Brazos River Basin
Highlights Report
2018

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BRAZOS RIVER BASIN HIGHLIGHTS REPORT 2018

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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 2018*. This report is a programmatic update that contains information and updates on on-going activities and projects that address water quality concerns in the lakes and streams of the Brazos River basin. It also summarizes the results of the 2014 Integrated Report (IR).

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 who have attended public meetings and other outreach events sponsored by the Authority and the Clean Rivers Program. Their input is the foundation of the watershed management process.

INTRODUCTION

The principal aim of the Texas Clean Rivers Program (CRP) is to ensure safe, clean water supplies for the future of Texans' drinking water needs, industry, agriculture, healthy ecosystems, recreation and for all other uses of this valuable state resource. 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 goal of the CRP is to maintain and improve the quality of water resources within each river basin in Texas through an ongoing partnership involving the TCEQ, other agencies, river authorities, regional entities, local governments, industry and citizens. The program's watershed management approach aims to identify and evaluate water quality issues, establish priorities for corrective action, work to implement those actions, and adapt to changing priorities. The Brazos River Authority (BRA) carries out the water quality management efforts in the basin under contract with TCEQ.

Described in this report are updates to water quality studies and projects being conducted in the Brazos River Basin in response to water quality issues. The report also includes a summary of water quality monitoring results, an overview of scheduled routine monitoring for FY 2018, and summarization of the 2014 Integrated Report (IR).

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 you will be directed to a website that will give you further information on the topic of interest. You can also click the Table of Contents to navigate to your desired section. After having been directed to another page in the document or to an internet page, you may press Alt+← to return to where you were previously in the document.

OVERVIEW OF WATER QUALITY MONITORING

The TCEQ assesses the condition of the state's waterbodies on a periodic basis under the Clean Water Act (CWA) Section 305(b). The results of the assessment 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. As required by the CWA, the IR is updated every two years and includes the review of the past seven years of data (with a lag-time of two years) collected by many organizations statewide, including the BRA. The IR remains a draft document until approval by EPA. Specific assessment methodologies are described in the 2014 Guidance for Assessing and Reporting Surface Water Quality in Texas. The 2014 IR, on which the following information is based, provides an assessment of water quality results using data acquired from December 1, 2005 through November 30, 2012. Please click here for more information and to review the 2014 Texas Integrated Report for Clean

Water Act Sections 305(b) and 303(d). On November 19, 2015, the 2014 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) was approved by the USEPA.

The 2014 IR provides an overview of surface water quality throughout the state, including issues relating to public health, fitness for use by aquatic species and other wildlife, and specific pollutants and their possible sources. These water quality issues are identified by comparing concentrations in the water to numerical criteria that represent the state's water quality standards or screening levels to determine if the waterbody supports its designated uses, such as suitability for aquatic life, for contact recreation, or for public water supply. 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", all of which indicate that a waterbody does not meet established water quality standards. Once placed on the list the waterbody is targeted for special study and/or corrective action.

The TCEQ also identifies segments where the data indicates 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.

Water quality standard numerical criteria are used by TCEQ as the maximum or minimum instream concentration 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. Each classified segment has been designated a four-digit code. The Brazos River Basin is designated by the number 12. Each classified segment is distinguished by the next two numbers, for example, Segment ID 1201 is the portion of the Brazos River that flows into the gulf and is referred to as the Brazos River Tidal segment. 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. Site-specific chlorophyll *a* has been developed for several reservoirs. Many streams that are not classified segments are still assessed by TCEQ and are considered unclassified waterbodies. This could be a small tributary of a classified segment, and they are coded with the four-digit Segment ID they flow into, followed by a letter, such as 1201A. These unclassified waterbodies 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 unless site-specific criteria for certain parameters have been developed, which is the case for dissolved oxygen and bacteria in several unclassified waterbodies throughout the basin. Use support is reported at both the segment and assessment unit (AU). An AU is defined as the smallest geographic area of use support reported in the assessment. Support of criteria and uses are examined for each AU. To address water quality regulatory activity such as permitting, standards development, and remediation, use support information applies to the AU level. The 303(d) list

is reported at the level of the AU for each waterbody. Each AU within a waterbody segment is given a number following an underscore after the segment designation, such as 1201_01. A segment may consist of one or more AU.

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 and Terminology

Following are typical terms that are used when discussing water quality with descriptions of several water quality parameters and how they relate to achieving water quality standards. There are two groups of parameters:

Field parameters are those water quality constituents that can be obtained on-site and generally include:

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
Temperature	Water temperature affects the oxygen content of the water, with warmer water unable to hold as much oxygen. When water temperature is too cold, cold-blooded organisms may either die or become weaker and more susceptible to other stresses, such as disease or parasites.	Colder water can be caused by reservoir releases. Warmer water can be caused by removing trees from the riparian zone, soil erosion, or use of water to cool manufacturing equipment.
Specific Conductance	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 stream.	Elevated concentrations of dissolved salts can impact the water as a drinking water source and as suitable aquatic habitat.

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
pH	Most aquatic life is adapted to live within a narrow pH range. Different organisms can live at and adjust to differing pH ranges, but all fish die if pH is below four (the acidity of orange juice) or above 12 (the pH of ammonia).	Algal blooms produce diel swings in dissolved oxygen causing super-saturation during the day while respiration can cause night-time oxygen levels to crash. Chemical byproducts of this photosynthesis/respiration process cause swings also in pH, with lower levels (acidic conditions) during the day and higher levels (alkaline conditions) at night. Industrial and wastewater discharge, runoff from quarry operations and accidental spills can also be a cause.
Dissolved Oxygen (DO)	Organisms that live in the water need oxygen to live. In stream segments where DO is low, organisms may not have sufficient oxygen to survive.	DO levels may be low due to no primary productivity, stagnant, pooled or low-flow conditions. Modifications to the riparian zone, human activity that causes water temperatures to increase, increases in organic matter, bacteria and over abundant algae may also cause DO levels to decrease. Algal blooms produce diel swings in dissolved oxygen causing super-saturation during the day while respiration can cause night-time oxygen levels to crash.
Stream Flow	Flow is an important parameter affecting water quality. Low flow conditions common in the warm summer months create critical conditions for aquatic organisms.	At low flows, the stream has a lower assimilative capacity for waste inputs from point and nonpoint sources. DO concentrations can also decrease as flow decreases.
Transparency and Secchi Disk Depth	Transparency is a measure of the depth to which light is transmitted through the water column and thus the depth at which aquatic plants can grow.	Low transparency or secchi disc depth is an estimate of turbidity.

Conventional Parameters are typical water quality constituents that require laboratory analysis and generally include:

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
Turbidity	Turbidity is a measure of the water clarity or light transmitting properties.	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.
Hardness	Hardness is a composite measure of certain ions in the water, primarily calcium and magnesium. The hardness of the water is critical due to its effect on the toxicity of certain metals	Higher hardness concentrations in the receiving stream can result in reduced toxicity of heavy metals.
Chloride	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.	Natural weathering and leaching of sedimentary rocks, soils and salt deposits can release chloride into the environment. Other sources can be attributed to oil exploration and storage, sewage and industrial discharges, run off from dumps and landfills and saltwater intrusion.
Sulfate	Effects of high sulfate levels in the environment have not been fully documented. However, sulfate contamination may contribute to the decline of native plants by altering chemical conditions in the sediment.	Due to abundance of elemental and organic sulfur and sulfide mineral, soluble sulfate occurs in almost all natural water. Other sources are the burning of sulfur containing fossil fuels, steel mills and fertilizers.
Total Dissolved Solids	High total dissolved solids may affect the aesthetic quality of the water, interfere with washing clothes and corrode plumbing fixtures. High total dissolved solids in the environment can also affect the permeability of ions in aquatic organisms.	Mineral springs, carbonate deposits, salt deposits and sea water intrusion are sources for natural occurring high concentration TDS levels. Other sources can be attributed to oil exploration, drinking water treatment chemicals, storm water and agricultural runoff and point/nonpoint wastewater discharges.
Total Suspended Solids (TSS)	Suspended solids increase turbidity which reduces light penetration and decreases the production of oxygen by plants. They can also clog fish gills.	Excessive TSS is the result of accelerated erosion and is often associated with high flows where river banks are cut or sediment is resuspended. It can

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
Total Suspended Solids (TSS) (cont.)	Eventually, the suspended solids settle to the bottom of the stream or lake, creating sediment. Excessive sediment in the water column can also reduce growth of algae and can transport other contaminants such as nutrients and bacteria. Habitat for aquatic organisms can also be reduced.	also be the result of sheet erosion, where over land flow of water causes a thin layer of soil to be carried by the water to the stream. Disturbing vegetation without a proper barrier to slow down overland flow (such as construction sites or row cropping) increases TSS.
Bacteria • ***Escherichia coli* (*E. coli*)** • **Enterococcus**	Although certain species of bacteria may not themselves be harmful to human beings, their presence is an indicator of recent fecal matter contamination and that other pathogens dangerous to human beings may be present.	Present naturally in the digestive system of all warm blooded animals, these bacteria are in all surface waters. Poorly maintained or ineffective septic systems, overflow of domestic sewage or nonpoint sources and runoff from animal feedlots can elevate bacteria levels.
Ammonia Nitrogen	Elevated levels of ammonia in the environment can adversely affect fish and invertebrate reproductive capacity and reduce the growth of young.	Ammonia is excreted by animals and is produced during the decomposition of plants and animals. Ammonia is an ingredient in many fertilizers and is also present in sewage, storm water runoff, certain industrial wastewaters and runoff from animal feedlots.
Nutrients • **Total Kjeldahl Nitrogen** • **Nitrate Nitrogen** • **Nitrite Nitrogen** • **Total Phosphorus** • **Ortho-phosphate phosphorus**	Nutrients increase plant and algae growth. When plants and algae die, the bacteria that decompose them use oxygen. This reduces the dissolved oxygen in the water. High levels of nitrates and nitrites can produce nitrite toxicity, or “brown blood disease,” in fish. This disease reduces the ability of blood to transport oxygen throughout the body.	Nutrients are found in effluent released from wastewater treatment plants (WWTPs), fertilizers and agricultural runoff carrying animal waste from farms and ranches. Soil erosion and runoff from farms, lawns and gardens can add nutrients to the water.
Chlorophyll *a*	High levels of nutrients in relatively stable waters can cause algae blooms, decrease water clarity and cause swings in dissolved oxygen and pH due to	Algal blooms can result in elevated chlorophyll *a* concentrations indicating an increase in nutrients

PARAMETER	POTENTIAL IMPACTS WHEN STATE STANDARDS ARE NOT MET	POTENTIAL CAUSES OF STATE STANDARDS NOT BEING MET
Chlorophyll *a* (cont.)	photosynthesis. This is most commonly measured using chlorophyll *a* concentrations.	that increase growth and reproduction in algal species.

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 IR.

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 or sediment, 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 or sediment, 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. The 14 major watersheds include:

- the Caprock watershed;
- the Salt and Double Mountain Forks of the Brazos watershed;
- the Clear Fork of the Brazos watershed;
- the Upper Brazos River watershed;
- the Aquilla Creek watershed;
- the Bosque River watershed;
- the Leon River watershed;
- the Lampasas River 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.

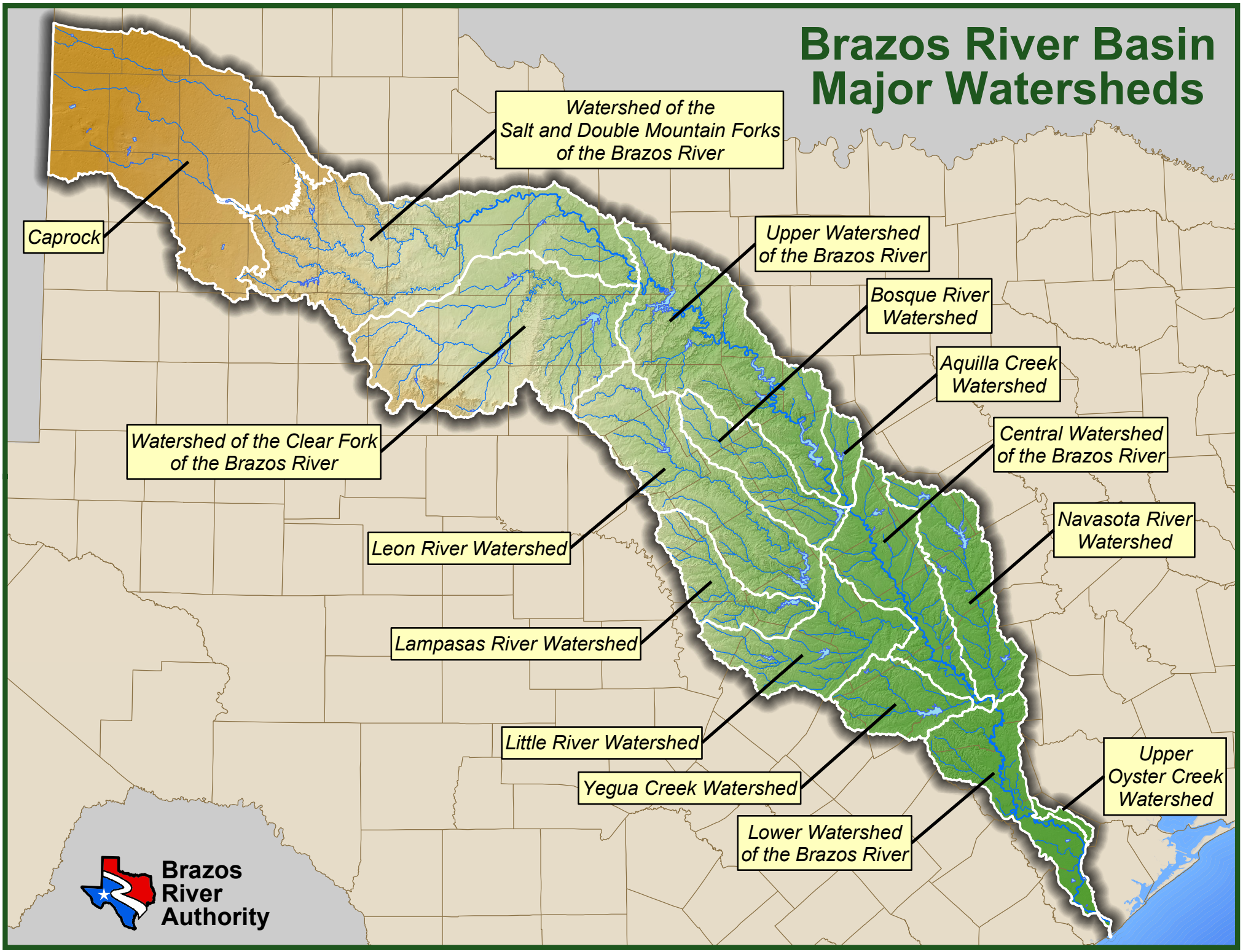

Brazos River Basin
Major Watersheds
Watershed of the
Salt and Double Mountain Forks
of the Brazos River
Caprock
Upper Watershed
of the Brazos River
Bosque River
Watershed
Aquilla Creek
Watershed
Watershed of the Clear Fork
of the Brazos River
Central Watershed
of the Brazos River
Navasota River
Watershed
Leon River Watershed
Lampasas River Watershed
Little River Watershed
Upper
Oyster Creek
Watershed
Yegua Creek Watershed
Lower Watershed
of the Brazos River
Brazos
River
Authority

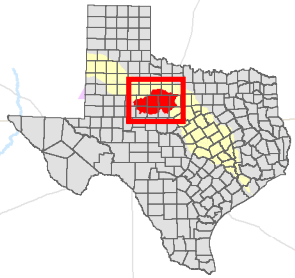
Table 2. FY 2018 Summary of Known Sampling for the Brazos River Basin (September 2017 through August 2018)								
Sampling Entity	**Field**	**Conventional**	**Bacteria**	**24-hr DO**	**Biological and Habitat**	**Metals in Water**	**Organics in Water**	**Metals in Sediment**
BRA	30 monthly 68 quarterly 7 semi-annually			3 semi-annually	3 semi-annually			
TCEQ	80 quarterly 13 semi-annually			1 semi-annually	1 semi-annually	5 quarterly 7 semi-annually	2 semi-annually	1 annually 6 semi-annually
	1 semi-annually							
TIAER	18 yearly 8 semi-monthly		8 monthly	18 yearly				
	10 monthly 9 quarterly							
USGS	6 bi-monthly			6 bi-monthly				

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

The remainder of this report contains summary water quality assessment results for each of the segments that were evaluated in the Brazos Basin Clean Rivers Program assessment area for the 2014 IR. 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 unmentioned or 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 major watershed is mapped separately and depicts watershed boundaries, segments with names and AUs, county boundaries, cities, major roads, monitoring locations, discharge locations, water quality impairments and selected water quality concerns. There are also tables summarizing segments in each watershed that are listed in the 2014 IR as possessing impairments or concerns and what parameter was evaluated that contributed to the listing. For each table: NS - indicates a segment is non-supporting for a designated use, or impaired, CS - indicates a segment has a concern for water quality based on screening levels, CN - indicates a segment has concern for near-nonattainment of applicable water quality standards. Entries in **BOLD** were newly listed in the 2014 IR and strike-throughs indicate listing removal from the 2014 IR.

Watershed of the Clear Fork of the Brazos River
FY18 Water Quality Monitoring and 2014 IR Status



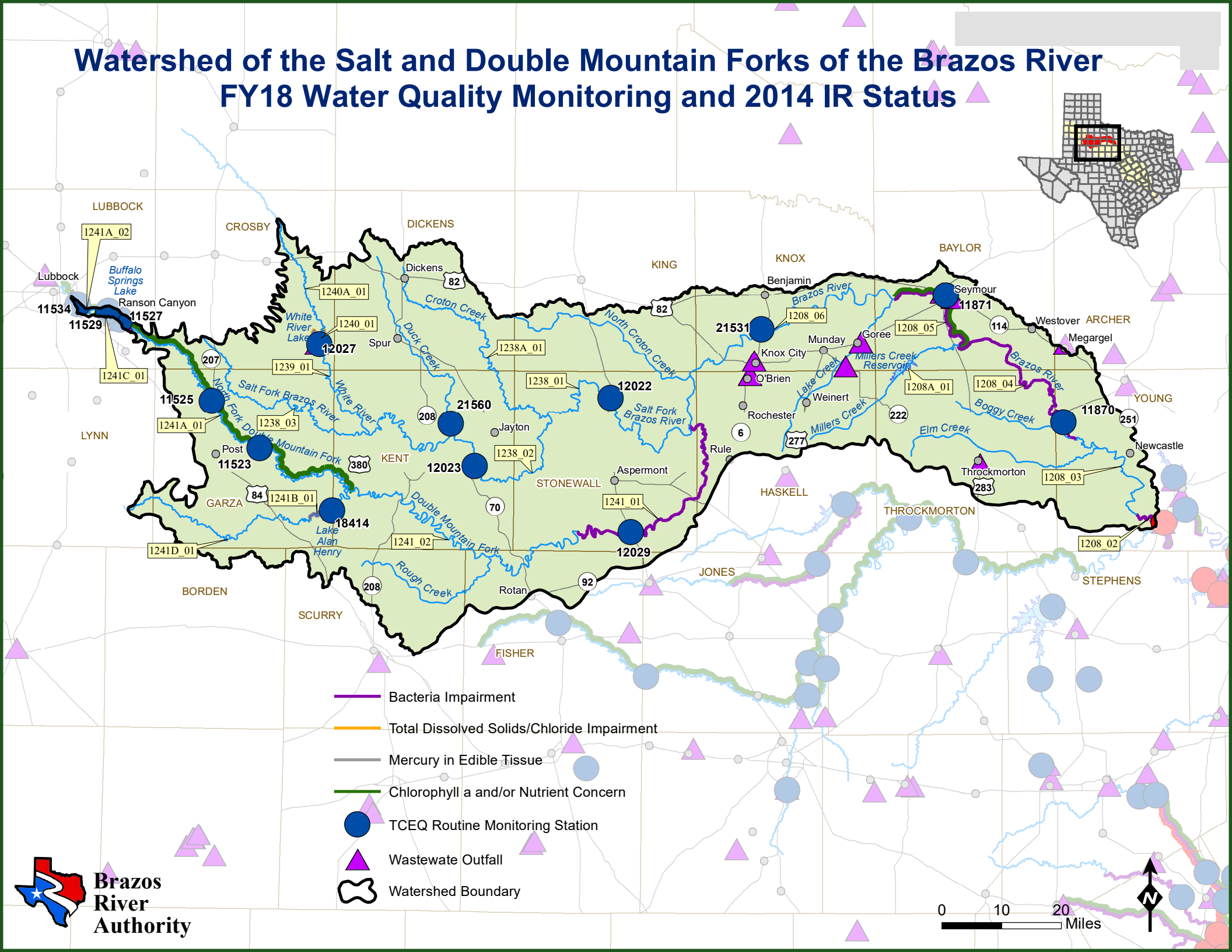
Brazos River Authority

Watershed of the Salt Fork and Double Mountain Fork of the Brazos River

Table 3: Waterbodies of the Salt Fork and Double Mountain Fork Watersheds IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
North Fork Double Mountain Fork Brazos River	1241A_01	Nutrients and/or Chl *a* – CS
	1241A_02	~~Bacteria – NS~~ MEETS Nutrients and/or Chl a – CS
Buffalo Springs Lake	1241C_01	Nutrients and/or Chl *a* – CS
Lake Alan Henry	1241B_01	Mercury in Edible tissue – NS
White River Lake	1240_01	TDS, Cl – NS
Double Mountain Fork Brazos River	1241_01	Bacteria – NS
Croton Creek	1238A_01	Bacteria – CN
Miller's Creek Reservoir	1208A_01	Bacteria – CN DO – CS
Brazos River Above Possum Kingdom Lake	1208_02 1208_04 1208_05	Bacteria – NS
	1208_05	Nutrients and/or Chl *a* – CS

Watershed of the Salt and Double Mountain Forks of the Brazos River
FY18 Water Quality Monitoring and 2014 IR Status

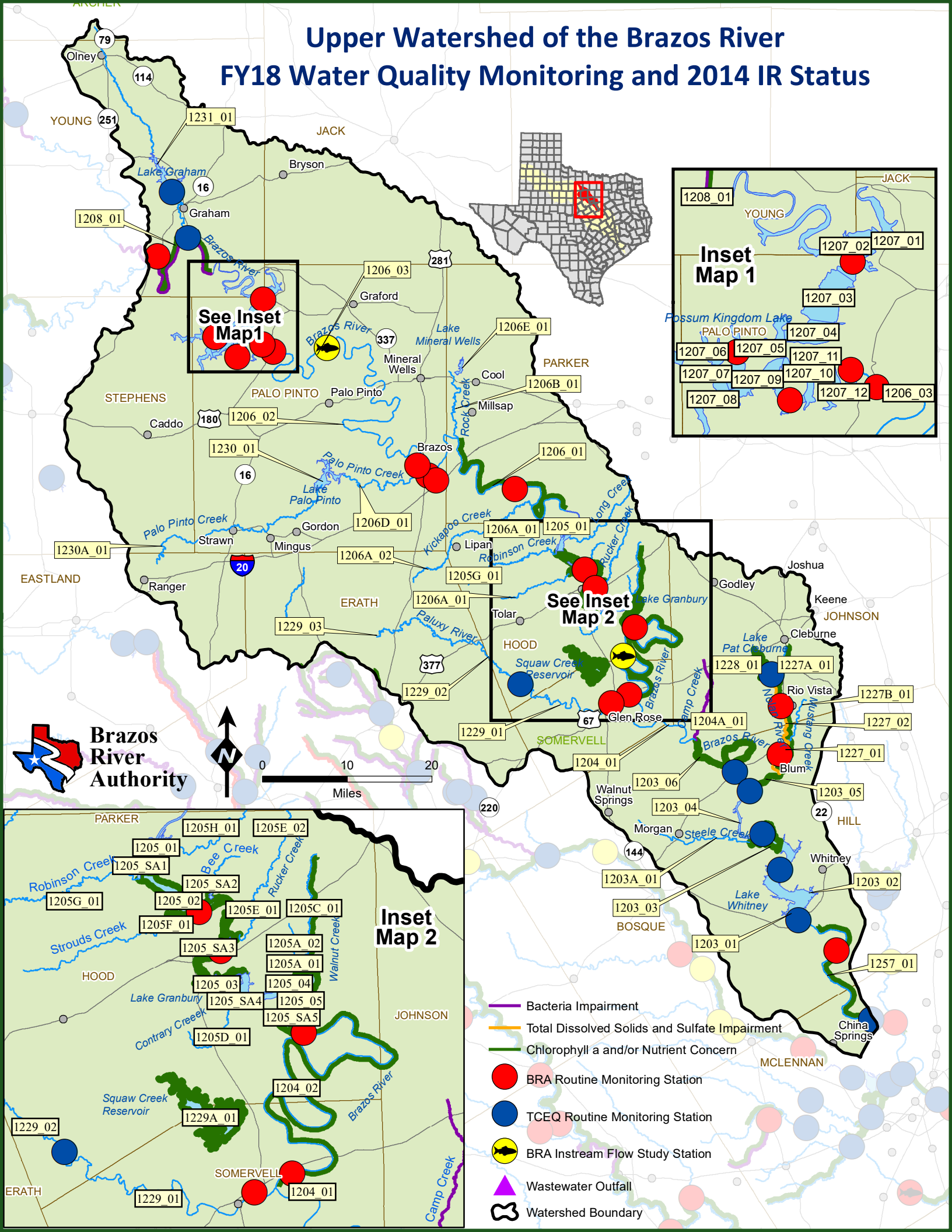


Watershed of the Clear Fork of the Brazos River

Table 4: Waterbodies of the Clear Fork Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Clear Fork Brazos River	1232_02	Nutrients and/or Chl *a* – CS pH - CN
	1232_03	Nutrients and/or Chl *a* – CS
	1232_04	DO – CS Nutrients and/or Chl *a* – CS
California Creek	1232A_01	Bacteria – NS Nutrients and/or Chl *a* – CS Fish/Macrobenthics – CN
Deadman Creek	1232B_01	~~Bacteria – NS~~ MEETS Nutrients and/or Chl *a* – CS
	1232B_02	Bacteria – CN
Paint Creek	1232C_01	Nutrients and/or Chl *a* – CS
Hubbard Creek Reservoir	1233_02	DO – CS
Big Sandy Creek	1233A_01	Bacteria – CN

Upper Watershed of the Brazos River
FY18 Water Quality Monitoring and 2014 IR Status

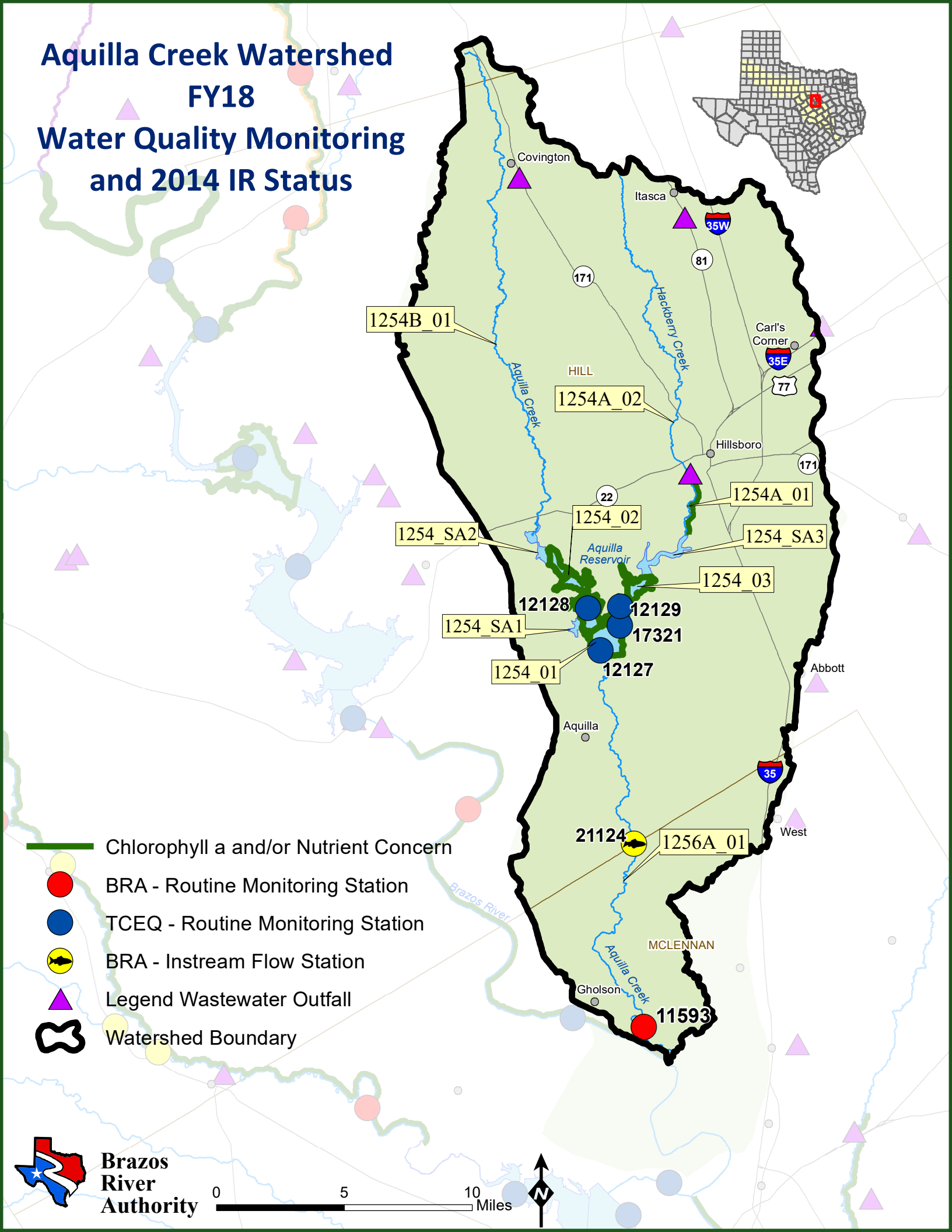


Upper Watershed of the Brazos River

Table 5: Waterbodies of the Upper Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Brazos River Above Possum Kingdom Lake	1208_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Brazos River Below Possum Kingdom Lake	1206_01	Nutrients and/or Chl *a* – CS
	1206_01 1206_02	Habitat – CS Macrobenthics – CN
Lake Granbury	1205_02 1205_03	Nutrients and/or Chl *a* – CS
	1205_05	DO – CS Nutrients and/or Chl *a* – CS
Walnut Creek	1205C	Nutrients and/or Chl *a* – CS
Brazos River Below Granbury	1204_02	Nutrients and/or Chl *a* – CS Habitat – CS
Camp Creek	1204A_01	Bacteria – NS
Squaw Creek Reservoir	1229A_01	Nutrients and/or Chl *a* – CS
Nolan River	1227_01 1227_02	TDS, SO_4 – NS Nutrients and/or Chl *a* – CS
Buffalo Creek	1227A_01	Nutrients and/or Chl *a* – CS
Lake Pat Cleburne	1228_01	Nutrients and/or Chl *a* – CS
Whitney Lake	1203_01	DO – CN
	1203_03 1203_05 1203_06	Nutrients and/or Chl *a* – CS
Brazos River Below Lake Whitney	1257_01	Nutrients and/or Chl *a* – CS

Aquilla Creek Watershed
FY18
Water Quality Monitoring and 2014 IR Status

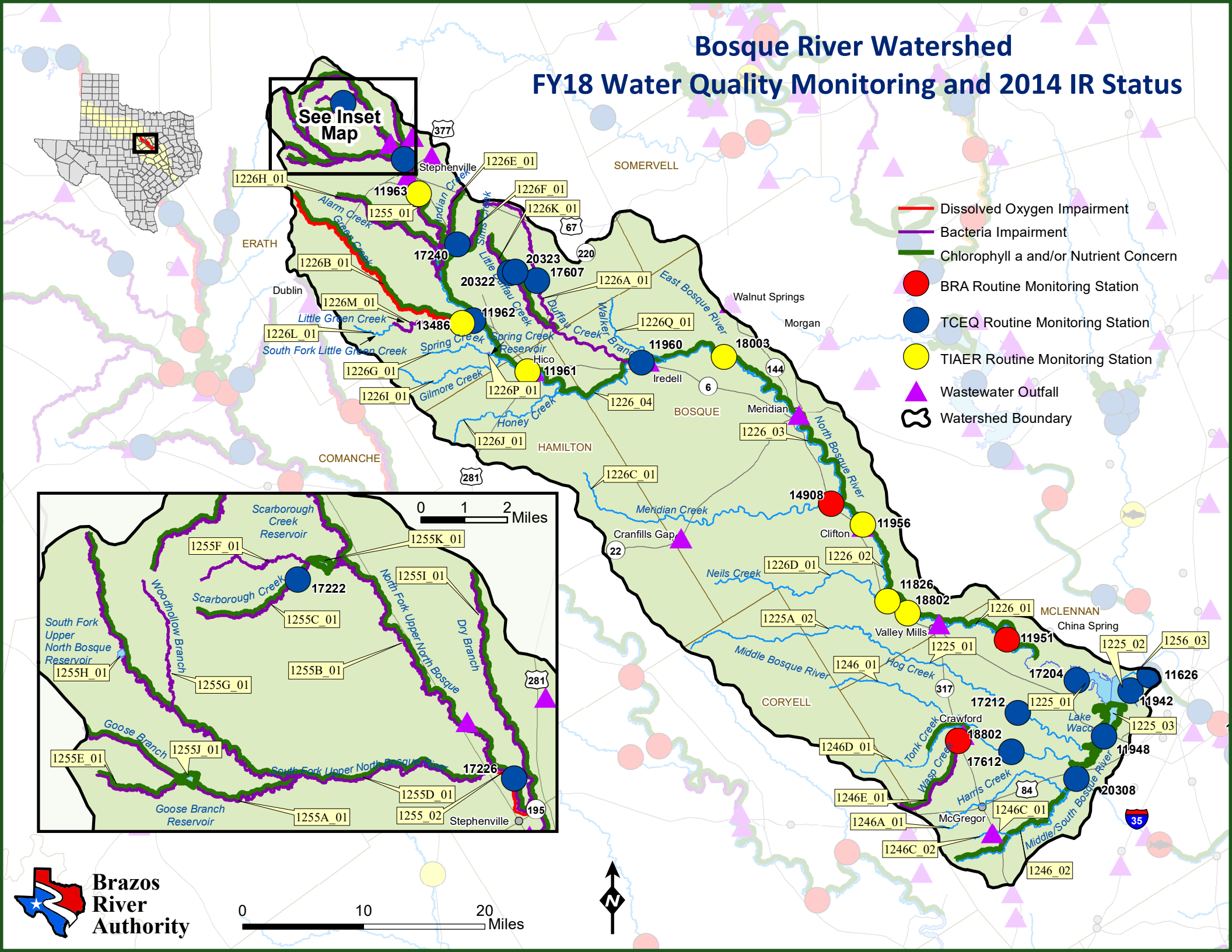


Aquilla Creek Watershed

Table 6: Waterbodies of the Aquilla Creek Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Aquilla Reservoir	1254_01 1254_02	Nutrients and/or Chl *a* – CS
	1254_03	Nutrients and/or Chl *a* – CS Sediment – CS
Hackberry Creek	1254A_01	DO – CS Nutrients and/or Chl *a* – CS

Bosque River Watershed
FY18 Water Quality Monitoring and 2014 IR Status



Bosque River Watershed

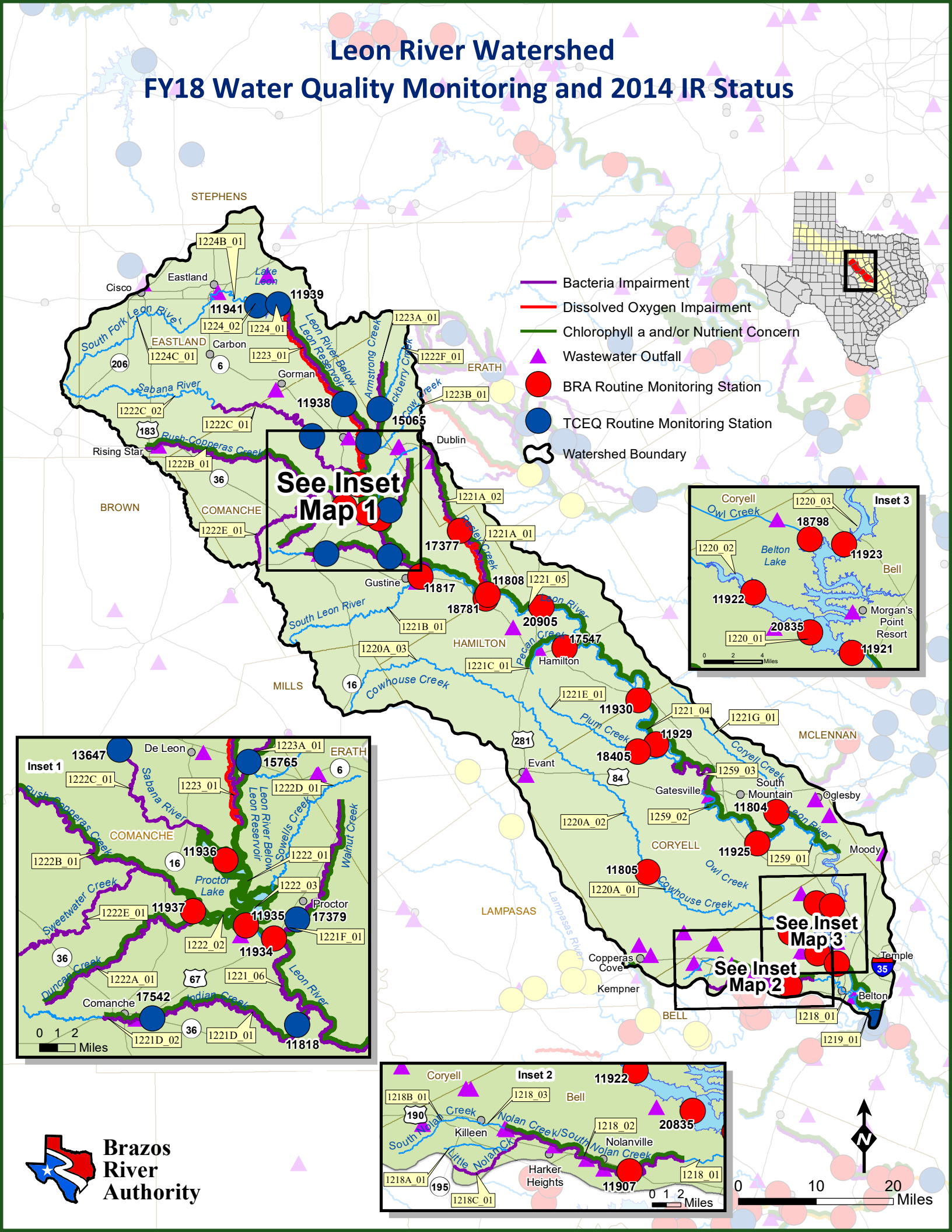
Table 7: Waterbodies of the Bosque River Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Upper North Bosque River	1255_01	Bacteria – NS Nutrients and/or Chl *a* – CS
	1255_02	Bacteria – NS DO – NS Nutrients and/or Chl *a* – CS
Goose Branch	1255A_01	Bacteria – NS Nutrients and/or Chl *a* – CS
North Fork Upper North Bosque River	1255B_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Scarborough Creek	1255C_01	Bacteria – NS Nutrients and/or Chl *a* – CS
South Fork North Bosque River	1255D_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Unnamed Tributary of Goose Branch	1255E_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Unnamed Tributary of Scarborough Creek	1255F_01	Bacteria – NS
Woodhollow Branch	1255G_01	Bacteria – NS
South Fork Upper North Bosque River Reservoir	1255H_01	DO – CS
Dry Branch	1255I_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Goose Branch Reservoir	1255J_01	Nutrients and/or Chl *a* – CS
Scarborough Creek Reservoir	1255K_01	Nutrients and/or Chl *a* – CS
North Bosque River	1226_01 1226_03	Nutrients and/or Chl *a* – CS

	1226_02	DO – CN Nutrients and/or Chl *a* – CS
	1226_04	Nutrients and/or Chl *a* – CS Macrobenthics – CN
Duffau Creek	**1226A_01**	**Bacteria – NS**
Green Creek	1226B_01	DO – NS Nutrients and/or Chl *a* – CS
Indian Creek	1226E_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Sims Creek	1226F_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Alarm Creek	1226H_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Little Duffau Creek	1226K_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Little Green Creek	1226M_01	Bacteria – NS
Indian Creek Reservoir	1226N_01	Nutrients and/or Chl *a* – CS
Sims Creek Reservoir	1226O_01	DO – CS Nutrients and/or Chl *a* – CS
Waco Lake	1225_03	Nutrients and/or Chl *a* – CS
Middle Bosque/South Bosque River	1246_02	Nutrients and/or Chl *a* – CS
Tonk Creek	1246D_01	Nutrients and/or Chl *a* – CS
Wasp Creek	1246E_01	Bacteria – NS Nutrients and/or Chl *a* – CS

Wastewater treatment plant effluent, agricultural runoff and the confined animal feeding operations (CAFOs) located in the watershed are potential contributors to the elevated nutrients. However, through implementation of the TMDL plan, reductions in nutrients have been achieved (Improving Water Quality in the North Bosque River, TCEQ 2012).

Leon River Watershed
FY18 Water Quality Monitoring and 2014 IR Status



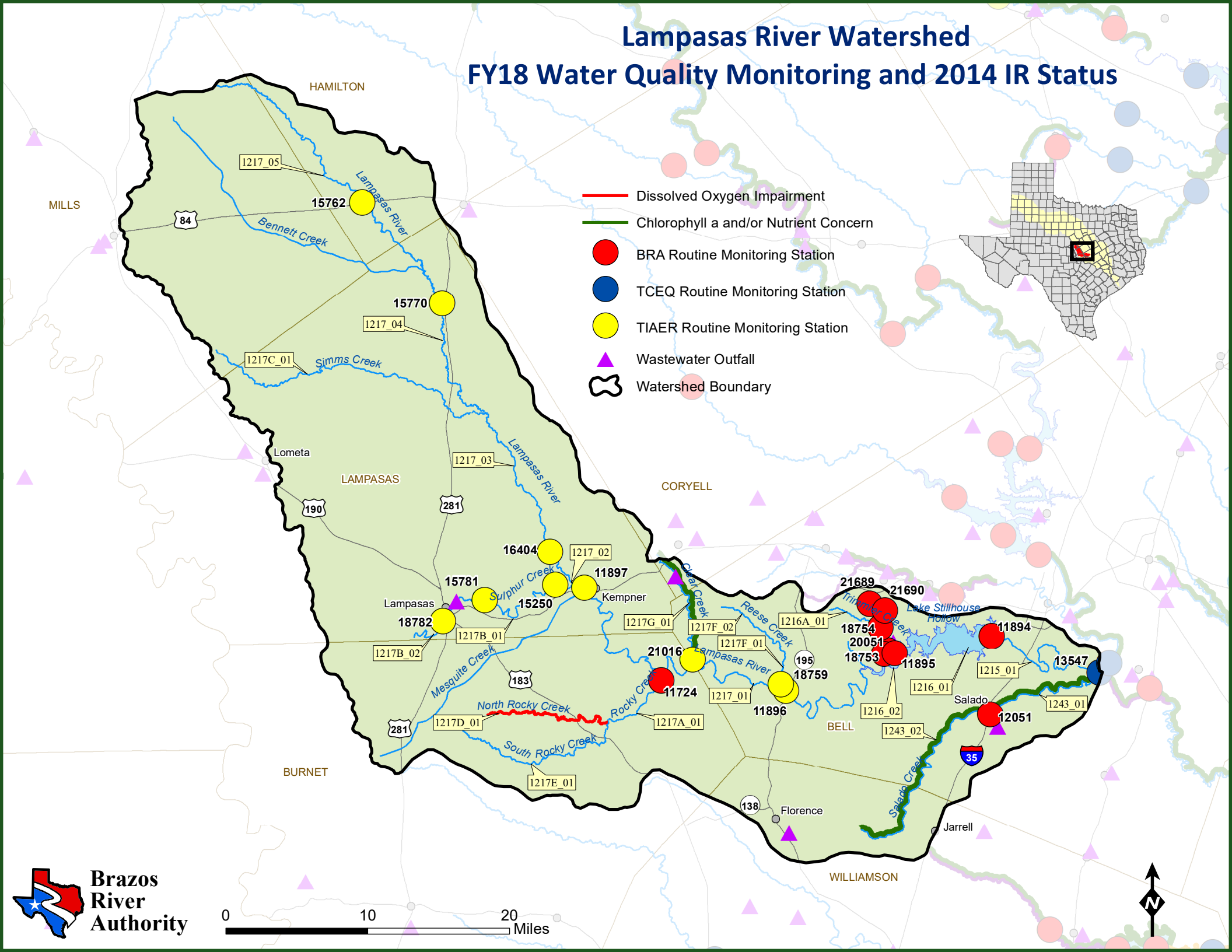
Leon River Watershed

Table 8: Waterbodies of the Leon River Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Nolan Creek/South Nolan Creek	1218_02	Bacteria – NS Nutrients and/or Chl a – CS
Unnamed Tributary to Little Nolan Creek	1218A_01	Bacteria – CN
Little Nolan Creek	1218C_01	Bacteria – NS
Leon River Below Belton Lake	1219_01	Nutrients and/or Chl a – CS
Cowhouse Creek	1220A_03	~~Bacteria – NS~~ MEETS
Leon River Below Proctor Lake	1221_01 1221_04 1221_05	~~Bacteria – NS~~ MEETS
	1221_03 1221_06	Bacteria – NS
	1221_01 1221_04 1221_05 1221_07	DO – CS Nutrients and/or Chl *a* – CS
	1221_02 1221_03 1221_06	Nutrients and/or Chl *a* – CS
Resley Creek	1221A_01	Bacteria – NS DO – NS Nutrients and/or Chl *a* – CS
	1221A_02	Bacteria – NS Nutrients and/or Chl *a* – CS
South Leon River	1221B_01	~~Bacteria – NS~~ MEETS Habitat – CS
Pecan Creek	1221C_01	Nutrients and/or Chl *a* – CS

Indian Creek	1221D_01	Bacteria – NS DO – CS Nutrients and/or Chl *a* – CS
	1221D_02	Bacteria – NS Nutrients and/or Chl *a* – CS
Walnut Creek	1221F_01	Bacteria – NS Nutrients and/or Chl a – CS
Proctor Lake	1222_01 1222_02 1222_03	Nutrients and/or Chl a – CS
Duncan Creek	1222A_01	Bacteria – NS Nutrients and/or Chl a – CS DO – CN
Rush-Copperas Creek	1222B_01	Bacteria – NS Nutrients and/or Chl a – CS
Sabana River	1222C_01	Bacteria – NS
Sowells Creek	1222D_01	Bacteria – CN
Sweetwater Creek	1222E_01	Bacteria – NS
Hackberry Creek	1222F_01	Bacteria – CN DO – CN
Leon River Below Leon Reservoir	1223_01	Bacteria – NS DO – NS Nutrients and/or Chl a – CS
Armstrong Creek	1223A_01	Bacteria – NS Nutrients and/or Chl a – CS
Cow Creek	1223B_01	Bacteria – CN

Lampasas River Watershed
FY18 Water Quality Monitoring and 2014 IR Status



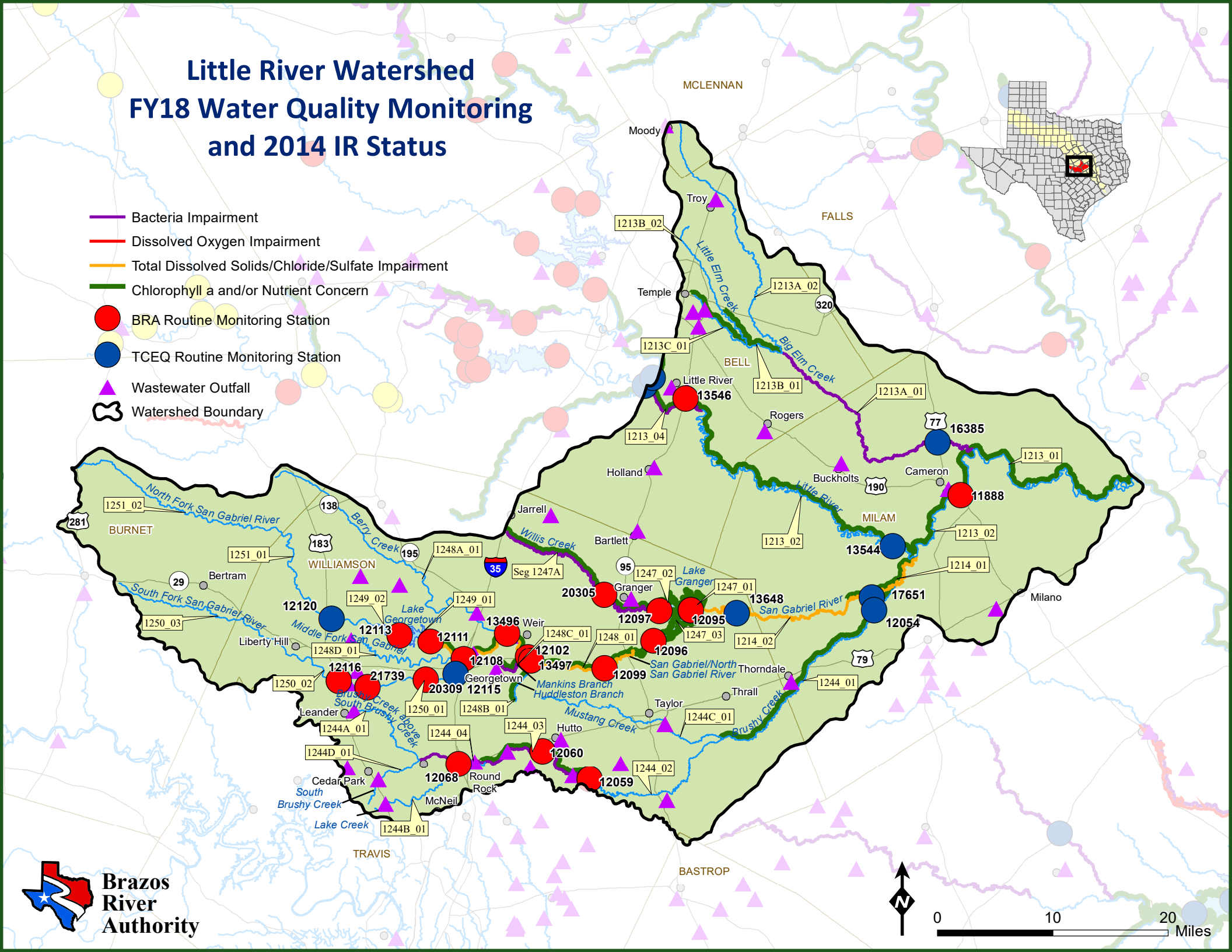
Brazos River Authority

Lampasas River Watershed

Table 9: Waterbodies of the Lampasas River Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Trimmier Creek	1216A_01	~~Bacteria – NS~~ MEETS Macrobenthics – CN
Sulphur Creek	1217B_02	DO – CS
North Rocky Creek	1217D_01	DO – NS
Clear Creek	1217G_01	Nutrients and/or Chl *a* – CS
Salado Creek	1243_01 1243_02	Nutrients and/or Chl *a* – CS

Little River Watershed
FY18 Water Quality Monitoring and 2014 IR Status

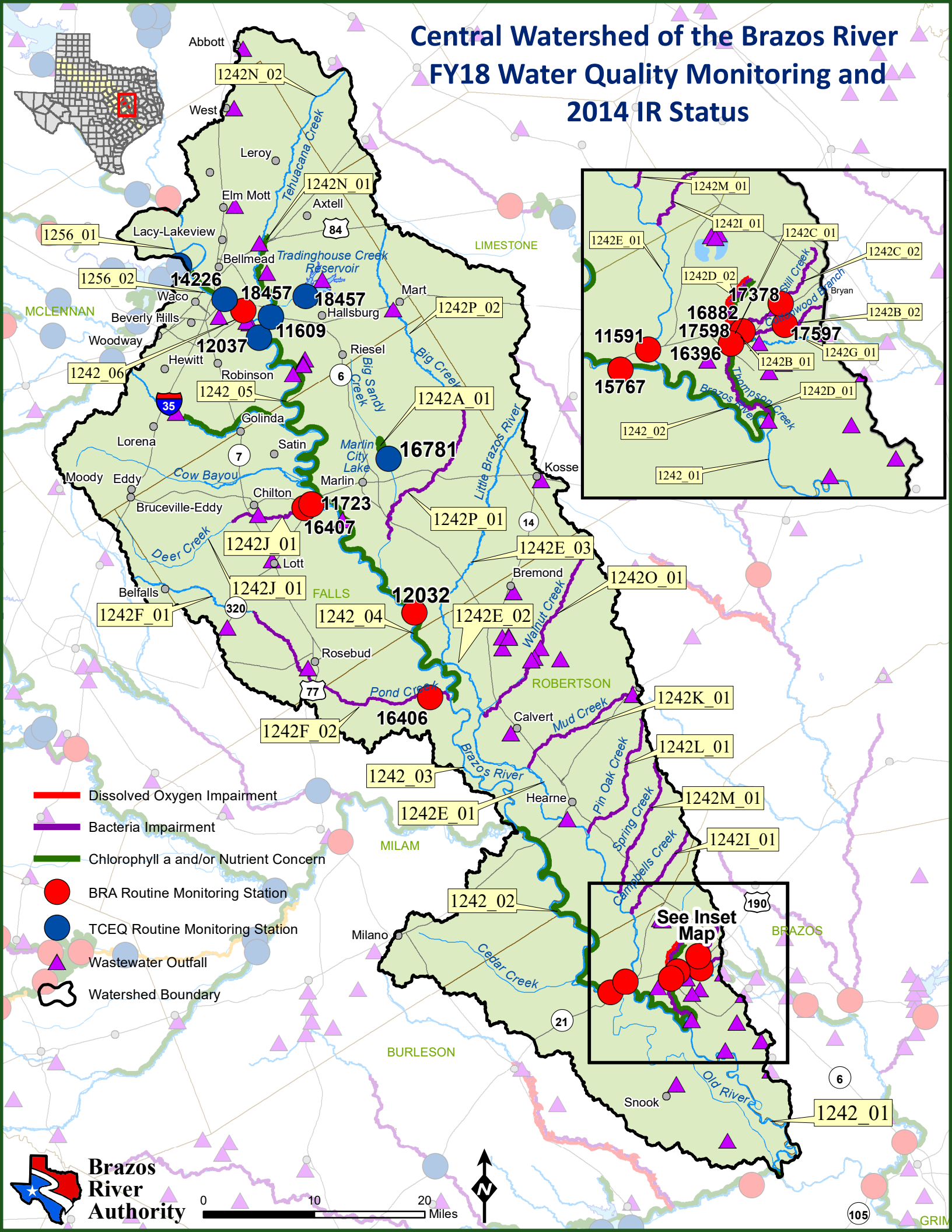


Little River Watershed

Table 10: Waterbodies of the Little River Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Little River	1213_01	~~Bacteria – NS~~ MEETS Nutrients and/or Chl *a* – CS
	1213_02 1213_03	Nutrients and/or Chl *a* – CS
	1213_04	Bacteria – NS Nutrients and/or Chl *a* – CS
Big Elm Creek	1213A_01	Bacteria – NS
Little Elm Creek	1213B_01	Nutrients and/or Chl *a* – CS DO – CN
Unnamed Tributary of Little Elm Creek	1213C_01	Nutrients and/or Chl *a* – CS Habitat – CS
San Gabriel River	1214_01	~~Bacteria – NS~~ MEETS Cl^- – NS SO_4 – NS Nutrients and/or Chl *a* – CS
	1214_02	Cl^- – NS SO_4 – NS Bacteria - CN
Brushy Creek	1244_01	Bacteria – CN Nutrients and/or Chl *a* – CS
	1244_03	Bacteria – NS Nutrients and/or Chl *a* – CS
	1244_04	Bacteria – NS
Granger Lake	1247_01 1247_02 1247_03	Nutrients and/or Chl *a* – CS

Water Body	Segment	Parameter(s) Impairment and/or Concern
Willis Creek	1247A_01	Bacteria – NS Nutrients and/or Chl *a* - CS
San Gabriel/North Fork San Gabriel River	**1248_01**	**Cl^- – NS** **TDS – NS** Nutrients and/or Chl *a* - CS
Huddleston Branch	1248B_01	Bacteria – CN Nutrients and/or Chl *a* – CS
Mankins Branch	1248C_01	Bacteria – NS Nutrients and/or Chl *a* – CS Habitat – CS
South Fork San Gabriel River	1250_03	DO – CS

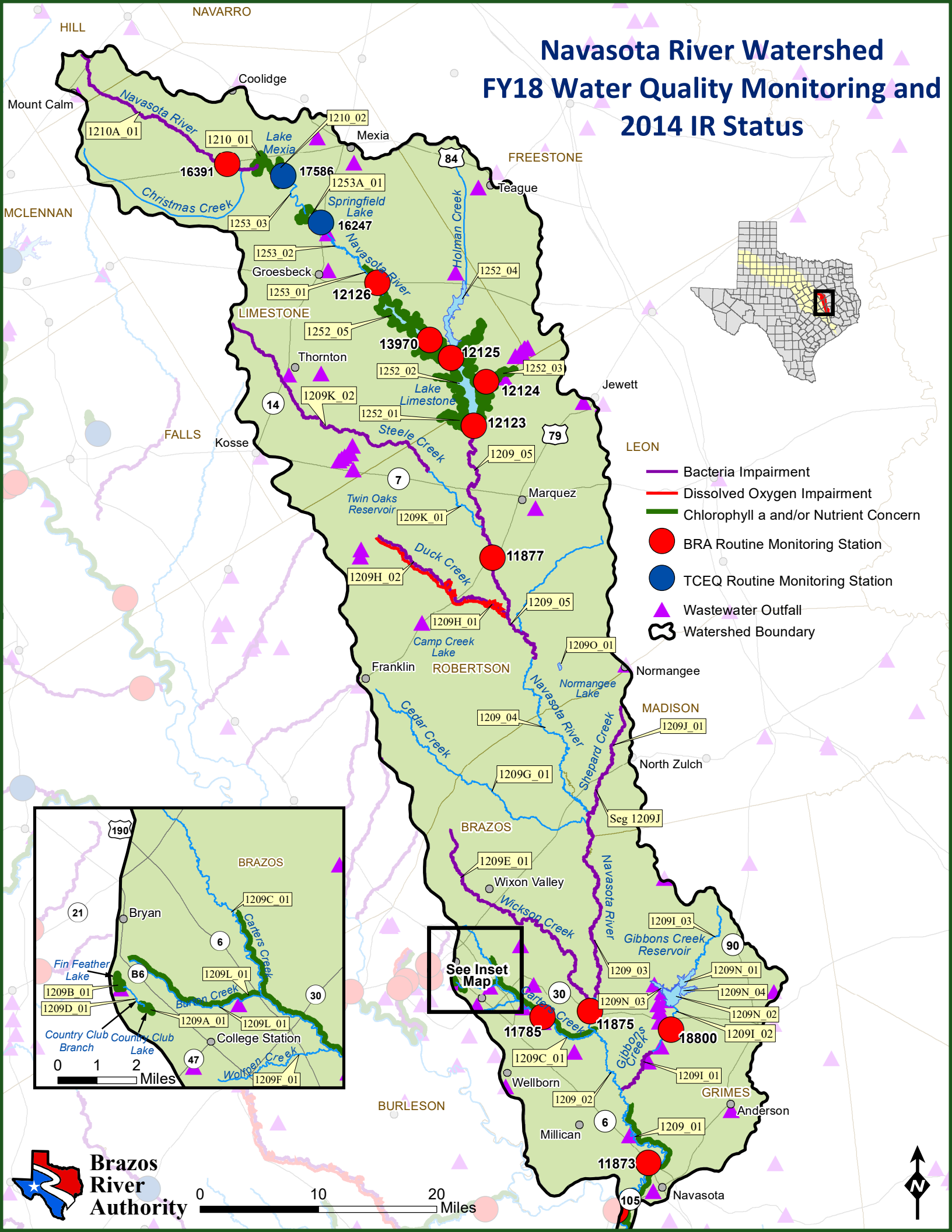

Central Watershed of the Brazos River
FY18 Water Quality Monitoring and
2014 IR Status
Abbott
1242N_02
West
Leroy
Tehuacana Creek
1242N_01
Elm Mott
Axtell
84
1256_01
Lacy-Lakeview
Bellmead
Tradinghouse Creek
Reservoir
1256_02
14226
Waco
18457
18457
Hallsburg
Mart
1242P_02
MCLENNAN
Beverly Hills
11609
Woodway
12037
Riesel
Hewitt
1242_06
Robinson
6
Big Sandy Creek
Big Creek
1242_05
35
1242A_01
Golinda
Lorena
Satin
7
Marlin City Lake
16781
Little Brazos River
Kosse
Moody
Eddy
Cow Bayou
Chilton
Marlin
11723
16407
Bruceville-Eddy
1242P_01
14
Deer Creek
1242J_01
Lott
1242E_03
Bremond
1242O_01
Belfalls
1242J_01
FALLS
12032
1242F_01
320
1242_04
1242E_02
Walnut Creek
Rosebud
ROBERTSON
77
Pond Creek
1242K_01
16406
Calvert
Mud Creek
1242F_02
1242L_01
Brazos River
Pin Oak Creek
1242_03
Hearne
1242M_01
1242E_01
Spring Creek
MILAM
1242I_01
Campbells Creek
1242_02
190
See Inset Map
Milano
BRAZOS
Cedar Creek
21
BURLESON
Old River
6
Snook
1242_01
105
GRIM
1242M_01
1242I_01
1242C_01
1242E_01
1242C_02
1242D_02
Still Creek
Cottonwood Branch
Bryan
17378
16882
1242B_02
17598
17597
11591
16396
1242G_01
1242B_01
15767
Brazos River
Thompson Creek
1242D_01
1242_02
1242_01
Dissolved Oxygen Impairment
Bacteria Impairment
Chlorophyll a and/or Nutrient Concern
BRA Routine Monitoring Station
TCEQ Routine Monitoring Station
Wastewater Outfall
Watershed Boundary
Brazos River Authority
0
10
20
Miles
N

Central Watershed of the Brazos River Basin

Table 11: Waterbodies of the Central Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Brazos River/Lake Brazos	1256_02	Nutrients and/or Chl *a* – CS
	1256_03	DO – CS
Brazos River Above Navasota River	1242_02 1242_04 1242_05	Nutrients and/or Chl *a* – CS
Marlin City Lake System	1242A_01 1242A_02	Nutrients and/or Chl *a* – CS
Cottonwood Branch	1242B_01	Bacteria – NS Nutrients and/or Chl *a* – CS
	1242B_02	Bacteria – NS
Still Creek	1242C_01	Bacteria – NS Nutrients and/or Chl *a* – CS
	1242C_02	Bacteria – NS
Thompson Creek	1242D_01	Bacteria – NS Nutrients and/or Chl *a* – CS Fish – CN
	1242D_02	Bacteria – NS DO – NS Nutrients and/or Chl *a* – CS Macrobenthic – CS
Pond Creek	1242F_01	Bacteria – NS
Tradinghouse Reservoir	1242H_01	Harmful Algal Bloom /Golden Algae – CN
Campbells Creek	1242I_01	Bacteria – NS DO – CS

Deer Creek	1242J_01	Bacteria – NS Macrobenthic – CN
Mud Creek	1242K_01	Bacteria – NS
Pin Oak Creek	1242L_01	Bacteria – NS
Spring Creek	1242M_01	Bacteria – NS DO – CS
Tehuacana Creek	1242N_01	Nutrients and/or Chl *a* – CS Macrobenthic – CN Fish Kill Report – CN
Walnut Creek	1242O_01	Bacteria – NS
Big Creek	1242P_01	Bacteria – NS
Bullhide Creek	1242Q_01	Nutrients and/or Chl *a* – CS


Navasota River Watershed
FY18 Water Quality Monitoring and
2014 IR Status
NAVARRO
HILL
Coolidge
Mount Calm
Navasota River
1210A_01
1210_01
Lake Mexia
1210_02
Mexia
16391
17586
1253A_01
Springfield Lake
16247
Christmas Creek
1253_03
MCLENNAN
84
FREESTONE
Teague
Holman Creek
1253_02
Groesbeck
1252_04
1253_01
12126
Navasota River
LIMESTONE
1252_05
13970
12125
Thornton
1252_02
1252_03
12124
Jewett
14
1209K_02
Lake Limestone
1252_01
12123
Steele Creek
FALLS
Kosse
79
LEON
1209_05
7
Marquez
Twin Oaks Reservoir
1209K_01
11877
Duck Creek
1209H_02
1209_05
1209H_01
Camp Creek Lake
1209O_01
Franklin
ROBERTSON
Normangee
Normangee Lake
Navasota River
MADISON
Cedar Creek
1209_04
1209J_01
Shepard Creek
North Zulch
1209G_01
Seg 1209J
BRAZOS
1209E_01
Wixon Valley
Navasota River
Wickson Creek
1209I_03
Gibbons Creek Reservoir
90
See Inset Map
1209_03
1209N_01
30
1209N_03
1209N_04
Carters Creek
11875
1209N_02
11785
18800
1209I_02
Gibbons Creek
1209C_01
1209I_01
Wellborn
GRIMES
Anderson
BURLESON
1209_02
6
Millican
1209_01
11873
105
Navasota
Legend
Bacteria Impairment
Dissolved Oxygen Impairment
Chlorophyll a and/or Nutrient Concern
BRA Routine Monitoring Station
TCEQ Routine Monitoring Station
Wastewater Outfall
Watershed Boundary
0 10 20 Miles
Brazos River Authority
N
190
BRAZOS
1209C_01
21
Bryan
Carters Creek
6
Fin Feather Lake
B6
1209L_01
1209B_01
Burton Creek
30
1209D_01
1209A_01
1209L_01
Country Club Branch
Country Club Lake
College Station
47
Wolfpen Creek
1209F_01
0 1 2 Miles

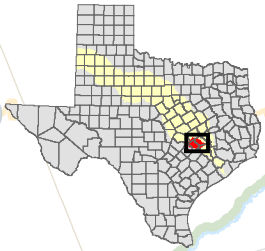
Navasota River Watershed

Table 12: Waterbodies of the Navasota River Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Navasota River Below Lake Limestone	1209_01	Nutrients and/or Chl *a* – CS DO – CS
	1209_02	DO – CS
	1209_03 1209_05	Bacteria – NS
Country Club Lake	1209A_01	Sediment – NS Nutrients and/or Chl *a* – CS
Fin Feather Lake	1209B_01	Sediment – NS Nutrients and/or Chl *a* – CS
Carters Creek	1209C_01	~~Bacteria – NS~~ TMDL Nutrients and/or Chl *a* – CS
Country Club Branch	1209D_01	~~Bacteria – NS~~ TMDL
Wickson Creek	1209E_01	Bacteria – NS
Cedar Creek	1209G_01	~~Bacteria – NS~~ MEETS
Duck Creek	1209H_01 1209H_02	Bacteria – NS DO – NS
Gibbons Creek	1209I_01	Bacteria – NS DO – CN
	1209I_02	Bacteria – CN
Shepherd Creek	1209J_01	Bacteria – NS
Steele Creek	1209K_02	Bacteria – NS
Burton Creek	1209L_01	~~Bacteria – NS~~ TMDL Nutrients and/or Chl *a* – CS

Normangee Lake	1209O_01	Sediment – CS
Lake Mexia	1210_01	DO – CS Nutrients and/or Chl *a* – CS
	1210_02	Nutrients and/or Chl *a* – CS
Navasota River Above Lake Mexia	1210A_01	Bacteria – NS
Lake Limestone	1252_01 1252_02 1252_03 1252_05	Nutrients and/or Chl *a* – CS
Navasota River Below Mexia	1253_01	Nutrients and/or Chl *a* – CS DO – CS
	1253_02	DO – CS
Springfield Lake	1253A_01	DO – CN Nutrients and/or Chl *a* – CS

Yegua Creek Watershed
FY18 Water Quality Monitoring and 2014 IR Status

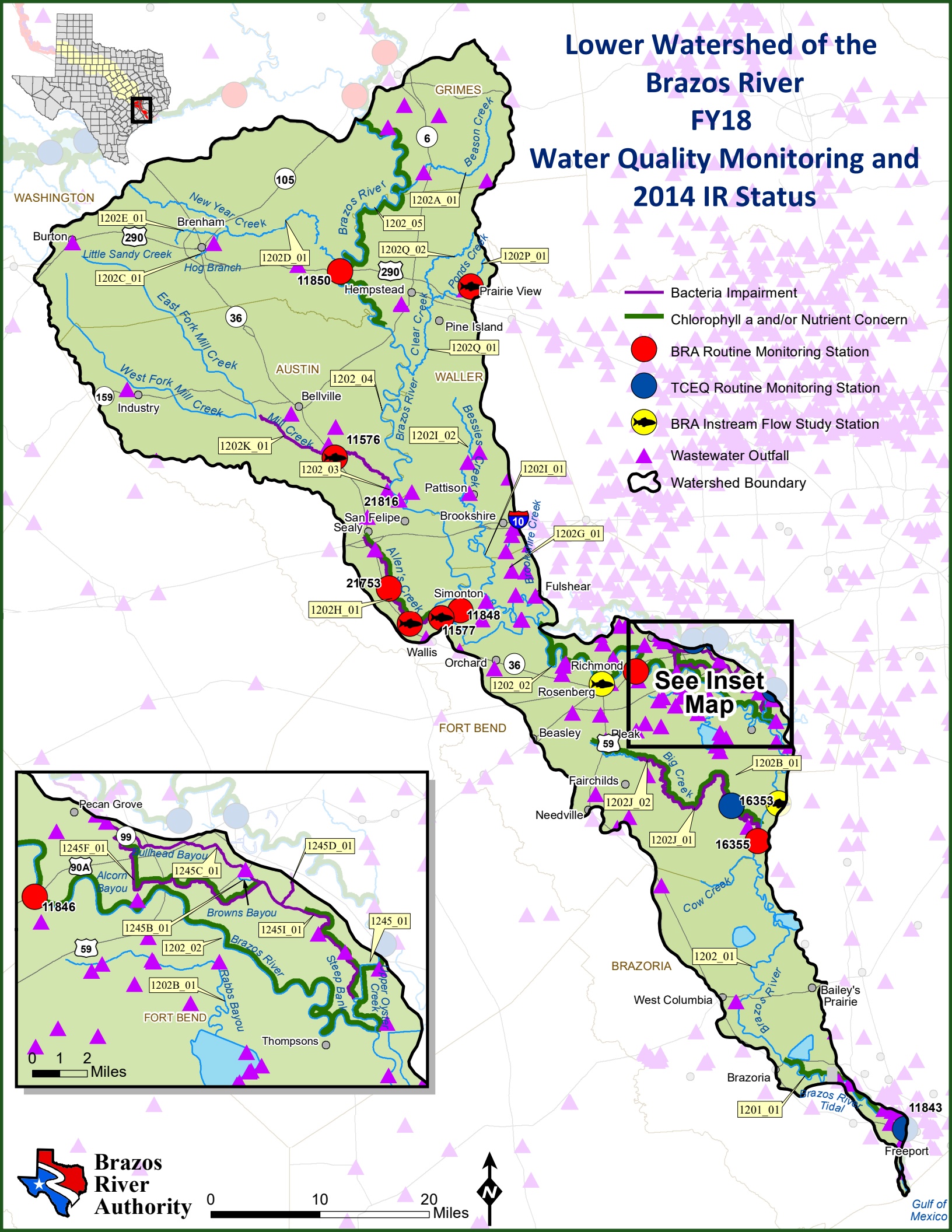


Brazos River Authority

Yegua Creek Watershed

Table 13: Waterbodies of the Yegua Creek Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Yegua Creek	1211_01	Nutrients and/or Chl *a* – CS
Davidson Creek	1211A_02	Bacteria – NS DO – NS
Somerville Lake	1212_01 1212_03 1212_04	High pH – NS Nutrients and/or Chl *a* – CS
Middle Yegua Creek	1212A_02	Bacteria – NS DO – CS Habitat – CS
East Yegua Creek	1212B_01	Bacteria – NS
Nail Creek	1212C_01	Nutrients and/or Chl *a* – CS DO – CS
Burns Creek	1212F_01	Nutrients and/or Chl *a* – CS DO – CS
Brushy Creek	1212K_01	Nutrients and/or Chl *a* – CS
Yegua Creek	1212L_01	Nutrients and/or Chl *a* – CS

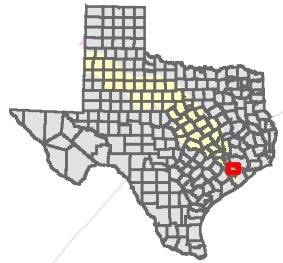

Lower Watershed of the Brazos River
FY18
Water Quality Monitoring and 2014 IR Status
Bacteria Impairment
Chlorophyll a and/or Nutrient Concern
BRA Routine Monitoring Station
TCEQ Routine Monitoring Station
BRA Instream Flow Study Station
Wastewater Outfall
Watershed Boundary
See Inset Map
GRIMES
WASHINGTON
AUSTIN
WALLER
FORT BEND
BRAZORIA
Burton
Brenham
Hempstead
Prairie View
Pine Island
Industry
Bellville
Pattison
Brookshire
San Felipe
Sealy
Fulshear
Simonton
Wallis
Orchard
Richmond
Rosenberg
Beasley
Pleak
Fairchilds
Needville
West Columbia
Bailey's Prairie
Brazoria
Freeport
Gulf of Mexico
Pecan Grove
Thompsons
Brazos River
New Year Creek
Little Sandy Creek
Hog Branch
East Fork Mill Creek
West Fork Mill Creek
Mill Creek
Clear Creek
Beason Creek
Ponds Creek
Bessies Creek
Allen's Creek
Brookshire Creek
Big Creek
Cow Creek
Bullhead Bayou
Alcorn Bayou
Browns Bayou
Rabbs Bayou
Steep Bank
Upper Oyster Creek
Brazos River Tidal
1202A_01
1202_05
1202Q_02
1202P_01
1202Q_01
1202_04
1202I_02
1202I_01
1202G_01
1202_03
1202K_01
1202H_01
1202_02
1202E_01
1202D_01
1202C_01
1202J_02
1202J_01
1202B_01
1202_01
1201_01
1245F_01
1245C_01
1245D_01
1245B_01
1245I_01
1245_01
11850
11576
21816
21753
11848
11577
16353
16355
11846
11843
6
105
290
36
159
10
59
99
90A
0 1 2 Miles
0 10 20 Miles
N
Brazos River Authority

Lower Watershed of the Brazos River Basin

Table 14: Waterbodies of the Lower Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Brazos River Tidal	1201_01	Nutrients and/or Chl *a* – CS
Brazos River Below Navasota River	1202_02 1202_05	Nutrients and/or Chl *a* – CS
Allen's Creek	1202H_01	Bacteria – NS DO – CS Nutrients and/or Chl *a* – CS
Big Creek	**1202J_01**	**Bacteria – NS** Habitat – CS Nutrients and/or Chl *a* – CS
	1202J_02	DO – CS Nutrients and/or Chl *a* – CS
Mill Creek	1202K_01	Bacteria – NS Habitat – CS
Bullhead Bayou	1245C_01	Bacteria – NS
Unnamed Tributary of Bullhead Bayou	1245D_01	Bacteria – NS
Alcorn Bayou	1245F_01	Bacteria – NS Nutrients and/or Chl *a* – CS
Steep Bank Creek	1245I_01	Bacteria – NS Nutrients and/or Chl *a* – CS DO – CS

Upper Oyster Creek Watershed
FY18 Water Quality Monitoring and 2014 IR Status



1245E_01
Fulshear
Flewellen Creek
1245_03
1245A_02
99
Upper Oyster Creek
1245A_01
Red Gully
Bullhead Bayou
1245C_01
12087
Sugar Land
12083
90A
Alkire Lake
1245H_01
Stafford
59
Brooks Lake
1202F_01
1245G_01
1245_02
Upper Oyster Creek
Stafford Run
1245J_01
1245_01
12074
1258_01
Middle Oyster Creek
6
HARRIS
FORT BEND
BRAZORIA

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

Brazos River Authority

0 5 10 Miles

N

Upper Oyster Creek Watershed

Table 15: Waterbodies of the Upper Oyster Creek Watershed IR status

Water Body	Segment	Parameter(s) Impairment and/or Concern
Upper Oyster Creek	1245_01 1245_02	DO – CS Nutrients and/or Chl *a* – CS
	1245_03	Nutrients and/or Chl *a* – CS
Red Gully	1245A_01	Bacteria – CN Nutrients and/or Chl *a* – CS
Flewellen Creek	1245E_01	Bacteria – CN
Stafford Run	1245J_01	Bacteria – CN

THIS YEARS HIGHLIGHTS

Central Texas Freshwater Mussels Research Program

In 2009, the Texas Legislature appointed the Texas Comptroller's Office to oversee the Interagency Task Force on Economic Growth and Endangered Species. The goal of the task forces is to assist landowners, industries, and local communities in working with endangered species issues and finding cost-effective solutions.

Currently, the U.S. Fish and Wildlife Service (FWS) is considering whether to place five Central Texas freshwater mussel species on the federal endangered species list: Texas fatmucket (*Lampsiilis bracteata*), Golden orb (*Quadrula aurea*), False spike (*Fusconaia mitchelli)*, Texas pimpleback (*Quadrula* petrina) and Texas fawnsfoot (*Truncilla macrodon)*. Two of these species, the False Spike and the Texas Fawnsfoot, are known to occur in the Brazos River basin. To ensure the best science about the mussels is available to FWS staff, the Comptroller's Office is funding a research proposal to study the five mussel species in Central Texas. This research will address data gaps in the species' range, life history cycle and tolerances, while also performing environmental flow analyses related to species survivability and conducting captive propagation studies.

Research is in progress in the Brazos, Colorado, and upper Guadalupe River basins, with tolerance studies anticipated to be complete in 2018 and captive propagation studies anticipated to be completed in 2020. The BRA is actively participating in, and assisting, the Comptroller's Office in their efforts by providing data and basin knowledge to support their research efforts, and participating on both the Fresh Water Mussels Working Group and the Technical Advisory Panel.

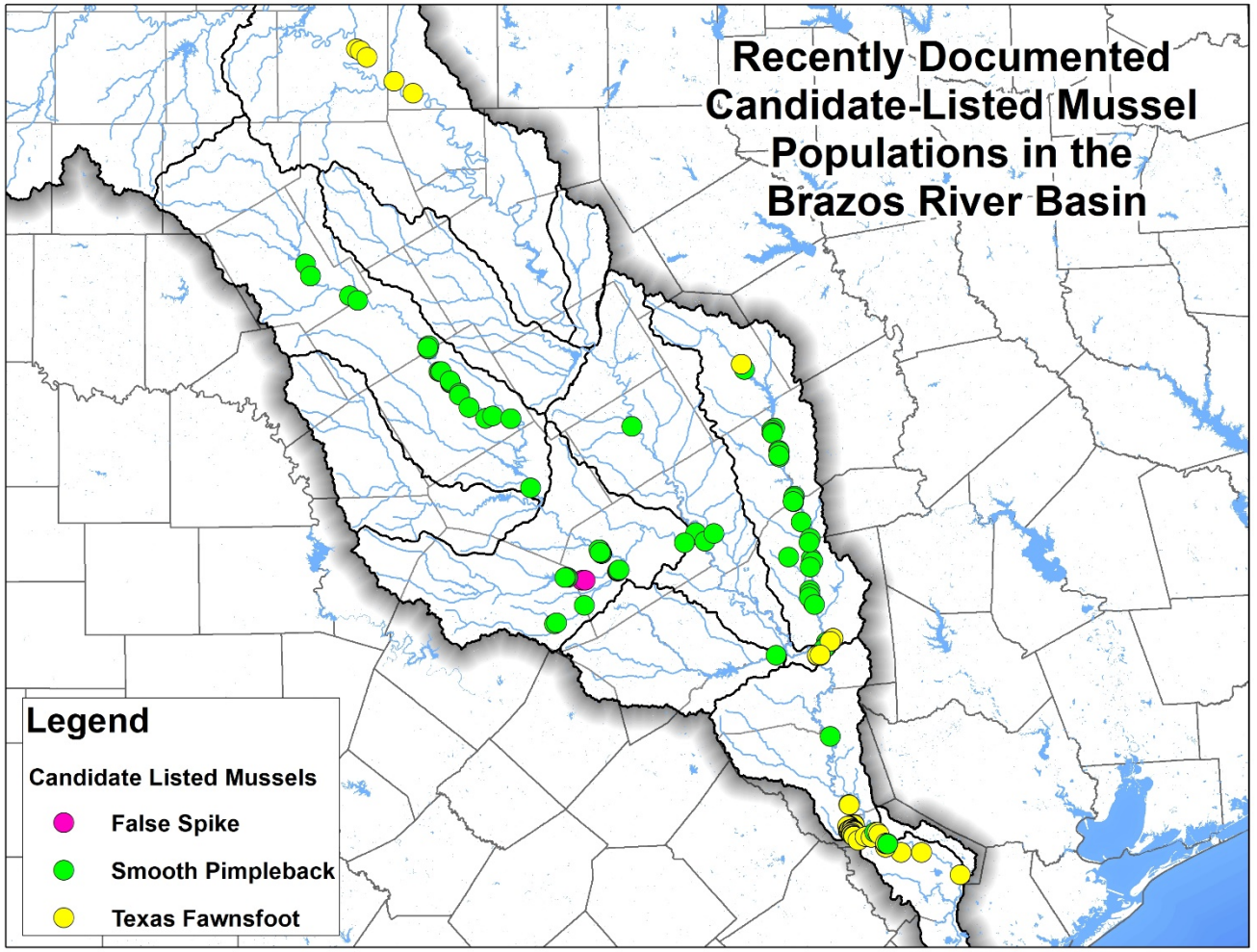
A third species known to occur in the basin, the Smooth Pimpleback (*Quadrula houstonensis*), will be considered in 2020 for endangered species protection. This mussel will be considered along with the Golden Orb (*Quadrula aurea*), which is a species known to occur in the Guadalupe and Lower Colorado River basins.

For more information on the Comptroller's endangered species efforts, see: https://comptroller.texas.gov/programs/species-economy/.

Freshwater Mussel Presence/Absence Surveys in the Brazos and Navasota Rivers

Knowing detailed distribution information and ecological status of existing populations is critical information needed to make determinations about species status. Unfortunately, this information is largely unknown for the five Central Texas mussel species currently under consideration for federal protection under the Endangered Species Act.

In the Brazos basin, there has been spot surveys to support development activities and some academic research but intensive basin-wide surveys of freshwater mussels are lacking. Areas where the species under consideration have been recently documented are detailed in the map below.



The Comptroller's research efforts, noted above, will conduct surveys in the Brazos River above Possum Kingdom Reservoir and in the Little River watershed. To complement the Comptroller's survey efforts and further broaden the knowledge base about mussel distribution, the BRA has contracted to have presence/absence surveys conducted in the Navasota River and the Brazos River between Waco and Possum Kingdom.

Surveys in the Navasota River were completed in 2016 and located 18 species of freshwater mussels throughout the entire length, with species abundance and richness being greatest in the lower reaches of the river. Texas Fawnsfoot and Smooth Pimpleback were two of the species identified in the river.

Surveys of the Brazos River between Waco and Possum Kingdom, conducted in 2017, revealed Texas Fawnsfoot populations in Segment 1206, between Possum Kingdom Reservoir and Lake Granbury. The final report on this project is due in August 2018.

Development of Operating Guidelines to Manage Impact on Fisheries from Reservoir Level Fluctuations

There has long been concern about the impact of prolonged drought on reservoir fisheries and identifying the level and duration of drought induced drawdown that significantly impacts recreational access and the sustainability of a reservoir's fishery. The recent prolonged drought that began in October 2010 and persisted until late summer 2013, provided BRA and Texas Parks and Wildlife Department (TPWD), an opportunity to observe available habitat at varying water levels in many Brazos Basin reservoirs. Reservoirs studied include: Possum Kingdom Lake, Lake Granbury, Lake Proctor, Lake Aquilla, Lake Whitney, Lake Belton, Stillhouse Hollow Lake, Lake Georgetown, Lake Granger, Lake Limestone and Lake Somerville.

From these studies, BRA and TPWD Inland Fisheries staff identified the water elevation below which recreational access is impeded and habitat availability and quality to support the fishery are reduced. These threshold elevations were then translated into an operational guideline in the BRA's Water Management Plan to provide direction regarding reservoir usage during times of future drought and to provide TPWD fisheries biologists' direction in how BRA plans to manage reservoirs during times of drought. BRA and TPWD have committed to work collaboratively to minimize or mitigate impacts to habitat or fisheries caused by prolonged drought. This project was selected as the American Fisheries Society's 2014 Outstanding Project in Sport Fishery Development and Management. Details on the methods and analyses used to develop the reservoir-specific thresholds are published in the *Journal of the Southeastern Association of Fish and Wildlife Agencies*. Currently most reservoirs in the basin are >90% full .

Reservoir Fisheries Habitat Improvement Project

While the lakes studied did comply with the guidelines developed in the above project during the recent prolonged drought, the lake levels and fisheries habitat in several of the reservoirs were impacted by low water levels for an extended period of time. Beginning in 2016, the BRA and TPWD Inland Fisheries Staff have entered into a partnership to perform habitat improvement projects on Possum

Kingdom Lake, Lake Granbury, Lake Proctor, Lake Aquilla, Lake Whitney, Lake Belton, Stillhouse Hollow Lake, Lake Georgetown, Lake Granger, Lake Limestone and Lake Somerville.

The goal is to improve fishery habitat, and thus resiliency, and to proactively mitigate the negative effects that future droughts may have on reservoir fisheries. Due to differences in fisheries, native habitat, and lake usage, a different plan will be developed and implemented for each lake.

Offshore view of the Sun City Hunting and Fishing Club readying artificial habitat structures for deployment into Georgetown Reservoir, November 7, 2017.

In 2016-2017, improvements were made on Lake Proctor, Possum Kingdom Lake, and Lake Granbury. In 2017, improvements were made on Lake Aquilla, Lake Georgetown, and Lake Granger. The types of structures deployed on the lakes varied greatly, but overall, three new water willow colonies were established and 160 artificial habitat structures have been deployed into Lake Aquilla. On Lake Georgetown, with the help of the Sun City Hunting and Fishing Club, 120 artificial habitat structures were deployed and restored/created 30 habitat sites on the reservoir. Finally, at Lake Granger, with the assistance of a prospective Eagle Scout and a local troop of the Boy Scouts of America, 10 habitat sites were restored using 160 artificial structures. Nineteen brush pile areas were created on Lake Proctor, while 28 artificial habitat structures and 70 crappie condos were deployed on Lake Granbury.

The program is anticipated to run through 2020 with lakes chosen for improvement collaboratively by BRA and TPWD Inland Fisheries staff.

Brazos Basin Instream Flow Monitoring Program to Inform on Environmental Flow Standards

Senate Bill 2, enacted in 2001 by the 77th Texas Legislature, established the Texas Instream Flow Program (TIFP). The purpose of the TIFP is to perform scientific studies to determine flow conditions necessary to support a sound ecological environment in the rivers and streams of Texas. With passage of Senate Bill 3 (SB3) in 2007, the Texas Legislature restated the importance of maintaining the

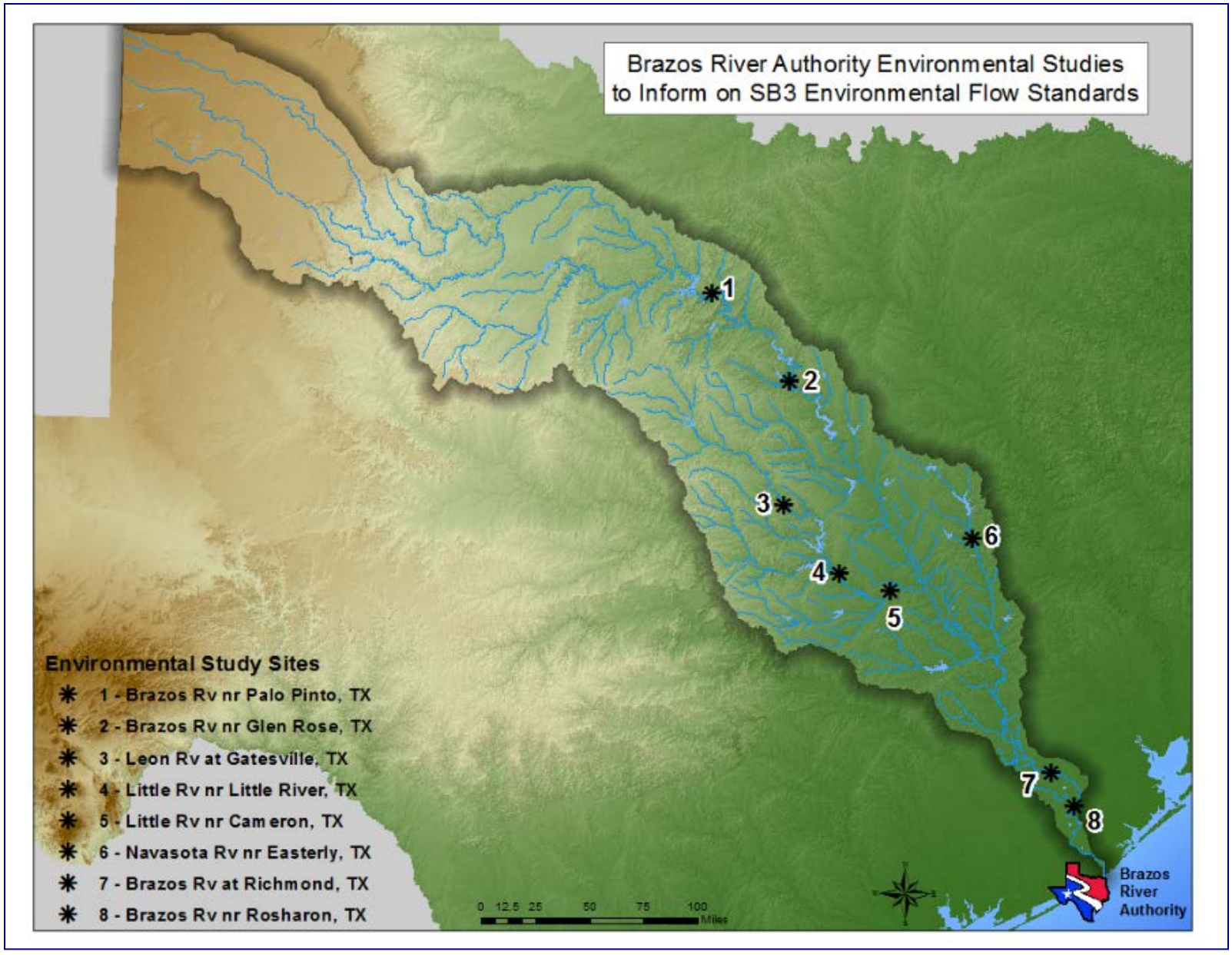
health and vitality of the State's surface-water resources and further created a stakeholder process that would result in science and policy based environmental flow regime recommendations to protect instream flows and freshwater inflows on a basin-by-basin basis. Instream flow studies function to provide scientific information that can be utilized during the adaptive management process within SB3 to inform environmental flow recommendations. These studies consist of multi-disciplinary assessments of biology, hydrology, water quality, geomorphology, and connectivity (where possible). Flow conditions are framed in the form of flow regimes comprising several components: subsistence, base flows, high flow pulses, and overbanking flows. As part of the TIFP process, the agency partners identified the middle and lower Brazos River as a priority sub-basin study area.

In 2012, the BRA initiated a program to perform extensive environmental studies at select locations in the Brazos River basin to gather data related to the TCEQ's adopted Senate Bill 3 (SB3) environmental flow baseline. The goal of these studies is to develop a baseline data set documenting habitat and species present in the river and riparian zones across the range of adopted subsistence and base flows for each selected location. When the next review of the environmental flow standards is commenced, all data will be provided to the Brazos Basin and Bay Expert Science Team (BBEST) and Basin and Bay Area Stakeholder Committee (BBASC) for their consideration when determining whether revisions to the environmental flow standards are warranted.

Many of the control points, or study sites for the TIFP were chosen at established USGS gage locations because flow can easily be determined at these sites. Because many of the studies require access to private property and because some USGS gage locations may not have much variety in habitat, the BRA may not be able to complete all studies at the exact location of the USGS gage. On the sites where studies have begun, the BRA has made every effort to site the studies as close to the proposed gage locations as prudent and as close to each other as prudent.

Components of the studies to be performed at each site include:

- Discharge, velocity and depth point measurements
- Temperature, pH, Conductivity, and Dissolved Oxygen Concentration
- Fixed photography, instream cover, habitat types, and channel surveys
- Macroinvertebrates, mussels (if present), and fish assemblage
- Riparian tree surveys
- Channel cross-section surveys
- Sediment sampling at the cross-sections


Brazos River Authority Environmental Studies
to Inform on SB3 Environmental Flow Standards
1
2
3
4
5
6
7
8
Environmental Study Sites
1 - Brazos Rv nr Palo Pinto, TX
2 - Brazos Rv nr Glen Rose, TX
3 - Leon Rv at Gatesville, TX
4 - Little Rv nr Little River, TX
5 - Little Rv nr Cameron, TX
6 - Navasota Rv nr Easterly, TX
7 - Brazos Rv at Richmond, TX
8 - Brazos Rv nr Rosharon, TX
0 12.5 25 50 75 100
Miles
Brazos River Authority

These studies are highly dependent on the occurrence of specific flow levels, so an accurate timeline for completion of all studies is difficult to predict. Table 1 displays, the number of each type of sampling event that BRA has completed to date.

Table 1. Number and type of sampling event completed by BRA to date.

Site	Water Quality	Instream Habitat Mapping	Micro-Habitat Fish	Meso-Habitat Fish	Mussels	Invertebrates	Riparian Trees	Riparian Species	Riparian Seedlings	Channel Surveys	Sediment Samples
Brazos River near Palo Pinto	63	8	9	8	11	11	5	5	5	5	3
Brazos River near Glen Rose	63	5	4	5	5	7	5	5	5	5	3
Aquilla Creek near Aquilla	22	9	8	8	9	9	5	5	5	5	4
Leon River near Gatesville	56										
Little River near Little River	10										
Little River near Cameron	62										
Navasota River near Franklin	21	4	4	4	3	4	2	2	2	2	2
Brazos River near Richmond	62	6	5	5	4	2	3	3	3	3	2
Brazos River near Rosharon	30	4	2	3	4	4	3	3	3	3	3

Impacts of Hurricane Harvey reduced the number of events that could be completed at the Brazos River near Richmond and Brazos River near Rosharon sites. Access to the Brazos River near Rosharon site, which washed out after the fall 2015 sampling, has been repaired and will resume in spring 2018. Biological sampling at the Brazos River near Glen Rose site has not been conducted since 2016. Issues with reservoir dam gate maintenance eliminated the ability to maintain steady flow conditions required to achieve a stable aquatic condition. Despite environmental and mechanical setbacks, the Authority completed six biological and six riparian events in 2017.

Biological

Baseline data collection has been completed at two sites, the Brazos River near Palo Pinto and Aquilla Creek near Aquilla. Data from the Brazos River near Palo Pinto site were collected over 13 sampling events between February 2012 and October 2017. Flows ranged from subsistence (17 cfs) to above high base (236 cfs). In eight events where Index of Biotic Integrity (IBI) values were calculated, six achieved an exceptional aquatic life use (ALU) and two achieved a high aquatic life use. A high ALU is assigned to the Brazos near Palo Pinto based on physical, chemical, and biological characteristics of the water body. There are five aquatic life use (ALU) categories: exceptional, high, intermediate, limited, or minimal (no significant) aquatic life use.

Invertebrate ALU categories for this site ranged from limited to high in nine samples. The two most recent invertebrate samples have not been processed yet. Twelve sampling evets on Aquilla Creek occurred between May 2012 and July 2017. Flow targets ranged from subsistence (0.25 cfs) to high base (30.9 cfs). IBI values were calculated for nine events, eight events achieved ALU values of exceptional and one event achieved a high ALU. Invertebrate ALU values for eight sampling events ranged from limited to high with one event yet to be processed. The Authority will continue to collect flow-targeted data on sites that require it as well as devise a long-term monitoring plan where baseline biological data collection has been completed.

Riparian

Twenty-four riparian assessments at six sites between April 2013 and September 2017 have been completed. Data is currently being processed for analysis. Efforts to collect riparian data at required flow targets to get a solid baseline data set will continue. This information will be used to guide and evaluate a long-term monitoring strategy for these riparian sites.

In spring 2018, reconnaissance and establishment of three new sites: Leon River near Gatesville, Little River near Little River, and Little River near Cameron will begin.

Little River, San Gabriel River, and Big Elm Creek Watershed Inventory

The Little River watershed is included in the 2017 IR as impaired due to elevated levels of *E. coli*. Data availability within the Little River watershed was limited, including information regarding sources of *E. coli* within the watershed and other factors that may influence pollution sources. Because of these issues, a watershed inventory was developed with data and information pertaining to water quality impairments and issues in the watershed.

In April 2017 the Texas Water Resources Institute completed a report to address water quality issues in the Little River (1213), Big Elm Creek (1213B) and the San Gabriel River (1214) watersheds. A geographic information system (GIS) inventory of the watershed was

developed and integrated numerous existing information resources into a single location. The data from this inventory will be used in future characterizations of the water body and in watershed-based plans in the future.

Watershed Protection Plan for the Leon River

The Leon River, Segment 1221, was placed on the State's 303(d) List in 1997 for having bacteria levels. Placement of the Leon River on the List caused the TCEQ to initiate the development of 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 the selection of appropriate implementation strategies for the watershed. The BRA received funding for the project through the Texas State Soil and Water Conservation Board (TSSWCB) and began hosting stakeholder meetings in 2007. Stakeholders worked diligently toward the development of a WPP document and a draft WPP was completed and released for public comment in December 2011. The Plan was submitted to the EPA in 2012. The Leon River Watershed Protection Plan was approved by the EPA in early 2015 and is now in the implementation phase. Several watershed implementation efforts have been implemented. You can also visit http://leonriver.tamu.edu/ for further information on the Leon Watershed and the WPP.

Watershed Protection Plan for the Lampasas River

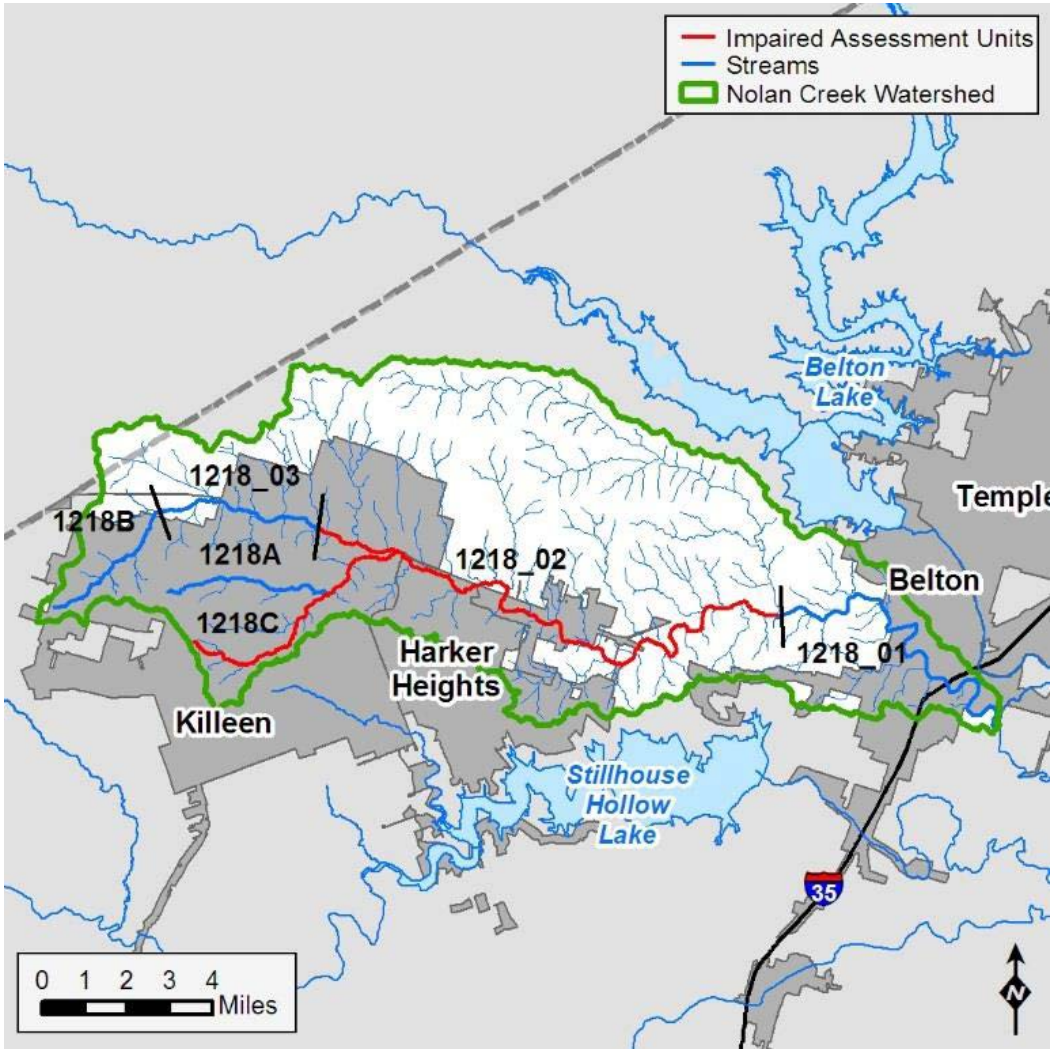
The Lampasas River, Segment 1217, was identified for watershed protection plan development due to concerns about elevated levels of bacteria, as reported in the 2002 IR. In 2009, the Lampasas River Watershed Partnership, area residents and other stakeholders worked to develop a WPP to address water quality concerns within the watershed. The Partnership has evaluated water quality issues and made recommendations for voluntary pollutant load reductions and management measures. A draft Lampasas River Watershed Protection Plan was submitted to EPA in the Spring of 2013, approved by the EPA in May 2013 and by the Steering Committee in September 2013. The project is in the implementation phase. For more information visit the web site at Lampasas River Watershed Protection Plan.

Watershed Protection Plan for Nolan Creek/South Nolan Creek

The full length of Nolan Creek/South Nolan Creek (Segment 1218), as defined by the TCEQ, stretches nearly 30 river miles from its headwaters in northern portion of Killeen to its confluence with the Leon River in Bell County below Belton. Segment 1218 was first included on the 303(d) list as impaired for elevated bacteria concentrations in 1996. While the 2014 Texas Integrated Report included only assessment units (AUs) 1218_02 along South Nolan Creek and 1218C representing Little Nolan Creek, under the draft 2016 Texas Integrated Report, AU 1218_01 along Nolan Creek is also listed as impaired for recreational use. Concerns for Segment 1219 include elevated nitrate and total phosphorus concentrations for AUs 1218_01 and 1218_02 as well as concerns for bacteria concentrating along AU 1218A, an unnamed tributary to Little Nolan Creek. Recreational use of South Nolan/Nolan Creek varies from its headwaters northwest of Killeen to its confluence with the Leon River southeast of Belton. Low flows often limit recreational use in the more upstream portions near Killeen and Harker Heights to noncontact activities, such walking or biking along trails near the creek, including the Community Center and Long Branch Parks in Killeen, and the Booker Green Space and Summit Soccer Complex in Harker Heights. As flows increase, secondary contact recreation activities increase, such as fishing and wading, which have been

observed below the US 190 in Nolanville. More downstream with higher flows, kayaking and canoeing are common activities, as well as fishing, swimming and wading. Parks in the lower portion of the watershed along Nolan Creek include the Lions, Harris Community, Yettie Polk, and Confederate Parks all within Belton.

The waters of South Nolan/Nolan Creek are an important feature in this region and planning efforts to protect and improve water quality have been on-going for a number of years. The Nolan Creek Partnership has been integral in providing local input for development of a Watershed Protection Plan (WPP), which is nearing completion. The Texas Institute for Applied Environmental Research is facilitating development of this WPP through Clean Water Act 319(h) project funding via the Texas Commission on Environmental Quality. The goal is for an Environmental Protection Agency's (EPA) accepted WPP by fall 2018, which then provides a guide for implementing an educational program and improvement practices to improve water quality. Funding for implementation activities are available through the 319(h) program and other funding sources once the WPP is accepted by EPA. Stakeholder participation is key to developing and implementing a successful watershed protection plan. Public meetings are held regularly, and information on partnership meetings, reports, and the WPP elements can be found at http://www.nolancreekwpp.com/.



Map Source: TCEQ WPP Project Fact Sheet (https://www.tceq.texas.gov/assets/public/waterquality/nps/projects/60281_FS_NolanCreekWPP.pdf)

Watershed Protection Plan for the Navasota River Below Lake Limestone

The Navasota River watershed is located in East-Central Texas in the Brazos River basin. Lake Limestone impounds the River causing a hydrological divide in the watershed. The majority of the watershed is rural and urbanization is largely confined to the Bryan/College Station area in Brazos County. Land use/land cover in the watershed is dominated by hay/pasture land and hardwood forests.

The Navasota River and several tributaries were first listed as impaired on the 2002 Texas Integrated Report (Texas 303(d) List) for elevated *E. coli* concentrations. Low dissolved oxygen (DO) in Duck Creek also resulted in a water quality impairment and concerns for elevated nutrients and chlorophyll-a, and depressed DO exist in several locations.

To address this need, watershed stakeholders organized to develop the Navasota River Below Lake Limestone Watershed Protection Plan. Recommended management measures focus on reducing *E. coli* loading to waterbodies by retaining it on the landscape or removing the source in the case of feral hogs. Management recommendations focus on sources that are feasibly managed including feral hogs, livestock, on-site sewage facilities (OSSFs), pets, and wastewater. All management recommended is voluntary and when implemented, will reduce *E. coli* loading to the Navasota River and its tributaries.

The Navasota River Below Lake Limestone WPP was completed in early 2017 and accepted by EPA as a plan that meets the EPA Nine Elements for Watershed Based Plans. The WPP is currently being implemented and additional funding is being sought to further implementation efforts.

Navasota River watershed stakeholders also decided to pursue development of a total maximum daily load (TMDL) and a TMDL Implementation Plan in addition to the WPP. The current drafts of the TMDL and its Implementation Plan include the same management measures in the WPP. The advantage of the TMDL is that once approved by EPA, the impairments are moved to category 4a on the CWA 303(d) List. The TMDL is currently undergoing TCEQ review and the Implementation Plan is out for stakeholder comment. The Navasota River and several tributaries were first listed as impaired on the 2002 IR for elevated *E. coli* concentrations. Low dissolved oxygen (DO) in Duck Creek also resulted in a water quality impairment. Additionally, concerns for elevated nutrients and chlorophyll-a, and depressed DO also exist in several locations. These impairments and concerns signify the need to improve water quality and protect the resource for future uses and users. For more information visit the web site at http://navasota.tamu.edu/.

PUBLIC INVOLVEMENT AND OTHER INFORMATION

Brazos River Basin Clean Rivers Program Steering Committee

The size and diversity of issues across the Brazos River basin continues to present 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 or Summary 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 jenna.olson@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** with a dedicated **CRP webpage** as a mechanism to keep the public informed. These websites provide information on topics of interest in the basin and also provide links to a range of information, including:

Water Supply

Clickable buttons provide information on Drought, Conservation, Planning, Contracting, System Operations, and a Reservoir Accounting Summary.

Water Quality

Clickable buttons provide information on Water and Wastewater Treatment, the Texas Clean Rivers Program, and Watershed Protection Plans.

Clear Rivers Program

Clicking on the Texas Clean Rivers Program button will take you to the BRA hosted CRP webpage. There is a clickable map with water quality data generated by the BRA available in a searchable format that can be easily downloaded to an Excel file. This site is updated weekly. This is also where all of the required CRP information and documents can be found. Including:

CRP Public Outreach – Information on becoming a Steering Committee member
CRP Calendar of Events – Steering Committee Meeting are announced
Program Documents – Required program documents

- Current Work Plan
- Quality Assurance Project Plan
- Coordinated Monitoring Schedule
- TCEQ CRP Data Tool

Reports, Presentations and Meeting Minutes – Basin Highlights Reports and past Steering Committee Meeting agendas and presentations
Links to other CRP Resources – Links to other CRP partners and the TCEQ
CRP Data – Direct link to the searchable database of BRA collected CRP data
Watershed Action Planning – Link to the TCEQ hosted Watershed Action Planning webpage
The most current Basin Summary Report

Reservoirs

Clickable buttons provide information on Possum Kingdom Lake, Lake Granbury, Lake Limestone, Allen's Creek Reservoir (proposed), Federal Reservoirs, and Lake Safety.

Water Levels

Clickable buttons provide information on River and Reservoir Levels, Water Supply and Reservoir Data and River Safety.

News

Information is provided on current BRA news, the BRA newsletters and the BRA News Room.

Education

Information is provided on all things water (Water School), a Speakers Bureau, the Major Rivers Program, and a Resource Library.

Brazos River Basin Highlights Report 2018

Brazos River Authority

THE TEXAS CLEAN RIVERS PROGRAM

TCEQ

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