

2014

Cypress Creek Basin Summary Report

Texas Clean Rivers Program

This report was prepared by Water Monitoring Solutions, Inc. for the Northeast Texas Municipal Water District in cooperation with the Texas Commission on Environmental Quality

Our Mission:

The mission of NETMWD is to protect the water quality in the Cypress Basin and to provide a sufficient supply of water to Northeast Texas.

PO Box 955
Hughes Springs, TX 75656

Phone 903-639-7538
www.netmwd.com



Water Monitoring Solutions.



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Foreword

The Clean Rivers Program (CRP) is a water quality monitoring, assessment, and public outreach program administered by the TCEQ and funded by state collected fees. The Northeast Texas Municipal Water District (NETMWD) coordinates the CRP for the Cypress Creek Basin. As a participant in the Clean Rivers Program, NETMWD submits its Basin Summary Report to the TCEQ and CRP partners.

This report and others submitted throughout the State are used to develop and prioritize programs that will protect the quality of healthy waterbodies and improve the quality of impaired waterbodies. Under the CRP, biologists and field staff collect water quality and biological samples, field parameters and measure flow at sites throughout the Cypress Creek Basin.

Monitoring and analysis are the basis for maintaining good water quality within the Cypress Creek Basin. Within a cooperative program directed by the Northeast Texas Municipal Water District (NETMWD) these activities are an integral part of the State's Clean Rivers Program. Other entities participating in the Cypress Creek Basin Clean Rivers Program include the following:

- Caddo Lake Institute
- U. S. Steel Tubular Products, Inc.
- Northeast Texas Community College
- Luminant
- Pilgrim's Pride Corporation
- AEP SWEPCO
- Titus Co. Fresh Water Supply District #1
- City of Marshall
- Texas Parks and Wildlife Department
- City of Longview
- United States Geological Survey
- Franklin County Water District
- East Texas Baptist University

NETMWD contracts with Water Monitoring Solutions, Inc. to fulfill the sampling and reporting requirements of the CRP.

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Executive Summary

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A comprehensive review of all of the historical data in the TCEQ Surface Water Quality Monitoring Information System (SWQMIS) database for the Cypress Creek Basin was performed. All surface water quality data, spanning over forty-five years in some segments, were reviewed and evaluated. Trend analyses were performed on stations with at least ten years of regular sampling and with a minimum of twenty to thirty data points. No trends that met the criteria for statistical significance were observed in the Little Cypress Creek or Black Cypress Creek watersheds indicating that water quality has remained relatively stable over the period of record. Most of the water quality trends were discovered in Big Cypress Creek and its impoundments beginning in Lake Cypress Springs and Lake Bob Sandlin and ending in the headwaters of Caddo Lake.

Three main statistical trends were observed through these analyses:

- Increasing trends for specific conductance/TDS throughout the Big Cypress Creek watershed
- Increasing trends for pH in Big Cypress Creek below Lake Bob Sandlin
- Increasing trends for Phosphorus in Big Cypress Creek below Lake Bob Sandlin and corresponding increasing chlorophyll *a* trends in Lake O' the Pines

Lake Bob Sandlin plays a key role in the hydrology of the Big Cypress Creek watershed. An area of interest in this report is the

relationship between annual rainfall, releases from Lake Bob Sandlin, and their effects on the water quality. The historical average rainfall over the past 35 years at Lake Bob Sandlin was 51.8 inches, but annual rainfall for the past four years (2010 - 2013) has averaged only 38.5 inches. The region experienced two extensive droughts over the past decade. Four of the six driest years on record occurred in 2005, 2006, 2010 and 2011.

Releases from Lake Bob Sandlin occur primarily to maintain freeboard at the dam. There are no in-stream flow requirements meaning that there are no releases required to supplement flow during periods of drought. Releases have occurred from Lake Bob Sandlin every year from 1979 through 2004. During that period, the average annual releases were slightly over 100,000 acre-feet. From 2005 – 2013, the average annual releases were 43,500 acre-feet with the bulk of those releases occurring in 2009. There were no releases in 2005 through 2007 and none since April 2010.

During periods of drought or low flow, Segment 0404 becomes dominated by treated municipal and industrial effluent due to the lack of or limited releases of freshwater from Lake Bob Sandlin. Wastewater effluents tend to have higher conductivity, TDS and nutrients than ambient stream conditions. These parameters exhibited statistically significant increasing trends in the Big Cypress Creek watershed below Lake Bob Sandlin and into Lake O' the Pines.

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Nutrient enrichment leads to higher primary productivity which is measured using chlorophyll *a*. The increasing phosphorus trends in Big Cypress Creek at stations 13631 (US 259) and 10308 (SH 11) have resulted in increasing trends for chlorophyll *a* in Lake O' the Pines at the dam. As primary producers consume the available carbon dioxide in the water column through the process of photosynthesis, carbonic acid is reduced, resulting in higher pH as exhibited in Big Cypress Creek below Lake Bob Sandlin (Segment 0404).

The 2012 Texas §303(d) List currently identifies fifteen segments and sub-segments, or unclassified water bodies in the Cypress Creek Basin that are non-supporting of water quality criteria for one or more parameters. The routinely identified non-supporting parameters are dissolved oxygen, pH, *E. coli*, and Mercury in fish tissue. The 2012 Texas Integrated Report includes nutrients and chlorophyll *a* as water quality concerns in the basin. A comparison of the 2012 Texas Integrated Report impairments and concerns was made to the historical data available in SWQMIS. The review of the data supported most of the current impairment concerns and listings in the assessment.

Most stream reaches approaching Caddo Lake are wetland habitat where the water bodies are characterized by low DO and low pH due to shallow depths, low flow, little mixing and elevated temperatures. Despite their inability to meet stream criteria in many of these reaches, most stream segments tend to support diverse biota.

Mercury in fish tissue data showed that mercury was detectable in

fish collected throughout the entire basin regardless of species or trophic level, and that the highest concentrations were found in fish obtained from Caddo Lake, Pruitt Lake and Lake Daingerfield. PCBs were detected in fish tissue sampled from Ellison Creek Reservoir. The Department of State Health Services has issued fish consumption advisories for these lakes and reservoirs.

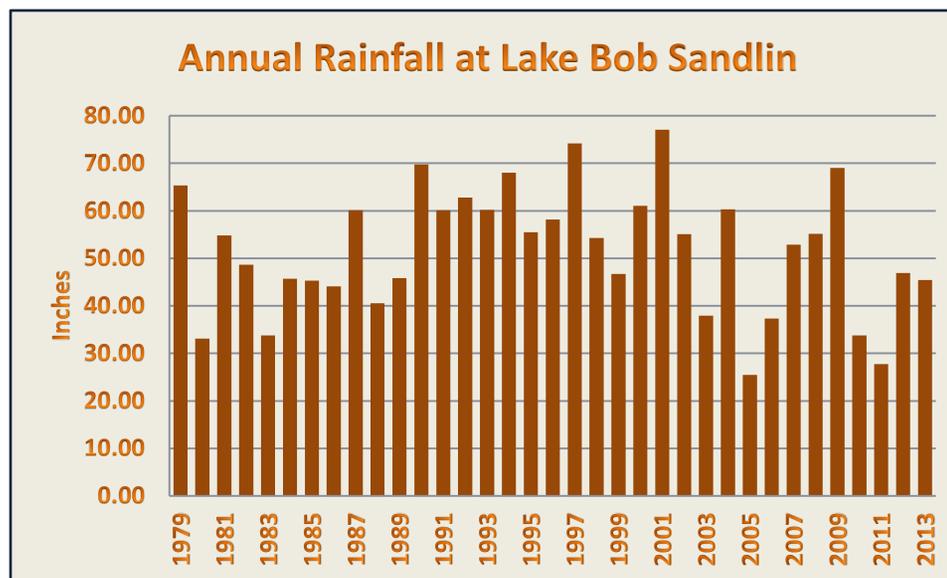


Figure ES-1: Annual precipitation at Lake Bob Sandlin 1979 - 2013

A review of the biological assessments conducted by CRP from 2001 to 2012 indicated that fish populations tended to score in the High category of the Index of Biotic Integrity (IBI) in all segments sampled. The results of benthic sampling and habitat assessments tend to score in the Intermediate/High range for both Rapid

Bioassessment (RBA) and Habitat Quality Index (HQI). Most segments tended to support diverse fish and benthic populations with over eighty fish and 285 benthic taxa collected.

Summary and Recommendations

The eutrophication process appears to be occurring throughout much of the Big Cypress Creek watershed. This is evidenced by the increasing pH trends in Big Cypress Creek below Lake Bob Sandlin. This is further evidenced by the increasing nutrient trends in Segment 0404 followed by increasing chlorophyll *a* trends in Lake O’ the Pines.

In addition, elevated *E. coli* in Segment 0404 and Little Cypress Creek indicates

possible impacts from non-point sources and/or improperly treated effluents. Preliminary results of the Comprehensive RUAA performed in Segment 0404, 0404B, and 0404C found no evidence of primary contact recreation occurring within the study area. A Comprehensive RUAA should be considered in the other segments with *E. coli* listings to determine whether

primary or secondary contact recreation is occurring in the segment.

A stream is defined as “Intermittent” if the stream has a period of zero flow for at least one week during most years. A stream defined as “Intermittent with Perennial Pools” is an intermittent stream that maintains persistent pools even when flow in the stream is less than 0.1 cfs. A change in the classification of Black Bayou and James’

Bayou from “Perennial” to “Intermittent with Perennial Pools” was approved by the EPA. However, despite these changes, the Aquatic Life Use classification for these streams remains high meaning the same level of biological and habitat diversity should still be observed.

Although low dissolved oxygen concentrations in the

summer and low pH often naturally occur in East Texas,

these issues are exacerbated through additional nutrient inputs. Efforts to reduce nutrient loadings through the implementation of BMPs, such as those used in the Lake O’ the Pines Total Maximum Daily Load (TMDL), should be considered across the Cypress Creek Basin.

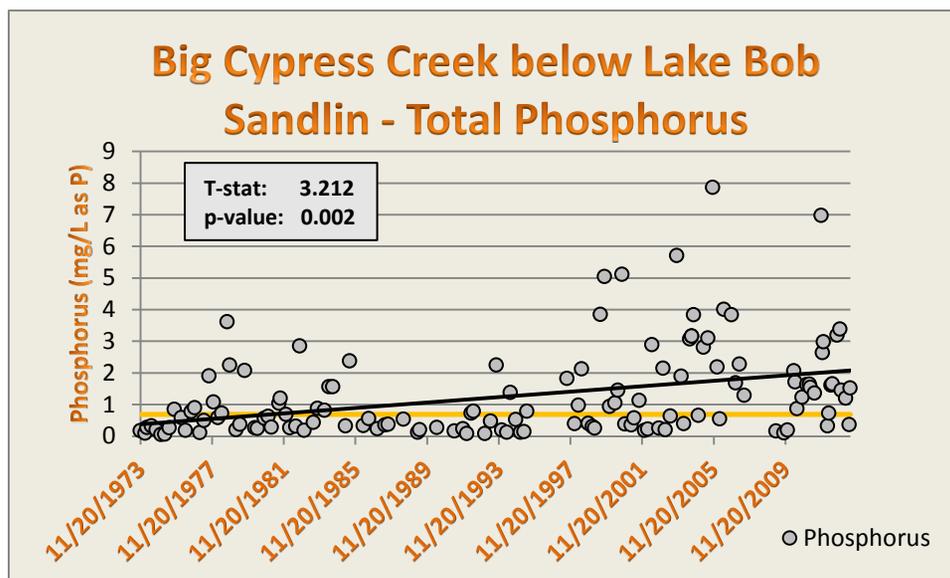


Figure ES-2: Total Phosphorus levels are gradually increasing over time. The orange line shows the screening level while the black line is the overall trend of the values.

Introduction

A Basin Summary Report is a requirement of the Clean Rivers Program (CRP) every five years. The purpose of the report is to provide a comprehensive review of water quality conditions, significant trends, and issues throughout the Cypress Creek Basin.

The objectives of this report are to:

- Identify and locate water quality issues
- Determine significant water quality trends
- Compare the 2012 *Texas Integrated Report* to historical data
- Examine the effects of water quality impairments on the biota

The Cypress Creek Basin

All of the land area within the Cypress Creek Basin drains primarily from the northwest to the southeast and eventually feeds into Caddo Lake (Figure I-1). Starting from the top of the basin, note that before entering Caddo Lake, some surface water first enters from smaller sub-watersheds through tributaries, or streams. The major tributaries that drain into Caddo Lake include Big Cypress Creek, Little Cypress Creek, James Bayou, Harrison Bayou, Kitchen Creek, and Black Cypress Bayou. The 6,000 square mile Cypress Creek Watershed extends upstream from Caddo Lake at the Texas-Louisiana state line, to the westernmost extreme of the Cypress Creek Basin in Hopkins County.

This watershed, which includes several reservoirs, is formed in the southern part of Hopkins and Franklin Counties and flows eastwardly into Camp, Titus, Morris, Marion, and Harrison Counties.

Big Cypress Creek is the boundary between Camp and Titus, Camp and Morris, and Morris and Upshur counties. Big Cypress Creek above Lake O' the Pines is intermittent in its headwaters. The stream runs through flat to rolling terrain surfaced by sandy and clay loams that support water-tolerant hardwoods, conifers, and grasses. Big Cypress Bayou flows into Caddo Lake through a jungle-like bottomland where cypress trees are common.

There are nine designated segments with 41 sub-segments within the Cypress Creek Basin. The 2012 §303(d) List currently identifies fourteen unclassified water bodies that are non-supporting of water quality criteria for one or more parameters. Table 1 details the parameters of concern.

Common Parameters of Concern

In the segment narratives that follow, the types of pollutants that are routinely identified as concerns in the Cypress Creek Basin are low dissolved oxygen, low pH, bacteria, and mercury in edible fish tissue.

E. coli bacteria are indicators of recent input of fecal matter that may contain pathogens harmful to human health. People should not swim in waters with high bacterial counts since they may come in contact with or ingest these pathogens. All warm blooded animals contain *E. coli* in their fecal matter. Common sources of fecal bacteria include improperly treated effluent, malfunctioning septic systems, livestock and wildlife.

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Bioaccumulation of mercury in the edible tissues of many fish species to the point of becoming a human health concern has prompted the Department of State Health Services (DSHS) to issue fish consumption advisories around the basin. Mercury in edible fish tissue is occurring in basins throughout the eastern half of Texas.

Nutrients (ammonia-nitrogen, nitrate-nitrogen, orthophosphorus and total phosphorus) are essential for life. However, elevated concentrations of nutrients can cause excessive growth in aquatic plants and may lead to algal blooms. Bloom conditions may cause low dissolved oxygen concentrations, fish kills, and decreased species diversity within a water body. The main sources of nutrient pollution within the basin are improperly treated effluent, malfunctioning septic systems, and agricultural non-point sources. Some nutrient loading may also be naturally occurring through biotic decomposition.

Many East Texas waters have a naturally low pH and limited buffering capacity (alkalinity). The pH can also be reduced by acidic industrial run-off or discharges and acid rain. The long-term effect of low pH on the ecology and biota of the watershed is currently undetermined.



Figure 1: Caddo Lake at Turtle Shell
west view

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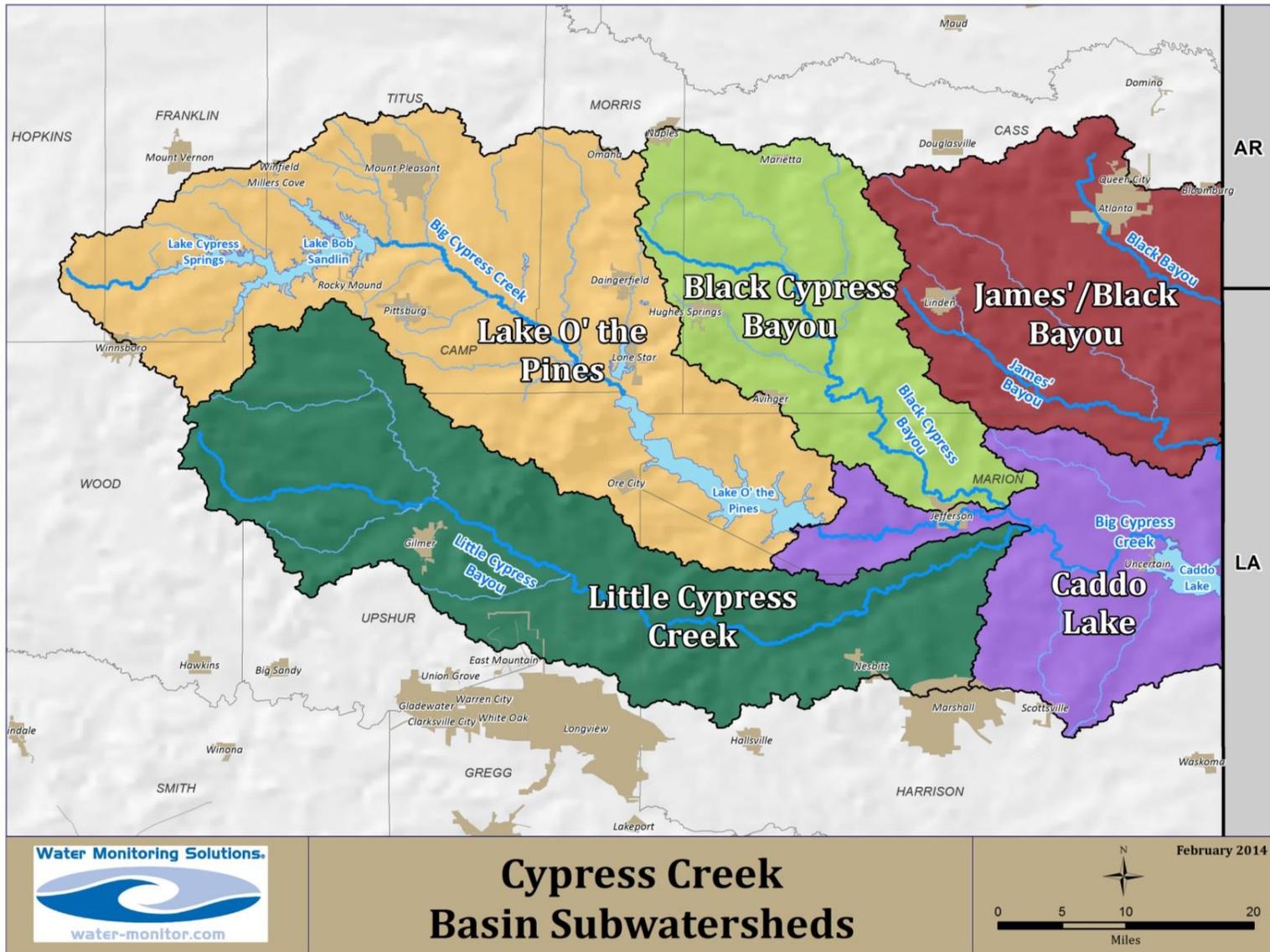


Figure 2: The Cypress Creek Basin is composed of the five main watersheds shown above

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Table 1: Parameters as listed in the 2012 §303(d) List for the Cypress Creek Basin

Segment	Description	Parameter
0401	Caddo Lake	Low DO, Low pH, Mercury in Tissue
0401A	Harrison Bayou	Low DO
0402	Big Cypress Bayou below Lake O' the Pines	Low DO, Low pH Mercury in Tissue
0402A	Black Cypress Bayou	Low DO, <i>E. coli</i> , Mercury in Tissue
0404	Big Cypress Creek below Lake Bob Sandlin	<i>E. coli</i>
0403	Lake O' the Pines	Low DO
0404A	Ellison Creek Reservoir	PCBs in Tissue, Sediment Toxicity
0404B	Tankersley Creek	<i>E. coli</i>
0404C	Hart Creek	<i>E. coli</i>
0404N	Lake Daingerfield	Mercury in Tissue
0405	Lake Cypress Springs	Low pH
0406	Black Bayou	Low DO <i>E. coli</i>
0407	James' Bayou	Low DO, Low pH, <i>E. coli</i>
0409	Little Cypress Bayou (Creek)	Low DO, <i>E. coli</i>
0409B	South Lilly Creek	<i>E. coli</i>

Rainfall and Releases

The uppermost reservoirs in the watershed are Lake Cypress Springs and Lake Monticello. Water from both reservoirs is released directly into Lake Bob Sandlin. The Titus County Freshwater Supply District Number 1 has recorded daily rainfall and releases from Lake Bob Sandlin since 1979 (Figure 2).

Lake Bob Sandlin plays a key role in the hydrology of the Big Cypress Creek watershed (Segment 0404). An area of interest in this report is the relationship between annual rainfall, releases from Lake Bob Sandlin, and their effects on the water quality of Big Cypress Creek and Lake O' the Pines. The average recorded rainfall over the past 35 years at Lake Bob Sandlin was 51.8 inches, but annual rainfall for the past four years (2010 - 2013) has averaged only 38.5 inches. The region experienced two extensive droughts during the past decade. Four of the six driest years of this 35-year period occurred in 2005, 2006, 2010 and 2011.

Lake Bob Sandlin reached conservation level in 1978 and began releasing water in 1979. Water is released primarily to maintain

freeboard at the dam. There are no in-stream flow requirements meaning that there are no releases required to supplement flow during periods of drought. Water was released from Lake Bob Sandlin every year from 1979 through 2004. During that period, the average releases were slightly over 100,000 acre-feet per year. From

2005 – 2013, the average annual releases were 43,500 acre-feet with the bulk of that volume occurring in 2009 at 232,000 acre-feet. There were no releases in 2005 through 2007 and no water was released between April 2010 and December 2013.

During periods of drought or low flow, Segment 0404 becomes dominated by treated municipal and industrial effluent due to the lack of (or limited) releases of freshwater from Lake Bob

Sandlin. Wastewater effluents tend to have higher conductivity, Total Dissolved Solids and nutrients than natural stream conditions. These parameters exhibited statistically significant increasing trends along with water quality concerns and impairments throughout the much of the basin.

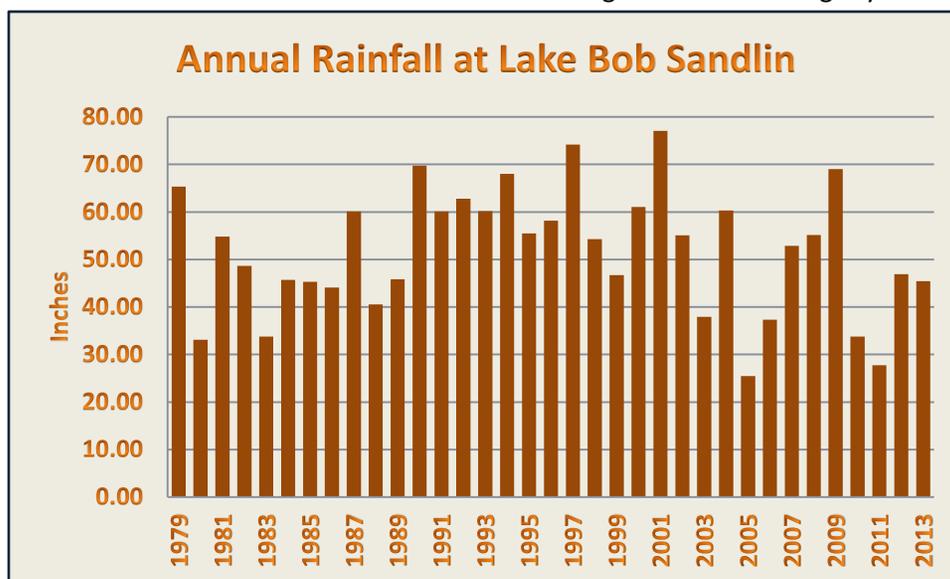


Figure 3: Annual precipitation at Lake Bob Sandlin 1979 - 2013

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The 2014 Cypress Creek Basin Summary Report is divided into three main chapters:

- Trends
- Segment Review
- Biological

In the Trends chapter, statistically significant trends are identified using historical data from routine monitoring stations that had a minimum of ten years of sample history with at least twenty to thirty data points. In the Segment Review chapter, the historical data are compared to concerns and impairments listed in the *2012 Integrated Report*. Toxins in fish tissue and the results of biological assessments are discussed in the Biological chapter of the report.

Only the surface sample data, typically collected at 0.3 meters, were evaluated and used for trend analyses and for the segment review.



Figure 4: This tree on Black Bayou shows the effects of beavers in the watershed. Behind the tree are a pile of trees washed down by flooding and inhabited by beavers.

Trends

All data used for trend analyses were obtained from the Surface Water Quality Monitoring Information System (SWQMIS). Basin-wide trends are discussed at the end of this section.

Analyses of Trends

Trend analyses for this report were conducted by following the TCEQ CRP guidance document for fiscal years 2014 - 2015. Trend analyses were then conducted on stations with significant historical data. Where appropriate, the trends were compared among stations within a segment and between segments.

A comprehensive review of all of the historical records for the basin was performed. Water quality sampling began over 45 years ago on some segments. All surface water quality data were reviewed and evaluated for the entire Cypress Creek Basin.

Trend analyses were conducted at stations with at least ten years of historical data, had regular sampling, and twenty to thirty data points. Relatively few stations in the Cypress Creek Basin had enough historical data for long-term trend analyses. Also note that in some cases, trend analyses were not conducted on the entire historical record so that data from two or more stations within a segment could be compared across a similar date range.

Trends were calculated using a linear regression with a ninety percent confidence interval. A trend was identified as statistically significant when meeting two criteria: the T-stat value was greater than the absolute value of two, and the p-value was less than 0.1. When determined applicable, contributing factors such as flow, flow severity, recent significant rain events, and other parameters were reviewed for anomalies or to determine the possibility of targeted

sampling and its impact on the trend. In these cases, trends that did not pass these evaluations were not included in this section.

Non-Detectable Results and Data Discrepancies

Data are reported as non-detectable when a sample result is below the detection limit of the laboratory instrumentation or method used in the analysis of the parameter. Data reported as “less than” quantitation limits are considered “censored data”. For the purposes of trend analyses, all non-detectable values were reduced to one half of the lowest detected value. This approach to non-detectable results assumes that the actual value lies somewhere between zero and the method detection limit. In all cases where the results were reported at or above the detection limit, the values were left unchanged. No trend analyses were performed on data sets with more than 50% of the results less than detectable limits.

It should also be noted that when comparing laboratory results with varying detection limits, the reliability of the data can be impacted, especially in situations where the method detection limit is at or near the screening level or criterion for the parameter of concern. Subtle variations in laboratory methodologies are another possible source of error. Unless the datum was remarked or guidance was provided by TCEQ, all data used for trend analyses were assumed to be valid and accurate.

Basin Trends Overview

Trend analyses on the Cypress Creek Basin were completed for the following parameters: Specific Conductance/TDS, Dissolved Oxygen, pH, Secchi (Transparency), Chlorophyll *a*, and Nutrients (ammonia-nitrogen, nitrate-nitrogen, orthophosphorus and total phosphorus). Only stations with parameters that had statistically significant trends are discussed in this report.

Table T-2 illustrates the overall results for the trend analyses of the

Cypress Creek Basin. Lake Cypress Springs, in southern Franklin County, is the farthest upstream segment in the basin. Both stations on Lake Cypress Springs showed an increasing trend for specific conductance/TDS. Water is released from Lake Cypress Springs and Lake Monticello into Lake Bob Sandlin. Only station 16158 at the mid-lake location had enough data to perform trend analyses. Specific conductance/TDS is increasing significantly at this station.

Water released from Lake Bob Sandlin flows into Segment 0404 (Big Cypress Creek) and flows past station 10308 at SH 11 and station 13631 at US 259 before entering Lake O' the Pines. Both stations had increasing trends for total phosphorus and orthophosphorus. Station 10308, in the upper part of the segment, also had increasing trends for specific conductance and pH. Segment 0404 is the only segment in the basin with increasing trends for phosphorus. There were no trends found in any segment for the other nutrients.

The farthest upstream site in Segment 0403 (Lake O' the Pines) is station 10300, about one km south of US 259. This station is located in a transitional zone and has a wide and braided channel.

Figure 5: Caddo Lake at Turtle Shell facing east, taken 10/10/2013 with floating, invasive aquatic vegetation.



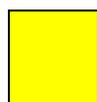
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Table 2: Overview of trends in the Cypress Creek Basin

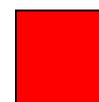
Segment Name	Segment Number	Station ID	Parameters					Total Phosphorus
			Sp Cond/ TDS	DO	pH	Secchi	Chlorophyll <i>a</i>	
Lake Cypress Springs	0405	10313	↑					
		10312	↑					
Lake Bob Sandlin	0408	16158	↑					
Big Cypress Creek Below Lake Bob Sandlin	0404	10308	↑		↑			↑
		13631						↑
Lake O' the Pines	0403	10300				↓		
		10297						
		16156	↑					
		10296	↑				↑	
Big Cypress Creek Below Lake O' the Pines	0402	15511			↑			
		10295	↑					
Caddo Lake	0401	15249	↑					
James' Bayou	0407	10321						
Black Bayou	0406	10314	↓	↓	↓			



No Concern



Concern



Not supporting

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A transition zone is a reach where the habitat and stream morphology changes from stream to reservoir conditions. There is a decreasing trend for Secchi depth (Transparency) at this station which is typical of waters that are heavily vegetated and actively productive at the basic trophic levels of the ecosystem. Station 10296 (closest to the dam) had increasing trends for specific conductance/TDS and chlorophyll *a*.

Segment 0402 is Big Cypress Creek (Bayou) below Lake O' the Pines and two stations had significant trends in this segment. Station 15511 at US 59 showed an increasing trend for pH. Specific conductance/TDS was also significantly increasing at the most downstream site (10295) at SH 43.

Black Cypress Bayou, a major tributary to Big Cypress Creek (Bayou) below Lake O' the Pines, discharges into Big Cypress Creek east of Jefferson. Water quality on Black Cypress Bayou has remained consistent throughout the period of record and no trends were observed for this segment.

Segment 0409 Little Cypress Creek (Bayou) flows from Wood County west to Marion County before its confluence with Big Cypress Creek (Bayou). Over the past forty years, the Little Cypress Creek (Bayou) watershed was regularly sampled at two locations: upstream at US 259 and downstream at US 59. No trends were identified for either station indicating stable water quality conditions throughout the period of record.

Big Cypress Creek flows into Segment 0401 (Caddo Lake), located on the Texas-Louisiana border. Station 15249, located near the "turtle shell" near Uncertain, was the only location with any significant

trends in this segment. Specific conductance was also increasing at this station.

Station 10314, located in Black Bayou at Cass CR 4659, approximately 1.3 miles east of the Louisiana state border was the only station with significant trends in this segment. There were decreasing trends for specific conductance/TDS, DO, and pH. The decreasing trend for DO is likely due to low flow conditions regularly encountered while monitoring this station. This is discussed further in the Assessment Section of this report.

The James' Bayou watershed is bordered on the east by the Louisiana and Arkansas State borders and on the west by Black Cypress watershed. Two stations in this segment had sufficient data for trend analyses. There were no significant trends discovered at station 10259 (Frazier Creek at US 59), or at station 10321 (James' Bayou at Cass CR 1775).

Trend Observations

The results of trend analyses were similar to those discussed in the 2009 Cypress Creek Basin Summary Report. As in 2009, the vast majority of the trends were for Specific Conductance and/or TDS. In 2009, almost 40 percent of the 31 significant trends found were for Conductance/TDS. Nine of the seventeen trends discovered for this report were for Conductance/TDS.

Specific Conductance/TDS is Increasing Significantly throughout the Cypress Creek Basin

Twelve sites in the basin had significant trends. Out of those stations, eight sites had a statistically significant increasing trend for specific conductance and Total Dissolved Solids (TDS). Trends for specific conductance and TDS were combined since they are directly related. As the concentration of dissolved solids increases, this causes the conductance of water to rise.

As discussed in the introduction, the average annual releases from Lake Bob Sandlin and average annual rainfall during the present decade have been much lower than in the 1990's. Due to low rainfall

combined with limited releases, Segment 0404 of Big Cypress Creek has become more effluent dominated than in previous decades.

Specific conductance is often increased by wastewater discharges. Reduced instream flows and high evaporation rates during periods of drought also contribute to the increase in dissolved solids (as demonstrated in Lake Cypress Springs, Lake Bob Sandlin and Lake O' the Pines). An increase in specific conductance is of interest because

Big Cypress Creek and its impoundments serve as municipal and industrial water supplies. High TDS can increase water treatment costs as well as interfere with industrial processes.

pH is Significantly Increasing below Lake Bob Sandlin

Much of the Cypress Creek Basin tends to have low pH due to the acidic composition

of the soils in the watershed. There were significant

increasing trends for pH at the stations below the reservoirs in Segments 0402 and 0404. The increase in pH in the lower portion of the basin is interesting since Segment 0402 is in the 2012 Texas Integrated Report for low pH values. Also of note, while there is a concern for low pH in much of Caddo Lake, most samples collected in

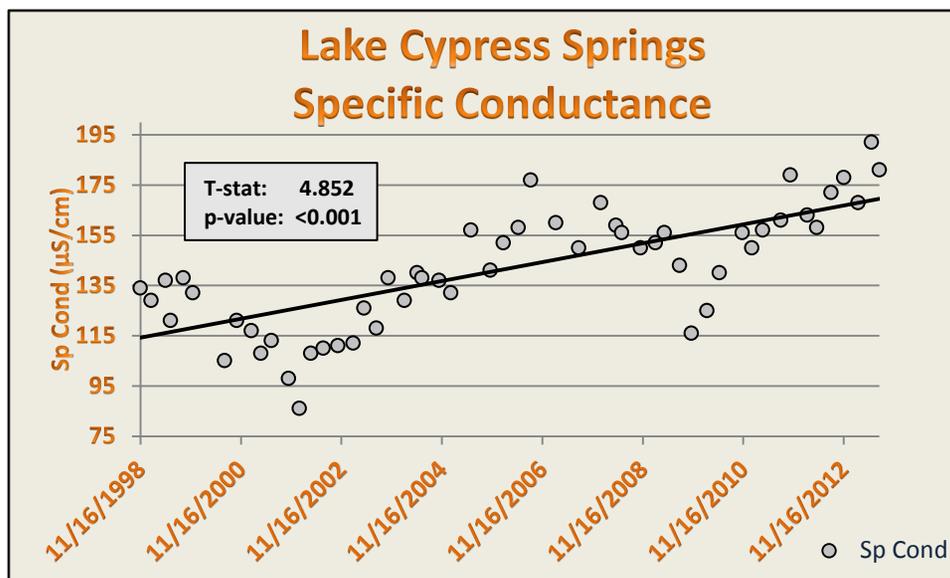


Figure 6: This graph illustrates a statistically significantly increasing trend for specific conductance.

Segments 0401 and 0402 have met the criterion over the past few years.

The increasing pH trend below Lake Bob Sandlin is of interest since it may serve as an indicator of eutrophication. Nutrient enrichment leads to increased primary productivity. During the process of photosynthesis, carbonic acid is reduced, thereby increasing the pH of the water column. Since most pH grab samples are collected during the mid-day hours, the peak hours for photosynthesis, pH readings will tend to be near their highest. Therefore, the increasing pH trend at this station coupled with the increasing trend for phosphorus, serves as a possible indicator of eutrophication. Diel monitoring should be performed to determine if the pH trend is being caused by nutrient enrichment or if it is naturally occurring.

Increasing Nutrients in Big Cypress Creek lead to Increasing Chlorophyll *a* in Lake O' the Pines

Segment 0404 historical data continued to show a significant increasing trend for phosphorus at station 10308 (Big Cypress Creek at Hwy 11) and at station 13631 (Big Cypress Creek at US 259). The nutrient enriched water flows into Lake O' the Pines resulting in increased primary productivity. Chlorophyll *a* has also continued to increase significantly at the dam station in Lake O' the Pines as a result of the high nutrient loads being transported in Segment 0404. High concentrations of nutrients may lead to excessive algal growth, which in turn, can cause taste and odor problems in drinking water and may lead to fish kills.

Increases in chlorophyll *a* in the lower portion of the reservoir is notable since an increase in chlorophyll *a* normally results in wider

daily ranges of DO and pH. At present, neither parameter has been significantly impacted at station 10296; however, this trend provides evidence that confirms the findings of the TMDL study. Phosphorus loading into Lake O' the Pines is providing the precursors for increased phytoplankton productivity in the lake which may result in lower night-time dissolved oxygen concentrations in the future.

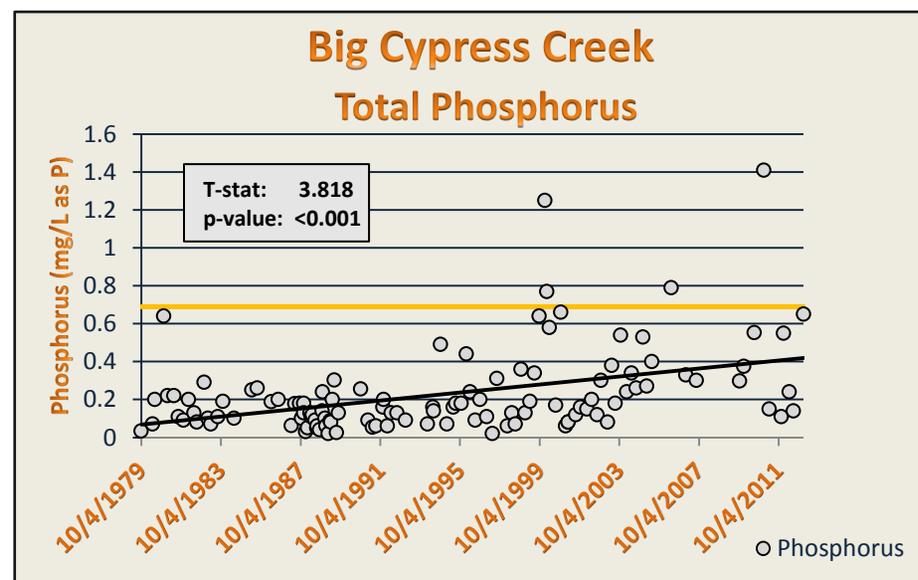


Figure 7: This graph illustrates a statistically significantly increasing trend for total phosphorus in Big Cypress Creek at US 259. The orange line shows the state screening level.

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Figure 8: Cypress Creek Basin CRP monitoring sites for FY 2014

Assessment

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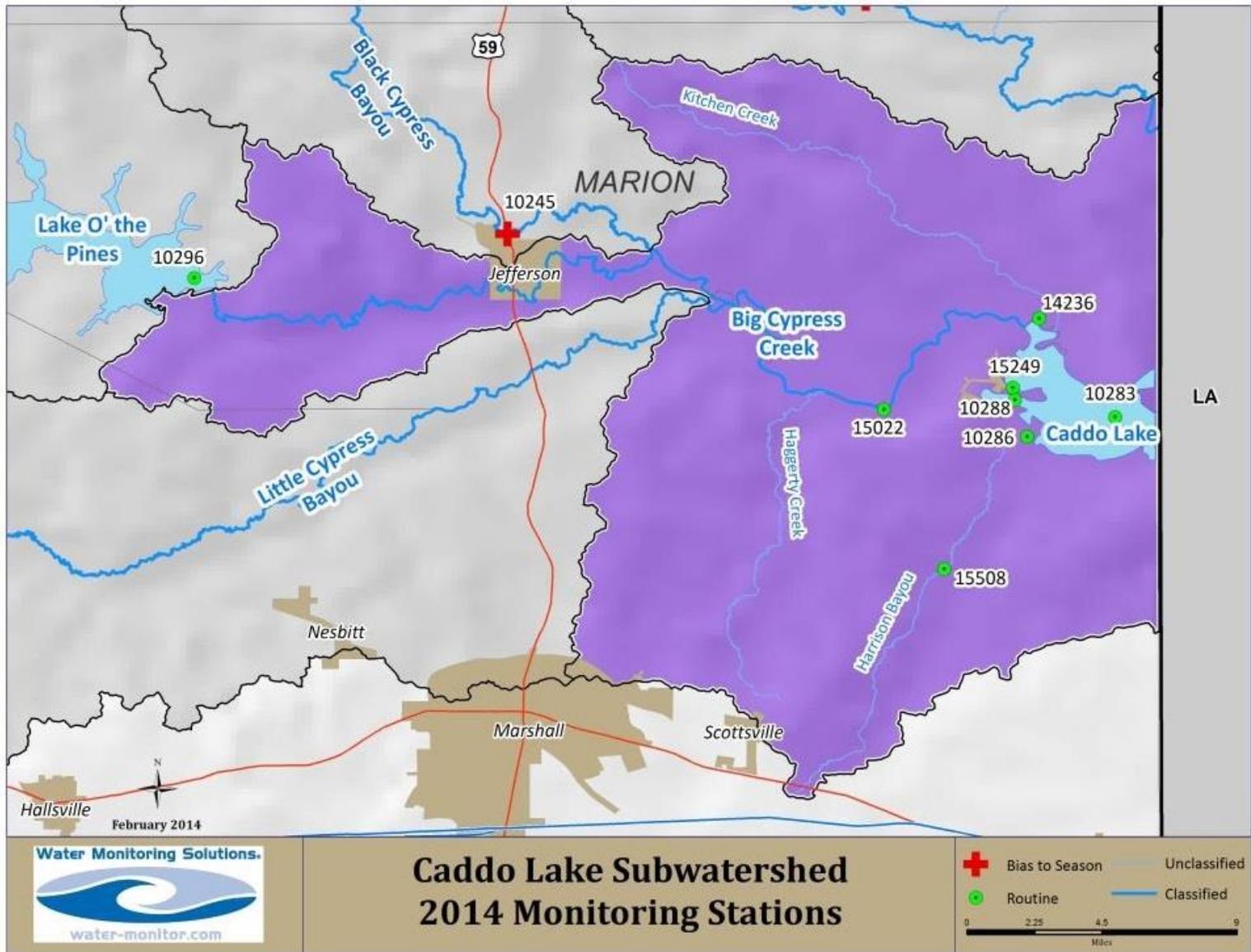


Figure 9: Caddo Lake watershed

Segment 0401 - Caddo Lake

The Caddo Lake Watershed covers approximately 330 square miles and includes Caddo Lake and the segment of Big Cypress Creek below Lake O' the Pines Ferrell's Bridge Dam (the downstream boundary of Segment 0402). The Caddo Lake Watershed Protection Plan, initiated in 2006, is a project designed to protect the water quality and aquatic life of Caddo Lake. With assistance from federal, state and local organizations, this effort is being lead by basin stakeholders, with the Northeast Texas Municipal Water District selected as watershed coordinator. The current issues identified include management of aquatic vegetation, pollution affecting water quality, threats to habitats and floodplain management, and instream flows to promote and maintain habitat.

Caddo Lake Watershed Protection Plan

The development of a Watershed Protection Plan (WPP) is an alternative to the TMDL process for solving water quality issues. The WPP is a strategic plan for management, monitoring, and protection of Caddo Lake designed to help minimize pollutants in this watershed. The focus of this effort is to protect the water quality and aquatic life of Caddo Lake. The key to attaining this goal is the identification of contamination sources and the creation of workable voluntary management practices.

Stakeholder and workgroup meetings were held to inform stakeholders on progress and to solicit input on basin and lake conditions. Their valuable input was incorporated into the water quality modeling efforts. The main interests for Caddo Lake were management of invasive aquatic vegetation, the restoration of water quality, and water availability. In 2008, a comprehensive data analysis was completed which lead to the identification of nutrients and bacteria as primary water quality issues that could be

Table 3: Segment 0401 water quality impairments and concerns

AUID	Description	DO, 24HR Avg.	DO, 24HR Min	DO, Grab Min	Low pH	E. coli	NH3	Metals in Sediment	Mercury in Fish Tissue
01	Lower 5000 Acres							CS	NS
02	Harrison Bayou Arm	NS	NS	NS					NS
03	Goose Prairie Arm			NS	NS				NS
05	Clinton Lake	NS	NS	NS			CS		NS
07	Mid-lake (Turtle Shell) near Uncertain	NS	NS	NS				CS	NS
0401A	Harrison Bayou	NS	NS	NS		CN			

AUID = Assessment Unit ID; NS = Non-supporting; CS = Concern for Screening Level; CN = Concern for Near Non-attainment

addressed through the WPP process. An intensive watershed and lake water quality modeling project was begun to evaluate existing conditions and future management measures that can address these matters.

Three workgroups were formed and each workgroup identified its main area of interest. These workgroups addressed stakeholders concerns to develop the Caddo Lake WPP. Stakeholder recommendations were integrated into a comprehensive WPP for Caddo Lake. In addition, outreach and education activities designed to promote participation in the current effort to develop the plan were being conducted.

The Physical Concerns Workgroup raised funds for the Giant Salvinia Rapid Response plan, developed and distributed an invasive aquatic plant identification guide specific to Caddo Lake, and held a clean-up day at Caddo Lake. The group helped develop an Aquatic Vegetation Management Plan for Caddo Lake that is updated by Texas Parks and Wildlife Department (TPWD) annually. The Cypress Valley Navigation District has implemented the TPWD Aquatic Vegetation Management Plan.

Since inception of this project, several special studies were performed to help with the development of the WPP: the Caddo Lake Water and Nutrient Budget Study and the Caddo Lake Watershed Sediment Study were completed 2006 - 2007. In 2009, TCEQ conducted additional lake sediment sampling to characterize nutrient conditions in Caddo Lake. Also in 2009, the depth of the lake was mapped in remote or uncharted areas. At the same time, properties of rooted lake vegetation were measured. These studies will help characterize flow patterns throughout the lake as well as water quality conditions.

Caddo Lake is listed in the 2012 §303(d) List for low pH, low dissolved oxygen and Mercury in fish tissue. In the 2012 Integrated Report, Segment 0401 was identified for not supporting water quality criteria for having low pH and depressed 24-Hour DO

Average concentrations. The mid-lake “Turtle Shell” station 15249 near Uncertain and the areas of Harrison Bayou and Clinton Lake are listed for having low dissolved oxygen; the Goose Prairie arm is listed for having low pH and low dissolved oxygen. There are concerns about high concentrations of manganese in sediments in the lower 5,000 acres

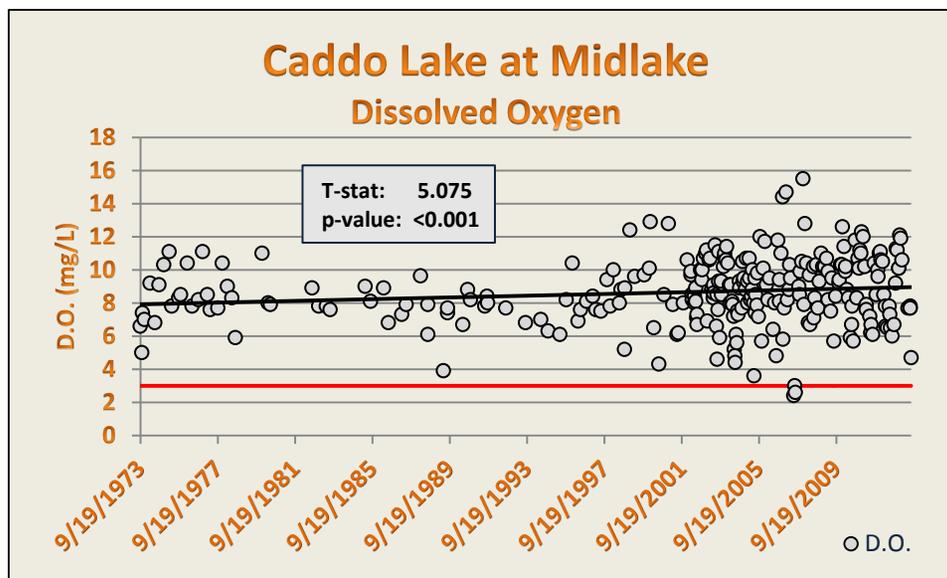


Figure 10: Dissolved Oxygen grab samples results are illustrated in this graph. There are 271 data points dating back to 1973. The red line is the State criterion.

and the mid-lake areas and high ammonia-nitrogen in water at the Clinton Lake station. Mercury in fish tissue is a concern throughout the lake. The Texas Department of State Health Services (DSHS) has issued a fish consumption advisory on Caddo Lake for Mercury in fish tissue. This topic is discussed in the Biological section of the report.

Assessment Unit 0401_01

The lower 5,000 acres of this segment were the farthest downstream AU assessed. Station 10283 is located near the middle of the lake and was the only station monitored in this AU of Caddo Lake. This station is also the only routinely monitored site in Caddo Lake that is representative of lake conditions. The area is primarily open-water with little aquatic plant and tree canopy coverage. The average depth was 2.1 meters, the median pH was 7.0 s.u., and the average DO of the 139 grab samples taken between December 2003 and August 2012 was 8.8 mg/L. Monthly field parameters and quarterly conventional samples are



scheduled at this station for FY 2014.

Metals in Sediment

The 2012 *Integrated Report* lists AU 0401_01 with concerns for screening level for iron and manganese in sediment. Only one manganese in sediment sample was collected during the assessment period. The result of the sample from station 10283 collected in June 2004 was 740 mg/kg which was below the screening level of 1,100 mg/kg (as Mn dry weight). There were no iron in sediment results available in SWQMIS for the assessment period. No metals in sediment samples are scheduled for FY 2014.

Assessment Unit 0401_02

AU 0401_02 is the Harrison Bayou Arm of Caddo Lake in far northwest Harrison County. Station 10286 was the only site in the AU with results available for the 2012 assessment period. The site is located on Caddo Lake near Harrison Bayou, south of Goose Island, and northeast of County Road Nine. This station is

Figure 11: Caddo Lake at Clinton Lake west view

primarily a wetland with an average depth of 0.9 meters and field notes show that aquatic plant coverage ranges from fifty percent to 95%, depending upon the season. AU 0401_02 is listed for not meeting the DO grab minimum, 24-Hour DO Average and 24-Hour DO Minimum criteria.

Dissolved Oxygen

Nineteen diel measurements were performed at station 10286 from 2004 - 2009. Sixteen of these samples (84%) were below the criterion for both the 24-Hour DO Average and 24-Hour DO Minimum. All but one of the low DO values came from diels performed during the summer months. One-third of the 66 DO grabs taken between 2007 and 2012 were below the 3.0 mg/L criterion. These data support the listings in this AU for 24-Hour DO Average, 24-Hour DO Minimum and DO grab minimum. Monthly grab sampling is being conducted by the Caddo Lake Institute (CLI) at this station.

Assessment Unit 0401_03

The Goose Prairie Arm of Caddo Lake branches from the west bank of the lake. Station 10288 was the only site with data available in this AU and was sampled 23 times between September 2010 and August 2012. This AU is listed for low dissolved oxygen DO grab samples and for not supporting the pH criterion.

Dissolved Oxygen

The average DO was 5.2 mg/L, however, nearly half of the grab samples (11) did not meet DO grab sample criterion of 3.0 mg/L.

pH

This AU is listed for not meeting the low pH criterion of 6.0 s.u. The median pH at this site was 6.4 s.u. with four measurements (17%) below the pH criterion. These measurements were collected in four consecutive months from December 2011 through March 2012. These results from this station support the listings for low DO and pH. Monthly grab sampling is scheduled for FY 2014 and is being conducted by the CLI.

Assessment Unit 0401_05

Clinton Lake is the border between Marion and Harrison Counties, and is northeast of Uncertain. The only site in AU 0401_05 was station 14236, located at Devils Elbow near Clinton Lake. This AU is listed for not supporting the 24-Hour DO Average, 24-Hour DO Minimum and DO grab minimum. There is also a concern for not meeting the ammonia screening level. This area of Caddo Lake functions as a wetland with an average depth of 1.2 meters and much of the water surface is covered by floating and emergent vegetation.

Dissolved Oxygen

There were eighteen diel measurements conducted between May 2004 and July 2009. Sixteen of the eighteen events (89%) were below the criterion for 24-Hour DO Average while fourteen samples failed to meet the 24-Hour DO Minimum. Thirty percent of the 63 DO grab samples failed to meet the 3.0 mg/L criterion. These data support the low dissolved oxygen listings. Monthly field parameters are being taken by the CLI at this station.

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AU	Station Description	Station ID	Lab Analyses	E. coli	Field Parameters
01	CADDO LAKE MID LAKE	10283	4		11
02	CADDO LAKE 0.25 MI. NE OF THE MOUTH OF HARRISON BAYOU	10286			11
03	CADDO LAKE IN GOOSE PRAIRIE	10288			11
05	CADDO LAKE AT DEVILS ELBOW IN UPPER LAKE NEAR CLINTON LAKE	14236	4 (NH ₃ Only)		11
07	CADDO LAKE AT JUNCTION OF BOAT LANES 1K AND 1L IN TURTLE SHELL	15249	4		11
0401A	HARRISON BAYOU AT FM 134	15508	4	4	11

Table 4: FY 2014 monitoring for Segment 0401

Ammonia

The AU is listed as a concern exceeding the screening level for ammonia-nitrogen. Only two ammonia-nitrogen samples were on record for station 14236 during the assessment period. Both samples were reported with values below the quantitative limit (<0.1 mg/L). Quarterly ammonia-nitrogen sampling began in FY 2012 and continues through FY 2014.

Assessment Unit 0401_07

AU 0401_07 is described as the mid-lake portion of Caddo Lake, downstream of Uncertain. This AU is listed for not supporting the 24-Hour DO Average, 24-Hour DO Minimum, DO grab minimum and a concern for manganese in sediment. Station 15249 is the farthest upstream site in Caddo Lake and is located near the shore, at the end of FM 2198 and southeast of Uncertain. Station 17867 is located downstream, approximately 0.25 miles east of Pine Island

off of Boat Road 1G. This area of Caddo Lake is primarily wetland with an average depth of 0.95 meters and has thirty percent to 95% aquatic plant coverage, depending upon the season.

Dissolved Oxygen

AU 0401_07 is listed as not supporting the 24-Hour DO Average, 24-Hour DO Minimum and DO grab minimum. Eight out of twelve diel measurements conducted at station 15249 failed to meet the 24-Hour DO Average and Minimum criteria. Additionally, forty percent of the 173 DO grab sample values failed to meet the 3.0 mg/L minimum criterion.

CLI will record field parameters monthly at station 15249 and quarterly conventionals are being sampled by WMS in FY 2014.

Manganese in Sediment

Only one manganese result was available in SWQMIS. The 1,350 mg/kg result exceeded the screening level of 1,100 mg/kg (as Mn

dry weight). This value supports the concern for this parameter; however, sediment monitoring should be conducted in order to provide enough data points for a complete assessment.

Big Cypress Creek flows into Segment 0401 (Caddo Lake), located on the Texas-Louisiana border. Station 15249, located near the “turtle shell” near Uncertain, was the only location with any significant trends in this segment. Specific conductance was also increasing at this station.

Segment 0401A Harrison Bayou

Segment 0401A (Harrison Bayou) is an unclassified waterbody and is a tributary of Caddo Lake. The reach extends parallel to SH 43 and to the Louisiana border. The middle three miles and lower five miles of the segment are on the 2012 §303(d) List for not supporting the 24-Hour DO Average, 24-Hour DO Minimum and DO grab minimum criteria. There is also a concern for not supporting the *E. coli* standard. There were two stations in Harrison Bayou that were assessed for dissolved oxygen:

- Station 15508 (Harrison Bayou at FM 134, four miles south of Karnack)
- Station 15509 (Harrison Bayou at CR 2607, east of the Longhorn Army Ammunition Plant)

Dissolved Oxygen

There were sixteen diel measurements made in this segment between May 2004 and July 2012. Sampling was conducted at both

stations. Four of the five diels that failed to meet the criterion for 24-Hour DO Average came from station 15509 and were from sampling conducted monthly from July through October 2004. Only one of the nine samples collected at station 15508 since 2007 failed to meet the 24-Hour DO Average criterion. A similar result was found for 24-Hour DO Minimum with two of the six low values coming from station 15508.

Five of the 22 DO grab samples failed to meet the 2.0 mg/L minimum. Three of those low values came from station 15509 during consecutive monthly samples from August through October 2004.

These data support the 24-Hour DO Average, 24-Hour DO Minimum and DO grab minimum listings.

E. coli

There were eight results in SWQMIS for *E. coli* samples collected during the assessment period. One sample exceeded criterion causing a listing for concern.

Monthly grab sampling will be conducted by the CLI and quarterly *E. coli* samples are being collected by WMS at station 15508 in FY 2014.

Segment 0401B Kitchen Creek

Kitchen Creek, an unclassified waterbody, is a tributary of Caddo Lake. The stream crosses Highway 49 near Smithland and drains into Clinton Lake east of Goat Island. Quarterly monitoring was

conducted at station 14998 during FY 2010 and FY 2011. No water quality issues were discovered during this time period. There are no listings or concerns in this reach.

Segment 0402: Big Cypress Creek below Lake O' the Pines

Segment 0402 is the reach of Big Cypress Creek from a point 12.3 kilometers downstream of SH 43 in Harrison/Marion County to Ferrell's Bridge Dam below Lake O' the Pines. This portion of Big Cypress Creek is generally wide and deep and supports heavy recreational use including boating and camping activities. The Texas Parks and Wildlife Department has placed this segment within the target area for the recovery of the state threatened paddlefish, and identified an area of over five thousand acres east of the City of Jefferson as containing priority bottomland hardwood forest dominated by cypress-tupelo swamps.

Environmental Flows Study

Environmental flow is the amount of flow in a river required to maintain the ecological system in the lake, river and flood plain. Senate Bill 3, which passed during the 2007 legislative session, assures adequate flows for ecological purposes.

The environmental flows study is being used to determine which flow regime and the amount of water that is required for the downstream environment to persist over time, while continuing to provide quality habitat. The ultimate goal of the project is to determine how much water is needed to maintain the ecological

health of Caddo Lake and its tributaries as habitat for animals and plants, while supplying adequate water for human needs such as drinking water, flood control, and recreation.

The USGS completed a study designed to prioritize important biological indicators. Those results will be used to evaluate the effectiveness of prescribed environmental flows for Big Cypress Creek, Black Cypress Bayou, and Little Cypress Creek. The USGS and NETMWD collected biological data and associated physical habitat data to observe baseline conditions for understanding changes in the aquatic biological community as a result of the selected environmental flows. Recent drought conditions have caused a delay in efforts to accurately assess the effects of the prescribed flows.

Please visit:

http://www.caddolakeinstitute.us/docs/flows/10.15.12_meeting/Cypress%20USGS%20Summary%20of%20Findings.pdf for more details and preliminary findings.

This segment is on the 2012 *§303(d) List* for having low DO, low pH, 24-Hour DO Average and mercury in edible fish tissue. None of the Assessment Units met the criterion for Mercury in fish tissue. Generally, a segment is listed in its entirety if there is a fish advisory due to the free movement of fish. This parameter is discussed in the biological section of this report. FY 2014 monitoring includes monthly and quarterly sampling at the stations shown in Table 6.

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Table 5: Segment 0402 water quality impairments and concerns

AUID	Description	DO, 24 HR Avg.	DO grab	Low pH	Mercury in Fish	Benthic Macroinvertebrates
01	Lower 15 km to Caddo Lake			NS	NS	
02	Haggerty Creek downstream 25 km of Black Cypress Bayou	NS	CS		NS	
03	Middle 23.8 km near Jefferson				NS	CN
04	From LOP downstream 13 km				NS	

AUID = Assessment Unit ID; NS = Non-supporting; CS = Concern for Screening Level; CN = Concern for Near Non-attainment

Assessment Unit: 0402_01

Assessment Unit 0402_01 is defined as the lower fifteen kilometers of Big Cypress Creek as it enters Caddo Lake. Two sites were sampled in this assessment unit:

- 10295 located at the crossing of State Highway 43, is the farthest upstream site,
- 15022 downstream at the boat ramp at Caddo Lake State Park.

pH

The TCEQ assessment lists AU 0402_01 as having low pH. The results of the pH data were combined from stations from 10295 and 15022. Out of 67 samples collected from 2004 through 2012, ten (15%) had pH less than 6 s.u. All but one of the low pH readings were collected at station 15022, and these values were collected primarily during the first quarter of the calendar year. The median value for all pH samples

collected during the assessment period was 6.6 s.u. These data support the 303(d) listing for low pH. Monthly grab sampling is being conducted by the CLI in FY 2014.

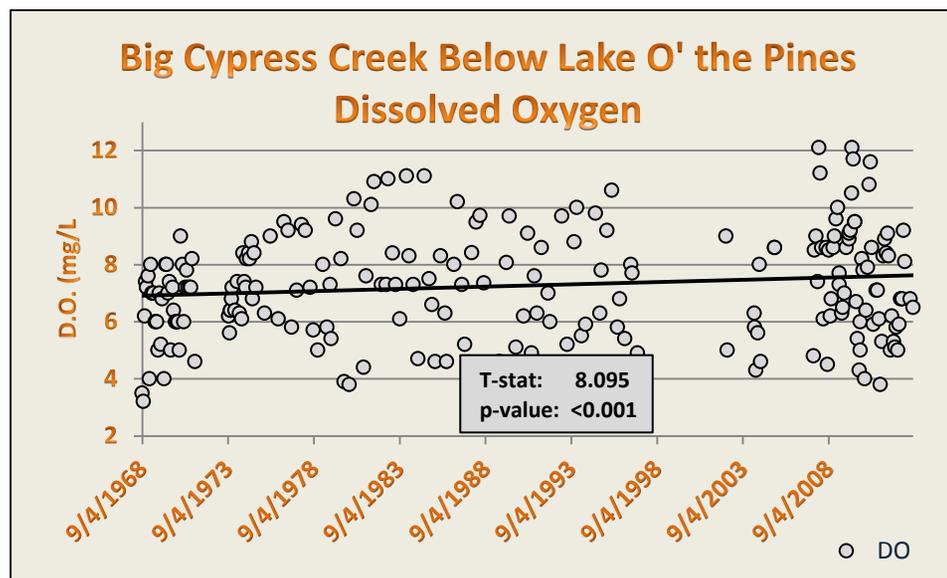


Figure 12: Dissolved Oxygen results from Big Cypress Creek at State Highway 43

Assessment Unit: 0402_02

AU 0402_02 is defined as from the Big Cypress Creek confluence with Haggerty Creek upstream 25km to the confluence with Black Cypress Bayou. Sampling took place at two sites in this assessment unit:

- 16254 located at the City of Marshall intake, approximately five miles upstream of State Highway 43
- 20635 located at Skeeter's Marina, southwest of the intersection of Marion County Road 3222

Dissolved Oxygen

This AU is listed for not supporting the 24-Hour DO Average criterion of 5 mg/L. Five of the 24 diels (23%) conducted from 2004 to 2012 failed to meet the criterion. Four of the low 24-Hour DO Averages were collected at station 16254. These data support this 303(d) listing in the assessment unit. There is also a concern for the 5.0 mg/L DO grab screening level in AU_02. Eleven percent of the 79 DO grab samples collected from 2004 – 2012 were below the criterion. The low DO readings were found at both stations and mostly during May to July site visits. The average DO concentration for all samples collected was 7.6 mg/L. Quarterly samples will be collected at station 20635 by the TCEQ Region 5 office; however, no 24-Hour sampling is scheduled for FY 2014.

Sampling at station 16254 was discontinued because the TCEQ determined that this station was not representative of the AU due to its flow regime. Monitoring in this AU was moved to station 20635 in FY 2010. TCEQ installed a continuous water quality

monitoring station at this location. This station was operated by the Region 5 staff for two years, but was discontinued due to accessibility issues because of the property being sold.

With the exception of Mercury in Fish Tissue and benthic macroinvertebrates in 0403_03, there were no listings or concerns in the 2012 Integrated Report.

Segment 0402A Black Cypress Bayou (unclassified water body)

Black Cypress Bayou (0402A) will become Segment 0410. The creek is a perennial stream and the segment is defined as from the confluence with Big Cypress in Marion County up to FM 250 in Cass County. The reach is on the 2012 §303(d) List for having low DO, elevated bacteria, copper in water and Mercury in fish tissue. AU 0402A_03 (Pruitt Lake) does not meet the criterion for Mercury in fish tissue. This parameter is discussed in the biological section of the report.

Assessment Unit: 0402A_01

AU 0402A_01 is defined as the lower 25 kilometers of Black Cypress Bayou from White Oak Creek to its confluence with Big Cypress Creek. The majority of the samples were collected at station 10245, located on Black Cypress Bayou at US Highway 59 north of Jefferson. Samples were also collected at station 10243 located at Black Cypress Creek at SH 49, north of Jefferson.

Dissolved Oxygen

AU 0402A_01 is listed as not supporting the 24-Hour DO Average standard and as concern for DO grab sample. The listing is based upon ten diel events that were performed at station 10245 between 2005 and 2012. Two events in 2010 failed to meet the 24-Hour DO Average criterion of 4 mg/L. Fifteen percent of the 85 DO grabs made between 2004 and 2012 failed to meet the screening level of 4.0 mg/L. These results support the assessment of this AU. WMS is scheduled to conduct four diel events in FY 2014.

Assessment Unit: 0402A_02

AU 0402A_02 is from the confluence with White Oak Creek upstream 31.3 kilometers to Pruitt Lake. This AU is on the 2012 §303(d) List for low DO. The majority of the data available for this AU was collected at station 16705, located on Black Cypress Bayou at CR 1617 in southern Cass County. A single sample was collected on August 31, 2011 at station 10244, which is located at Black Cypress Bayou at County Road, 3.7 miles northwest of Berea.

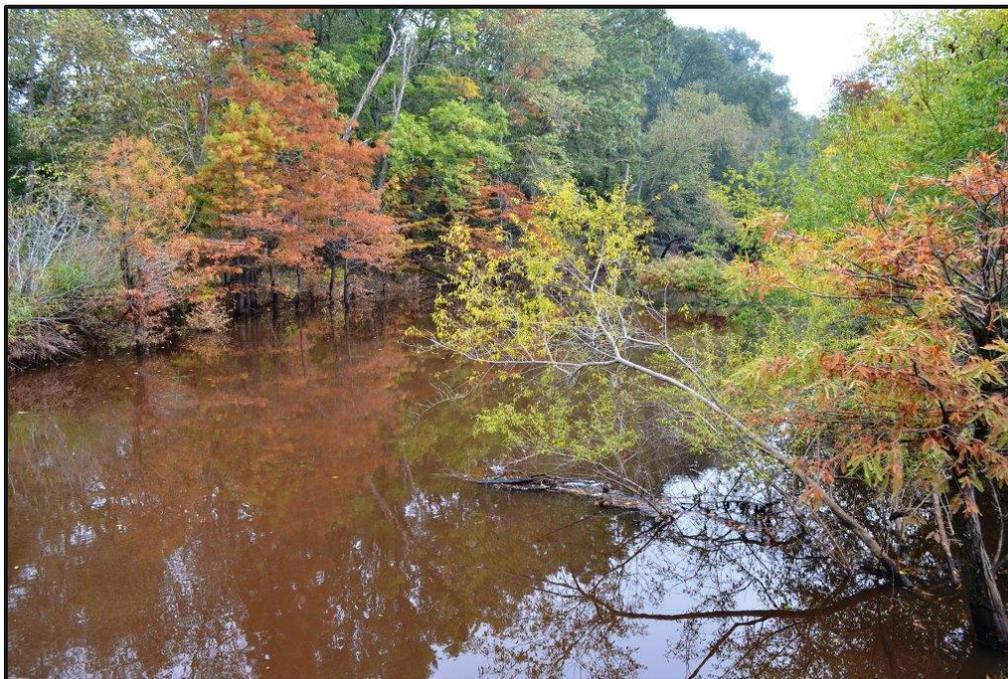


Figure 13: Black Cypress Creek at US 59

Dissolved Oxygen

AU 0402A_02 is listed for not supporting both the 24-Hour DO Average and Minimum criteria. Half of six diels performed at station 16705 between 2004 and 2006 were below the 24-Hour DO Average criterion while two did not meet the 24-Hour DO Minimum criterion. Twenty percent of the 25 DO grab samples taken between

2004 and 2011 were below the 3.0 mg/L criterion. These results support the listings; however, more 24-Hour monitoring should be conducted in order to provide adequate data for the assessment. No sampling is scheduled in this AU for FY 2014. Segment 0402 is Big Cypress Creek (Bayou) below Lake O' the Pines and two stations had significant trends in this segment. Station 15511 at US 59 showed an increasing trend for pH. Specific conductance/TDS

was also significantly increasing at the most downstream site (10295) at SH 43.

Assessment Unit: 0402A_03

AU 0402A_03 is a small reach located in southeastern Cass County and is identified as Pruitt Lake and extending 1.8 kilometer upstream. Station 10246 (Black Cypress Creek at SH 155) is the only station with sample results for this AU.

Dissolved Oxygen

AU 0402A_03 is listed for not supporting the 24-Hour DO Minimum standard. One of the four diels conducted from June to October 2004 fell below the criterion at 2.8 mg/L. Based upon limited data, this station does not meet the 24-Hour DO Minimum criterion; however, additional diels need to be performed in order to have sufficient samples to properly assess the AU. Five out of the 14 DO grabs taken between 2004 and 2009 failed to meet the screening level of 4.0 mg/L.

Copper

This AU is listed for Copper in water in the 2012 §303(d) List. There is no known source of this metal in the watershed. Since the implementation of “clean metals” techniques, all six copper samples collected in 2007 through 2009 have been detectable with half of the concentrations ranging above the 3.65 µg/L criterion.

Chlorophyll *a*

AU 0402A_03 is listed as a concern for not meeting the screening level for Chlorophyll *a*. Three out of the five chlorophyll samples collected in 2004 exceeded the screening level with one of the samples reported as non-detectable. No samples were collected at this station after October 2004. Sampling for this parameter is recommended.

No sampling is scheduled in this AU for FY 2014.

Table 6: FY 2014 monitoring for Segment 0402

Station Description	Station ID	24-Hour DO	Field Parameters	Flow
BIG CYPRESS CREEK APPROX 1.2KM DOWNSTREAM OF SH43 AT CADDO LAKE STATE PARK BOAT RAMP	15022		11	11
BLACK CYPRESS CREEK AT US 59 NORTH OF JEFFERSON	10245	4	4	4
HUGHES CREEK AT SH155 APPROX 6KM NE OF AVINGER	16936		4	
KELLEY CREEK AT FM250 APPROX 15KM NE OF HUGHES SPRINGS	16934		4	4

Assessment Unit: 0402A_04

AU 0402A_04 goes from Pruitt Lake upstream 26.4 kilometers to the confluence with Arbery Branch. There is one station on this reach (10247) located at State Highway 11 in eastern Cass County between Hughes Springs and Linden. This AU is listed for not meeting the DO grab minimum and *E. coli* criteria. There are also concerns for 24-Hour DO Average and DO grab screening level.

Dissolved Oxygen

The assessment unit is listed for not meeting the DO grab minimum criterion of 3.0 mg/L. Out of twenty grabs taken from 2004 to 2012, five failed to meet this criterion. A concern for 24-Hour DO Average is also listed for this AU. Only one diel was conducted during the assessment period. The 24-Hour DO Average of 3.9 mg/L failed to meet the criterion of 4.0 mg/L. Additional diels should be performed in order to provide adequate data for the assessment of this AU.

E. coli

AU 0402A_04 is listed for not meeting the *E. coli* geometric mean criterion. Station 10247 had a geometric mean of 176 MPN/100 mL based upon 16 samples collected from 2004 through 2012. These data support the current listing for *E. coli*.

No sampling is scheduled in this AU for FY 2014.

Assessment Unit: 0402A_05

AU 0402A_05 is the upper 24 kilometers to the headwaters of this unclassified water body. Station 10248 (Black Cypress Creek at FM

250) is the only station in the AU and is located in eastern Cass County, north of Hughes Springs.

Dissolved Oxygen

The AU is listed for not supporting the 24-Hour DO Average, 24-Hour DO Minimum and DO grab criteria. No diel sampling was performed during the assessment period and the listing is a carry-forward from previous assessments. Diel sampling should be performed at this station in order to provide adequate data for the assessment of this AU.

Sixteen percent of the 25 DO grabs failed to meet the 3.0 mg/L criterion. These results support the listing for this parameter.

E. coli

There is a concern for not meeting the *E. coli* geometric mean criterion. Eighteen samples collected from 2006 to 2012 at station 10247 had a geometric mean of 197 MPN/100 mL. These data support the concern for *E. coli*.

No sampling is scheduled in this AU for FY 2014.

Black Cypress Bayou, a major tributary to Big Cypress Creek (Bayou) below Lake O' the Pines, discharges into Big Cypress Creek east of Jefferson. Water quality on Black Cypress Bayou has remained consistent throughout the period of record and no trends were observed for this segment.

Segment 0402B Hughes Creek (unclassified water body)

Segment 0402B is listed with concerns for DO grab Minimum and DO screening level. All results for this reach were collected at station 16936 at SH 155. One third of the nine DO grabs taken in 2007 and 2008 failed to meet the 3.0 mg/L grab minimum and 5.0 mg/L screening level. These low DO results came from samples taken on July 21, 22 and 31, 2007. Although these results support the concern, additional data is needed to adequately assess this stream. WMS is scheduled to sample station 16936 quarterly during FY 2014.

Segment 0402C **Haggerty Creek** **(unclassified water body)**

There are no concerns or impairments listed in the *2012 Texas Integrated Report* for this stream. Station 14997 (Haggerty Creek at CR 2116) was sampled seven times from October, 2005 to August, 2006 during the 2005 - 2006 drought. No flow is reported for most sampling events and the resulting data show low dissolved oxygen grab samples as well as one low 24-Hour DO Average and Minimum sample. Monitoring at this station should be conducted during normal flow conditions to provide appropriate assessment data.

Segment 0402D **Flat Creek** **(unclassified water body)**

There are no concerns or impairments listed for this stream. Station 16935 (Flat Creek at SH 11) was sampled four times from October,

2000 to August, 2001. No flow and low flow were reported for three of the sampling events and the resulting data show low dissolved oxygen grab samples as well as low 24-Hour DO Average and Minimum for the single diel performed at this station. Monitoring at this station should be conducted during normal flow conditions to provide appropriate assessment data.

Segment 0402E **Kelley Creek** **(unclassified water body)**

Segment 0402E is listed with concerns for DO grab screening level. All results for this reach were collected at station 16934 (Kelley Creek at FM 250) near Hughes Springs. All four DO grabs taken in June and July 2009 failed to meet the 4.0 mg/L screening level. Although these limited results support the concern, additional data is needed to adequately assess this stream. WMS is scheduled to sample station 16934 quarterly during FY 2014.



Figure 14: Dr. Roy Darville records field observations during CRP routine field monitoring

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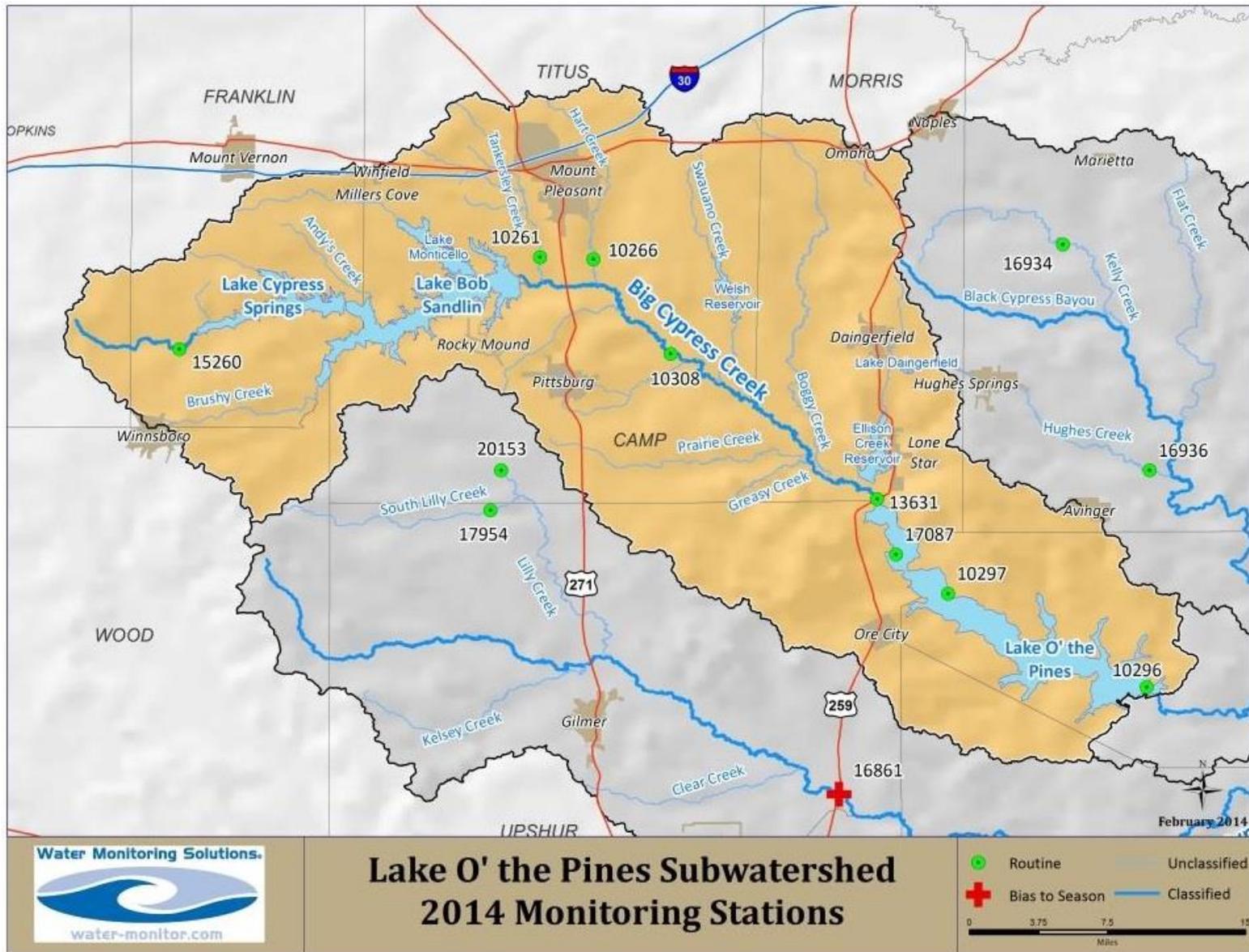


Figure 15: Upper segments of the Cypress Creek Basin

Segment 0403 Lake O' the Pines

Lake O' the Pines is listed in the *2012 Texas Integrated Report* as non-supporting the 24-Hour DO Minimum criterion in the upper 3,700 acres. This segment has been previously listed on the *Texas §303(d) List* for depressed DO. However, the listing has been moved to Category 4a due to the completion of a TDML and approval by EPA.

Lake O' the Pines TMDL

A Total Maximum Daily Load (TMDL) study was conducted on this segment for concerns of non-supporting DO concentrations. The TMDL concluded that the low dissolved oxygen in Lake O' the Pines (LOP) was a result of phosphorus loading from Big Cypress Creek and its tributaries in Segment 0404. The distribution of dissolved oxygen throughout LOP depends on the interplay of the lake's physical properties and the biological processes of photosynthesis and respiration.

A TMDL was developed for LOP under the guidance of TCEQ and U.S. Environmental Protection Agency (EPA). The final project report was approved by EPA in June 2006. A TMDL implementation plan, designed to achieve a 56% phosphorus reduction, was developed by

watershed stakeholders and approved by TCEQ in July 2008. Project milestones include tracking implementation activities in eight categories including point source discharge permits, confined animal feeding operations, forestry operations, on-site sewage facilities, marine sanitation, land application, and activities that support education and management in the watershed. The review strategy included community and stakeholder input. It was

determined that phosphorus loadings, dissolved oxygen,

and nutrient monitoring will be the water quality indicators to monitor progress of the project. Dissolved Oxygen monitoring will take place via three continuous monitoring stations in LOP and by water quality sampling in Big Cypress Creek. The detailed report can



Figure 16: Segment 0403, Lake O' the Pines

be found at the TCEQ website listed in the bibliography of this report.

Beginning in late 2012, a stakeholder process to review the “Implementation Plan for One Total Maximum Daily Load for Dissolved Oxygen in Lake O’ the Pines” began. This document was originally approved in July 2008 and implementation began shortly thereafter. The goal of this effort is to review the implementation status of the items included in the original implementation plan and determine what updates or additions to the plan are needed. Working with local watershed stakeholders, working groups were formed to review specific areas of the plan and provide recommendations on changes and additions to make that will improve the plan and lead to additional improvements in water quality once implemented.

The need for additional water quality monitoring data was a resounding comment made by watershed stakeholders. Realizing the utility of sound data, stakeholders suggested an increased focus on collecting sufficient water quality and stream flow data to adequately represent water quality both in-stream and in Lake O’ the Pines. Additional language and description of needed water quality monitoring has been added to the draft of the revised plan; however, the need for additional funding to support increased monitoring remains critical.

This process is currently in its closing stages as the first round of comments on the revised plan have been received from the working group. Following a review and comment period by all watershed stakeholders, comments received will be addressed and the final draft of the revised plan will be submitted to TCEQ for their review.

The formal TCEQ review process can take a considerable amount of time; however, it is dependent upon the level of comments they have and the time it takes to address those comments. Hopefully this process can be completed before the end of 2014.

Assessment Unit 0403_01

AU 0403_01 is the lower 5000 acres of LOP including stations near the dam. Regular sampling was conducted from 2004 to 2012 at station 10296 located near the dam. Four stations in this AU were sampled in February, April and August 2004 by the USGS:

- Station 13974
- Station 13975
- Station 13976
- Station 13978

There are no impairments or concerns listed for this AU; however, there continues to be an increasing trend for chlorophyll *a* at station 10296. TCEQ is scheduled to collect field parameters, and conventional samples at station 10296 four times in FY 2014.

Assessment Unit 0403_02

AU 0403_02 is the middle 5000 acres of LOP. There were three stations that transect the lake near its mid-point. Regular monitoring was conducted at station 16156 located in the middle of the lake opposite the FM 729 crossing and equidistant from both banks. Two additional stations were sampled in February, April and August 2004 by the USGS:

- Station 13977
- Station 13979

There are no impairments or concerns listed for this AU. TCEQ is scheduled to collect field parameters, conventionals, and *E. coli* samples at station 16156 four times in FY 2014.

Assessment Unit 0403_03

AU 0403_03 is described as the middle 5000 acres below SH 155. This AU is in the upper middle end of the lake and below what is identified as the lower part of a transition zone where the habitat and flow regime changes from riverine to reservoir conditions. There are no impairments or concerns listed for this AU. Thirty-one samples have been collected at station 10297, located in the river channel southeast of SH 155 between February 2004 and September 2012. There were no values reported below criterion for DO grab sample at this station. TCEQ is scheduled to collect quarterly field parameters and conventionals at station 10297 in FY 2014.

Assessment Unit 0403_04

AU 0403_04 is described as the upper 3700 acres of the segment. The stations in this AU are located in a transition zone on the far

upstream boundary of this segment. From upstream to downstream the widths of the banks widen and velocity decreases as water enters the lake. There were two stations in this AU where the data was used for the 2012 assessment. Station 10300 is southeast of US 259 on the Camp and Upshur County line, and station 17087 is located north of SH 155.

Dissolved Oxygen

This AU is on the *Texas §303(d) List* for failing to meet the criterion for 24-Hour DO Minimum. No diel monitoring has been conducted since 2001 and none during the 2012 assessment period. There is also a concern for meeting the DO grab screening level. Out of 49 DO grabs collected in 2004 - 2012, eight (16%) did not meet the 5.0 mg/L criterion. The lowest reading was 3.4 mg/L.

Nitrate

There is a concern for screening level of nitrate. The average of all samples collected in this AU between 2005 and 2012 is 0.99 mg/L. Forty percent of the samples exceeded 0.37 mg/L. These data support the nitrate concern.

TCEQ is scheduled to sample for field parameters and conventionals at station 17087 quarterly in FY 2014.

The farthest upstream site in Segment 0403 (Lake O' the Pines) is station 10300, about one km south of US 259. This station is located in a transitional zone and has a wide and braided channel. A transition zone is a reach where the habitat and stream morphology changes from stream to reservoir conditions. There is a decreasing trend for Secchi depth (Transparency) at this station which is typical of waters that are heavily vegetated and actively productive at the basic trophic levels of the ecosystem. Station 10296 (closest to the dam) had increasing trends for specific conductance/TDS and chlorophyll *a*.

Segment 0404 - Big Cypress Creek below Lake Bob Sandlin

Big Cypress Creek drains much of the western Cypress Creek Basin, a predominantly rural watershed of rolling wooded hills with regional elevations of 200 to 800 feet MSL. Stream flow in Big Cypress Creek is influenced by releases from Lake Bob Sandlin upstream. Vegetation within this area ranges from areas cleared for agriculture to dense forests. The floodplain contains numerous sloughs and depressions that tend to hold water following flood events, is heavily wooded and contains widespread forested wetlands.

The *Texas 2012 §303(d) List* includes Big Cypress Creek, Tankersley Creek and Hart Creek for high levels of *E. coli*. Ellison Creek Reservoir is listed for PCBs in fish tissue and sediment toxicity. Lake Daingerfield is listed for high mercury levels in fish tissue. There are concerns for nutrients (nitrate and phosphate) in the upstream portion of Big Cypress Creek and a concern for chlorophyll *a* in the lower AU of the stream as it reaches the swampy headwaters of Lake O' the Pines. There are also concerns for nutrients in Tankersley, Hart, Dry and Prairie Creeks, but there were no data available for these parameters collected during the 2012 assessment period. Nutrient sampling has been scheduled in FY 2014 for Tankersley and Hart Creeks.

In response to the *E. coli* listings in Big Cypress Creek, Tankersley Creek and Hart Creek, an intensive two-year study was conducted in these streams. *The Assessment of Contact Recreation Use Impairments and Watershed Planning for Big Cypress Creek and Tributaries (Hart and Tankersley Creeks)* was a project funded by the

Texas State Soil and Water Conservation Board which commenced in June 2009 and was completed in August 2011. Several public meetings were held to discuss the project scope, design, progress, preliminary findings, and to solicit stakeholder input on activities in the watershed.



Figure 17: Big Cypress Creek at US 259

A review of the historical data showed that much of the bacteria data for Big Cypress Creek, Tankersley Creek, and Hart Creek were collected during a storm event or within a couple of days of an

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Table 7: Segment 0404 water quality impairments and concerns

AUID	Description	Habitat	DO grab	DO, 24 HR Min	DO, 24 HR Avg.	Nutrients	<i>E. coli</i>	Toxics in Sediment	Toxics in Fish
01	Lower 24 km to LOP			CN	CN	CS			
02	37.2 km u/s to LBS					CS	NS		
0404A	Ellison Creek Reservoir							NS	NS
0404B	From BCC 16.1 km to Tankersley Lake	CS				CS	NS		
0404C	Hart Creek		CN			CS	NS		
0404E	Dry Creek					CS			
0404J	Prairie Creek			CN	CN				
0404N	Lake Dainferfield								NS

AUID = Assessment Unit ID ; NS = Non-supporting; CS = Concern for Screening Level; CN = Concern for Near Non-attainment

event. Removal of the event-based data yielded substantial reductions in the geometric mean and the percent of single samples that exceeded criterion at most stations. The bacteria source survey identified many contributors of possible sources of bacteria. Non-point sources included livestock, pets, wildlife, sludge application fields, and on-site septic systems. There are two point sources in the study area: the City of Mount Pleasant WWTP located in Hart Creek and the Pilgrim’s Pride Corporation Southwest WWTP in Tankersley Creek.

Preliminary monitoring data showed that bacteria geometric means exceeded the state criterion at all stream stations in the study area. Monitoring data showed that the treatment plants were not

significant sources of *E. coli* loading and that storm event results showed that the majority of the loading came from non-point sources. The preliminary results of BST analysis and SELECT modeling supported these findings. Both BST analysis and SELECT modeling showed that the highest levels of bacterial contributions came from wildlife and livestock, and that loading from humans and poultry were not significant sources. Preliminary results of the Comprehensive Recreational Use Attainability Analysis found no evidence of primary contact recreation occurring within the study area. Interviews with landowners, public officials, game wardens and stakeholders at public meetings supported these findings.

The results of this report are under review by the Texas State Soil and Water Conservation Board and TCEQ. All data discussed in this report were presented at public meetings and those presentations are available on the project website: <http://bcc.tamu.edu/>.

Assessment Unit 0404_01

Assessment Unit 0404_01 is identified as the lower 24 kilometers of Big Cypress Creek above Lake O' the Pines. Sampling has primarily been conducted at Station 13631 on Big Cypress Creek at US 259 with a few samples collected in 2004 at Station 15257 on Big Cypress Creek at FM 997.

Dissolved Oxygen

The *2012 Texas Integrated Report* includes this AU as concerns for the 24-Hour DO Average and 24-Hour DO Minimum criteria. The concern is a carry over from previous assessments as there were no diels conducted during this assessment period. Station 13631 is located in a swampy backwater area near the headwaters of LOP. The Big Cypress Creek channel is braided as the US 259 crossing and a main channel is not clearly evident at this location. There have been 21 DO grabs collected at this location during the assessment period with only three results below 5 mg/L, with the lowest being 4.0 mg/L.

Chlorophyll *a*

This AU is also listed as a concern for chlorophyll *a*. The mean of the twenty chlorophyll *a* samples collected from February 2004 to July 2012 was 14.7 µg/L. Forty percent of those samples exceeded the 14.1 µg/L criterion. These results support the concern for this parameter.

Trend analyses continued to show an increasing trend for phosphorus at station 13631. This trend was first reported in the *2009 Cypress Creek Basin Summary Report*. The elevated chlorophyll *a* concentrations are likely the result of nutrient enrichment. There is also an increasing pH trend which is possibly the result of the increased primary productivity at this station.

According to the Lake O' the Pines TMDL Implementation Plan monitoring program, monthly sampling for field parameters and nutrients are scheduled at station 13631. Quarterly samples will be collected by TCEQ Region 5, and quarterly sampling will be conducted by WMS under the Clean Rivers Program. The remaining samples will be collected under the LOP TMDL program. Please see Segment 0403 for details about the TMDL I-Plan.

Assessment Unit 0404_02

Assessment Unit 0404_02 is identified as the upper 37.2 kilometers of Big Cypress Creek to Lake Bob Sandlin. Sampling was conducted at two locations:

- Station 10308 – Big Cypress Creek at SH 11, east of Pittsburg
- Station 10310 – Big Cypress Creek at US 271, north of Pittsburg

E. coli

This AU is included in the *2012 Texas §303(d) List* as impaired for *E. coli*. There were 166 sample results with a geometric mean of 234 MPN/100 mL exceeding the 126 MPN/100 mL criterion. The geometric mean for the 101 samples collected from January 2004

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through July 2012 at station 10308 was 212.9 MPN/100 mL. Station 10310 had a geometric mean of 269.6 MPN/100 mL based upon 65 samples collected between May 2007 and March 2012. These data support the impairment listing for *E. coli*.

Nutrients

The 2012 Texas Integrated Report lists this AU as a concern for screening level for Nitrate-nitrogen, Total Phosphorus, and Orthophosphorus. Fifteen Nitrate-nitrogen samples were collected at station 10308 from January 2004 to July 2012 with 73 percent exceeding the 1.95 mg/L screening level. The mean of all samples was 14.3 mg/L.

Total Phosphorus was sampled eleven times at station 10310 with a mean of 4.2 mg/L. Station 10308 had an average of 2.2 mg/L for the 34 samples collected during the assessment period. The mean of all 45 Total Phosphorus results was 2.7 mg/L with 82% of the samples exceeding the 0.69 mg/L screening level. Ninety percent of the Orthophosphorus samples exceeded the screening level of 0.37 mg/L. The average concentration of the twenty samples collected from February 2004 to January 2011 was 2.65 mg/L. Of note, trend

analyses showed an increasing trend for phosphorus at station 10308. These results support the concerns for high nutrient concentrations in AU 0404_02.

The TCEQ is scheduled to sample station 10310 quarterly in FY 2014 for conventionals, bacteria, field parameters and flow. Monthly sampling for field parameters, conventionals, *E. coli* and flow is scheduled at station 10308 for the TMDL Implementation Plan

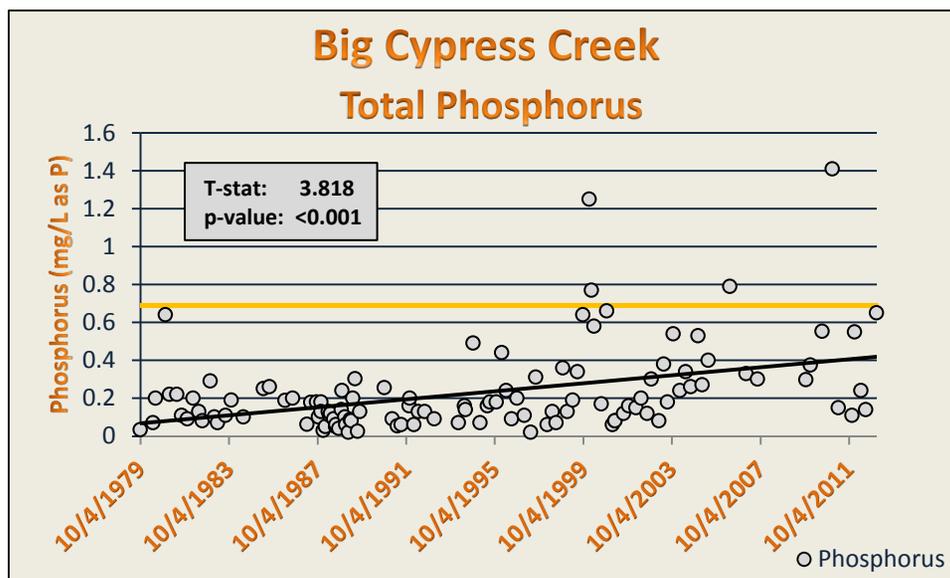


Figure 18: Total phosphorus results are increasing over time.

monitoring program. Quarterly samples will be collected by TCEQ Region 5, and quarterly sampling will be conducted by WMS under the Clean Rivers Program. The remaining samples will be collected under the LOP TMDL I-Plan program. Please see Segment 0403 for details on the LOP TMDL.

Water released from Lake Bob Sandlin flows into Segment 0404 (Big Cypress Creek) and flows past station 10308 at SH 11 and station 13631 at US 259 before

entering Lake O' the Pines. Both stations had increasing trends for total phosphorus and orthophosphorus. Station 10308, in the upper part of the segment, also had increasing trends for specific conductance and pH. Segment 0404 is the only segment in the basin

with increasing trends for phosphorus. There were no trends found in any segment for the other nutrients.

Segment 0404A
Ellison Creek Reservoir
(unclassified water body)

The entire Ellison Creek Reservoir is on the 2012 §303(d) List for PCBs in fish tissue and sediment toxicity. This reservoir was first listed for these parameters in the 2006 §303(d) List. There are also concerns for sediment screening levels for Iron, Lead, Manganese, Nickel, Zinc and Cadmium. No sediment sampling has taken place in Ellison Creek Reservoir since 2005. These listings were discussed in detail in the 2009 Cypress Creek Basin Summary Report.

No sediment samples are scheduled during FY 2014.

Segment 0404B
Tankersley Creek
(unclassified water body)

Tankersley Creek is divided into three assessment units. AU 0404B_01 is the lower 16.1 kilometers running from the Tankersley Lake dam to its confluence with Big Cypress Creek. Assessment Unit 0404B_02 is the impounded area that forms Tankersley Lake and AU 0404B_03 is the upper 5.9 km reach above the reservoir. AU 0404B_01 is on the 2012 §303(d) List for not supporting the recreational use standard for bacteria. This AU is also included in the 2012 Texas Integrated Report for concerns for Ammonia, Nitrate-nitrogen, Orthophosphorus and Total Phosphorus. This

reach is also included as a concern for impaired habitat which is discussed in the Biological section of this report.

Assessment Unit 0404B_01

Assessment Unit 0404B_01 is identified as the lower 16.1 kilometers of Tankersley Creek to its downstream border. Tankersley Creek discharges into Big Cypress Creek on its east bank in southern Titus County. The majority of the samples available for the assessment period were collected as part of “The Assessment of Contact Recreation Use Impairments and Watershed Planning for Big Cypress Creek and Tributaries (Hart and Tankersley Creeks)” project. *E. coli* samples were collected every other week during this two year study in addition to storm event monitoring. The AU was sampled at the following three locations:

- Station 10264 located at FM 899
- Station 10263 located FM 127
- Station 10261 located at FM 3417

E. coli

This AU is listed as not supporting the *E. coli* geometric mean criterion of 126 MPN/100 mL. The geometric mean of the 187 samples collected in this AU from May 2004 to May 2011 was 345 MPN/100 mL. Of interest is the geometric mean for this period of record almost doubles from the upper station (10264) to the most downstream station (10261).

Station 10264	262 MPN/100 mL
Station 10263	424 MPN/100 mL
Station 10261	443 MPN/100 mL

These data support the *E. coli* listing.

Nutrients

The 2012 Texas Integrated Report lists concerns for screening level for Ammonia, Nitrate-nitrogen, Total Phosphorus, and Orthophosphorus. These concerns are carry-forwards from previous assessments. There were no nutrient samples collected in this AU during the 2012 assessment period and none on record since 2003. WMS is scheduled to collect field parameters, conventionals and *E. coli* samples quarterly during FY 2014 at station 10261.

Segment 0404C - Hart Creek (unclassified water body)

Hart Creek encompasses the entire water body from its headwaters above IH 30 to its confluence with Big Cypress Creek. Hart Creek is on the 2012 §303(d) List for not supporting the recreational use standard for bacteria. The reach is also included in the 2012 Texas Integrated Report for concerns for screening level DO grab minimum and Nitrate.

The majority of the samples available for the assessment period were collected as part of “The Assessment of Contact Recreation Use Impairments and Watershed Planning for Big Cypress Creek and Tributaries (Hart and Tankersley Creeks)” project. *E. coli* samples were collected every other week during this two year study in addition to storm event monitoring. The AU was sampled at the following five locations:

- Station 10273 located at US 67
- Station 10272 located SH 49
- Station 10266 located at CR 4550

- Station 20704 Evans Creek at US 67
- Station 20705 Hays Creek at US 67

E. coli

This AU is listed as not supporting the *E. coli* geometric mean criterion of 126 MPN/100 mL. The geometric mean of the 255 samples collected in this AU from May 2007 to May 2011 was 412 MPN/100 mL. These data support the *E. coli* listing. Below is a break down of the geometric mean by station:

Station 10273	522 MPN/100 mL
Station 10272	406 MPN/100 mL
Station 10266	424 MPN/100 mL
Station 20704	447 MPN/100 mL
Station 20705	294 MPN/100 mL



Figure 19: Hart Creek at CR SE 12

Dissolved Oxygen

The average of the 254 DO grabs collected from August 2009 to May 2011 was 7.5 mg/L. Eighteen (7.6%) were below the DO grab minimum criterion of 3.0 mg/L and 28 were below the DO screening level of 4.0 mg/L. Based upon these results, this assessment unit supports DO grab sample criterion.

Nutrients

The *2012 Texas Integrated Report* lists concerns for screening level for Nitrate-nitrogen. This concern is a carry-forward from previous assessments and there were no nitrate samples collected in this AU during the 2012 assessment period. WMS is scheduled to collect field parameters, conventionals and *E. coli* samples quarterly at station 10266 during FY 2014.

Segment 0404E Dry Creek (unclassified water body)

The *2012 Texas Integrated Report* lists this stream as a concern for screening level for Nitrate-nitrogen. Dry Creek enters Big Cypress Creek from the west bank, flowing past Pittsburg in northeast Camp County.

Assessment Unit 0404E_01

AU 0404E_01 is described as the entire water body. Station 10274 was the only site with data available during the assessment period. It is located at the Titus County Road SE 12 crossing and was last sampled for field parameters and flow in August 2005.

Nitrate-nitrogen

The *2008 Texas Integrated Report* shows a carry-forward concern for Nitrate-nitrogen. There were no nutrient data available for this AU and sampling should be conducted to provide adequate data to fully assess the stream.

Segment 0404F - Sparks Branch (unclassified water body)

There were no listings or concerns for Sparks Branch in the *2012*



Figure 20: Walkers Creek at US 271

Texas Integrated Report. It was last sampled for field parameters and flow in July 2005 at station 10277.

Segment 0404J - Prairie Creek **(unclassified water body)**

Prairie Creek flows on the southern border of Camp County before its confluence with Big Cypress Creek near US 259. The *2012 Texas Integrated Report* lists concerns for the 24-Hour DO Average and 24-Hour DO Minimum criteria. There were no data available for this unclassified water body from the current assessment period. Diel sampling should be conducted to provide adequate data to fully assess the stream.

Segment 0404K - Walkers Creek **(unclassified water body)**

Walkers Creek generally runs east to west in Camp County, about 3 miles north of Pittsburg. All monitoring for this creek was conducted at station 16454, located at the US 271 crossing. The majority of the data available for this station were collected as part of “*The Assessment of Contact Recreation Use Impairments and Watershed Planning for Big Cypress Creek and Tributaries (Hart and Tankersley Creeks)*” project. There were no listings or concerns for Walkers Creek shown in the *2012 Texas Integrated Report*.

Segment 0404N **Lake Daingerfield** **(unclassified water body)**

Lake Daingerfield is an eighty acre reservoir which was completed in 1935 as a Civilian Conservation Corps project and is located inside the Lake Daingerfield State Park. This segment is listed on the *2012 §303(d) List* for Mercury in fish tissue. DSHS has issued a fish consumption advisory.

Segment 0404O Dragoo Creek **(unclassified water body)**

Dragoo Creek is defined as from the confluence with Tankersley Creek to the headwaters approximately 2 miles NW of US 67. Station 18326 is the only station located in this creek and is located at SW 35th Street, west of Mount Pleasant. Sampling has been performed at this station as part of a bacteria special study in 2004-2005 and was included in the “*The Assessment of Contact Recreation Use Impairments and Watershed Planning for Big Cypress Creek and Tributaries (Hart and Tankersley Creeks)*” project. This station tends to go dry but retain small perennial pools. There were no concerns or impairments listed in the *2012 Texas Integrated Report* for this creek.

Segment 0404P Unnamed Tributary **to Tankersley Creek** **(unclassified water body)**

The Unnamed Tributary to Tankersley Creek extends from its confluence with Tankersley Creek upstream approximately 2 miles to NHD RC 11140305001088.

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Table 8: FY 2014 monitoring for Segment 0404

Sampling Location	Station ID	Lab Analyses	Bacteria	Metals in Water	Flow	Field
BIG CYPRESS CR BRIDGE ON SH 11	10308	8	4	8	8	8
BIG CYPRESS CREEK AT US 259 3 MI SOUTH OF LONESTAR	13631	8		8		8
TANKERSLEY CREEK AT FM3417 5.7 KM SOUTH OF MOUNT PLEASANT	10261	4	4	4	4	4
HART CREEK AT TITUS COUNTY ROAD SE 12 3.8 KM UPSTREAM OF BIG CYPRESS CREEK CONFLUENCE SOUTH OF MOUNT PLEASANT	10266	4	4	4	4	4

The only data available were collected at station 18324 as part of a bacteria special study in 2004-2005. There were no concerns or impairments listed in the *2012 Texas Integrated Report* for this creek.

Segment 0404Q Unnamed Tributary to Tankersley Creek (unclassified water body)

The Unnamed Tributary to Tankersley Creek extends from its confluence with Tankersley Creek upstream approximately four miles to the headwaters near the end of 26th Street in Mount

Pleasant. The only data available were collected at station 18325 as part of a bacteria special study in 2004-2005. There were no

concerns or impairments listed in the *2012 Texas Integrated Report* for this creek.

Segment 0404R Unnamed Tributary to Dragoo Creek (unclassified water body)

The Unnamed Tributary to Dragoo Creek extends from its confluence with Dragoo Creek upstream approximately 1.4 km (0.8 mi) southwest to the headwaters. The only data available were collected at station 18323 as part of a bacteria special study in 2004-2005. There were no concerns or impairments listed in the *2012 Texas Integrated Report* for this creek.

Segment 0405 - Lake Cypress Springs

Lake Cypress Springs is included on the 2012 §303(d) List for high pH and the 2012 Texas Integrated Report shows a concern for high chlorophyll *a* concentration. There is a concern in Big Cypress Creek above the reservoir for elevated *E. coli* and a concern in Panther Creek for habitat quality.

For assessments performed prior to 2010, the Texas Integrated Report showed listings and concerns for non-attainment of the 24-Hour DO Average, 24-Hour DO Minimum and DO grab sample minimum. In the 2009 Cypress Creek Basin Summary Report, it was noted that many of the stations used to assess Lake Cypress Springs were not representative of reservoir conditions. These non-representative stations had been used for the purpose of studying the effects of non-point source pollution and were located in the transition zone where water velocity changes from lotic to lentic conditions. Since those transition zone stations were not representative of reservoir conditions, their data were no longer considered in the assessment of the reservoir, thus removing the listings and concerns from the §303(d) List and Texas Integrated Report.

Lake Cypress Springs remains on the 2012 Integrated Report for not supporting pH criterion. Concerns for chlorophyll *a* in the upper reaches and *E. coli* in Big Cypress Creek, the tributary are also documented.

FY 2014 monitoring includes quarterly sample collection for *E. coli*, field parameters, and flow on Big Cypress Creek at State Highway 37 (15260).

Assessment Unit 0405_01

AU 0405_01 is described as the lower 800 acres of Lake Cypress Springs. This reach extends to the downstream boundary at the dam that discharges into the east bank of Lake Bob Sandlin near the Franklin and Titus County line. Routine monitoring is scheduled to be conducted at station 10312 located near the dam. There were no concerns or impairments listed in the 2012 Texas Integrated Report for this AU.

Assessment Unit 0405_02

This AU is identified as the upper 2,600 acres of Lake Cypress Springs. The downstream boundary of this reach is FM 115 in south Franklin County. It extends to the upstream transitional area on the west side of the lake where the flow regime changes from stream to reservoir. Station 10313, located at FM 115, is scheduled to be monitored on a quarterly basis in FY 2014 by TCEQ Region 5.

pH

This AU is on the 2012 §303(d) List for high pH. 2012 was the first year this segment has been listed for pH. Between February 2004 and August 2012, thirteen out of 62 samples (21%) exceeded the pH criterion of 8.5 s.u. The median pH of all samples was 7.85 s.u. with the highest reading of 9.4 s.u. The high pH readings were observed across all seasons and primarily at station 10313, although a pair of high pH readings were obtained at station 20346, located on Lake Cypress Springs at the west end, 2.44 kilometers of FM 115. These data support the listing.

Chlorophyll *a*

Approximately 32 percent of all chlorophyll samples collected from 2004 to 2012 exceeded the screening criterion of 26.7 µg/L. The mean value for all 57 chlorophyll samples collected was 25.8 µg/L. The vast majority of the high values came from samples collected in the late fall and winter months. These data support the concern for elevated chlorophyll concentrations in this AU, 0405_02.

Segment 0405A - Big Cypress Creek (unclassified water body)

Big Cypress Creek originates in Hopkins County near the Franklin County line and flows southeast into Lake Cypress Springs. Station 15260, located on SH 37 and north of Winnsboro, was the only location sampled in this creek.

There was a concern shown in the *2012 Texas Integrated Report* for elevated *E. coli* in this unclassified water body. The geometric mean for the sixteen samples collected from November 2008 to July 2012 was 741 MPN/100 mL, exceeding the criterion of 126 MPN/100 mL. These data support the concern for high *E. coli* in the AU. Station 15260 is scheduled to be monitored on quarterly by WMS staff for *E. coli* and field parameters in FY 2014.

Segment 0405B - Panther Creek (unclassified water body)

Panther Creek rises near Purley in Franklin County. The stream, which is intermittent in its upper reaches, originally ran southeast

for 6.5 miles to its confluence with Big Cypress Creek before Lake Cypress Springs was impounded in 1970.

There was a concern for habitat listed in the *2012 Texas Integrated Report* for this creek and this concern is a carry-forward from previous assessments. There were no data collected during the assessment period and no sampling is scheduled for FY 2014.

Segment 0405C - Blair Creek (unclassified water body)

Blair Creek rises eight miles southwest of Mount Vernon and flows south for three miles to Lake Cypress Springs. There was one station (17952) located at Franklin CR 3330 SE. Two samples were collected in May and July 2004. There were no concerns or impairments listed in the *2012 Texas Integrated Report* for this creek. There were no other data collected in this creek during the assessment period and no sampling is scheduled for FY 2014.

Lake Cypress Springs, in southern Franklin County, is the farthest upstream segment in the basin. Both stations on Lake Cypress Springs showed an increasing trend for specific conductance/TDS. Water is released from Lake Cypress Springs and Lake Monticello into Lake Bob Sandlin. Only station 16158 at the mid-lake location had enough data to perform trend analyses. Specific conductance/TDS is increasing significantly at this station.

Segment 0406 - Black Bayou

Black Bayou is a relatively small watershed that rises near Springdale Cemetery in northeastern Cass County and runs southeast for twenty-nine miles to its mouth on Black Bayou Lake in Caddo Parish, Louisiana, just south of the Louisiana-Arkansas state line. The stream is intermittent in its upper reaches and traverses flat to gently rolling terrain surfaced by sand with clay loam that supports grasses and mixed hardwoods and pines.

Black Bayou is generally a slow, meandering water body with sand and clay loam bottom. When combined with little rainfall and seasonal climate change, water has a tendency to become stagnant as it flows intermittently in the upper reaches. Dissolved oxygen levels decrease under these conditions.

Black Bayou is included in the *2012 §303(d) List* for depressed dissolved oxygen concentrations throughout the segment, and elevated bacteria in the lower reaches. The entire reach of Black Bayou is on the *2012 §303(d) List* for not supporting its designated use for dissolved oxygen grab minimum concentration.

Historically, the TCEQ Region 5 staff has recorded no or low flow conditions during 46 percent of their 37 site visits to station 10314 since January 2004. Similar observations were noted (64% of site visits) at station 10318 even though this station is located below the City of Atlanta WWTP. While conducting biological sampling at station 10318 in October 2012, residents of the basin informed WMS staff that the stream had gone completely dry during the drought of 2011. WMS and NETMWD staff found station 10314 to

be intermittent with pools during both site visits in September and October 2012.

Assessment Unit 0406_01

Stations:

- 10314: Black Bayou at Cass CR 4659, north of McLeod
- 10315: Black Bayou at FM 1841, south of Atlanta

The lower portion of the segment (AU 0406_01) extends from the Louisiana state line upstream 19.1 kilometers to the confluence with Hurricane Creek. All sample results for this assessment unit were collected at Station 10314 which is located on Cass CR 4659 near the Louisiana state line.

Dissolved Oxygen

Data were reviewed from January 2004 to July 2012 and included 37 grab samples. The average dissolved oxygen concentration of those samples was 4.2 mg/L; however, nearly half of the samples collected were below the 3.0 mg/L criterion. These data support the listing for DO grab minimum; however, it should be noted that on fourteen of the eighteen low DO results the corresponding flow measurement was reported as 0 cfs. The low DO samples occurred primarily during the summer months, but spring and fall sampling also had 0 cfs flow measurements.

E. coli

Bacteria data for this AU dates from January 2004 to May 2012. Since the *2012 Texas Integrated Report* was released, the geometric mean has dropped to 119 MPN/100 mL. These data indicate that bacteria is meeting the criterion in the assessment unit.

Assessment Unit 0406_02

Station(s):

- 10316: Black Bayou at FM 251, south of Atlanta
- 10317: Black Bayou at Railroad bridge 1.2 miles upstream of SH 251
- 10318: Black Bayou at SH 43 at mid-bridge, south of Atlanta
- 16157: Black Bayou at FM 2791, near Queen City

AU 0406_02 represents the upper reaches of the segment and ranges from the confluence with Hurricane Creek upstream 28.6 kilometers near FM 96. All data collected during this assessment period were collected at Station 10318, located immediately southwest of Atlanta; and Station 16157, located northwest of Atlanta.

Dissolved Oxygen

There were 35 dissolved oxygen grab samples collected from February 2004 to October 2012 with an average concentration of 4.7 mg/L; however, 37 percent of the samples collected were below the water quality criterion of 3.0 mg/L. These data support the listing for DO grab minimum. Like station 10314, similar flow results were discovered for station 10318. Out of the 13 low DO readings,

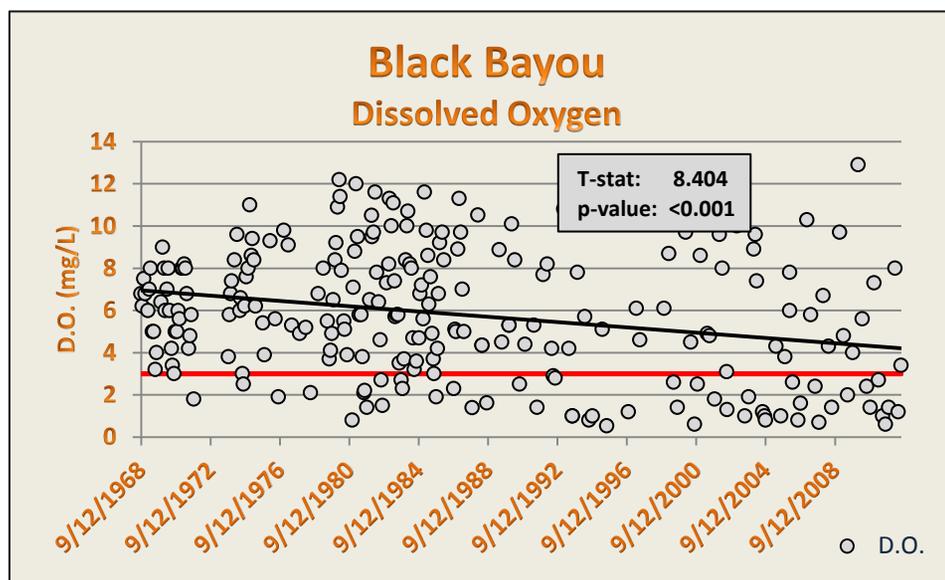


Figure 21: Dissolved oxygen levels continue to drop steadily in Black Bayou. The red line is the state criterion 3.0 mg/L. The black line shows the trend of results for the period of record.

half of the flow measurements were reported as 0 cfs and two more were less than 1 cfs. The “no flow” site visits occurred primarily during the summer months. Based upon these results, Black Bayou is not classified as intermittent with perennial pools.

E. coli

There is a concern shown in this AU for not meeting the *E. coli* geometric mean criterion in the *2012 Texas Integrated Report*. The geometric mean of the samples collected in this AU was 219 MPN/100 mL, supporting the impairment listing.

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Sampling in FY 2014 includes quarterly monitoring for conventionals, *E. coli*, field parameters and flow at stations 10314 and 10318 by TCEQ Region 5. WMS and NETMWD staff are scheduled to conduct biological and habitat monitoring twice at both stations in 2014.

Station 10314, located in Black Bayou at Cass CR 4659, approximately 1.3 miles east of the Louisiana state border was the only station with significant trends in this segment. There were decreasing trends for specific conductance/TDS, DO, and pH. The decreasing trend for DO is likely due to low flow conditions regularly encountered while monitoring this station. This is discussed further in the Assessment Section of this report.



Figure 22: Black Bayou with State Highway 43 in the background during biological monitoring in October 2011

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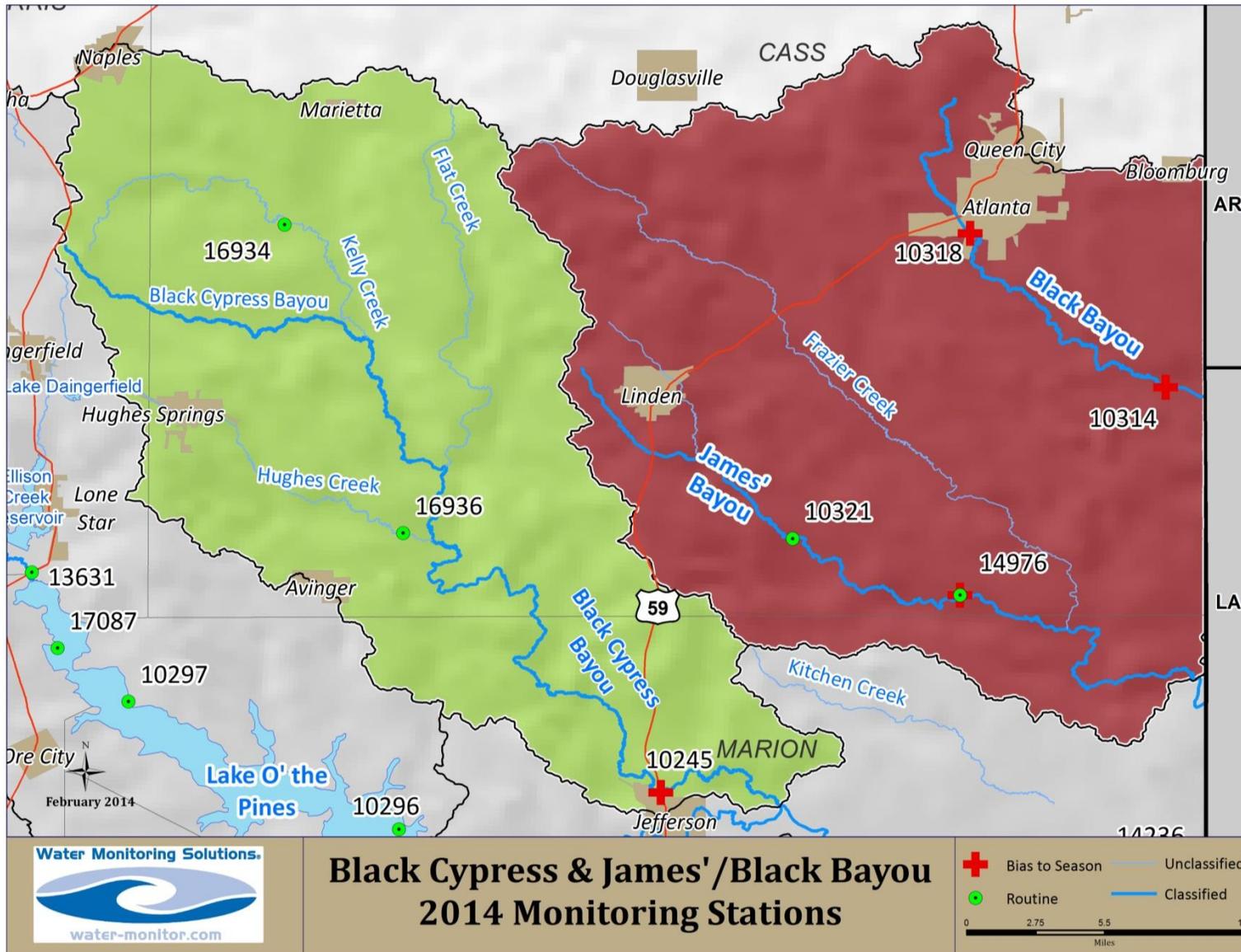


Figure 23: James' Bayou and Black Cypress Creek watersheds

Segment 0407 - James' Bayou

Continuous and well-developed riparian woodlands cover a large portion of James' Bayou. The watershed consists predominately of forested hills with wide, flat, heavily wooded bottomlands along the major streams. During the 2012 Coordinated Monitoring Meeting, the flow status of James' Bayou at Cass CR 1775 (station 10321) was discussed. Field personnel observed that the station was often intermittent with perennial pools. If the stream became designated as intermittent with perennial pools, the AU would not be subject to the same water quality standards as perennial streams.

A review of the data collected at station 10321 from January 2004 through July 2012 showed that the flow severity was reported as "no flow" on seven out of the 36 site visits (19.4%) while eleven more visits were reported as "low flow." The average flow measured at this station was 8.9 cfs with 24 percent of those measurements being reported as 0 cfs. Although many of the 0 cfs measurements were made during the summer months, no flow was recorded during all seasons.

Similar results were found for station 14976. Out of the 34 site visits made between October 2005 and July 2012, nine (26.5%) were reported as having a flow severity of "no flow" along with nine more being reported as having "low flow." Twenty flow measurements were made during this time with a mean flow of 4.0 cfs. Nine of those measurements were reported as 0 cfs and two more were 0.4 cfs. The "no flow" site visits occurred throughout the year. Based upon these results, James' Bayou is now classified as intermittent with perennial pools.

James' Bayou is included in the 2012 Texas §303(d) List for 24-Hour DO Average and 24-Hour DO Minimum along the entire segment. The upper 29.8 kilometers is also listed for DO grab minimum and *E. coli* while AU 0407_01 is listed for pH. The 2012 Texas Integrated Report shows concerns for DO grab and *E. coli* in the lower portion of the stream. There are concerns for DO grab in Segment 0407A and in 0407B along with a concern for *E. coli* in 0407A (See Table 10.)

Table 9: Impairments and concerns for James' Bayou

AUID	Description	Dissolved Oxygen	DO, 24 HR Avg.	DO, 24 HR Min	pH	<i>E. coli</i>	Fish Community
01	Lower 31.6 km	CS	NS	CN	NS	CN	
02	Upper 29.8 km	NS	NS	NS		NS	CS
0407A_01	Beach Creek	CS				CN	
0407B_02	Frazier Creek	CS					

AUID = Assessment Unit ID; NS = Non-supporting; CS = Concern for Screening Level; CN = Concern for Near Non-attainment

Assessment Unit 0407_01

AU 0407_01 is defined as the lower 31.6 kilometers of James' Bayou. The downstream boundary is at the Louisiana State Line in Marion County. Station 14976, at SH 43, was the only station sampled in this AU.

Dissolved Oxygen

Between May 2006 and March 2012, twelve diel events were conducted at station 14976. The mean of all twelve 24-Hour DO Average was 6.4 mg/L. One third of the events failed to meet the 24-Hour DO Average criterion of 4.0 mg/L while two samples failed to meet the 24-Hour DO Minimum criterion. One of these low DO events occurred in July 2006. This event should not be considered in the assessment since the flow was reported as 0 cfs.



Figure 24: James Bayou at SH 43, upstream view

Six of the 35 DO grab samples (17%) failed to meet the screening level of 4.0 mg/L; the flow severity for all six of these low DO readings was reported as “no flow.” Three of the low DO grabs were collected within a week in July 2006 and were also the last low DO grabs made in the AU. The flow measurement made during this time period was 0 cfs. All 24 DO grabs obtained since this date have been above 4.0 mg/L.

pH

About twelve percent of the 34 pH samples collected from October 2005 to April 2012 were below the pH criterion of 6.0 s.u. All four low pH readings were recorded a day apart with two low readings in January 2011 and two in January 2012. The median pH of all samples was 6.6 s.u.

E. coli

The geometric mean of the seven *E. coli* samples collected since

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October 2005 was 154 MPN/100 mL. Additional samples need to be collected to fully assess this AU; however, the data collected thus far support the concern for *E. coli*.

Quarterly field parameters, *E. coli* and flow monitoring are scheduled to be collected by WMS in FY 2014 at station 14976. Diel monitoring is scheduled to be conducted four times in FY 2014: twice during the index period, once during the critical period and once during the fall or winter.

Assessment Unit 0407_02

This AU is identified as the upper 29.8 kilometers of James' Bayou which extends upstream to Club Lake Road northwest of Linden. All data available for the assessment were collected at station 10321 located at Cass County Road 1775.

Dissolved Oxygen

Between May 2004 and July 2006, seven diel events have been conducted at station 10321. The mean of all 24-Hour DO Average was 3.9 mg/L. Four of the events failed to meet the 24-Hour DO Average criterion of 4.0 mg/L while three samples failed to meet the 24-Hour DO Minimum criterion. One of these low DO

events occurred in July 2006. This event should not be considered in the assessment since the flow was reported as 0 cfs.

Five of the 35 DO grab samples (14%) failed to meet the criterion of 3.0 mg/L. The flow severity for four of the low DO readings was recorded as "no flow." Three of those low DO grabs were collected within a week in July 2005 and reported a flow of 0 cfs.

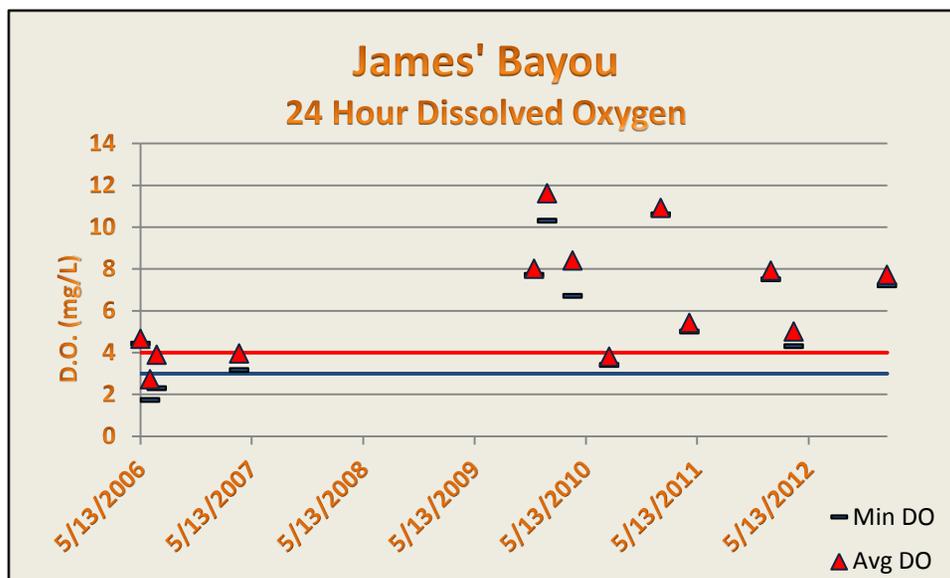


Figure 25: 24 Hour dissolved oxygen monitoring results since 2006. The red line is average criterion and blue is the minimum criterion.

E. coli

Eight *E. coli* samples were collected from January 2004 to April 2012. The geometric mean for these samples was 192 MPN/100 mL. Additional samples need to be collected to fully assess this AU; however, the limited data set supports the listing for *E. coli*.

WMS is scheduled to collect quarterly field parameters, *E. coli* and flow in FY 2014 at station 10321. No diel monitoring is presently scheduled for this AU.

The James' Bayou watershed is bordered on the east by the Louisiana and Arkansas State borders and on the west by Black Cypress watershed. Two stations in this segment had sufficient data for trend analyses. There were no

significant trends discovered at station 10259 (Frazier Creek at US 59), or at station 10321 (James' Bayou at Cass CR 1775).

Segment 0407A - Beach Creek (unclassified water body)

Beach Creek originates half a kilometer upstream of US 59 in central Cass County and flows southeast for 8.4 kilometers to its confluence with James' Bayou. The stream is intermittent in its upper and middle reaches. The lone station on Beach Creek (10256) is located at FM 125. There are concerns for DO grab screening level and *E. coli* listed in the 2012 Texas Integrated Report. These concerns are carry-forward from previous assessments. Sampling should be conducted in this creek as there are no DO or *E. coli* data available for the current assessment period and no sampling is scheduled for FY 2014.

Segment 0407B - Frazier Creek (unclassified water body)

Frazier Creek originates near US 59 in Cass County and flows southeast for 38.6 kilometers to its confluence with James' Bayou in Marion County.

DO grab screening level is the only concern shown in the 2012 Texas Integrated Report for this reach. One grab sample was collected at each station in September 2011. The flow was reported as 0 cfs for both stations and the DO ranged from 2.0 mg/L at station 21078 to 6.3 mg/L at station 10259. No other data were available for this assessment period. TCEQ Region 5 is scheduled to visit station 10259 once in FY 2014 to conduct a perennial pool survey.

Table 10: Reservoirs of the Cypress Creek Basin listed by impoundment date

Reservoir (other names)	Date	Surface area (acres)	Capacity (acre-feet)
Caddo Lake	1873	26,800	129,000
Ellison Creek Reservoir	1943	1,516	24,700
Lake O' the Pines	1959	16,919	241,363
Johnson Creek Reservoir	1961	650	10,100
Cypress Springs, Lake	1970	3,252	66,756
Monticello Reservoir	1972	2,001	34,740
Welsh Reservoir (Swauano Creek)	1976	1,269	18,431
Bob Sandlin, Lake	1977	8,703	190,822
Gilmer Reservoir	2001	1,010	12,720

Segment 0408 - Lake Bob Sandlin

Segment 0408 (Lake Bob Sandlin) fully supports all water quality criteria and no assessment units in the segment are included in the *2012 Texas Integrated Report*. FY 2014 monitoring includes quarterly sampling for conventionals, *E. coli*, and field parameters at station 16158 at FM 21, station 17059 at the Mt. Pleasant raw water intake, and at station 17060 at the City of Pittsburg raw water intake.

There are three Assessment Units in Lake Bob Sandlin:

- Assessment Unit 0408_01: Lower 2000 acres
- Assessment Unit 0408_02: Middle 4460 acres
- Assessment Unit 0408_03: Upper 3000 acres

Segment 0408A - Lake Monticello (unclassified water body)

Lake Monticello is approximately eight miles southwest of Mount Pleasant in Titus County. This waterbody was not assessed in the *2012 Texas Integrated Report*.

Segment 0408B - Andy's Creek (unclassified water body)

Andy's Creek, also known as Anders Creek, rises five miles southeast of Mount Vernon in Franklin County and runs southeast for six miles to its mouth on Lake Bob Sandlin. There is one site on Andy's Creek

at Titus CR 2910. There were no concerns or impairments shown in the *2012 Texas Integrated Report* for this reach.

Segment 0408C – Brushy Creek (unclassified water body)

Brushy Creek originates north of Winnsboro in Franklin County and is joined by the South Fork of Brushy Creek, which rises six miles southeast of Winnsboro in Wood County. The South Fork runs northeast for six miles, briefly forming part of the Wood-Franklin county line. There is one station located on Brushy Creek at FM 115. There are concerns for habitat and benthic macroinvertebrates listed in the *2012 Texas Integrated Report* for this creek.

Segment 0408D - Blundell Creek (unclassified water body)

Blundell Creek originates three miles south of Mount Vernon in Franklin County. The stream is intermittent in its upper and middle reaches. There is one station on Blundell Creek at Franklin CR 4130, southwest of Winfield. There were no concerns or impairments shown in the *2012 Texas Integrated Report* for this creek.

Segment 0409 - Little Cypress Creek

Little Cypress Creek originates near FM 2088 in Wood County and flows approximately ninety miles to its confluence with Big Cypress Creek on the Harrison/Marion County line. This segment was included in the *2012 Texas §303(d) List* for low dissolved oxygen levels and elevated *E. coli*. Segment 0409 is also listed in the *2009 Texas Integrated Report* as having a concern for DO and *E. coli* in the 25 mile segment below Highway 271. This reach also showed a concern for impaired benthic macroinvertebrate community structures which is discussed in the Biological section of this report.

Assessment Unit 0409_01

AU 0409_01 is the lower 41 kilometers of Little Cypress Creek. The downstream boundary is the confluence with Big Cypress Creek on the Harrison/Marion County line and upstream boundary is its confluence with Lawrence Creek. Station 10332 (Little Cypress Creek at US 59) was the only station with data available in this AU.

Dissolved Oxygen

This AU is on the *2012 Texas §303(d) List* for not meeting the 24-

Hour DO Average criterion. The listing was a carry-forward and based upon limited data using a single sample collected in April 2007. The 24-Hour DO Average of that sample was 5.74 mg/L with a 24-Hour DO Minimum of 5.52 mg/L. Additional diel sampling needs to be conducted in the AU in order to provide adequate data for the assessment of the AU.

There was also a concern for DO grab screening level of 5.0 mg/L. Seven out of 35 DO grabs obtained from 2004 through 2012 were below the screening level. All of the low DO readings were recorded in July, August or September. These data support the concern. TCEQ Region 5 is scheduled to collect quarterly samples at station 10332 in FY 2014.

Assessment Unit 0409_02

This AU is identified as from the confluence with Lawrence Creek upstream 29.2 km. Station 15773, located at FM 450 in Harrison County, was the only site with data collected during the assessment period.

Table 11: Non-supporting parameters and parameters of concern for Segment 0409

AUID	Description	DO, 24 HR Avg.	DO, 24 HR Min	DO, Grab	<i>E. coli</i>
01	Lower 41 km	NS		CS	
02	Middle 29 km above SH 154	NS	CN	CS	NS
03	Middle 52 km to Kelsey Creek	NS		CS	
04	Upper 41 km				NS
0409B	Entire segment				NS

AUID = Assessment Unit ID ; NS = Non-supporting; CS = Concern for Screening Level; CN = Concern for Near Non-attainment

Dissolved Oxygen

This reach is on the *2012 Texas §303(d) List* for not supporting the 24-Hour DO Average criterion. Five diel measurements were made at station 15773 between May 2004 and July 2005. Four failed to meet the criterion for 24-Hour DO Average while two were below the 24-Hour DO Minimum. No stream flow data were available in SWQMIS, but flow severity was reported as low for both of the low DO Minimum and the lowest DO Average results. Additional diel sampling needs to be conducted in the AU in order to provide adequate data for the assessment of the AU.

There was also a concern for DO grab screening level of 5.0 mg/L. Eight out of 29 DO grabs obtained from 2004 to 2012 were below the screening level. All of the low DO readings were recorded in June through September. These data support the concern.

E. coli

The AU was listed for not supporting the *E. coli* criterion of 126 MPN/100 mL. The geometric mean from 22 samples was 132 MPN/100 mL. These data support the listing.

TCEQ Region 5 is scheduled to collect quarterly samples at station 15773 in FY 2014.



Figure 26: Little Cypress Creek at US 259, downstream view

Assessment Unit 0409_03

AU 0409_03 is the middle 52.2 kilometers to the confluence with Kelsey Creek. There were three stations in this AU:

- Station 16861, located at US 259
- Station 10334, located at FM 555
- Station 10335, located at SH 155

Dissolved Oxygen

This reach is on the *2012 Texas §303(d) List* for not supporting the 24-Hour DO Average criterion. Out of the 22 diels performed at stations 10334, 10335 and 16861, fourteen failed to meet the 24-

Hour DO Average criterion while five were below the 24-Hour DO Minimum criterion of 3.0 mg/L. All but four of the low 24-Hour DO Average results were from sampling conducted in June through September 2004 at stations 10334 and 10335. Another two low values were a result of sampling conducted in July 2005 at both stations. The flow was reported as 0 cfs for this event, so these results should not be considered in the assessment. About 40 percent of the 62 DO grab samples collected from March 2004 to October 2012 were below the DO grab screening level of 5.0 mg/L. These data support the concern in this AU.

TCEQ Region 5 is scheduled to collect quarterly samples at station 16861 in FY 2014. WMS is scheduled to conduct four diel events at this station in FY 2014.

Assessment Unit 0409_04

This AU is the upper reach of the segment and extends from its headwaters near FM 2088 downstream 41.1 km. There were two stations sampled in the AU during the assessment period:

- Station 16017, located at US 271 north of Gilmer
- Station 14975, located at FM 852

E. coli

This AU is on the *2012 Texas §303(d) List* for not supporting the *E. coli* geometric mean criterion of 126 MPN/100 mL. The geometric mean of the 32 samples collected from March 2004 to October 2012 was 178 MPN/100 mL. These data support the *E. coli* listing.

TCEQ Region 5 is scheduled to collect quarterly samples at station 16017 in FY 2014.

Segment 0409 Little Cypress Creek (Bayou) flows from Wood County west to Marion County before its confluence with Big Cypress Creek (Bayou). Over the past forty years, the Little Cypress Creek (Bayou) watershed was regularly sampled at two locations: upstream at US 259 and downstream at US 59. No trends were identified for either station indicating stable water quality conditions throughout the period of record.

Segment 0409A - Lilly Creek (unclassified water body)

Lilly Creek originates two miles west of Pine in Camp County and flows southeast for nine miles to its confluence with Little Cypress Creek. There is one site on Lilly Creek (20153) located at US 271, north of Gilmer. WMS has been sampling at this station quarterly since October 2007 and is scheduled to continue in FY 2014. There are no concerns or impairments listed for this creek.

Segment 0409B - South Lilly Creek (unclassified water body)

South Lilly Creek is a branch of Lilly Creek and this unclassified water body extends from its confluence with Lilly Creek to approximately two miles west of FM 1647 in Upshur County. South Lilly Creek is included in the *2012 Texas §303(d) List* for not meeting the *E. coli* criterion.

There were two stations sampled in this reach during the assessment period:

- Station 17954, located at FM 2454

- Station 17953, located at Woodchuck Road

E. coli

The 2012 Texas §303(d) List includes *E. coli* geometric mean criterion of 126 MPN/100 mL. There were 23 samples collected in the AU between November 2008 and July 2012. Eight samples were collected at station 17953 and fifteen at station 17954. The geometric mean of all samples was 218 MPN/100 mL. These data support the listing for not meeting the *E. coli* criterion.

WMS is scheduled to perform quarterly monitoring for field parameters and *E. coli* in FY 2014 at station 17954.

Segment 0409D - Lake Gilmer (unclassified water body)

Lake Gilmer is located in central Upshur County. There were two stations on this reservoir:

- Station 17478, located near the dam
- Station 18825, located at FM 852

There were no concerns or impairments listed for this reservoir in the 2012 Texas Integrated Report. TCEQ Region 5 is scheduled to sample at both stations quarterly in FY 2014.

Segment 0409E – Clear Creek (unclassified water body)

Clear Creek rises two miles west of Piedmont in south central Upshur County and runs northeast for eleven miles to its mouth on

Little Cypress Creek. The surrounding flat to rolling terrain is surfaced by clay and sandy loam that supports water-tolerant hardwoods, conifers, and grasses.

Clear Creek has a concern for riparian habitat and is not supporting its designated use for impaired benthic macroinvertebrates.



Figure 27: Construction taking place on the banks of Lilly Creek at FM556.

Biological Monitoring

The Biological chapter has been updated from the *2009 Cypress Creek Basin Summary Report* and divided into three parts:

- Toxins in fish tissue
- Review of the *2012 Texas Integrated Report* listings
- Evaluation of biological assessments performed in the Cypress Creek Basin

Toxins in Fish Tissue

The Texas Department of State Health Services (DSHS) monitors fish for the presence of contaminants and alerts the public through bans or advisories when fish consumption may pose a threat to human health. DSHS has issued fish consumption advisories for Caddo Lake, Big Cypress Creek in Marion County, Pruitt Lake, and Lake Daingerfield due to Mercury in fish tissue. In December 2005, DSHS issued a fish consumption advisory for all fish species in Ellison Creek Reservoir due to high levels of PCBs.

The *2012 Texas §303(d) List* includes all of Caddo Lake (Segment 0401), Big Cypress Creek below Lake O' the Pines (Segment 0402), Black Cypress Bayou (Segment 0402A), and Lake Daingerfield (Segment 0404N) for not supporting the Mercury in tissue screening level. Ellison Creek Reservoir (Segment 0404A) is listed for having elevated levels of PCBs in fish tissue. With the exception of Segment 0406 (Black Bayou), fish tissues have been sampled from every segment in the Cypress Creek Basin, and mercury was detectable in tissues from all segments sampled.

There has been no Mercury in fish tissue sampling conducted in the basin since the *2009 Cypress Creek Basin Summary Report* was written. The following is a summary of the tissue sampling results discussed in that report.

The most extensive tissue monitoring in the basin has been conducted in Segment 0401 - Caddo Lake. Twelve sampling events were held from 1983 to 2000. Tissue samples were collected from eight fish species and included fifteen whole fish, 57 edible filets, two livers and four hearts. The mean mercury concentration of all samples was 0.52 µg/g, with 28 percent of the samples exceeding the screening level. Mercury was detectable in every fish species in Caddo Lake regardless of trophic level or functional feeding group.

Fish tissue samples were collected during four events from 1994 to 1998 in Segment 0402A - Pruitt Lake. Forty-four filet samples from eleven fish species were analyzed with 81 percent of these samples exceeding the screening level. The mean mercury concentration for all species was almost twice the screening level at 0.92 µg/g, and mercury was detectable in every sample collected at this station.

Tissue samples were collected from August to November 2000 in Segment 0404N - Lake Daingerfield. Thirteen out of seventeen of the filet samples exceeded the screening level with a mean mercury concentration of 0.57 µg/g. All of the largemouth bass, blue catfish and one of the channel catfish samples exceeded the screening level, but mercury was not detected in two of the channel catfish filets.

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On June 17, 2002, seven filet and five whole fish samples were collected for PCB analysis in Segment 0404A - Ellison Creek Reservoir. Three of the seven filet samples had detectable levels of PCBs ranging from 0.15 to 0.18 mg/kg. All five channel catfish (whole fish samples) and all three of the white crappie filets were below the detection limit of 0.05 mg/kg. Both of the largemouth bass and one of the channel catfish filets were above the detection limit. Additional sampling has been conducted by DSHS, but no data were available in SWQMIS for review.

Fish tissue samples were collected on seven occasions from 1989 to 2006 in Segment 0403 (Lake O' the Pines). Thirty-two filet samples from five fish species were analyzed for mercury in tissue and two large mouth bass filets exceeded the screening level. Mercury was not detectable in the three channel catfish samples.

None of the fish tissue samples exceeded the mercury in tissue screening level for samples collected in Lake Cypress Springs (Segment 0405), Frazier Creek at US 59 (Segment 0407B), or Lake Bob Sandlin (Segment 0408). It should be noted that although none of these samples exceeded the screening level, mercury was at detectable levels in all of the fish samples obtained in these segments. In general, channel catfish had the lowest amount and largemouth bass had the highest amount of mercury.

Unfortunately, mercury in fish tissue across the Cypress Creek Basin will most likely persist, since mercury does not decay. Once mercury enters a stream or impoundment, it can remain for decades, cycling between the sediment and biota, provided conditions that favor methylation (such as low pH) are present



Figure 28: TPWD and WMS biologists identify fish during sampling on Black Bayou

(Twidwell, 2000).

Segment Discussion

The following section discusses the available data in SWQMIS as compared to listings in the *2012 Texas Integrated Report*.

Biological assessments are important in determining whether a segment meets its aquatic life use designation and determining the chronic effects of pollutants on the biota of the stream. The presence and absence of intolerant benthic macroinvertebrates and fish species along with the number of species collected (richness) are useful indicators of long-term water quality. While intolerant organisms may survive brief periods of water quality impairment, these species are much less likely to endure the impairment over a longer period of time. The presence of intolerant species indicates that the stream has likely had good water quality over an extended period of time.

Fish sampling, benthic macroinvertebrate collection, and habitat assessment are the main parts of a biological assessment. Organisms are identified, enumerated, and assigned value using trophic and tolerance levels. A score is the result of tallying these values using a series of metrics. The Rapid Bioassessment (RBA) score is computed for benthic macroinvertebrates; the Index of Biotic Integrity (IBI) for fish; the Habitat Quality Index (HQI) for habitat measurements.

Segment 0402 – Black Cypress Creek

Assessment Unit 03 of Black Cypress Creek is listed as a concern for its designated use for benthic community since this segment has a High Aquatic Life Use (ALU) rating. One biological assessment was

conducted at station 20108 (Black Cypress Creek at Bob Sanders Property) on May 30, 2007. The RBA score was 24 (Intermediate). No further sampling has been performed at this station. Additional sampling should be conducted in this AU.

Segment 0404B – Tankersley Creek

Tankersley Creek originates northwest of Mount Pleasant and runs along the east side of the city before its confluence with Big Cypress Creek below Lake Bob Sandlin. Tankersley Creek is listed with a concern for riparian habitat.

Segment 0405B – Panther Creek

Panther Creek is listed as a concern for impaired habitat. Two habitat assessments were conducted at station 17322 (Panther Creek at CR 4260) in the summer of 2002. The average HQI score of the two field efforts was 17.8 – Intermediate. No other sampling has occurred at this station since then. Additional sampling should be performed in this creek.

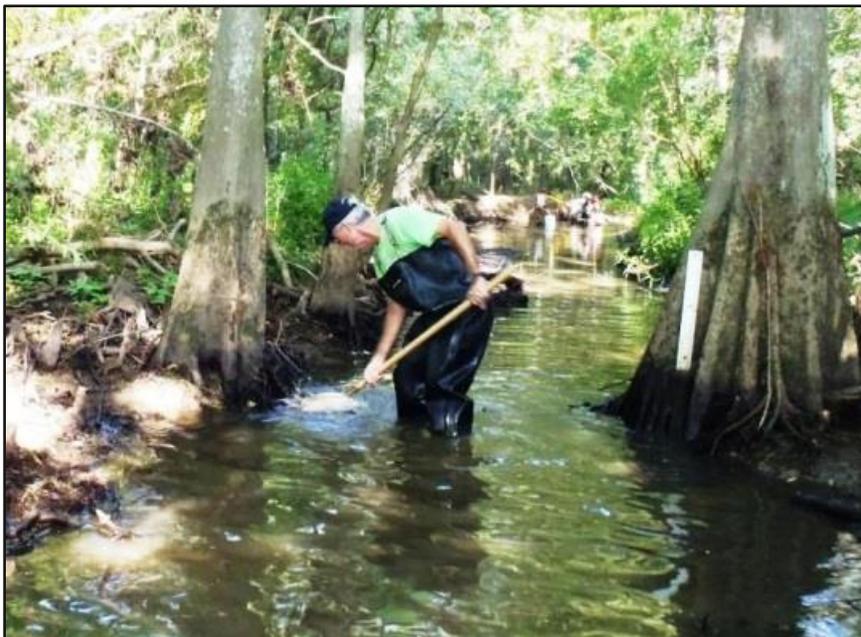
Segment 0407 – James Bayou

James Bayou is listed as a concern for impaired fish community. Station 10321 (James Bayou at CR 1775) has the most biological data of any station in the Cypress Creek Basin. The criterion for concern is an IBI score of 36. Ten biological sampling events were performed annually at this station between 2001 and 2006. The mean of all IBI scores was 50.8 (High) and with the lowest IBI score of 42 (High) occurring in 2006. These results do not support the fish

community concern and show that this AU meets its High ALU designation.

Segment 0408C – Brushy Creek

Segment 0408C is listed as a concern for habitat and benthic macroinvertebrate screening levels. Two assessments were performed at station 15261 (Brushy Creek at FM 115) in June and August 2002. The habitat score for both events was seventeen (Intermediate). The biological summary data showed the station to have limited in-stream cover, moderately unstable stream banks, and unstable bottom substrates. No additional information was available about the station. The stream scored on the borderline of Intermediate/High for both RBA (27.5) and IBI (47) using the



statewide scoring method.

Segment 0409 – Little Cypress Creek

Assessment Unit 0409_03 is listed as a concern for near non-attainment for benthics. Two events have been conducted at station 10335 (Little Cypress Creek at SH 155, Figure B2) in July and August 2004. The criterion for listing is 29 and both RBA events scored were well within the High category with an average of 31.5. The fish community was also high scoring between the High and Exceptional ratings using the statewide metrics. These results do not support the benthic concern and show that this AU meets its High ALU designation.

Segment 0409E – Clear Creek

Segment 0409E is listed as a concern for the benthic community and habitat screening levels. There were no data available in SWQMIS and no biological summary reports were available for review.

Biological Assessments

A total of 65 biological assessments have been conducted in the Cypress Creek Basin since 2001. The average RBA falls into the Intermediate category; average IBI, High; average HQI, Intermediate. In general, the Cypress Creek Basin supports diverse benthic and fish populations despite regular periods of drought, flooding, summertime low DO and typically turbid water conditions.

Figure 29: Dr. Roy Darville collects aquatic insects while the fish sampling team performs electroshocking upstream

Overall, 286 benthic taxa and 83 fish species have been collected in the basin. It should also be noted that out of all of the fish collected over the past thirteen years, no diseased fish have been recorded.

Although these scores are often viewed individually, each one describes only a single part of the overall stream health and each part can have an impact on the scores of the others. For example, poor habitat quality normally leads to less diverse benthic communities; and fewer benthos, a primary food source for invertivorous fish, often leads to lower IBI scores. Additionally, these scores and taxa lists should be evaluated across similar watersheds and within the same ecoregion in order to gain a better understanding of the overall health of the biotic community.

In 2006, the IBI scoring method changed from using a uniform, state-wide format to using ecoregion specific scoring metrics. This change has had little impact on the historical data since most IBI's in the basin were already in the High to Exceptional range. However, the Ecoregion 33 & 35 IBI does not use the number of darter species metric, but uses the number of Cyprinid species instead. Cyprinids were selected as indicator species because darter richness varies greatly among Texas river basins and have distributional limitations, with many western basins having few if any darters present (Linam *et al.*, 1999). Both groups are benthic invertivores and are sensitive to water quality impairments and habitat disturbance, but the Cypress Creek Basin, unlike most of Texas, supports a diverse darter population. Darters typically comprise over fifteen percent of the species richness in most segments.

One concern noted in the *2009 Cypress Creek Basin Summary Report* was that no darter species were collected at station 10314 (Black Bayou at CR 4659) as part of Use Attainability Analysis conducted by the TCEQ in 2003 and 2004. According to the historical data, slough darters (*Etheostoma gracile*) had been collected at this station during events conducted in September 1994 and August 1995. Sampling was scheduled to be conducted at this station in FY 2013; however, the site was found to be completely dry on the upstream side of the bridge and had one pool on the downstream side so biological sampling could not be conducted according to SWQM protocols. Sampling was conducted at station 10308 (Black Bayou at SH 43) and darter species were collected during both sampling events.

As discussed in the previous chapter, station 10314 has been regularly reported as intermittent or having low flow conditions. The absence of darter species at this station during UAA sampling is likely due to limited flow conditions rather than due to contaminants or perturbed water quality. WMS is scheduled to sample at this station in FY 2014.

RBA's in the Cypress Creek Basin often fall into the Intermediate category (Crowe and Bayer, 2005, Rogers and Harrison, 2007). One might infer that impaired water quality is negatively affecting benthic diversity; however, the benthic population is very diverse with over 285 species collected in the watershed.

Impaired water quality with a negative impact on the benthic community should also negatively affect the fish community. Biological monitoring results indicate this is not the case for the

Cypress Creek Basin. State-wide scoring metrics may not accurately reflect results in the ecoregions in the basin. The present metrics include an abundance of EPT taxa (Ephemeroptera, Plecoptera, Trichoptera) and percent Elmidae. Regionalization of benthic scoring metrics will possibly show more correlation between fish and benthic community scoring.

Although species within the EPT families are found in the basin, due to the lack of riffles, emergent plants, clear water and rock/gravel substrate, these species are not abundant. Many species of mayflies (Ephemeroptera) and stone flies (Plecoptera) in particular have fine gills that cannot function efficiently in the turbid waters commonly found in the Cypress Creek Basin, thus are seldom present in abundant numbers. These organisms, along with the caddisflies (Trichoptera) and riffle beetles (Elmidae) require stable substrates, such as gravel or rock bed streams. Only a few species within these four families are adapted to the turbid water and silty bottomed streams commonly found in East Texas. While the lack of diverse habitat plays a major role in limiting the number of intolerant benthic species, ecoregion-specific RBA metrics should also be developed to more adequately evaluate the benthic community.

The average HQI score in the basin is on the borderline of Intermediate and High. Some components of the habitat assessment metrics include the number of riffles, types of substrate, and emergent vegetation. Many streams in the basin will have a reduced HQI score due in part to these metrics (Crowe and Hambleton, 1998). Most perennial streams in East Texas function as glide/pool rather than as riffle/run. Streams typically have low velocity and due to the murkiness of the water, it is often difficult to

determine where a pool begins and ends without making stream width and depth measurements. Riffles are not common in the watershed and are mostly found in the western portion of the basin. When riffles are present, they are usually in small, intermittent streams that often become completely dry without pools during extended periods of drought. While it is common to find aquatic plants along stream margins, due to the high turbidity, erosional sediments and heavy tree canopy, emergent macrophytes are rarely encountered within the stream channel.

Even though the riparian zone may be completely natural and show few, if any, signs of human impact, the HQI may still score at the low end of the High range or at the upper end of the Intermediate range. For example, Frazier Creek is considered an ecoregion reference stream and has been classified as a “Least Disturbed Stream” (Bayer *et al.*, 1992; Linam *et al.*, 1999). Due to these designations, one would expect HQI scores for Frazier Creek to be in the High or Exceptional categories. However, the assessors scored the habitat at 18.5 (Intermediate) during both monitoring events in 2003. While diverse habitats such as riffles and emergent vegetation are important to supporting diverse biota, an ecoregion-specific habitat assessment should be developed to better describe streams within the Cypress Creek Basin especially when considering that least impacted reference sites should represent realistic, attainable conditions for aquatic ecosystems (Omernik, 1995).

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Table 12: Biological monitoring conducted by CRP with average RBA, IBI and HQI by segment from 2001 – 2012

CRP Biological Monitoring				
June 2001 - October 2012				
Segment	RBA	IBI	HQI	# Events
0401	29.5 High	48.0 High	18.0 Intermediate	2
0402	27.1 Intermediate	53.6 Exceptional	19.9 High	8
0404	27.5 Intermediate	48.9 High	21.5 High	8
0405	29.0 High	47.3 High	19.2 High	6
0406	21.4 Limited	46.4 High	20.7 High	6
0407	26.9 Intermediate	49.8 High	19.3 High	15
0408	26.7 Intermediate	45.7 High	18.0 Intermediate	6
0409	25.8 Intermediate	48.9 High	16.7 Intermediate	14
Scoring Ranges:				
Exceptional	>36	>52	26 - 31	
High	29 - 36	42 - 51	20 - 25	
Intermediate	22 - 28	36 - 41	14 - 19	
Limited	<22	<36	<13	

Summary and Recommendations

The eutrophication process appears to be occurring throughout much of the Big Cypress Creek watershed. This is evidenced by the increasing pH trends in Big Cypress Creek below Lake Bob Sandlin. This is further evidenced by the increasing nutrient trends in Segment 0404 followed by increasing chlorophyll *a* trends in Lake O' the Pines. As a result of the lack of freshwater inflow into Big Cypress Creek due to lower than average annual rainfall and reduced releases from Lake Bob Sandlin, the stream flow has become increasingly dominated by effluent especially over the past decade. This is demonstrated by statistically significant increasing Specific Conductance/Total Dissolved Solids trends in Big Cypress Creek below Lake Bob Sandlin and below Lake O' the Pines.

Elevated bacteria levels and nutrient enrichment appear to be significant threats to the water quality and the biological communities in the Cypress Creek Basin. High *E. coli* values in Segments 0404 and 0409 (Little Cypress Creek) is a concern since this is often associated with improperly treated effluent and non-point sources such as malfunctioning septic systems and agricultural run-off.

Segments 0402A, 0404B, 0404C, 0406, 0407, 0409, and 0409B are included on the 2012 §303(d) List for not supporting the *E. coli* geometric mean criterion of 126 MPN/100 mL. In 2011, a Comprehensive Recreational Use Attainability Analysis (RUAA) was conducted in Segment 0404 of Big Cypress Creek, Tankersley Creek, and Hart Creek. Physical measurements were made, landowner interviews were conducted and several public meetings were held.

Preliminary results of the Comprehensive RUAA found no evidence of primary contact recreation occurring within the study area. A Comprehensive RUAA should be considered in the other segments with *E. coli* listings to determine whether primary or secondary contact recreation is occurring in the segment.

The decreasing trend for dissolved oxygen in Segment 0406 (Black Bayou) appears to be drought related. The Cypress Creek Basin has experienced much lower than normal rainfall with an average of 38.5 inches over the past four years. Nearly half of the samples collected over the past eight years in the segment were below the 3.0 mg/L criterion; however, it should be noted that for most of those low DO results, the corresponding flow measurement was reported as 0 cubic feet per second (cfs). The low DO samples occurred primarily during the summer months, but spring and fall sampling also had 0 cfs flow measurements. During the 2009 *Cypress Creek Basin Summary Report*, a concern for the lack of darter species collected during the TCEQ UAA was discussed. Despite station 10314 going completely dry in 2011, darters were collected during both sampling events conducted in 2012.

Due to the regular occurrence of no flow and intermittent conditions as noted by samplers at stations in Segments 0406 and 0407, a change in the classification from "Perennial" to "Intermittent with Perennial Pools" was made for these water bodies. As mentioned previously, approximately eighty percent of the low DO readings corresponded with a reported flow of 0 cfs in Black Bayou. Similar results were found for James' Bayou where

nearly 90 percent of the low DO grab samples taken over the past eight years were collected when there was no flow. According to Chapter 307.3 of the *Texas Administrative Code*, a stream is defined as “Intermittent” if the stream has a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 flow of less than 0.1 cfs is considered intermittent. A stream defined as “Intermittent with Perennial Pools” is an intermittent stream that maintains persistent pools even when flow in the stream is less than 0.1 cfs.

Despite the water quality impairments in the basin, they do not appear to have adversely affected the biological communities in the basin, especially when considering that Segments 0404 and 0409 support some of the most diverse fish populations in the watershed. Since the majority of the biological assessments have been conducted over the past fifteen years, the long-term effects of these impairments on the biota cannot be determined. However, continued nutrient inputs may eventually lead to an overall reduction in the number of intolerant species.

Although low dissolved oxygen concentrations in the summer and low pH often naturally occur in East Texas, these issues are exacerbated through additional nutrient inputs. Efforts to reduce nutrient loadings through the implementation of BMPs, such as those used in the Lake O’ the Pines TMDL, should be considered across the Cypress Creek Basin.



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Appendix A

2014 Cypress Creek Basin Summary Report

Table 13: Summary of statistical analysis for the Cypress Creek Basin

Segment Name	AU	Parameter	Date Range	# of Data Points	T-stat	p-value	Trend Direction
Lake Cypress Springs (0405)	01	Specific Conductance	11/98 - 8/13	54	-5.035	<0.001	↑
	02	Specific Conductance	11/98 - 8/13	55	-4.852	<0.001	↑
Lake Bob Sandlin (0408)	03	Specific Conductance	11/98 - 7/13	57	-4.939	<0.001	↑
Big Cypress Creek Below Lake Bob Sandlin (0404)	02	Specific Conductance	9/73 - 7/13	225	-2.508	0.013	↑
		pH	9/73 - 7/13	218	28.04	<0.001	↑
		Phosphorus	11/73 - 7/13	133	-3.212	0.002	↑
	01	Total Organic Carbon	10/79 - 7/13	121	5.818	<0.001	↓
		Phosphorus	10/79 - 1/13	117	-3.818	<0.001	↑
Lake O' the Pines (0403)	04	Transparency	10/03 - 8/13	34	4.147	<0.001	↓
	02	Specific Conductance	1/99 - 8/13	68	-5.010	<0.001	↑
	01	Specific Conductance	10/73 - 8/13	127	6.645	<0.001	↑
		Chlorophyll <i>a</i>	11/73 - 4/13	113	-3.960	<0.001	↑
Big Cypress Creek Below Lake O' the Pines (0402)	03	pH	11/98 - 7/13	58	3.463	0.001	↑
	01	Specific Conductance	9/02 - 8/13	77	-3.025	0.003	↑
Caddo Lake (0401)	07	Specific Conductance	10/00 - 8/13	200	-4.212	<0.001	↑
Segment 0406: Black Bayou	01	Specific Conductance	9/73 - 7/12	198	4.496	<0.001	↓
		Dissolved Oxygen	9/68 - 7/12	239	8.404	<0.001	↓
		pH	9/73 - 7/12	199	28.04	<0.001	↓

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Table 14: Periods of record for the Cypress Creek Basin trend analysis

Segment Name	Segment Number	Data Points	Date Range	
Caddo Lake	0401	12,945	September 9, 1973	August 6, 2013
Big Cypress Creek below Lake O' the Pines	0402	10,124	September 4, 1968	August 6, 2013
Lake O' the Pines	0403	11,489	October 24, 1973	August 29, 2013
Big Cypress Creek below Lake Bob Sandlin	0404	10,860	September 10, 1968	July 11, 2013
Lake Cypress Springs	0405	7,487	September 13, 1973	August 1, 2013
Black Bayou	0406	7,389	September 12, 1968	July 9, 2012
James' Bayou	0407	5,827	September 12, 1968	July 5, 2013
Lake Bob Sandlin*	0408	4,777	October 29, 1981	July 31, 2013
Little Cypress Creek	0409	8,070	September 26, 1973	October 9, 2013
Total		78,968		

For questions or comments regarding this report, please contact:

Water Monitoring Solutions, Inc.

P.O. Box 1132

Sulphur Springs, Texas 75483

(903) 493-4741

info@water-monitor.com

www.water-monitor.com

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water-monitor.com