

BASIN OVERVIEW

The Basin Overview section of this report contains water quality assessment information about each of the classified segments in the Brazos Basin Clean Rivers Program assessment area. It is presented as a result of TCEQ and 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. It is also important to note that although a segment may be identified as having “no known problems” it does not necessarily mean there are no problems, 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 1).

Table 1. Ranking Key

Rank	NS	CS	CN	Description
6	0	0	0	No impairments or concerns.
5	0	1	0	One parameter of concern for screening levels, or
	0	0	1	One parameter of concern for near non-attainment of standard
4	1	0	0	One parameter is impaired, or One parameter of concern for screening levels, or
	0	1+	0	One parameter of concern for near non-attainment of standard, or
	0	0	1+	One parameter of concern for screening levels and one parameter of concern for near non-attainment of standard
	0	1	1	
3	1	0	1	One parameter is impaired and one parameter of concern for near non-attainment of standard, or
	1	1	0	One parameter is impaired and one parameter of concern for screening levels, or
	0	1+	1+	Multiple concerns for screening levels and near non attainment of standards, or
	2	0	0	Two parameters impaired
1+	2+	2+	2+	One or more parameters impaired and multiple concerns

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

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

Salt Fork of the Brazos River (Segment 1238) –



This segment has been listed on the 303(d) List for elevated chloride since the 2002 assessment. The 2006 assessment also indicates a concern for near non attainment of dissolved oxygen (DO) in the portion of the segment near Highway 83. Total Dissolved Solids (TDS) were removed from the 303(d) List in 2006, but will likely return to the list in 2008 because trend analysis indicates increasing concentrations for both chloride and TDS.

White River (Segment 1239) –



This segment has no impairments or concerns.

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 dissolved solids are a result of 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 TDS. Like the Salt Fork of the Brazos River and White River Lake, this segment is impacted by naturally occurring salt deposits that result in non attainment of standards.

Unclassified sub-segment 1241A, the North Fork Double Mountain Fork of the Brazos River, is listed as not supporting for *E. coli* and has a concern for

ammonia, nitrate, and chlorophyll a. The most likely source of bacteria and nitrogen loading in this segment is from point source municipal discharges. The nitrogen loading in this segment in turn is most likely stimulating the algal growth and leading to elevated chlorophyll a levels.

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

Buffalo Creek Reservoir (sub-segment 1241C) is listed as having a concern for chlorophyll a. The most likely cause of excessive algal growth is from nutrient loading from point source municipal discharges and residential runoff.

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

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

Clear Fork of the Brazos River (Segment 1232) –



The Clear Fork is listed as having concerns for nitrate nitrogen and orthophosphate phosphorus for the portion of the segment downstream from the confluence with Deadman Creek. Nutrient concentrations and concerns in the Clear Fork generally are higher near the inflow of Deadman Creek but decrease downstream of the inflow. Deadman Creek is an effluent dominated stream and municipal discharges are most likely the greatest contributor to the nutrient loading in the Clear Fork.

There is also a DO concern in the portion of the segment upstream from the Deadman Creek inflow and is most likely a function of low flows, seasonal ambient air temperatures and high evaporative rates.

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

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

**Hubbard Creek Reservoir (Segment 1233) and
Lake Cisco (Segment 1234) –**

Neither segment is listed for impairments or concerns.



Lake Stamford (Segment 1235) –

Lake Stamford is listed as not supporting for chloride and TDS. Data collected since the 2006 assessment indicate that this segment will likely be fully supporting for chloride and TDS and removed from the 303(d) List in the 2008 assessment. This improvement in water quality data is most likely a result of the increased precipitation in the watershed observed in 2007 that led to a dilution of chloride and TDS concentrations.



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

Neither reservoir is listed for concerns or impairments.



UPPER WATERSHED OF THE BRAZOS RIVER (MAP)

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



Lake Graham (Segment 1231) –

Lake Graham is listed as not supporting for TDS; however, data from the lake indicates a decreasing trend for TDS and the segment is expected to be removed from the 303(d) List during the 2008 assessment. The decline in TDS levels is most likely a result of the above normal precipitation observed in the watershed during in 2007 which had a diluting effect on TDS concentrations.



**Brazos River above Possum Kingdom Reservoir
(Segment 1208) –**

The Brazos River above Possum Kingdom 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 portion of the segment from the confluence with Boggy Creek upstream to the confluence with Spring Creek has a concern for near non-attainment of

bacteria on the 2006 303(d) List and additional data collected since the 2006 assessment indicate the segment will not be supporting for *E. coli* in the 2008 assessment. Elevated levels of bacteria are attributed to general non-point source pollution.

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



Possum Kingdom Lake (Segment 1207) –

PK is a large reservoir that is an important source of drinking water, electric generation, and recreation. The 2006 assessment did not find any impairment 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 elevated chlorides in this segment are a result of the drought conditions observed from 2005 through early 2007 that resulted in chloride levels becoming even more concentrated than normal due to evaporation which reduced water levels while concentrating chlorides in the remaining water. During the drought period, chloride levels in Possum Kingdom Lake reached unprecedented concentrations. Water releases from Possum Kingdom then caused abnormally high chloride levels to be observed downstream of the reservoir.



Lake Palo Pinto (Segment 1230) –

Lake Palo Pinto has no surface water impairments or concerns.



Lake Granbury (Segment 1205) –

Lake Granbury is an important source of drinking water and recreation and is unimpaired. A concern for elevated chlorides, sulfates and TDS has been identified. Like segment 1206, elevated chloride concentrations were a result of the drought. Recent data indicates much lower chloride concentrations and the concern may be removed in the 2008 assessment.

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. This data collection event has identified bacteria impairments in many of these canals and concerns for dissolved oxygen and elevated nutrient levels in a few of the canals. This seems to be a result of the stagnant conditions in the canals because these concerns are not observed in the main body of Lake Granbury. The on-site

sewage facilities located along the many canals and coves of Lake Granbury may be a significant source of bacteria and nutrients to the reservoir, and along with stormwater runoff, may be the cause of water quality concerns in many of the canals. To address the concerns that these canals present, the BRA and TCEQ are currently developing a Watershed Protection Plan (WPP) for Lake Granbury.



Brazos River below Lake Granbury (Segment 1204) –

The Brazos River below Lake Granbury is not listed as impaired or as having concerns.



Paluxy River (Segment 1229) –

The Paluxy River has no water quality impairments or concerns.

Squaw Creek Reservoir (sub-segment 1229A) has concerns for phosphorus. The source of elevated phosphorus in Squaw Creek Reservoir is currently unknown.



Lake Pat Cleburne (Segment 1228) –

Lake Pat Cleburne was not evaluated during the 2006 assessment due to insufficient data. Data collected since the 2006 assessment indicates that it will likely have no concerns or impairments identified during the 2008 assessment.



Nolan River (Segment 1227) –

Nolan River is listed as not supporting for chloride, sulfate, and TDS, and has concerns for fecal coliform bacteria, nitrate and chlorophyll a. Fecal coliform data has not been collected since 2003; the more recent *E. coli* data collected between 2002 and 2007 indicates no concern or impairment for bacteria. Groundwater in the area contains high concentrations of dissolved solids. This brackish ground water is the primary source of water for industrial and municipal uses in this area. After use, this brackish water is passed to the local municipal waste water treatment plants which, are not equipped to remove the dissolved solids. Thus the TDS passes through the wastewater systems and is discharged to the Nolan River. In light of the impact of the groundwater on surface water, the TCEQ is currently reevaluating the chloride, sulfate, and TDS criteria for this segment.



Lake Whitney (Segment 1203) –

Lake Whitney has a concern for nitrate in the Nolan River Arm and a concern for near non-attainment for chloride throughout the reservoir. Potential nonpoint sources of nitrate in the watershed include municipal discharges, on-site sewage facilities and municipal and agricultural runoff.

Like segments 1206 and 1205, the recent drought caused elevated chloride concentrations. Recent data indicates much lower chloride concentrations and the concern may be removed in the 2008 assessment.



Brazos River below Lake Whitney (Segment 1257) –

The Brazos River below Lake Whitney is not listed for any impairments or concerns in the 2006 Assessment.

AQUILLA CREEK WATERSHED (MAP)

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



Aquilla Reservoir (Segment 1254) –

Aquilla Reservoir is the major drinking water source for Hill County. In the past, Aquilla Reservoir had elevated concentrations of Atrazine in its finished drinking water that exceeded the state standard of 3 parts per billion (ppb). In 1998 TCEQ placed Aquilla Reservoir on the 303(d) List of impaired waterbodies. As a result of technical assistance to corn and sorghum producers, using agricultural best management practices, and educating residents, Atrazine concentrations in Aquilla Reservoir declined by 60 percent and the lake was removed from the 303(d) List in 2004. However, this segment is identified as having concerns for Atrazine in drinking water.

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

The Hackberry Creek portion of the segment also 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.



Brazos River/Lake Brazos (Segment 1256) –

The Brazos River/Lake Brazos and the Aquilla Creek sub-segment are not listed for any impairments or concerns in the 2006 assessment.

BOSQUE RIVER WATERSHED (MAP)

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



Upper North Bosque River (Segment 1255) –

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

Goose Branch (Sub-segment 1255A), North Fork Upper North Bosque River (Sub-segment 1255B), and Scarborough Creek (Sub-segment 1255C) – these sub-segments are listed as not supporting for *E. coli* and as having concerns for nutrients and chlorophyll a.

South Fork North Bosque River (Sub-segment 1255D) – this unclassified sub-segment has a concern for chlorophyll a.

Unnamed Tributary to Goose Creek (Sub-segment 1255E), Unnamed Tributary to Scarborough Creek (Sub-segment 1255F), and Woodhollow Branch (Sub-segment 1255G) – these unclassified sub-segments are not supporting for *E. coli*.

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

Goose Branch Reservoir (Sub-segment 1255J) and Scarborough Creek Reservoir (Sub-segment 1255K) – these unclassified sub-segments have concern for phosphorus and chlorophyll a, but were not assessed for *E. coli*.

There is one commonality between the Upper North Bosque River and all the sub-segment streams that may be a significant contributor to their impairments and leads to questions about the appropriateness of monitoring such streams in Texas and the appropriateness of applying water quality standards meant for large river segments to small, ephemeral streams. The Upper North Bosque River and all of these sub-segment streams are small, prairie streams with no flow to low flow for most of the year, so when water is present in these streams, it is a result of storm events. Stormwater is known to accumulate high levels of both bacteria and nutrients as it travels over land. These pollutants are then deposited in the small streams where they can cause impairment and also contribute to other concerns such as excessive algal growth and low DO levels.

Because the streams have little to no consistent flow (e.g. flow contributed by springs or other streams), the stormwater and its associated pollutants tend to stay in the stream and accumulate, where in a larger stream with constant flow the pollutants would be diluted and distributed throughout the stream system.

North Bosque River (Segment 1226) –



The North Bosque River is listed as not supporting for algae and the portion of the river upstream of Hico has concerns for chlorophyll a, phosphorus, and fecal coliform. 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.

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

Green Creek (Sub-segment 1226B) – this unclassified sub-segment is not supporting for DO, concern for chlorophyll a, and near non attainment for *E. coli*.

Indian Creek (Sub-segment 1226E) and Little Duffau Creek (Sub-segment 1226K) – these unclassified sub-segments are not supporting for *E. coli* and have concern for nutrients.

Indian Creek Reservoir (Sub-segment 1226N) – this unclassified sub-segment has concerns for chlorophyll a and nutrients.

Sims Creek Reservoir (Sub-segment 1226O) – this unclassified sub-segment 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 is listed as having a 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.

Tonk Creek (Sub-segment 1246D) – this unclassified sub-segment has a concern for nitrate.

Wasp Creek (Sub-segment 1246E) – this unclassified sub-segment is not supporting for fecal coliform and has a concern for nitrate.



Waco Lake (Segment 1225) -

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

LEON RIVER WATERSHED (MAP)

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



Leon Reservoir (Segment 1224) -

In Eastland County, this 1628 acre reservoir was impounded in 1954. The Leon Reservoir currently has no impairments. There is a concern for manganese in the sediment although there is limited data and it is recommended that additional data be collected prior to the 2008 assessment.



Leon River Below Leon Reservoir (Segment 1223) -

In 2006, the Leon River below Leon Reservoir was placed on the 303(d) List as impaired for recreational use due to elevated bacterial levels with additional concerns for depressed dissolved oxygen and chlorophyll a. Recent data collected support continued listing of this segment for bacteria. It is anticipated that this segment will also be listed as impaired for depressed dissolved oxygen during the 2008 assessment. This segment frequently experiences low water levels which hinder its ability to buffer against high ambient air temperatures in the summer and fall and are the likely cause for depressed dissolved oxygen levels.

Armstrong Creek, an unclassified tributary is also listed as impaired for bacteria.

Both Segment 1223 and Armstrong Creek 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, four tributaries to Lake Proctor possess impairments for bacteria: Duncan Creek, Rush-Copperas Creek,

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

Proctor Lake also has concerns for chlorophyll a with current data suggesting a potential additional concern for nutrient loading.

Leon River Below Proctor Lake (Segment 1221) -



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

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

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

Belton Lake (Segment 1221) -



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

An unclassified tributary to Belton Lake, Cowhouse Creek is impaired for bacteria. Potential sources of bacteria in this stream include: runoff from agricultural land and range land, on-site sewage facilities and municipal discharges.

Leon River Below Belton Lake (Segment 1221) -



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

Nolan Creek/South Nolan Creek (Segment 1221) -



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

LAMPASAS RIVER WATERSHED (MAP)

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

Lampasas River Above Stillhouse Hollow Lake (Segment 1217) -



The portion of Segment 1217 from the crossing of FM 1690 up to the crossing of CR 117 is listed as impaired for bacteria in the 2006 303(d) list. This portion of the river is strongly intermittent and only possesses flowing water immediately following a rain event, which is most likely the source of the bacteria.

The unclassified tributary of North Fork Rocky Creek possesses an impairment for depressed dissolved oxygen. That North Fork Rocky Creek is impaired for DO is not surprising because the creek frequently experiences low water levels which hinder its ability to buffer against high ambient air temperatures in the summer and fall reducing the water's capacity to maintain dissolved oxygen levels.

Stillhouse Hollow Lake (Segment 1216) -



Water quality in Lake Stillhouse Hollow currently meets all water quality standard criteria and nutrient screening levels and has no impairments or concerns at this time. However, Authority staff is becoming increasingly concerned about Trimmer Creek, an unclassified tributary to Stillhouse Hollow Lake. The creek flows through an area experiencing rapid development and appears to be carrying a large sediment load caused by urban runoff to Stillhouse Hollow Lake.

Because there are no State standards for sediment or suspended solids, assessing this issue is difficult but visual observations of the confluence of Trimmier Creek and the lake indicate that the lake is being impacted by the sediment load in the creek.

Lampasas River Below Stillhouse Hollow Lake (Segment 1215) -



The Lampasas River below Stillhouse Hollow Lake is listed as impaired for bacteria in the 2006 303(d) List; however, re-assessment of current data for this segment indicate compliance with TCEQ bacteria standard criteria and it is anticipated that the segment will be removed from the 2008 303(d) List.

Salado Creek (Segment 1243) -



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

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

LITTLE RIVER WATERSHED (MAP)

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

North Fork San Gabriel River (Segment 1251), South Fork San Gabriel River (Segment 1250) and Lake Georgetown (Segment 1249) -



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



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

The San Gabriel/North Fork San Gabriel River is in full support of all of its designated uses and possesses no concerns. However, Authority staff is becoming increasingly concerned about this segment 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. Because there are no 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 in Lake Granger.

Huddleston Branch, an unclassified stream, possesses concerns for nitrate and bacteria. Mankins Branch, a tributary which flows into the San Gabriel River above Lake Granger, is currently identified on the 2006 303(d) list for bacterial impairments. Concerns for elevated nitrate, orthophosphorus and total phosphorus also exist in Mankins Branch. Issues in Mankins Branch are most likely a combination of municipal discharges, on-site sewage facilities and agricultural and urban runoff.



Granger Lake (Segment 1247) -

Lake Granger is in full support of all of its designated uses but a concern for elevated nitrate levels exists. Willis Creek, a tributary to Lake Granger, is currently identified on the 2006 303(d) List for bacterial impairments and recent data continues to support the impairment designation. Data collected also reveal a concern for nitrate. The watershed in the immediate vicinity of both Lake Granger and Willis Creek is highly utilized for agriculture, and runoff from these fields is the most likely source of both bacteria and nutrients into the lake.

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



Brushy Creek (Segment 1244) -

Brushy Creek, from the confluence of Cottonwood Creek to the headwaters of the creek, is currently listed on the 2006 303(d) List for bacteria impairment. Concerns for elevated nutrients including nitrate, orthophosphate and total phosphorus exist in Brushy Creek with two tributaries to Brushy Creek also possessing concerns for nutrients: Brushy Creek above South Brushy Creek and South Brushy Creek. Both elevated bacteria levels and nutrient levels in Brushy

Creek may be attributed to municipal discharges and runoff from residential and agricultural properties.



San Gabriel River (Segment 1214) -

In 2006, the San Gabriel River was listed as impaired for bacteria and sulfate with a concern for nitrate. Data collected since the 2006 assessment continues to support the impairment for bacteria and sulfate in the segment with chloride likely to be added as an impairment during the 2008 assessment. 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 sulfate impairment is currently unknown.



Little River (Segment 1213) -

The Little River is on the 2006 303(d) List for a bacterial impairment. The Little River also possesses a concern for nitrate. The nitrogen concerns are most likely entering the Little River from the San Gabriel River and Brushy Creek which both have nutrient concerns. The bacteria concerns most likely result from runoff from agricultural lands, wildlife waste, and municipal discharges.

CENTRAL WATERSHED (MAP)

The Central Brazos River Watershed drains approximately 2,710 square miles from Lake Brazos Dam in Waco to the mouth of the Navasota River southeast of College Station through Falls, Burleson, Robertson, and portions of McLennan and Brazos Counties. Land usage is primarily agricultural, with two sizeable urban areas, Waco and Bryan/College Station.



Brazos River Above Navasota (Segment 1242) -

The Brazos River above Navasota possesses a bacteria impairment based on the fecal coliform criteria for the 2006 303(d) assessment. Current data collected show no bacterial impairment based on the *E. coli* screening criteria and is expected to be removed from the list during the 2008 assessment.

However, there is a concern for the Public Water Supply use due to the possibility of incurring a higher cost for water treatment in the form of demineralizing the water. If chloride concentrations continue to increase in this segment, there will be a need for more advanced and costlier water treatment. Like the upper basin mainstem segments, the chloride concentrations in Segment 1242 are highly dependent on rainfall patterns in the upper basin. The elevated chlorides in this segment are a result of the drought conditions observed from 2005 through early 2007 that resulted in chloride levels becoming even more concentrated than normal due to evaporation, which reduced water levels while leaving chlorides in the remaining water. During this drought period, chloride levels in Possum Kingdom Lake reached high concentrations never

previously observed in either lake. Water releases from Possum Kingdom then caused abnormally high chloride levels to be observed in the entire main stem. More recent data indicates that the lake has returned to normal concentrations and it is not anticipated that Segment 1242 will be listed in the 2008 assessment.

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

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

NAVASOTA RIVER WATERSHED (MAP)

The Navasota River Watershed drains approximately 2,235 square miles through Limestone, Robertson, Brazos, Grimes and portions of Madison, Leon and Freestone Counties. The main stem of the river is impounded in three places in Limestone County creating Lake Mexia, Lake Springfield and Lake Limestone. Land use in this watershed is primarily agricultural with one growing urban area, Bryan/College Station.



Lake Mexia (Segment 1210) -

Lake Mexia is listed as impaired for elevated levels of bacteria with concerns for chlorophyll a, orthophosphorus and total phosphorus. Current data suggests removal of the bacteria impairment during the 2008 assessment and the addition of a concern for depressed dissolved oxygen. The Navasota above Lake Mexia, which is highly intermittent, is also listed as impaired due to bacteria. Potential sources of bacteria include: on-site sewage facilities, wildlife wastes, and runoff from residential areas and agricultural lands.



Navasota River Below Lake Mexia (Segment 1253) -

There is a water quality impairment for fecal coliform for this segment in the 2006 303(d) assessment. However, fecal coliform data has not been collected since 2003; more recent *E. coli* data collected between 2002 and 2007 indicates no concern or impairment for bacteria and it is anticipated that the bacteria impairment will be removed during the 2008 assessment.

This segment also has a concern for chlorophyll a, from the headwaters of Springfield Lake to the Lake Mexia Dam. The unclassified Springfield Lake is in full support of all of its uses, but there is a concern for elevated levels of chlorophyll a. The cause of elevated chlorophyll a levels is currently unknown, but may be a result of nutrient rich runoff entering the river and lake.



Lake Limestone (Segment 1252) -

This 15,998-acre lake built in 1978 by the Brazos River Authority for water supply possesses concerns for nitrate and atrazine in finished drinking water. However, more recent data does not support these concerns and they are expected to be removed from the 303(d) List during the 2008 assessment.



Navasota River Below Lake Limestone (Segment 1209) -

The Navasota River below Lake Limestone is listed on the 2006 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.

There are nine tributaries and two off-channel city lakes that contribute to this segment with impairments. Country Club and Fin Feather Lake both have impairments for their aquatic use designation due to toxic sediments. Country Club Lake also possesses concerns for phosphates and Fin Feather Lake possesses concerns for arsenic, chromium, and copper in the sediment and nutrients. These impairments are mostly a remnant from historically poor industrial practices.

Carter's Creek, Country Club Branch, Wickson, Cedar, Duck, Gibbons, Shepherd, Steele, and Burton Creeks all have impairments for their recreation use designation due to elevated bacteria levels. Carter's Creek and Burton Creek both have concerns for nutrients, while Cedar, Duck and Shepherd Creeks have concerns for depressed dissolved oxygen.

Carter's Creek and Burton Creek are both strongly influenced by municipal discharges that are most likely the source of both elevated bacteria and nutrients.

Country Club Branch, Wickson, Cedar, Duck, Gibbons, Shepherd, and Steele Creeks all have one commonality that may be a significant contributor to their impairments and leads to questions about the appropriateness of monitoring such streams in Texas. These creeks are small, prairie streams with no flow to low flow for most of the year, so when water is present in these streams it is a result of storm events. Stormwater is known to accumulate high levels of both bacteria and nutrients as it travels over land. These pollutants are then deposited in the small streams where they can cause an impairment and also contribute to other concerns such as excessive algal growth and low DO levels.

Because the streams have little to no consistent flow (e.g. flow contributed by springs), the stormwater and its associated pollutants tend to stay in the stream and accumulate, where in a larger stream with constant flow the pollutants would be diluted and distributed throughout the stream system.

YEGUA CREEK WATERSHED (MAP)

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



Somerville Lake (Segment 1212) -

Somerville Lake is on the 2006 303(d) List as being impaired for high pH levels at the eastern end of the reservoir near the dam. This elevated concentration fails to fully support the general use criteria for this water body. There is also concern for depressed dissolved oxygen levels and increased chlorophyll a concentrations. The extremes in pH are most likely a result of algal activity; the observed high concentrations of chlorophyll a may be a potential cause for fluctuations in pH. Photosynthesis and respiration are two major factors that influence the amounts of carbon dioxide in the lake, which in turn affects pH levels and dissolved oxygen levels.

One tributary to the lake, East Yegua Creek, is on the 2006 303(d) List as impaired for recreational use due to elevated bacteria levels. Sources of bacteria may include municipal discharges and runoff from agricultural lands and wildlife.



Yegua Creek (Segment 1211) -

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

LOWER WATERSHED (MAP)

The Lower Brazos Watershed drains approximately 2,077 square miles through Washington, Grimes, Waller, Austin, Fort Bend, and Brazoria Counties before discharging into the Gulf of Mexico. Land uses include agriculture, oil and gas retrieval, chemical industry, and municipalities. Agricultural interests include row crops such as cotton, corn, and sorghum in the northern counties of the watershed, and rice and sorghum in Brazoria County with cattle and chicken

farming throughout the watershed. Surface mining operations can be found in Grimes County. There is also a concentration of chemical industry activity in Brazoria County. Fort Bend County has experienced an explosion of growth with the sprawl of the Houston metropolitan area.



Brazos River Below Navasota River (Segment 1202) -

The Brazos River Below Navasota River is in full support of all of its designated uses but possesses a concern in the lower portion of the segment for bacteria. However, more recent data does not continue to support the bacteria concern and the concern is expected to be removed from the Texas Water Quality Inventory during the 2008 assessment.

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

The upper portion of Big Creek continues to be non-supporting for contact recreation use due to bacteria and concerns for orthophosphate and chlorophyll a. The bacteria and nutrient concerns in this portion of Big Creek are most likely a result of agricultural and wildlife runoff. Big Creek also 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. This section of the creek is shallow, with muddy bottoms and low sloping banks. There is little variety in this portion of the creek which leads to low diversity in the fish community.

Mill Creek has a concern for an impaired fish community.



Brazos River Tidal (Segment 1201) -

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

UPPER OYSTER CREEK WATERSHED (MAP)

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

Upper Oyster Creek (Segment 1245) -



Upper Oyster Creek was originally listed on the 2000 303(d) List for dissolved oxygen and bacterial impairments and remains on the 2006 303(d) List today. In response to these issues, a total maximum daily load (TMDL) project has been initiated to determine the pollution controls necessary to restore and maintain water quality in Upper Oyster Creek. The TMDL for bacteria was approved by the U.S. Environmental Protection Agency in September 2007 and recommended a 73 percent reduction in bacteria loading in each section to meet the contact recreation use. The next step in the process is for the TCEQ and its stakeholders to develop an implementation plan that will outline the management strategies needed to restore water quality to Upper Oyster Creek. The TCEQ continues to work with stakeholders in developing a TMDL for dissolved oxygen.

Additional concerns that have been identified in Upper Oyster Creek include nitrate and chlorophyll a. The elevated nitrate 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 runoff from urban and residential lands.

Bullhead Bayou and an associated unnamed tributary are also impaired due to elevated bacteria levels.