will be based on the long term median of chlorophyll *a* measurements collected. The median concentration will be compared to the chlorophyll *a* criteria. There is some concern for some Brazos Basin reservoirs whose median chlorophyll *a* concentrations are very near to the proposed chlorophyll *a* criteria. Table 2 summarizes the proposed nutrient standards for the basin's reservoirs and their current status. The reservoirs highlighted in green are expected to be impaired when the standards become effective.

Table 2. Proposed Nutrient Standards and Current Status of Brazos River Basin Reservoirs

Segment	Reservoir	Station	Chlorophyll *a* Criteria (µg/L)	Long term Chlorophyll *a* Median Concentration (µg/L)
1203	Whitney Lake	11851	18.34	10.3
1205	Lake Granbury	11860	22.16	18.21
1207	Possum Kingdom Lake	11865	10.74	7.13
1212	Somerville Lake	11881	53.05	39.13
1216	Stillhouse Hollow Lake	11894	5.00	1.50
1220	Belton Lake	11921	6.38	4.32
1222	Proctor Lake	11935	28.15	29.2
1225	Waco Lake	11942	23.16	18.6
1228	Lake Pat Cleburne	11974	19.04	17.16
1231	Lake Graham	11979	6.07	6.39
1233	Hubbard Creek Reservoir	12002	5.61	3.19
1234	Lake Cisco	12005	5.00	10.0
1235	Lake Stamford	12006	16.85	10.0

Segment	Reservoir	Station	Chlorophyll *a* Criteria (µg/L)	Long term Chlorophyll *a* Median Concentration (µg/L)
1237	Lake Sweetwater	12021	13.28	7.80
1240	White River Lake	12027	13.85	14.2
1247	Granger Lake	12095	11.72	9.05
1249	Lake Georgetown	12111	5.00	3.5
1252	Lake Limestone	12123	19.26	14.74
1254	Aquilla Reservoir	12127	14.10	12.35

It is not known how the EPA will receive TCEQ's proposed changes to the water quality standards or when these proposed rules will become effective. Increasing the contact recreation categories for bacteria impairments will eliminate inappropriate impairments and allow the state to focus its limited water quality resources on waterbodies with legitimate impairments. While the proposed nutrient standards will cause some Brazos Basin lakes to be impaired as soon as the new standards are effective, these proposed nutrient standards will provide TCEQ the tools they need to protect Texas reservoirs from excessive eutrophication and will give the TCEQ to ability to limit nutrient loading from wastewater discharges in to the reservoirs of Texas.

Other than Standards revision there are several other efforts under way in the Brazos River Basin with goals of identifying and improving water quality impairments and concerns. Several Watershed Protection Plan projects had final drafts developed in 2010 and either out for comment or already submitted to the EPA for approval.

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 have helped Stakeholders develop 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 and as a result the Plan was approved by the Stakeholders in June 2010 and the final draft of the Plan was submitted to the EPA January 2011. Please click here for more information on the Lake Granbury Watershed Protection Plan.

Watershed Protection Plan for the Leon River

The Leon River was placed on the State's 303(d) List in 1997, and the TCEQ began developing a Total Maximum Daily Load (TMDL) on the portion of the river downstream of Lake Proctor and upstream of Hamilton in 2002. Upon completion of the TMDL modeling report, local stakeholders requested the BRA to facilitate the development of a WPP for the Leon River to assist the TCEQ in selection appropriate implementation strategies for the watershed. The BRA received funding for the project through the TSSWCB and began hosting stakeholder meetings in 2007. In the fall of 2008 the TMDL was put on hold, indefinitely, pending proposed changes to water quality standards. Stakeholders, however, continued to work toward the development of a WPP document. A draft WPP was completed and released for public comment in December 2011. The Plan will be submitted to the EPA in Spring 2011. Please click here for more information on the Leon River Watershed Protection Plan.

Little Brazos River Tributaries Bacteria Assessment

The BRA has received funding from the TSSWCB 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. Along with routine monitoring for bacteria, flow, and stormwater monitoring, BRA collected data to be used in a Recreational Use Attainment Analysis (RUAA) for the five tributaries. Data collection was completed in 2010 and was submitted to the TSSWCB in February 2011. Please click here for more information on the Little Brazos River Tributaries Bacteria Assessment.

Biological and Habitat Assessments in 2010

In 2010, 10 monitoring stations were assessed for biology and habitat on the following streams: two stations on Resley Creek upstream of CR 392 and at FM 2823 (Segment 1221A), South Leon River at SH 36 near Gustine (Segment 1221B), the Leon River at FM 1829 (Segment 1221), the Lampasas River at US 190 near Kempner (Segment 1217), the South Fork San Gabriel River at the Weir Pit west of Georgetown (Segment 1250), two stations on Thompson's Creek at Sandy Point Road and at SH 21(Segment 1242D), Cow Bayou at CR 417 south of Satin (Segment 1242R), and the

Navasota River upstream of Gibbons Creek southeast of College Station (Segment 1209). Results of each Biological Assessment are discussed in the Water Quality Conditions section in the appropriate segment discussion.

WATER QUALITY MONITORING

The 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. This report is referred to as the Integrated Report (IR). As required by the Act, the IR is updated every two years and includes the review of the past seven years' data collected by many organizations statewide, including the BRA. The draft 2010 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. Please click here for more information and to review the draft 2010 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d). In February 2010, the Draft 2010 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) was sent out for public comment.

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, 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. 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. Site-specific water quality criteria have been developed for water temperature, dissolved oxygen, pH, bacteria, chloride, sulfate and total dissolved solids 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 having a "concern for near non-attainment 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* (although chlorophyll *a* criteria has been developed for certain reservoirs). 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 or chlorophyll *a* are referred to as having 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, specific conductance, pH, water temperature, stream flow (not in reservoirs) and transparency.

Dissolved oxygen (DO) 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 in the form of 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 The three components evaluated during a biological assessment include: measurement of physical habitat parameters, collection of fish community and the benthic macroinvertebrate community data. Each component, depending on the nature of a particular waterbody and its biota, is classified as having limited, intermediate, high, or exceptional aquatic life. Assessments 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.

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 2011 (September 2010 through August 2011).

Table 3. FY 2011 Summary of Known Sampling for the Brazos River Basin (September 2010 through August 2011)

Sampling Entity	Field	Conventional	Bacteria	24-hr DO	Biological and Habitat	Metals in Water	Organics in Water
BRA	49 monthly 75 quarterly 8 semi-annually			9 semi-annually 2 stations 3 events 1 station 1 event	9 semi-annually	7 quarterly	7 quarterly
	10 monthly 2 stations 7 events		5 monthly				
TCEQ	10 monthly 60 quarterly 9 semi-annually			7 semi-annually	3 semi-annually 1 annually	11 quarterly	3 semi-annually
	1 semi-annually						
TIAER	11 monthly 20 semi-monthly						
	8 semi-monthly						
TPWD				3 annually			

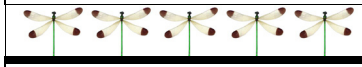
Information compiled from the Clean Rivers Program Coordinated Monitoring website (http://cms.lcra.org/)

WATER QUALITY CONDITIONS

The Water Quality Conditions 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 impairments or concerns 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. Impairment or Concern 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
	>1	0	0	Multiple 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
	≥1	>1	>1	One or more impairments 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)

Salt Fork of the Brazos River (Segment 1238)

This segment has been listed on the TCEQ 303(d) for elevated chloride since the 2002 assessment. The draft 2010 assessment lists this segment as fully supporting for chloride and recommends removing it from the 303(d) list although trend analysis continues to indicate a slightly increasing trend in chloride and TDS.

White River (Segment 1239)

This segment was only assessed for drinking water use and has no impairments.

White River Lake (Segment 1240)

White River Lake is listed as not supporting for chloride, sulfate, and TDS. As with this entire watershed the source of the dissolved solids are natural, due to the geology of the watershed. Trend analysis indicates an increasing trend in chloride and TDS.

Double Mountain Fork of the Brazos River (Segment 1241)

This segment is listed as not supporting for chloride and has a concern for TDS. The draft 2010 assessment lists this segment as not supporting for chloride, TDS, and *E. coli* at the current standards.

The North Fork Double Mountain Fork of the Brazos River (1241A) is listed as not supporting due to bacteria with a concern for nitrate, and chlorophyll *a*. The most likely source of nitrogen loading in this segment is from point source municipal discharges.

Lake Alan Henry (1241B) is in full support of all designated uses and possesses no water quality concerns in the 2008 assessment. The 2010 assessment found an impairment for mercury in edible tissue. Buffalo Creek Reservoir (1241C) is listed as having a concern for chlorophyll *a*.

Watershed of the Clear Fork of the Brazos River (Map)

Clear Fork of the Brazos River (Segment 1232)

The Clear Fork is listed as having concerns for nitrate nitrogen, orthophosphate phosphorus, chlorophyll *a*, and DO for the portion of the segment downstream from the confluence with Deadman Creek. Nutrient concerns decrease as you move downstream with the sites closest to Deadman Creek inflow having the highest level of nutrients. The DO concern is in the portion of the segment upstream from the Deadman creek 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.

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

Deadman Creek (1232B) is listed as not supporting due to bacteria and as having concerns for nitrate nitrogen and phosphorus. Paint Creek (1232C) is listed as having a concern for chlorophyll *a*. Special studies on California Creek, Paint Creek, and Deadman Creek identified agricultural nonpoint pollution and municipal discharges as possible sources of nutrient loadings.

Hubbard Creek Reservoir (Segment 1233)

Hubbard Creek Reservoir is currently listed as having concerns for DO in the Hubbard Creek Arm of the reservoir. The 2010 assessment finds this segment fully supporting for DO. Hubbard Creek Reservoir is frequently impacted by drought and low water levels which is most likely the cause of the DO concern in 2008.

Big Sandy Creek (1233A) has a concern for bacteria. Potential contributors to the bacteria concerns include: wildlife runoff, agricultural runoff and on-site sewage facilities. TCEQ did not assess chloride, yet data indicate that this segment would exceed the standard. Hubbard Creek (1233B) is not listed for any impairment or concerns.

Lake Cisco (Segment 1234)

Lake Cisco is not listed for any concerns or impairment.

Lake Stamford (Segment 1235)

Lake Stamford is listed as having concerns for DO 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. The draft 2010 assessment lists DO as fully supporting.

Fort Phantom Hill Reservoir (Segment 1236) and **Lake Sweetwater (Segment 1237)**

Both reservoirs were only assessed for drinking water use and did not have any concerns or impairments. Fort Phantom Hill Reservoir was fully assessed in 2010 yet did not have sufficient data to determine concerns, while Lake Sweetwater was not assessed.

Upper Watershed of the Brazos River (Map)

Lake Graham (Segment 1231)

The Lake Graham listing has been upgraded from not supporting to having concerns for TDS. The data indicates a statistically significant decreasing trend for TDS, another residual effect of drought relief in 2007. The draft 2010 assessment further upgrades TDS to fully supporting.

Brazos River above Possum Kingdom Reservoir (Segment 1208)

The Brazos River above Possum Kingdom is listed as having a concern for chlorophyll *a* in the portion of the segment upstream of Possum Kingdom to the confluence with Spring Creek. The nutrient sources causing the excessive algal growth are unknown. The entire segment is listed as not supporting for bacteria. Elevated levels of bacteria are attributed to general nonpoint source pollution. An RUAA was scheduled for this segment.

Millers Creek Reservoir (1208A) is listed as having concern for DO and concern for near non attainment for bacteria. The DO concern is most likely a result of the shallow depths of the reservoir (ranging from 6 to 8 feet in depth) with insufficient quantity of water to buffer against high ambient air temperatures.

Possum Kingdom Lake (Segment 1207)

Possum Kingdom is a large reservoir that is an important source of drinking water and recreation. There are no impairments for the reservoir.

Brazos River below Possum Kingdom Reservoir (Segment 1206)

The Brazos River below Possum Kingdom is listed as not supporting for chloride. The chloride is mostly the result of salt bearing formations in the Salt and Double Mountain Forks of the Brazos River. The 2008 Assessment lists this segment as not supporting for macrobenthic community and having concerns for biological habitat. The draft 2010 assessment found that the chloride now meets the segment standard and the macrobenthic community impairment was removed and has become a concern due to new assessment methods.

Palo Pinto Creek (1206D) supports all of it designated uses with no impairments.

Lake Palo Pinto (Segment 1230)

Lake Palo Pinto has no impairments or concerns.

Lake Granbury (Segment 1205)

The 2008 303(d) lists this reservoir as not supporting due to high chloride. Chloride in the segment fluctuates greatly with the naturally occurring drought/flood cycle and the segment is frequently being listed and de-listed due to this fluctuation. The draft 2010 assessment found that the reservoir is now fully supporting for chloride but having concern for chlorophyll *a*.

Brazos River below Lake Granbury (Segment 1204)

The draft 2010 assessment found concern for chlorophyll *a* and the portion of the river from the confluence with the Paluxy River upstream to DeCordova Dam has concern for impaired habitat.

Camp Creek (1204A) is not supporting for *E. coli* at the current standard of 126 mpn/100mls and has concern for nitrate nitrogen in the draft 2010 assessment.

Paluxy River (Segment 1229)

There are no impairments in the Paluxy River.

Squaw Creek Reservoir (1229A) possesses concerns for phosphorus. The source of elevated phosphorus in Squaw Creek Reservoir is currently unknown.

Lake Pat Cleburne (Segment 1228)

The draft 2010 assessment found a concern for chlorophyll *a* in this reservoir at the criteria of 26.7 ug/L, the proposed chl a standard is 19.04 ug/L.

Nolan River (Segment 1227)

Nolan River is listed as not supporting for chloride, sulfate, and TDS, and having concerns for fecal coliform, nitrate and chlorophyll *a*. More recent bacteria data collected to be included in the 2010 assessment indicate no concern or impairment for bacteria. The ground water in the watershed contains dissolved solids, this water is used by industry and the local municipal waste water treatment can't remove the dissolved solids and thus discharges them to the Nolan River. TCEQ is reevaluating the chloride, sulfate, and TDS criteria for this segment.

Lake Whitney (Segment 1203)

Lake Whitney is listed as having concerns for nitrate in the Nolan River Arm, chlorophyll *a* in the Nolan River Arm and Brazos River Arm, and DO near the dam. Potential non-point sources of nitrate in the watershed include municipal discharges, on-site sewage facilities and municipal and agricultural runoff. 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. The draft 2010 assessment found concern for chlorophyll *a* in the downstream portion of the segment.

Aquilla Creek Watershed (Map)

Aquilla Reservoir (Segment 1254)

This segment is listed as having concerns for atrazine in drinking water and nitrate. The 2010 assessment finds there is no longer a concern for Atrazine in drinking water for this reservoir but continues to have a concern for nitrate nitrogen. Sources of the nitrate in the watershed have not been determined but may include permitted discharges, agricultural runoff and other non-point source runoff. The Hackberry Creek arm 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

Hackberry Creek (1254A) the draft 2010 assessment finds the sub-segment has concerns for DO, ammonia, nitrate nitrogen, and orthophosphate phosphorus, while Aquilla Creek upstream of Aquilla reservoir (1254B) had no impairments or concerns.

Brazos River/Lake Brazos (Segment 1256)

The Brazos River/Lake Brazos is listed having concerns for chlorophyll *a,* and nitrate nitrogen in the Lake Brazos portion of the segment. 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. Aquilla Creek (1256A) is listed as having concern for nitrate nitrogen.

Bosque River Watershed (Map)

Upper North Bosque River (Segment 1255)

The Upper North Bosque River is listed as not supporting due to bacteria and DO, having concerns for nutrients and chlorophyll *a.* Both wastewater treatment plant effluent and the CAFOs located in the watershed are potential contributors to the elevated bacteria and nutrients.

Goose Branch (1255A), North Fork Upper North Bosque River (1255B), and Scarborough Creek (1255C) segments are listed as not supporting due to bacteria and as having concerns for nutrients and chlorophyll *a*.

South Fork North Bosque River (1255D) has a concern for chlorophyll *a*.

Unnamed Tributary to Goose Creek (1255E) has concerns for *E. coli* and nutrients.

Unnamed Tributary to Scarborough Creek (1255F) and Woodhollow Branch (1255G) segments are not supporting due to bacteria.

South Fork Upper North Bosque River Reservoir (1255H) has a concern for DO
Dry Branch (1255I) is listed as not supporting for *E. coli* and has concerns for phosphorus.

Goose Branch Reservoir (1255J) and Scarborough Creek Reservoir (1255K) segments have concern for phosphorus and chlorophyll *a* but were not assessed for bacteria.

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. Because there are many such systems not only in the Brazos River basin, but in other river basins in Texas, the TCEQ has made a focused effort to complete RUAAs for these small streams which may result in water quality standards changes for streams such as these.

North Bosque River (Segment 1226)

North Bosque River is listed as not supporting for algae and except the portion from the confluence with Lake Waco upstream to the confluence with Neils Creek has concerns for chlorophyll *a*, and phosphorus. The portion of the river between Neils Creek and Meridian Creek also has a concern for DO. 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. A TMDL has been completed and implemented for this segment.

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) have no impairments or concerns.

Green Creek (1226B) is not supporting for DO and has concerns for chlorophyll *a*, and near non attainment for bacteria. The 2010 assessment upgraded DO to concern and *E. coli* to fully supporting.

Indian Creek (1226E) and Little Duffau Creek (1226K) segments are not supporting for bacteria and have concern for nutrients.

Sims Creek (1226F) and Little Green Creek (1226M) are not supporting for bacteria.

Alarm Creek (1226H) is not supporting for bacteria and has concern for chlorophyll *a*.

Indian Creek Reservoir (1226N) has concerns for chlorophyll *a* and nutrients.

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 recreational use due to bacteria. Potential sources of bacteria include on-site sewage systems and runoff from rangeland and agricultural lands. The draft 2010 assessment found this sub-segment is fully supporting for fecal coliform.

Waco Lake (Segment 1225)

Waco Lake is listed as having concerns for nitrate and chlorophyll *a*. The Bosque River watershed fills Waco Lake and is the source of the nutrients needed for algae growth. The draft 2010 assessment found this segment has only a concern for nitrate nitrogen.

Leon River Watershed (Map)

Leon Reservoir (Segment 1224)

The Leon Reservoir has no impairment. There is a concern for manganese in the sediment although data is limited.

Leon River Below Leon Reservoir (Segment 1223)

The Leon River below Leon Reservoir is on the 303(d) List as impaired for recreational use due to elevated bacterial levels and depressed DO. There is a concern for increased chlorophyll *a*. In the draft 2010 assessment the dissolved oxygen impairment has been downgraded to a concern, but the number of exceedance below the standard are too many to delist. 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 DO levels.

Unclassified segment Armstrong Creek (1223A) is impaired for bacteria and as predicted the draft 2010 assessment found another unclassified segment, Cow Creek (1223B), has concerns for elevated bacteria and chlorophyll *a*. These creeks are 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; there is concern for high chlorophyll *a* values with an additional concern for total phosphorous in the upstream portion of the lake. The elevated chlorophyll *a* levels are most likely caused by increased nutrient inputs via tributary streams to the reservoir from runoff from rural lands.

Five tributaries to Lake Proctor possess impairments for bacteria: Duncan Creek (1222A), Rush-Copperas Creek (1222B), Sabana River (1222C), Sowells Creek (1222D) and Sweetwater Creek (1222E). As in the case of the small tributary streams mentioned in the Bosque River Watershed, the tributary streams of Proctor Lake are also dominated by stormwater runoff. The draft 2010 assessment found that Duncan and Hackberry Creeks also have concerns for low dissolved oxygen.

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 currently listed as impaired for bacterial with concerns for chlorophyll *a* and depressed DO.

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. Please click here for more information on the Leon River Watershed Protection Plan that addresses issues in this segment.

Biological Assessment

Segment 1221, the Leon River below Proctor Lake, has a designated high aquatic life use (ALU), and 24-hour dissolved oxygen criteria of 5.0 mg/L (average) and 3.0 mg/L (minimum) (Texas Surface Water Quality Standards, Appendix A). BRA's aquatic life monitoring site at FM 1829 southeast of Gatesville (Station 11925) integrates effects of most water quality influences in the watershed upstream from Belton Lake. Monitoring objectives have been to evaluate the condition of aquatic life, in light of past 305(b) assessment concerns for bacteria, dissolved oxygen, chlorophyll *a*, and algal growth in portions of the segment, and to provide a baseline for evaluating the effectiveness of ongoing water quality improvement projects, including the Leon River/Proctor Lake Watershed Protection Plan and best management practices for dairy operations in the watershed.

All components of the 2010 assessments met or exceeded high ALU expectations. The reason the fish assemblage failed to attain a high ALU in 2008 remains unknown, although previously-described hydrological factors, low-flow water quality influences, and/or natural year-to-year variability in fish assemblage structure may have been involved. The most recent results indicate that depressed fish assemblage integrity has not persisted, and that present-day environmental conditions are favorable.

Four of the tributaries to this segment are not supporting their recreational use due to bacteria: Resley Creek (1221A), the South Leon River (1221B), Indian Creek (1221D), and Walnut Creek (1221F). Resley Creek's 303(d) Listing also includes an impairment for depressed DO, and has concerns for nutrients and chlorophyll *a*. Nutrients, chlorophyll *a*, and depressed DO levels are concerns for South Leon River and Indian Creek. With additional data collection to be included in the 2010 assessment, the bacterial impairment for Pecan Creek will likely be removed. Pecan Creek (1221C) did not have any impairments or concerns. The Two Data Collection Initiatives project is addressing issues in Resley Creek.

Two Data Collection Initiatives – Segment 1221

Resley Creek (1221A) is on the 303(d) List for depressed dissolved oxygen (DO). This is a small, rural stream characterized by highly intermittent flow and frequent low water levels. The DO impairment is caused in part by the frequent low water levels which hinder the ability of the water to buffer against high ambient air temperatures in the summer and fall reducing the water's capacity to maintain dissolved oxygen levels. BRA will conduct a series of biological and 24-hour DO data collections. An Aquatic Life Assessment (ALA) will be conducted on Resley Creek (1221A) to determine the appropriate

aquatic life use and associated dissolved oxygen criteria. Year 1 of an Aquatic Life Assessment (ALA) was conducted on Resley Creek (1221A) in 2010. Preliminary results indicate all biological components attained at least a high ALU, indicating favorable environmental conditions. High biological integrity prevailed despite less-than-optimal physical habitat, and late summer development of intermittent flow conditions and slightly depressed dissolved oxygen concentrations. Indigenous fish and benthic assemblages obviously are adapted for such conditions and are not negatively affected by these factors. The level of biological integrity observed, the bottom line in ALU attainment, indicates that a high ALU designation is appropriate for the segment, despite the hydrological regime. Site-specific dissolved oxygen criteria should be developed to complement this designation. Year 2 sampling will begin in the spring of 2011, and will help refine initial indications.

Biological Assessment

The South Leon River, an unclassified tributary of Leon River Segment 1221, has not been assigned an aquatic life use (ALU) or dissolved oxygen criteria by TCEQ. Following TCEQ convention, a limited ALU and 24-hour dissolved oxygen criteria of 3.0 mg/L (average) and 2.0 mg/L (minimum) are presumed to apply, since flow is intermittent with perennial pools. This contradicts TCEQ's 305(b) assessment presumption that the river is perennial. BRA's contention is based on analysis of flow severity data for Station 11817 from the TCEQ SWQMIS database. Of 89 determinations during the period of record (1995-present), there have been 11 instances of no flow with pools, and one instance where the stream was dry. Intermittency has occurred in 13.5% of the determinations, and during eight different years over the 16-year period of record, indicating that no flow with pools is a typical, recurring hydrological condition. Biological assessments were performed at SH 36 near Gustine, Station 11817, on June 10-11 and August 5-6, 2010.

All biological components attained at least a high ALU during both events, indicating favorable environmental conditions. High biological integrity prevailed despite less-than-optimal physical habitat, and late summer development of intermittent flow conditions and slightly depressed dissolved oxygen concentrations. Indigenous fish and benthic assemblages obviously are adapted for such conditions and are not negatively affected by these factors. The level of biological integrity observed, the bottom line in ALU attainment, indicates that a high ALU designation is appropriate for the segment, despite the hydrological regime. Site-specific dissolved oxygen criteria should be developed to complement this designation.

Belton Lake Segment (Segment 1220)

Water quality in Belton Lake is fully supporting of all uses assessed; however, an increasing trend in nutrient concentrations near the Leon River arm, specifically nitrate nitrogen poses a concern.

An unclassified tributary to Belton Lake, Cowhouse Creek (1220A) 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 nitrogen and phosphorus, but is otherwise fully supporting of all assessed uses. The source of elevated nutrients in this segment is believed to be a result of point source discharges 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 nitrogen and phosphorus. Sources of each include municipal discharges, on-site sewage facilities and urban runoff.

Lampasas River Watershed (Map)

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 is listed as impaired for bacteria. 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. Additional bacteria data will be collected by the TCEQ TMDL team from September 2010 through November 2011 to further investigate this impairment. Please click here for more information on the Lampasas River Watershed Protection Plan that addresses issues in this segment

Biological Assessment

Segment 1217, the Lampasas River above Stillhouse Hollow Lake, has a designated high aquatic life use (ALU), and 24-hour dissolved oxygen criteria of 5.0 mg/L (average) and 3.0 mg/L (minimum) (Texas Surface Water Quality Standards, Appendix A). The stream was assessed at US 190 near Kempner, Station 11897, on June 16-17 and August 26-27, 2010. The objective was to evaluate ALU attainment, in light of potential threats indicated by concerns for bacteria in portions of the segment, and excessive algal growth below Sulphur Creek, which enters 1.7 km above the site.

Whereas all components of the assessments met or exceeded high ALU expectations, nutrient enrichment was indicated by dense filamentous algae growth. However, associated effects were not severe, as diel dissolved oxygen fluctuations were relatively narrow and fish and benthic macroinvertebrate assemblages were not impaired.

An abnormality occurred in August, when a benthic macroinvertebrate disease outbreak was observed. Nineteen of the 29 taxa, and 30.9% of the specimens, had dark-colored tissue necrosis on parts of the body. The disorder is believed to be a fungal infection, caused by some type of sediment-related stressor which compromises benthic organisms' immunity. Similar outbreaks were observed in the North Bosque River and Trimmier Creek in 2009. The condition evidently is episodic rather than chronic, but is virulent and ultimately results in substantial mortality. Although benthic integrity in the Lampasas wasn't perceptibly degraded at the time of sampling, severe impairment may have eventually occurred before the outbreak ran its course. Research is needed to characterize the disease and identify environmental stressors that trigger it.

The unclassified tributaries Sulphur Creek (1217B) and North Rocky Creek (1217D) possess impairment or concern for depressed DO. 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 DO levels. A TMDL project was initiated in 2002 to address the impairment. Biological data collected indicated that North Rocky Creek supports a relatively healthy biological community even with depressed DO levels. The TCEQ's Water Quality Standards program is reviewing data from North Rocky Creek to determine if a site-specific criterion for DO would be appropriate for the creek. The current criterion for the segment is based on a presumed standard. No TMDLs will be developed for the creek unless conditions change.

Stillhouse Hollow Lake (Segment 1216)

Water quality in Lake Stillhouse Hollow currently meets all water quality standard criteria and nutrient screening levels with no impairments or concerns at this time. However, Authority staff is becoming increasingly concerned about Trimmier Creek (1216A), 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. The draft 2010 assessment found that Trimmier Creek has a concern for impaired macrobenthic community and is not supporting for *E. coli* at 126 mpn/100mls.

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. The draft 2010 assessment indicates not supporting for *E. coli* at 126 mpn/100mls but data collected after the assessment date bring *E. coli* back to fully supporting.

Salado Creek (Segment 1243)

Salado Creek possesses a concern for nitrate nitrogen 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. Both TCEQ and the Bell County Health Department have been informed of both the Authority's and SCPC's data results indicating a very isolated problem. Water samples collected from upstream and downstream of this area do not indicate any concern for bacteria.

Little River Watershed (Map)

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 portion of the segment from the Williamson CR 279 crossing to the upper end of the segment has a concern for depressed DO. This DO concern 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 capacity to maintain DO levels.

Biological Assessment

Segment 1250, the South Fork San Gabriel River, has a designated high aquatic life use (ALU), and 24-hour dissolved oxygen criteria of 5.0 mg/L (average) and 3.0 mg/L (minimum) (Texas Surface Water Quality Standards, Appendix A). Historically, the segment has been considered perennial, as implied by TSWQS Appendix A and TCEQ's 305(b) assessment approach. BRA contends that the segment is intermittent with perennial pools from the headwaters to a point approximately 3.2 km upstream from IH 35, and perennial from that point to the confluence with the North Fork San Gabriel River. This contention is based on five years of field observations and flow severity data from multiple locations throughout the segment, and USGS flow records from IH 35. Flow severity data from BRA's aquatic life monitoring site at the Weir Pit west of

Georgetown (Station 20309) reflect conditions in the intermittent reach, as no flow with pools has occurred in 10 of 46 determinations (21.7%). Intermittency occurred during three different years of the five-year period of record (2006, 2008, and 2009).

The original objective of aquatic life monitoring was to assess instream effects of rapid development in the watershed. Circumstances during the early stages of the project shifted the focus to impacts of major sewer line installation activities along the streambed in the study area. The first set of assessments were performed in March and July, 2008. Sewer line installation progressed from early stages during the first event to middle stages by the second event. Construction activities extended from IH 35 in Georgetown to about 14 km upstream, and involved clearing of riparian vegetation, and trenching in and immediately adjacent to the stream channel. The sewer line crosses the streambed in approximately nine places. Environmental effects included destruction of large amounts of riparian vegetation, increased turbidity, and excessive deposition of silt on the streambed. Additionally, direct physical damage to the stream channel occurred due to trenching and maneuvering of heavy machinery in and immediately adjacent to the river, including construction of temporary low water dams drained by culverts which were used as vehicle crossings.

In the March 2008 event, during the non-critical portion of the index period, dissolved oxygen concentrations and benthic macroinvertebrates achieved an exceptional ALU, and fish and physical habitat a high ALU. In the July 2008 event, during the critical portion of the index period, dissolved oxygen concentrations achieved an exceptional ALU based on the 24-hr. minimum, and a high ALU based on the 24-hr. mean. Benthic macroinvertebrates attained an exceptional ALU, fish a high ALU, and physical habitat an intermediate ALU.

The fact that all biological components achieved or exceeded high ALU expectations indicated that early to middle stages of sewer line installation did not significantly impact the biota. The physical habitat rating did deteriorate, falling from high in March to intermediate in July. Responsible factors included construction-related disturbances and extreme low flow. Monthly observations and routine water quality monitoring through the end of September 2008 revealed progressive deterioration of instream conditions during the advanced stages of sewer line installation, and significant aquatic life impacts more than likely did occur at some point in time.

Follow-up assessments were conducted on April 14-15 and July 19-20, 2010, to evaluate temporal changes. In the first event, during the non-critical portion of the index period, dissolved oxygen concentrations achieved an exceptional ALU, physical habitat and fish a high ALU, and benthic macroinvertebrates an intermediate ALU.

In the second event, during the critical portion of the index period, reassessment of one habitat transect showed that characteristics had not changed appreciably; therefore, the 4/14/10 physical habitat data, which attained a high ALU, were re-utilized. Dissolved oxygen concentrations achieved an exceptional ALU, and benthic macroinvertebrates and fish a high ALU.

Failure of the benthic assemblage to meet high ALU expectations in April was due to a prevalence of relatively tolerant organisms, including *Cheumatopsyche* and Chironomidae, and an absence of elmid beetles. Although a high ALU was attained in July, both 2010 benthic IBI scores were depressed compared to 2008 scores. Less-suitable conditions in 2010 were attributed to lingering effects of previously-described stream channel disturbance. Adverse effects were limited to the streambed, probably in association with residual, excessive silt deposits. The water column appeared unaffected, judging by fish assemblage integrity.

In conclusion, evidence exists that the lower South Fork San Gabriel River hasn't completely recovered from stream channel disturbance caused by sewer line installation in 2008. Additional aquatic life monitoring is recommended within the next few years to further evaluate recovery from that incident, and to assess ongoing environmental threats as development continues in the watershed.

On a final note, weight of evidence from two years of aquatic life monitoring indicates that the designated high ALU is appropriate for the segment, despite much of the length being intermittent with perennial pools rather than perennial.

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 in the 2008 assessment. The draft 2010 assessment has found the segment impaired for chloride. Authority staff has been 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.

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 and remains on the draft 2010 303(d) List. Concerns for elevated nitrate, orthophosphorus and total phosphorus also exist in Mankins Branch. Issues in these sub segments 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 (1247A), a tributary to Lake Granger, is identified on the 2008 303(d) List as possessing bacterial impairments and a concern for elevated nitrate. The draft 2010 assessment did not find any change from the previous assessment. 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.

Lake Granger Watershed Assessment and Implementation Project

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 (TSSWCB) 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. Please click here for more information on the Lake Granger Watershed Assessment and Implementation Project.

Brushy Creek (Segment 1244)

Brushy Creek is on the 2008 303(d) List for bacterial impairment. Concerns for elevated nutrients including nitrate, orthophosphate and total phosphorus exist in Brushy Creek. An RUAA is underway. Two tributaries to Brushy Creek also possess concerns for nutrients: Brushy Creek above South Brushy Creek (1244A) and South Brushy Creek (1244D). In the draft 2010 assessment the concern for nitrate nitrogen in sub-segment 1244A is removed. Both elevated bacteria levels and nutrient levels in Brushy Creek are attributed to municipal discharges and urban runoff.

San Gabriel River (Segment 1214)

The San Gabriel River is listed as impaired for bacteria, chloride, and sulfate with a concern for nitrate. The draft 2010 assessment found an additional concern for orthophosphate phosphorus. 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. 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 and possesses a concern for nitrate. In the draft 2010 assessment the upper and lower portions of the Little River are listed as impaired for bacteria and the entire river has a concern for nitrate nitrogen. The immediate watershed to segment 1213 is dominated by agricultural activities. Nitrogen concerns in this segment 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. The draft 2010 assessment also found tributary Big Elm Creek (1213A) would exceed the criteria for *E. coli* of 126 mpn/100mls and the Unnamed tributary of Little Elm Creek (1213C) had a concern for impaired habitat.

Central Watershed (Map)

Brazos River above Navasota (Segment 1242)

In the draft 2010 assessment this segment has no impairments and only the portion of the segment from the confluence with Deer Creek upstream to the confluence with Tehuacana Creek had a concern for chlorophyll *a*.

For the Marlin City Lake System (1242A), orthophosphate 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. Tradinghouse Reservoir (1242H) has a concern for harmful algal bloom/golden algae.

Eleven tributaries to the Brazos above Navasota possess bacterial impairments, including: Cottonwood Branch (1242B), Still Creek (1242C), Thompson Creek (1242D) (also with depressed DO impairment), Pond Creek (1242F), Campbell's Creek (1242I), Deer Creek (1242J), Mud Creek (1242K), Pin Oak Creek (1242L), Spring Creek (1242M), Walnut Creek (1242O) and Big Creek (1242P). Nutrient enrichment is a concern for Cottonwood Branch, Still Creek, Thompson Creek, and Pond Creek. In the 2010 assessment Tehuacana Creek (1242N) has concerns for bacteria, chlorophyll *a*, and fish kill report.

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.

There are two project in progress intended to address many of the issues in these unclassified streams. Please click here for more information on the Little Brazos River Tributaries project that is addressing the bacterial impairment in the Campbell's, Mud, Pin Oak, Spring, and Walnut Creeks. The Two Data Collection Initiatives project is addressing issues in Thompson's, Deer and Tehuacana Creeks.

Two Data Collection Initiatives - 1242

Tehuacana Creek (1242N) and Deer Creek (1242J) are on the 303(d) List for bacteria impairment. Because these unclassified streams are small, ephemeral streams where recreational potential is low to non-existent, the efficacy of applying water quality standards meant for large, recreational river segments has come into question. Typically these streams have low flow to no flow for most of the year and if water is present, 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 accumulate possibly causing impairment. Data will be collected to verify the impairment, a land use assessment for the watershed will be prepared, and intensive watershed surveys will be performed. This data will allow TCEQ to determine if existing bacteria criterion applied to these creeks are appropriate and, if not, to develop information necessary to adjust the criterion. Collection of this data began in 2010.

Thompsons Creek (1242D) is on the 303(d) List for depressed dissolved oxygen (DO). This stream is characterized by highly intermittent flow and frequent low water levels. The DO impairment is caused in part by the frequent low water levels which hinder the ability of the water to buffer against high ambient air temperatures in the summer and fall reducing the water's capacity to maintain dissolved oxygen levels. BRA will conduct a series of biological and 24-hour DO data collections. A Use attainability analysis (UAA) will be conducted on Thompsons Creek (1242D) to determine if existing aquatic life use/dissolved oxygen criterion are appropriate and, if not, to develop information necessary to adjust the aquatic life use/dissolved oxygen criterion. Year 1 of the UAA was conducted on Thompsons Creek (1242D) in 2010. Preliminary data indicate several generalities that held true during year 1, independent of hydrology and DO concentrations: (1) all habitat quality index scores rated intermediate; (2) all benthic IBI scores rated limited; (3) three of the four fish IBI scores rated high, with the March score for Sandy Point Road falling only slightly below the high ALU range. Interestingly, biological integrity did not decrease proportionally to DO through the gradient to intermittency. In fact, all July IBI scores for benthics and fish, under conditions of no flow and extremely low oxygen levels, were higher than corresponding scores for March, when the creek was flowing and oxygen concentrations were much greater. Year 2 sampling will begin in the spring of 2011, and will help refine initial indications.

Biological Assessment

Cow Bayou (1242R) has not been assigned an aquatic life use (ALU) or dissolved oxygen criteria by TCEQ. Following TCEQ guidelines, a high ALU and 24-hour dissolved oxygen criteria of 5.0 mg/L (average) and 3.0 mg/L (minimum) are presumed to apply, since flow is perennial. Biological assessments were performed at CR 417 south of Satin, Station 11717, on April 29-30 and July 26, 2010. The site integrates effects of most water quality influences in the subwatershed, due to its location in the lower portion of the creek. The location is an original ecoregion site assessed by TCEQ in July 1987. Cow Bayou has not been included in previous 305(b) assessments, so the present status of water quality and biology is not well known. Aquatic life monitoring was conducted to determine if the creek has retained least-impaired characteristics over the past 23 years and its value as a reference stream to which other middle Brazos River tributaries can be compared, and to provide up-to-date information for future state assessments.

2010 aquatic life monitoring results, particularly for fish, indicated favorable environmental conditions. Based on a temporal comparison, it is concluded that present-day aquatic life characteristics are comparable to those in 1987, and that no significant ecological changes have occurred over the past 23 years. Observed differences were within the realm of expected natural variability. No widescale development has occurred in the subwatershed, and there are no major point source discharges. Therefore, it is concluded that Cow Bayou has retained least-impaired characteristics and its value as a middle Brazos River tributary reference stream.

Navasota River Watershed (Map)

Lake Mexia (Segment 1210)

Lake Mexia is listed as having concerns for low DO, chlorophyll *a*, ammonia, phosphorus, and copper in water. Nutrient concerns are attributable to runoff from wildlife and agricultural lands. Low DO levels are most likely attributable to elevated chlorophyll *a* levels and advanced sedimentation which has significantly reduced the reservoirs capacity.

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. An RUAA is tentatively scheduled for this segment.

Navasota River Below Lake Mexia (Segment 1253)

There are concerns for depressed DO on the portion of the river from the headwaters of Lake Limestone upstream to Springfield Lake. 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 DO levels.

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*, phosphorus, and depressed DO. The cause of depressed DO is likely the elevated chlorophyll *a* levels due to nutrient rich runoff entering the river and lake.

Lake Limestone (Segment 1252)

The portion of the lake near the dam possesses concerns for depressed DO, while the rest of the lake has concerns for chlorophyll *a*. The cause of the depressed DO is currently unknown.

Navasota River Below Lake Limestone (Segment 1209)

The Navasota River below Lake Limestone is listed on the draft 2010 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 nitrogen, 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 Wickson, Cedar, Duck and Shepherd Creeks have concerns for depressed DO. 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. A TMDL was initiated for Carter's and Burton Creek in August 2007. An implementation plan is currently being developed and the TCEQ expects to submit a draft TMDL report for public comment in 2011.

Country Club Branch, Wickson, Cedar, Duck, Gibbons, Shepherd, and Steele 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. At this time,

these streams are held to the same standards as all surface water streams in Texas. To assess standard appropriateness, RUAAs have been initiated for all of these creeks to help determine what standards should be applied to these streams.

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 chlorophyll *a*. A TMDL was completed on these segments in 2003.

Biological Assessment

Segment 1209, the Navasota River below Lake Limestone, has a designated high aquatic life use (ALU), and 24-hour dissolved oxygen criteria of 5.0 mg/L (average) and 3.0 mg/L (minimum) (Texas Surface Water Quality Standards, Appendix A). Assessments were conducted 3.5 km upstream from the mouth of Gibbons Creek southeast of College Station, Station 20529, on May 10-11 and August 16-17, 2010. The site integrates effects of most water quality influences in the watershed, due to its location in the lower portion of the river. Fisheries surveys were performed at the site by TPWD/BRA in 2006 for the Texas Instream Flow Program. The present effort was conducted to generate more comprehensive information on existing ecological conditions. Past 305(b) assessments have identified impairments for bacteria and concerns for nitrate and orthophosphorus in portions of the segment. Biological data were collected to determine if any water quality-related impacts are occurring, and to help elucidate the effectiveness of the recently completed Brazos/Navasota Watershed Protection Plan.

In the first event, during the non-critical portion of the index period, physical habitat, benthic macroinvertebrates, and fish achieved a high ALU. No dissolved oxygen data were collected due to equipment failure.

In the second event, during the critical portion of the index period, reassessment of one habitat transect showed that characteristics had not changed appreciably; therefore, the 5/5/10 physical habitat data, which reflected achievement of a high ALU, were re-utilized. Dissolved oxygen concentrations achieved a high ALU based on the 24-hr. mean, and an exceptional ALU based on the 24-hr. minimum. Fish and benthic macroinvertebrates achieved a high ALU.

Nutrient enrichment was indicated by water chemistry data. Nitrate, orthophosphorus, and total phosphorus exceeded TCEQ screening levels during both events, along with chlorophyll *a* during the August event. However, no adverse effects on dissolved oxygen concentrations or aquatic life were evident.

Fish species richness was noteworthy for Brazos River Basin streams – 26 in May and 30 in August – indicating a rich and diverse assemblage. This, together with the fact that all aquatic life monitoring components met high ALU expectations, reflected favorable environmental conditions.

Yegua Creek Watershed (Map)

Somerville Lake (Segment 1212)

Somerville Lake is on the draft 2010 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 DO levels. With a grant from the TCEQ, BRA is collecting additional data through the Two Data Collection Initiatives project, to gain a better understanding of the possible causes of the elevated pH levels and depressed DO in Lake Somerville. The study will run from December 2009 through September 2013.

Two tributaries to the lake, Middle Yegua Creek (1212A) and East Yegua Creek (1212B), are on the 2010 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. Middle Yegua Creek also has a concern for impaired habitat.

Two Data Collection Initiatives - 1212

This project will help characterize Somerville Lake water quality conditions and identify possible contributing sources of pollution. Somerville Lake is on the draft 2010 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*. 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 dissolved oxygen levels in the lake and the amounts of carbon dioxide in the lake, which in turn affects pH levels.

One tributary to the lake, East Yegua Creek, remains on the draft 2010 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.

At this time, watershed land use has not been quantified, and the cause of the pH impairment has not been confirmed. Cyanobacteria are believed to be the primary organism leading to the pH and DO fluctuations in the reservoir. However, there is not sufficient data to determine that cyanobacteria are the only organism causing this oscillation in pH and DO. Additionally, historical data collection indicates that nutrient concentrations in Lake Somerville and its major tributary, Yegua Creek, are low. The low nutrient level brings into question the cause of cyanobacteria blooms. The limiting factor leading to algal blooms in the lake is not currently known making regulation of inflows to control blooms virtually impossible.

This project will collect the additional data necessary for TCEQ to determine what course of action is most appropriate to address the impairment; again, whether it is a standards amendment, a TMDL, development of at Watershed Protection Plan, etc. This project is a collaborative effort between the Brazos River Authority (Authority) and the Texas Institute for Applied Environmental Research (TIAER).

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 and there is a concern for depressed DO. 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)

Brazos River Below Navasota River (Segment 1202)

The Brazos River below Navasota River is in full support of all of its designated uses but the portion of the river from the confluence with Flat Bank Creek upstream to the confluence with Bessie's Creek has a concern for chlorophyll *a*.

Allen's Creek (1202H) possesses a concern for depressed DO and orthophosphate while the upper portion of Big Creek (1202J) has concerns for nitrate nitrogen, phosphorus, and chlorophyll *a*. Allen's Creek is not supporting for contact recreation use due to bacteria on the draft 2010 303(d) List.

Bacteria issues and nutrient concerns in Big Creek are most likely a result of agricultural and wildlife runoff. Big Creek also has concerns for the fish community and habitat in the upper portion of the creek. The poor diversity in the fish community is a result of the poor habitat available. Like Allen's Creek, his section of the creek is shallow, with muddy bottoms and low sloping banks. There is little habitat variety in this portion of the creek which leads to low diversity in the fish community.

Mill Creek (1202K) concern for an impaired fish community has been upgraded to fully supporting but is not supporting for contact recreation use due to bacteria. Pond Creek (1202P) has a concern for orthophosphate phosphorus.

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 are concerns for nitrate nitrogen and chlorophyll *a*. Potential sources of nitrates may include: industrial and municipal discharges, and stormwater runoff from urban and residential lands. The elevated chlorophyll *a* may be the result of the increased nitrate.

Upper Oyster Creek Watershed (Map)

Upper Oyster Creek (Segment 1245)

Upper Oyster Creek is on the draft 2010 303(d) List for DO and bacteria impairments. The bacteria problems led to a TMDL being initiated. 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. The TMDL for DO was approved by the EPA in September 2010.

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), Flewellen Creek (1245E), Alcorn Bayou (1245F), Steep Bank Creek (1245I), and Stafford Run (1245J) are also impaired due to elevated bacteria levels.

Red Gully (1245A) has concerns for bacteria and nutrients; Alcorn Bayou (1245F) and Steep Bank Creek (1245I) also have concern for nutrients.

RUAAs are in process for Upper Oyster Creek (Segment 1245), Bullhead Bayou (1245C) and unnamed tributary of Bullhead Bayou (1245D).

PUBLIC INVOLVEMENT AND OTHER INFORMATION

Brazos River Basin Clean Rivers Program Steering Committee

The size and diversity of issues across the Brazos River basin 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.

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, developing actions to address potential problem areas in the basin and commenting on the current year's draft Basin Highlights Report.

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 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/). This site is updated quarterly. 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.

Recreational Information

Information is provided on boating, fishing and other river and lake activities including canoeing maps below Possum Kingdom Lake and Lake Granbury.

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

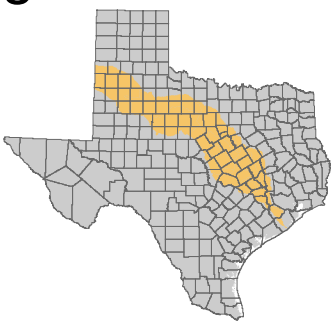
Information is provided on reservoir locations, elevations, and capacities and surface area.

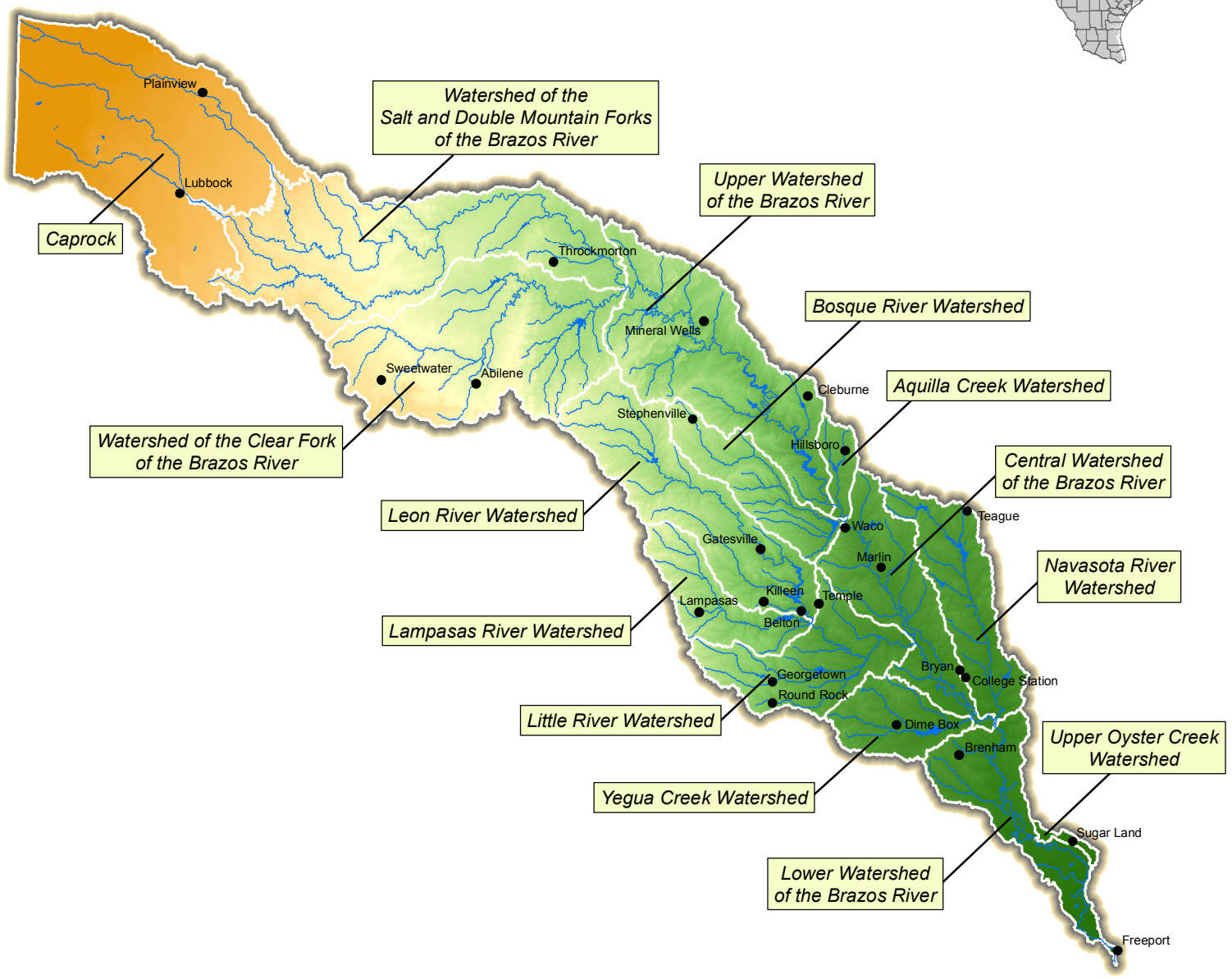
Technical Assistance Program

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.

Maps

Watersheds of the Brazos River Basin
FY11 Water Quality Monitoring





Brazos River Authority

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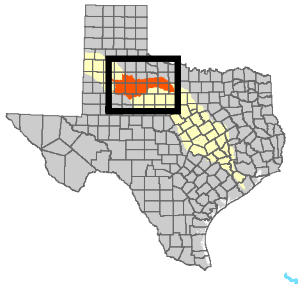
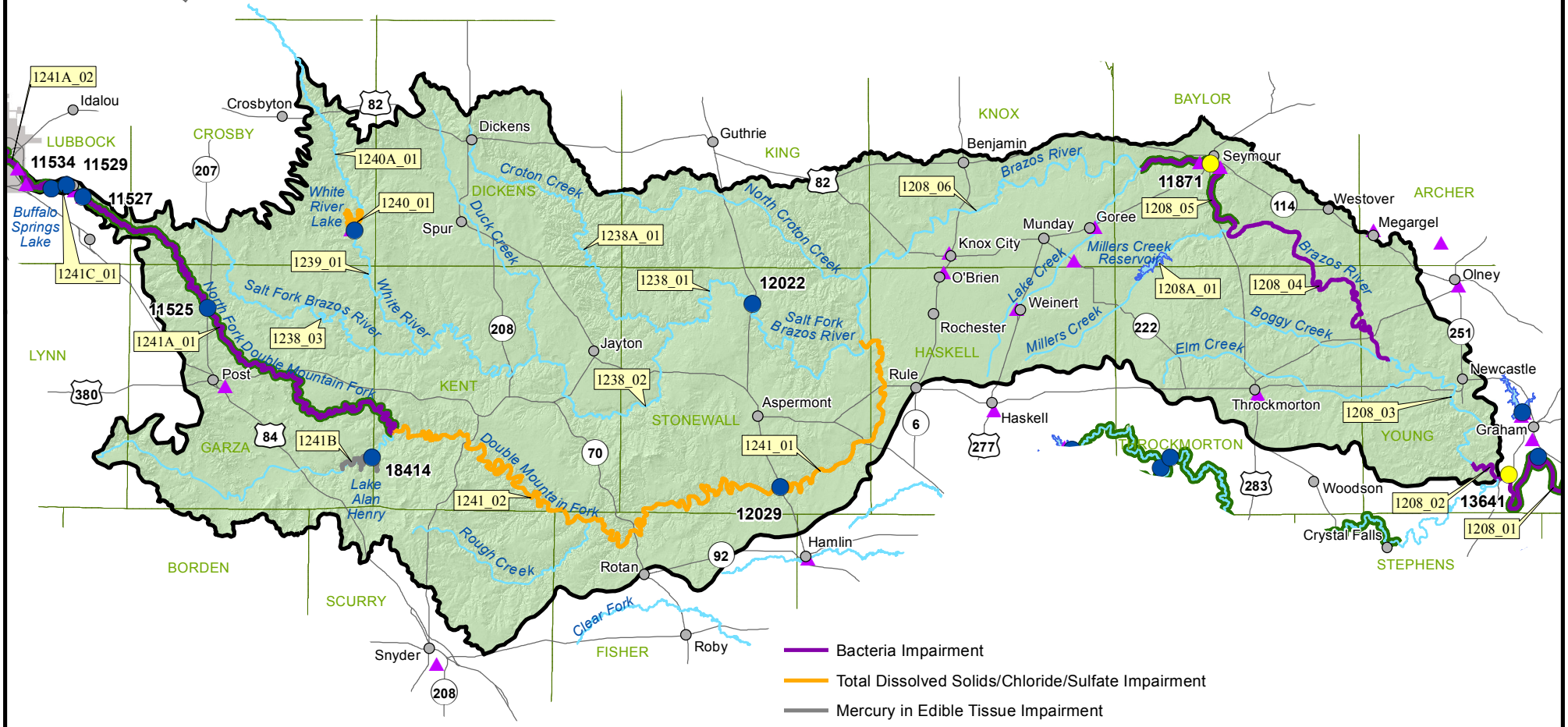
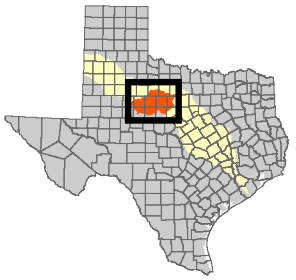
Watershed of the Salt and Double Mountain Forks of the Brazos River Impairments from 2010 303(d) List





Brazos River Authority

Watershed of the Clear Fork of the Brazos River
FY11 Water Quality Monitoring



Bacteria Impairment
Chlorophyll a and/or Nutrient Concern
TCEQ Monitoring Station
Wastewater Outfall
Watershed Boundary

Rochester
Weinert
Rule
HASKELL
Haskell
Throckmorton
THROCKMORTON
Graham
YOUNG
Sagerton
STONEWALL
Lake Stamford
Paint Creek
Woodson
Fort Griffin
Crystal Falls
Hamlin
Rotan
Stamford
California Creek
Clear Fork Brazos River
Hubbard Creek Reservoir
Foyle Creek
Lueders
Breckenridge
Caddo
SCURRY
Roby
Anson
JONES
SHACKELFORD
Albany
FISHER
Cottonwood Creek
Clear Fork Brazos River
Lake Fort Phantom Hill
Hawley
Salt Prong Hubbard Creek
Gonzales Creek
Lake Daniel
STEPHENS
Bitter Creek
Mulberry Creek
Seg 1236
Impact
Hubbard Creek
Battle Creek
Big Sandy Creek
Moran
Deadman Creek
Deep Creek
Lake Cisco
Ranger
MITCHELL
Sweetwater
Trent
Merkel
Tye
Abilene
Lake Sweetwater
Roscoe
Loraine
Clyde
Baird
Putnam
Cisco
Eastland
EASTLAND
CALLAHAN
NOLAN
TAYLOR
Elm Creek
Cedar Creek
Buffalo Gap
Tuscola
Lawn
Cross Plains

12029
12006
18765
18766
11985
11709
12002
11697
13640
13641
12005

1232C_01
1235_01
1232C_02
1232C_03
1232_01
1232_02
1232A_02
1232A_01
1233_01
1233_02
1233_03
1232_04
1232_03
1232B_01
1233A_01
1233B_01
1234_01
1237_01
1232B_02
1236A_01

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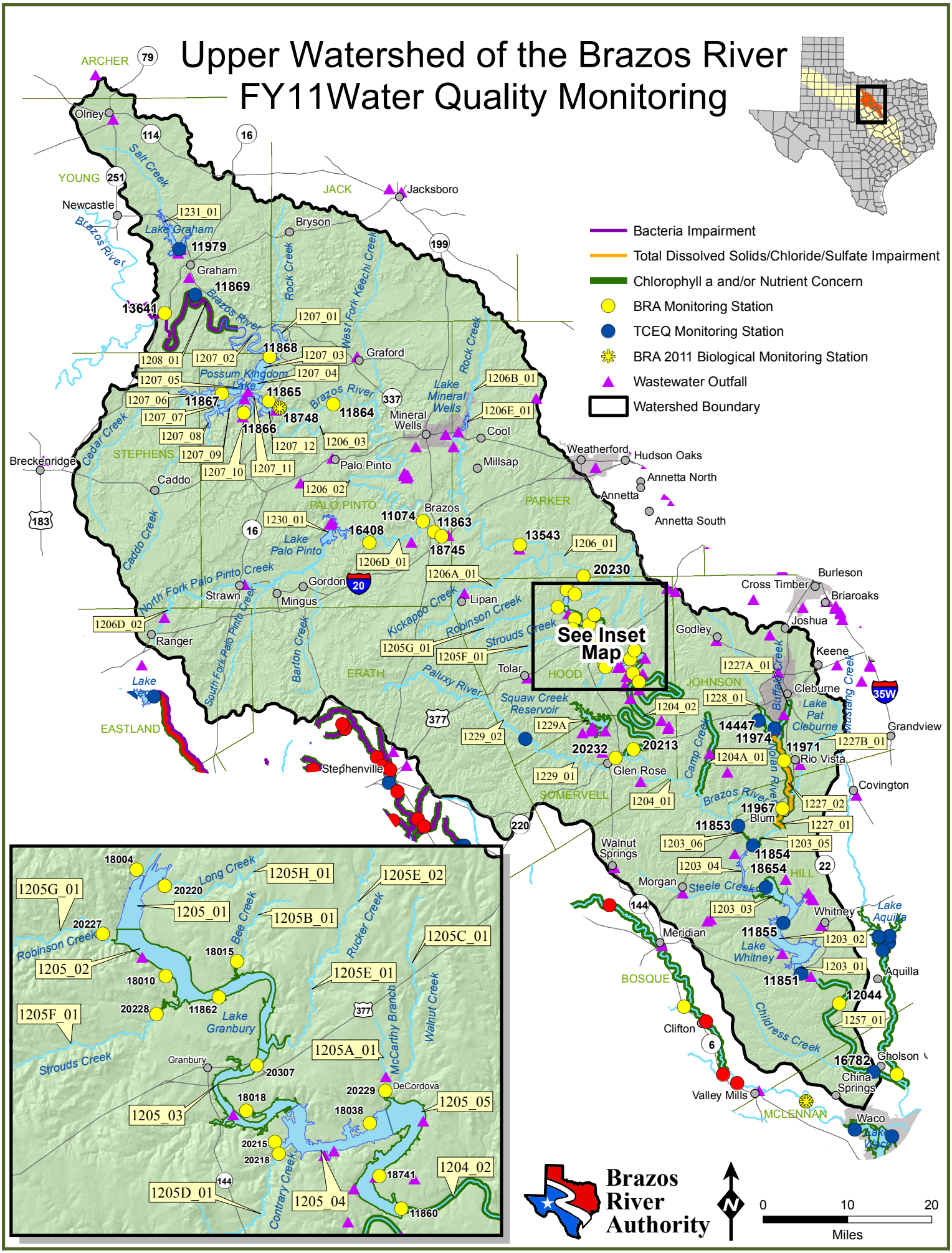
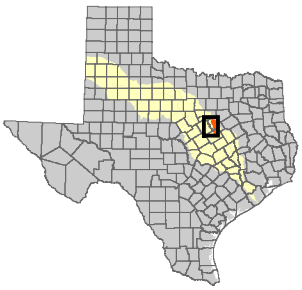
Miles

Brazos River Authority


Upper Watershed of the Brazos River
FY11Water Quality Monitoring
Bacteria Impairment
Total Dissolved Solids/Chloride/Sulfate Impairment
Chlorophyll a and/or Nutrient Concern
BRA Monitoring Station
TCEQ Monitoring Station
BRA 2011 Biological Monitoring Station
Wastewater Outfall
Watershed Boundary
See Inset Map
Brazos River Authority
0 10 20
Miles

Aquilla Creek Watershed
FY11 Water Quality Monitoring



- Chlorophyll a and/or Nutrient Concern
- BRA Monitoring Station
- TCEQ Monitoring Station
- Wastewater Outfall
- Watershed Boundary

JOHNSON
Covington
Itasca
35W
81
171
Hackberry Creek
35E
Carl's Corner
1254B_01
Aquilla Creek
HILL
77
1254A_02
Hillsboro
171
1254A_01
22
1254_02
Aquilla Reservoir
Whitney
1254_03
12128
12129
17321
1254_01
12127
Abbott
Aquilla
West
1256A_01
Brazos River
MCLENNAN
35
Aquilla Creek
Ross
Gholson
11593
Elm Mott
1257_01
1225_01
1256_01
Brazos River
Lacy-Lakeview
North Bosque River
1256_03
1256_02
Bellmead
Lake Waco
1225_02
84
Waco

Brazos River Authority

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Miles

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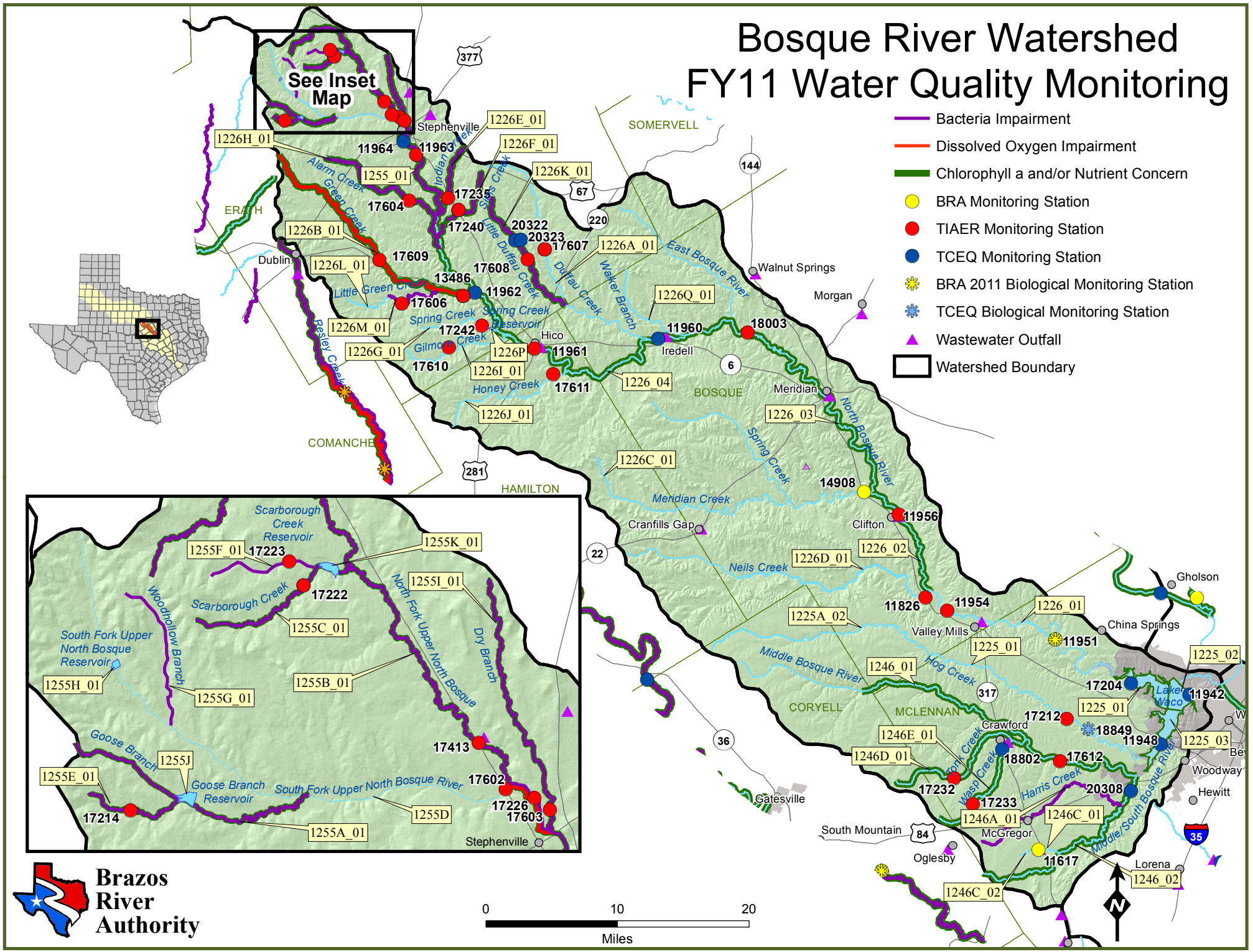
Bosque River Watershed
FY11 Water Quality Monitoring
Bacteria Impairment
Dissolved Oxygen Impairment
Chlorophyll a and/or Nutrient Concern
BRA Monitoring Station
TIAER Monitoring Station
TCEQ Monitoring Station
BRA 2011 Biological Monitoring Station
TCEQ Biological Monitoring Station
Wastewater Outfall
Watershed Boundary
See Inset Map
Stephenville
Dublin
Walnut Springs
Morgan
Hico
Iredell
Meridian
Clifton
Cranfills Gap
Valley Mills
China Springs
Gholson
Crawford
McGregor
Gatesville
South Mountain
Oglesby
Lorena
Woodway
Hewitt
Scarborough Creek Reservoir
South Fork Upper North Bosque Reservoir
Goose Branch Reservoir
Spring Creek Reservoir
Lake Waco
Alarm Creek
Green Creek
Little Green Creek
Spring Creek
Gilmore Creek
Resley Creek
Honey Creek
Little Duffau Creek
Duffau Creek
Walker Branch
East Bosque River
Neils Creek
Meridian Creek
North Bosque River
Middle Bosque River
Hog Creek
Wasp Creek
Harris Creek
Middle/South Bosque River
Woodhollow Branch
Scarborough Creek
North Fork Upper North Bosque
Dry Branch
Goose Branch
South Fork Upper North Bosque River
ERATH
COMANCHE
HAMILTON
SOMERVELL
BOSQUE
CORYELL
MCLENNAN
11964
11963
17604
17235
17240
20322
20323
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1226E_01
1226F_01
1226K_01
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1226L_01
1226M_01
1226G_01
1226P
1226I_01
1226J_01
1226_04
1226A_01
1226Q_01
1226_03
1226C_01
1226D_01
1226_02
1226_01
1225A_02
1225_01
1246_01
1246E_01
1246D_01
1246A_01
1246C_01
1246C_02
1246_02
1225_02
1225_03
1255F_01
1255K_01
1255I_01
1255C_01
1255B_01
1255G_01
1255H_01
1255J
1255E_01
1255D
1255A_01
377
144
67
220
6
281
22
317
36
84
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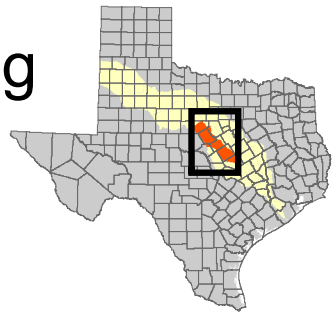
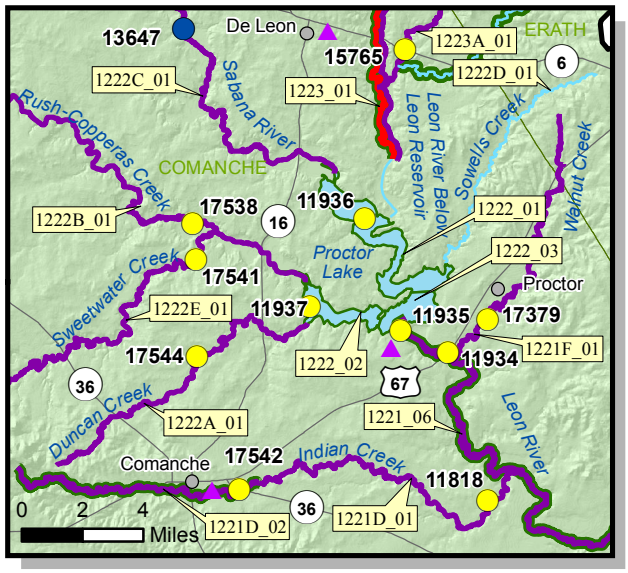
20
Miles
N
Brazos River Authority

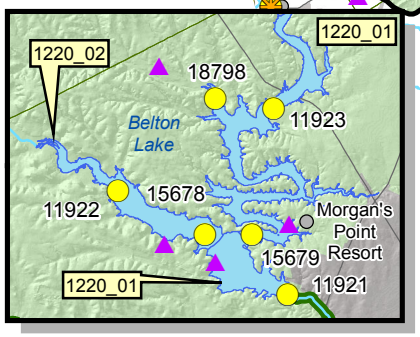
Leon River Watershed
FY11 Water Quality Monitoring



Bacteria Impairment
Dissolved Oxygen Impairment
Chlorophyll a and/or Nutrient Concern
BRA Monitoring Station
TCEQ Monitoring Station
BRA 2010 Biological Monitoring Station
BRA 2011 Biological Monitoring Station
Wastewater Outfall
Watershed Boundary

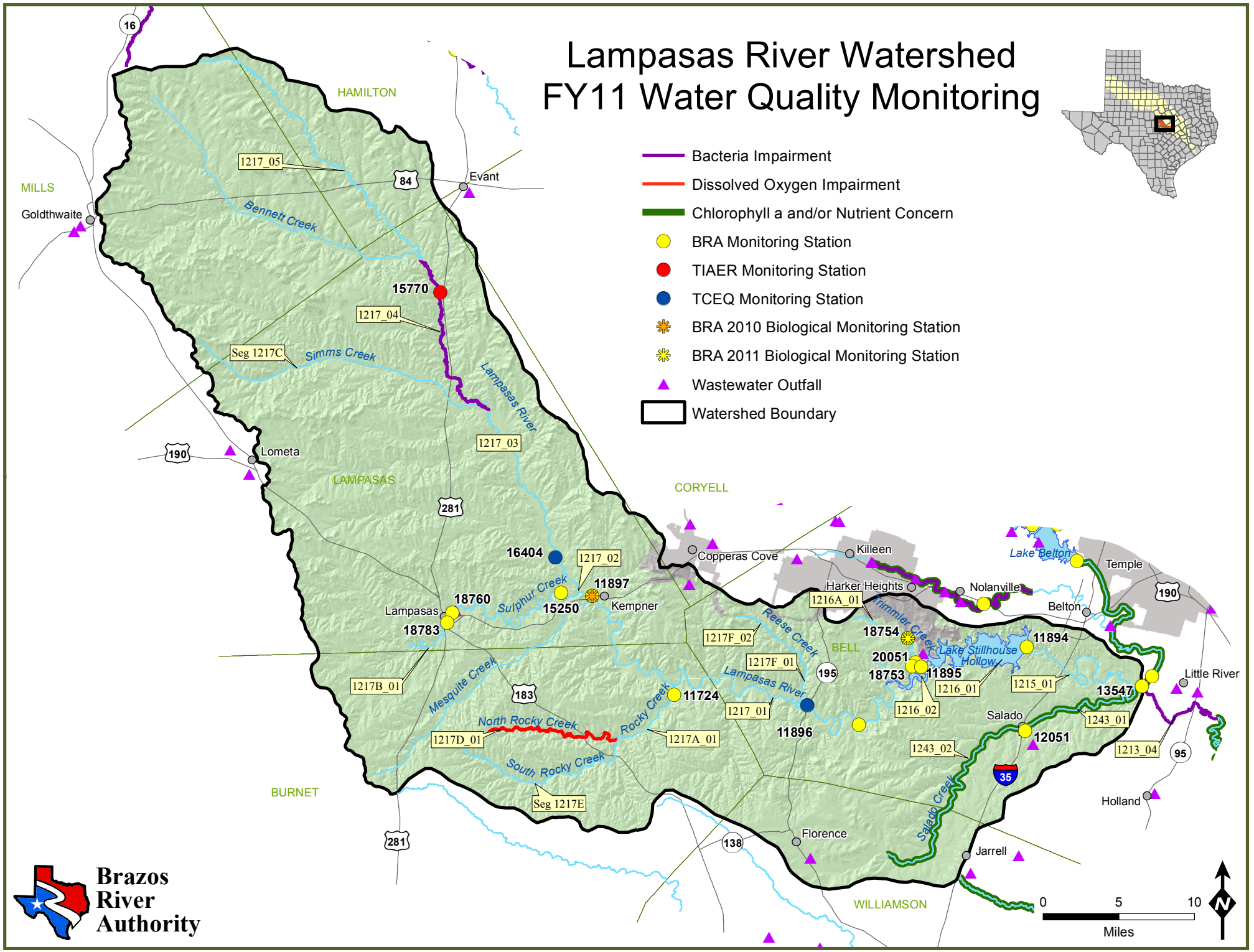
STEPHENS
Ranger
12005
Eastland
Cisco
1224B_01
Lake Leon
11939
11941
1224_02
1224_01
South Fork Leon River
EASTLAND
Carbon
1224C_01
1223_01
206
6
Gorman
Sabana River
1222C_02
11938
1222C_01
Cross Plains
Rush-Copperas Creek
Rising Star
1222B_01
36
BROWN
COMANCHE
1222E_01
183
See Inset Map
Leon River Below Leon Reservoir
Armstrong Creek
Hackberry Creek
Cow Creek
108
1223A_01
1222F_01
ERATH
1223B_01
Dublin
1221A_02
17377
Resley Creek
1221A_01
17477
11817
Gustine
11808
1221_05
Blanket
South Leon River
1221B_01
18781
20905
Leon River
BOSQUE
Cranfills Gap
HAMILTON
Pecan Creek
17547
1220A_03
1221C_01
Hamilton
MILLS
16
Cowhouse Creek
17546
1221E_01
11930
1221_04
Plum Creek
11929
MCLENNAN
18405
Evant
84
Gatesville
1221_03
Coryell Creek
McGregor
South Mountain
Oglesby
17501
1221_02
11804
1220A_02
CORYELL
11926
Leon River
11925
1221_01
Moody
11805
Cowhouse Creek
1220A_01
281
LAMPASAS
Lampasas River
Belton Lake
See Inset Map
1218_03
BELL
Killeen
Copperas Cove
Nolan Creek
Temple
Harker Heights
Belton
11907
1218_02
1219_01
1218_01
195
Little River
35
95



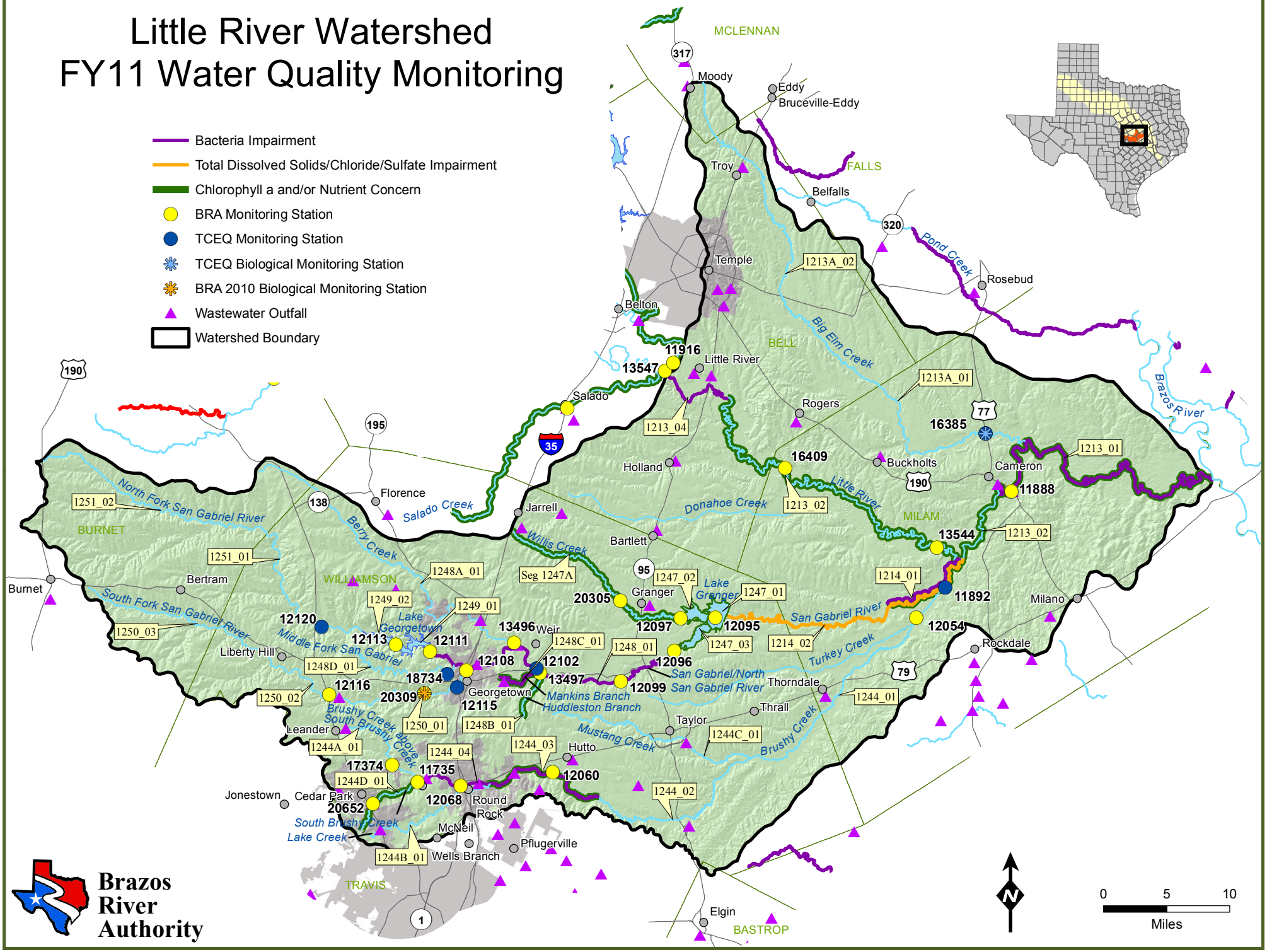


Brazos River Authority

0 10 20 Miles

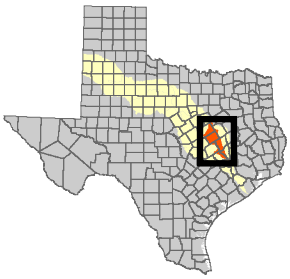

Lampasas River Watershed
FY11 Water Quality Monitoring
Bacteria Impairment
Dissolved Oxygen Impairment
Chlorophyll a and/or Nutrient Concern
BRA Monitoring Station
TIAER Monitoring Station
TCEQ Monitoring Station
BRA 2010 Biological Monitoring Station
BRA 2011 Biological Monitoring Station
Wastewater Outfall
Watershed Boundary
HAMILTON
MILLS
LAMPASAS
CORYELL
BELL
BURNET
WILLIAMSON
Goldthwaite
Evant
Lometa
Copperas Cove
Killeen
Harker Heights
Nolanville
Belton
Temple
Lake Belton
Lampasas
Kempner
Salado
Florence
Jarrell
Holland
Little River
Lake Stillhouse Hollow
Bennett Creek
Simms Creek
Lampasas River
Sulphur Creek
Mesquite Creek
North Rocky Creek
Rocky Creek
South Rocky Creek
Reese Creek
Trimmier Creek
Salado Creek
1217_05
1217_04
Seg 1217C
1217_03
1217_02
1217_01
1217A_01
1217B_01
1217D_01
Seg 1217E
1217F_01
1217F_02
1216A_01
1216_01
1216_02
1215_01
1243_01
1243_02
1213_04
15770
16404
11897
15250
18760
18783
11724
11896
18754
20051
18753
11895
11894
13547
12051
Miles
0
5
10
N
Brazos River Authority

Little River Watershed
FY11 Water Quality Monitoring



Brazos River Authority

Central Watershed of the Brazos River
FY11 Water Quality Monitoring



- TCEQ Monitoring Station
- Chlorophyll a and/or Nutrient Concern
- BRA 2011 Biological Monitoring Station
- BRA 2010 Biological Monitoring Station
- BRA Monitoring Station
- Wastewater Outfall
- Watershed Boundary
- Bacteria Impairment
- Dissolved Oxygen Impairment
- Toxicity in Sediment Impairment

Bynum, Malone, Abbott, Penelope, Hubbard, West, Mount Calm, Ross, Leroy, Gholson, Elm Mott, Axtell, Lacy-Lakeview, Bellmead, Waco, Tradinghouse Creek Reservoir, Mart, Hallsburg, Groesbeck, Woodway, Riesel, Hewitt, Robinson, McGregor, Thornton, Lorena, Golinda, Satin, Marlin City Lake, Kosse, Moody, Eddy, Chilton, Marlin, Bruceville-Eddy, Troy, Lott, Belfalls, Bremond, Twin Oak Reservoir, Temple, Rosebud, Franklin, Calvert, Hearne, Milano, Caldwell, Snook, Wellborn, College Station, Bryan, Millican, Navasota, Somerville

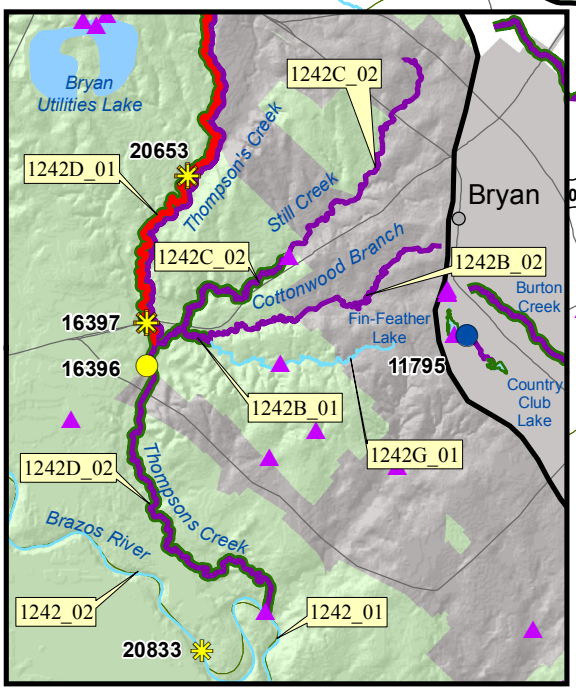
MCLENNAN, LIMESTONE, FALLS, ROBERTSON, MILAM, BRAZOS, BURLESON, WASHINGTON, GRIMES

Tehuacana Creek, Big Sandy Creek, Big Creek, Little Brazos River, Bullhide Creek, Cow Bayou, Deer Creek, Brazos River, Walnut Creek, Pond Creek, Mud Creek, Pin Oak Creek, Spring Creek, Campbells Creek, Cedar Creek, Old River, Yegua Creek

17204, 11942, 14226, 18457, 15771, 11609, 11948, 12038, 20308, 12037, 11617, 20128, 16781, 11723, 12033, 12032, 11591, 11785, 11880, 12030, 11873, 11593

1242N_02, 1242N_01, 1242_06, 1242H_01, 1256_01, 1256_02, 1242P_02, 1242P_01, 1242_05, 1242Q_02, 1242A_01, 1242A_02, 1242Q_01, 1242R_01, 1242E_03, 1242J_01, 1242F_02, 1242_04, 1242E_02, 1242F_01, 1242O_01, 1242_03, 1242K_01, 1242L_01, 1242M_01, 1242I_01, 1242E_01, 1242D_02, 1242_02, 1242_01

See Inset Map

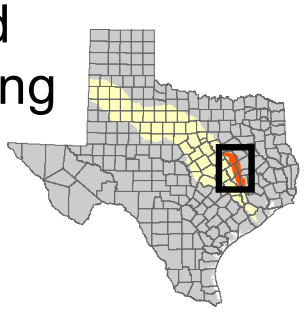


Brazos River Authority

0 10 20 Miles

N

Navasota River Watershed
FY11 Water Quality Monitoring

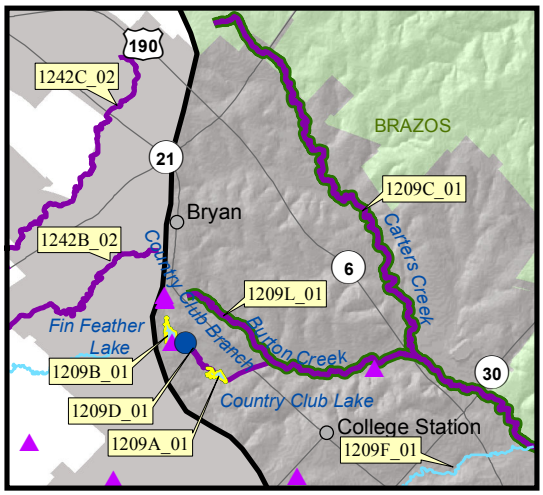


- Bacteria Impairment
- Dissolved Oxygen Impairment
- Toxicity in Sediment Impairment
- Chlorophyll a and/or Nutrient Concern
- BRA Monitoring Station
- TIAER Monitoring Station
- TCEQ Monitoring Station
- BRA 2010 Biological Monitoring Station
- TPWD 24-hr DO Station
- Wastewater Outfall
- Watershed Boundary

Penelope, Hubbard, HILL, NAVARRO, Wortham, Kirvin, Coolidge, Tehuacana, Mount Calm, Axtell, MCLENNAN, Mart, Mexia, FREESTONE, Teague, Groesbeck, LIMESTONE, Thornton, Jewett, Kosse, FALLS, Marquez, Franklin, ROBERTSON, Normangee, MADISON, North Zulch, Cottonwood, BRAZOS, Wixon Valley, Bryan, College Station, Wellborn, GRIMES, Anderson, Millican, BURLESON, Navasota

Navasota River, Christmas Creek, Springfield Lake, Lake Mexia, Holman Creek, Lake Limestone, Steele Creek, Twin Oaks Reservoir, Duck Creek, Cedar Creek, Shepard Creek, Wickson Creek, Carters Creek, Gibbons Creek, Gibbons Creek Reservoir

1210A_01, 1210_01, 1210_02, 17586, 1253_03, 1253A_01, 17039, 16247, 18799, 1253_02, 1253_01, 12126, 1252_04, 1252_05, 13970, 12125, 1252_03, 1252_02, 12124, 1209K_02, 1252_01, 12123, 16384, 1209_05, 1209K_01, 11877, 1209H_02, 16389, 1209H_01, 1209_04, 1209J_01, 1209G_01, 11790, Seg 1209J, 11787, 1209E_01, 1209I_03, 1209_03, 1209N_03, 1209N_01, 1209N_04, 1209N_02, 1209I_02, 11875, 11785, 1209C_01, 18800, 20719, 20528, 1209I_01, 11756, 1209C_02, 1209_01, 11873, 12030

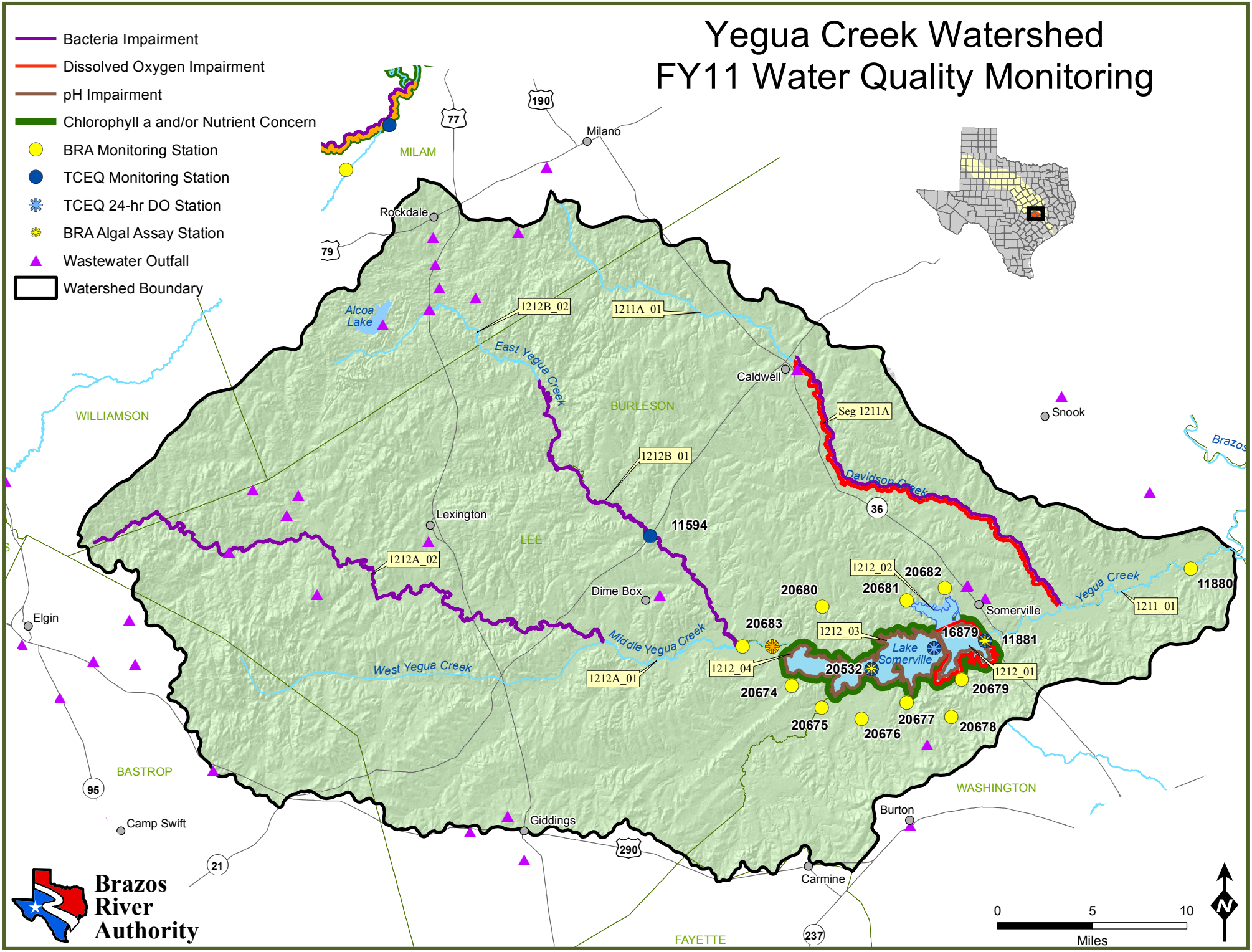


See Inset Map

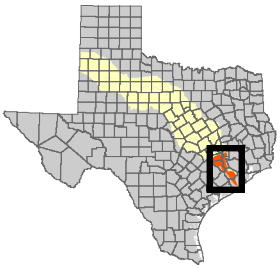
Brazos River Authority

0 10 20
Miles

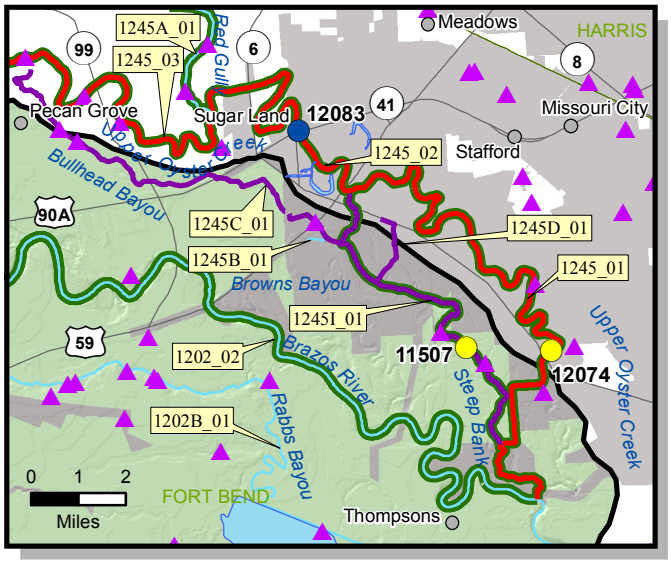
N


Yegua Creek Watershed
FY11 Water Quality Monitoring
Bacteria Impairment
Dissolved Oxygen Impairment
pH Impairment
Chlorophyll a and/or Nutrient Concern
BRA Monitoring Station
TCEQ Monitoring Station
TCEQ 24-hr DO Station
BRA Algal Assay Station
Wastewater Outfall
Watershed Boundary
MILAM
WILLIAMSON
BURLESON
LEE
BASTROP
WASHINGTON
FAYETTE
Milano
Rockdale
Caldwell
Snook
Lexington
Dime Box
Elgin
Camp Swift
Giddings
Burton
Carmine
Somerville
Alcoa Lake
East Yegua Creek
Middle Yegua Creek
West Yegua Creek
Davidson Creek
Yegua Creek
Brazos
Lake Somerville
1212B_02
1211A_01
1212B_01
1212A_02
1212A_01
Seg 1211A
1212_02
1212_03
1212_04
1212_01
1211_01
11594
11880
11881
16879
20680
20681
20682
20683
20532
20674
20675
20676
20677
20678
20679
77
190
79
36
95
21
290
237
0
5
10
Miles
Brazos River Authority

Lower Watershed of the Brazos River FY11 Water Quality Monitoring

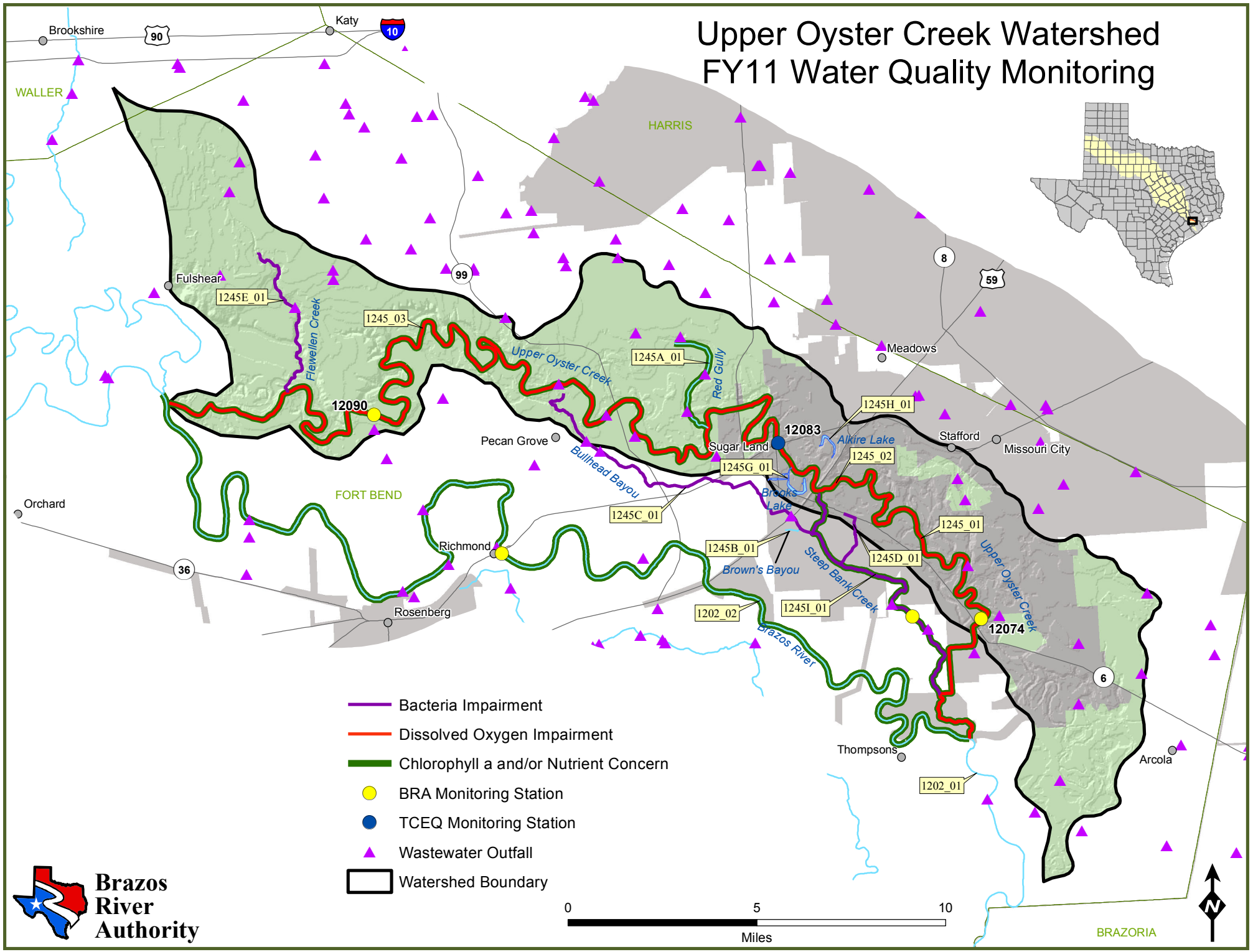


- Bacteria Impairment
- Dissolved Oxygen Impairment
- Chlorophyll a and/or Nutrient Concern
- BRA Monitoring Station
- TCEQ Monitoring Station
- TCEQ Biological Monitoring Station
- Wastewater Outfall
- Watershed Boundary



Brazos River Authority

0 10 20
Miles


Upper Oyster Creek Watershed
FY11 Water Quality Monitoring
Brookshire
Katy
WALLER
HARRIS
FORT BEND
BRAZORIA
Fulshear
Pecan Grove
Sugar Land
Meadows
Stafford
Missouri City
Alkire Lake
Orchard
Richmond
Rosenberg
Thompsons
Arcola
Brooks Lake
Brown's Bayou
Brazos River
Flewellen Creek
Upper Oyster Creek
Red Gully
Bullhead Bayou
Steep Bank Creek
1245E_01
1245_03
1245A_01
1245H_01
1245_02
1245G_01
1245C_01
1245B_01
1245D_01
1245_01
1245I_01
1202_02
1202_01
12090
12083
12074
Bacteria Impairment
Dissolved Oxygen Impairment
Chlorophyll a and/or Nutrient Concern
BRA Monitoring Station
TCEQ Monitoring Station
Wastewater Outfall
Watershed Boundary
0
5
10
Miles
Brazos River Authority
N

Brazos River BasinBasin Highlights Report 2011

Brazos River Authority

THE TEXAS CLEAN RIVERS PROGRAM

TCEQ

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Prepared in cooperation with the Texas Commission on Environmental Quality under the authorization of the Texas Clean Rivers Act.