January 2023 Update to the Texas Water Quality Management Plan

Prepared by
Water Quality Division, Office of Water

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY • PO BOX 13087 • AUSTIN, TX 78711-3087

Prepared by the
Office of Water
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WQMP updates are available on the TCEQ webpage:
www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html

Developed in accordance with Sections 205(j), 208,
and 303 of the Clean Water Act
and applicable regulations thereto.

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Introduction

The Texas Water Quality Management Plan (WQMP) is the product of a wastewater treatment facility (WWTF) planning process developed and updated in accordance with provisions of Sections 205(j), 208, and 303 of the federal Clean Water Act (CWA), as amended. The WQMP is an important part of the State's program for accomplishing its clean water goals.[1]

The Texas Department of Water Resources, a predecessor agency of the Texas Commission on Environmental Quality (TCEQ), prepared the initial WQMP for waste treatment management during the late 1970s. The CWA mandates that the WQMP be updated as needed to fill information gaps and revise earlier certified and approved plans. Any updates to the plan need involve only the elements of the plan that require modification. The original plan and its subsequent updates are collectively referred to as the "State of Texas Water Quality Management Plan."

The WQMP is tied to the State's water quality assessments that identify priority water quality problems. WQMPs are used to direct planning for implementation measures that control and/or prevent water quality problems. Several elements may be contained in the WQMP, such as effluent limitations of wastewater facilities, total maximum daily loads (TMDLs), nonpoint source management controls, identification of designated management agencies, and groundwater and source-water protection planning. Some of these elements may be contained in separate documents, which are prepared independently of the current WQMP update process, but may be referenced as needed to address planning for water quality control measures.

This document, as with previous updates[2], will become part of the WQMP after completion of the public comment period, certification by TCEQ, and approval by the United States Environmental Protection Agency (EPA).

The materials presented in this document revise only the information specifically addressed in the following sections. Previously certified and approved WQMPs remain in effect.

[1] See the formal definition of a water quality management plan in Title 40 Code of Federal Regulations (CFR) Section 130.2(k).

[2] Fiscal Years 1974, 1975, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984/85, 1986/88, 1989, 1990, 1991, 1992, 1993/94, 1995, 1996, 1997/98, 02/1999, 05/1999, 07/1999, 10/1999, 01/2000, 04/2000, 07/2000, 10/2000, 01/2001, 04/2001, 07/2001, 10/2001, 01/2002, 04/2002, 07/2002, 10/2002, 01/2003, 04/2003, 07/2003, 10/2003, 01/2004, 04/2004, 07/2004, 10/2004, 01/2005, 04/2005, 07/2005, 10/2005, 01/2006, 04/2006, 07/2006, 10/2006, 01/2007, 04/2007, 07/2007, 10/2007, 01/2008, 04/2008, 07/2008, 10/2008, 01/2009, 04/2009, 07/2009, 10/2009, 01/2010, 04/2010, 07/2010,10/2010, 01/2011, 04/2011, 07/2011, 10/2011, BPUB 2011, 01/2012, 04/2012, 07/2012,10/2012, 01/2013, 04/2013, 07/2013,10/2013, 01/2014, 04/2014, 07/2014, 10/2014, 01/2015, 04/2015, 07/2015, 10/2015, 01/2016, 04/2016, 07/2016, 10/2016, 01/2017, 04/2017, 07/2017, 10/2017, 01/2018, 04/2018, 07/2018, 10/2018, 01/2019, Terra Verde 2019, 04/2019, 07/2019, 10/2019, 01/2020, 04/2020, 07/2020 10/2020, 01/2021, 04/2021, 07/2021 10/2021, 01/2022, 04/2022, 07/2022 and, 10/2022.

The January 2023 WQMP update addresses the following topics for water quality planning purposes:

1. Projected Effluent Limits Updates
2. TMDL Updates

The public comment period for the draft January WQMP update was from February 17, 2023 through March 21, 2023.

The "Projected Effluent Limit Update" section provides information compiled from November 1, 2022 through January 31, 2023 and is based on Texas water quality standards (WQS). Projected effluent limits may be used for water quality planning purposes in Texas Pollutant Discharge Elimination System (TPDES) permit actions.

The "Total Maximum Daily Load Update" section provides information on proposed wasteload allocations (WLA) for new dischargers and revisions to existing TMDLs and was developed by the TCEQ TMDL Program in the Water Quality Planning Division.

Projected Effluent Limit Updates

Table 1 reflects proposed effluent limits for new dischargers and preliminary revisions to original proposed effluent limits for preexisting dischargers. Abbreviations used in the table heading include:

- BOD5–5-Day Biochemical Oxygen Demand
- CBOD5–5-Day Carbonaceous Biochemical Oxygen Demand
- DO–Dissolved Oxygen
- lbs/day–Pounds per Day
- MGD–Million Gallons per Day
- mg/L–Milligrams per Liter
- NH_3-N–Ammonia-Nitrogen

Effluent flows indicated in Table 1 reflect future needs and do not reflect current permits for these facilities. These revisions may be useful for water quality management planning purposes. The effluent flows and constituent limits indicated in the table have been preliminarily determined to be appropriate to satisfy the stream standards for dissolved oxygen in their respective receiving waters. These flow volumes and effluent sets may be modified at the time of permit action. These limits are based on the Texas WQS effective at the time of the production of this update. The WQS are subject to revision on a triennial basis.

Table 1. Projected Effluent Limit Updates

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
10503-002	2491	TX0024112	City of Edinburg Hidalgo	13.5	5	562.95	2	225.18			4	
10903-001	0823	TX0026565	Town of Lakewood Village Denton	0.3	10	25.02	3	7.51			4	
11770-002	1001	TX0136174	Harris County MUD No. 50 Harris	0.36	10	30.02	3	9.01			4	
13415-001	0805	TX0104345	Trinity River Authority of Texas Ellis	12	10	1000.8	2	200.16			6	May-September
				12	10	1000.8	4	400.32			6	October-April
13647-001	0839	TX0056588	City of Aubrey Denton	4.5	7	262.71	2	75.06			4	
14233-001	1229	TX0027685	City of Tolar Hood	0.3	10	25.02	3	7.51			4	
14803-001	0818	TX0129623	Las Lomas Municipal Utility District No. 4B of Kaufman County Kaufman	0.95	5	39.62	1	7.92			4	

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
15163-002	2491	TX0140490	North Alamo Water Supply Corporation Hidalgo	0.99	10	82.57	3	24.77			4	
15721-001	1209	TX0138746	Bassichis Development LLC Brazos	0.22	10	18.35	3	5.5			4	
16091-001	0821	TX0142255	Venetian 141 Swisher, LLC Collin	1.0	5	41.7	1	8.34			6	
16115-001	0902	TX0142484	Woodmere Development Co. Ltd. Harris	0.25	10	20.85	3	6.26			4	
16143-001	1008	TX0142727	Quadvest, L.P. Harris	0.5	10	41.7	3	12.51			4	
16179-001	1247	TX0143065	Theon Ranches, LP Williamson	0.75	5	31.28	2	12.51			4	
16192-001	1903	TX0143251	Forest Glen Utility Company Medina	0.15	5	6.26	1.6	2			6	
16193-001	1014	TX0143260	MAS Houston Revocable Trust Harris	0.04	10	3.34	2	0.67			6	

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
16195-001	1302	TX0143286	Undine Environmental LLC Fort Bend	0.24	10	20.02	3	6			4	
16196-001	1302	TX0143294	Undine Environmental LLC Fort Bend	0.24	10	20.02	3	6			4	
16207-001	1243	TX0143383	JTX Land Holding, LLC Williamson and Bell	0.4	5	16.68	2	6.67			5	
16215-001	1009	TX0143464	Prologis, L.P. Harris	0.15	10	12.51	3	3.75			4	
16218-001	0821	TX0143499	BR-Seven LLC Collin	0.95	10	79.23	2	15.85			5	
16222-001	0823	TX0143529	Clairmont Acquisitions, LLC & JLMCG Properties LLC Denton	0.515	10	42.95	3	12.89			4	
16227-001	2311	TX0143561	Alta Frontera, LLC Jeff Davis	0.02	20	3.34	12	2			3	
16229-001	1248	TX0143596	Terrell Timmermann Farms, LP Williamson	0.975	5	40.66	2	16.26			4	

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
16232-001	0823	TX0143626	Old Stoney Ranch Dev LLC Denton	0.37	10	30.86	3	9.26			4	
16235-001	1108	TX0143642	New Rodeo 288, Ltd. Brazoria	0.2	10	16.68	3	5			6	
16236-001	1810	TX0143651	Clayton Properties Group Inc. Hays	0.3	5	12.51	2	5			4	
16237-001	1202	TX0143669	Finney Vallet Rd Owner, LP Fort Bend	0.84	10	70.06	3	21.02			4	
16238-001	1202	TX0143677	Maple Grove Development, LLC Waller	0.375	5	15.64	2	6.26			4	
16240-001	1008	TX0143693	Prairie Estates at Waller LLC Harris	0.6	10	50.04	2	10.01			5	
16242-001	0818	TX0143707	Cayetano Development LLC Kaufman	0.435	10	36.28	3	10.88			4	
16243-001	0814	TX0143715	Circle S Midlothian, LLC Ellis	0.95	10	79.23	3	23.77			4	

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
16244-001	0823	TX0143723	1720 Westminster LLC Denton	0.45	10	37.53	3	11.26			5	
16245-001	1011	TX0143731	Splendora Acquisitions LTD Montgomery	0.7	10	58.38	3	17.51			4	
16247-001	1202	TX0143758	Quadvest, LP Waller	0.25	10	20.85	3	6.26			4	
16253-001	1002	TX0143782	544 WD, LLC Harris	0.18	10	15.01	3	4.5			4	
16255-001	0507	TX0143791	HMH Caddo Mills Land LP Hunt	0.25	10	20.85	3	6.26			4	
16260-001	1244	TX0143847	705 Limmerloop JV LLC Williamson	0.05	10	4.17	3	1.25			4	

Total Maximum Daily Load Revisions

The TMDL Program works to improve water quality in impaired or threatened water bodies in Texas. The program is authorized by and created to fulfill the requirements of Section 303(d) of the CWA.

The goal of a TMDL is to restore the full use of a water body that has limited quality in relation to one or more of its uses. The TMDL defines an environmental target, and based on that target, TCEQ and stakeholders develop an implementation plan with wasteload allocations for point source dischargers to mitigate human-caused sources of pollution within the watershed and restore full use of the water body.

TMDLs are developed based on intensive data collection and scientific analysis. After adoption by TCEQ, TMDLs are submitted to EPA for review and approval.

The attached appendixes may reflect proposed wasteload allocations for new dischargers and/or additions or revisions to TMDLs. Updates and addendums will be provided in the same units of measure used in the original TMDL document and will include the segment and assessment unit (AU) numbers of the affected segments. Also, note that for bacteria TMDLs, loads will typically be expressed as colony-forming units per day (cfu/day). On occasion, other expressions may be used due to different laboratory methods, such as counts or most probable number per day. For the purposes of the TMDL program, these terms are considered to be synonymous.

Appendix I. Updates to Eighteen TMDLs for Bacteria in Buffalo and Whiteoak Bayous and Tributaries

Segments 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E

This appendix provides updates to TMDLs previously submitted through the State's WQMP for: Buffalo and Whiteoak Bayous and Tributaries.

The report *Eighteen Total Maximum Daily Loads for Bacteria in Buffalo and Whiteoak Bayous and Tributaries For Segment Numbers 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E* was adopted by TCEQ on 04/08/09 and approved by EPA on 06/11/09. Upon EPA approval, the TMDLs became part of the State's WQMP.

The Texas WQMP has since been updated 33 times prior to this update for this TMDL. The previous updates have revised the list of individual WLAs in the original TMDL document. Additionally, TCEQ submitted addenda to the original TMDL in the April 2013, April 2015, and January 2021 WQMP updates. These addenda added three new AUs to the original TMDL project.

The purpose of this update is to make the following change to the TMDL (presented in Table I-1):

- Increased flow to an existing permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for future growth (FG) in one AU. This was originally presented in Table 53 in the original TMDL document. The affected AU in this update is included here as Table I-2.

In Table 54 of the original TMDL, the WLAs for permitted facilities are the sum of the individual WLAs and the allowance for FG within each AU. These overall numbers did not change; Table 54 of the original TMDL remains the same.

Table I-1 - Change to individual WLAs for the TMDL watershed

Updates Table 45, p. 99-103 in the original TMDL document.

The WLA is expressed in billion MPN/day *E. coli*.

State Permit Number	Outfall	EPA Permit Number	AU	Permittee Name	Flow (MGD)	WLA	TMDL Comments
16193-001	001	TX0143260	1014L_01	MAS HOUSTON REVOCABLE TRUST	0.04	0.095	Increased flow

Table I-2 - TMDL summary calculations for one AU in the TMDL watershed

Updates Table 53, p. 116-117 in the original TMDL document.

All loads expressed as billion MPN/day *E. coli*.

AU	Segment Name	TMDL	WLA $_{WWTF}$	WLA $_{SW}$	LA	MOS	Upstream Load	FG
1014L_01	Mason Creek	69.66	33.29	23.11	2.57	0	0	10.69

Appendix II. Updates to Seven TMDLs for Indicator Bacteria in Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds

Segments 1002, 1003, 1004, and 1004D

This appendix provides updates to TMDLs previously submitted through the State's WQMP for: Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds.

The report *Seven Total Maximum Daily Loads for Indicator Bacteria in Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds For Segments 1002, 1003, 1004, and 1004D* was adopted by TCEQ on 08/24/16 and approved by EPA on 10/07/16. Upon EPA approval, the TMDLs became part of the State's WQMP.

The Texas WQMP has since been updated 13 times prior to this update for this TMDL. The previous updates have revised the list of individual WLAs in the original TMDL document. Additionally, TCEQ submitted an addendum to the original TMDL in the October 2018 WQMP update. This addendum added one new AU to the original TMDL project.

The purpose of this update is to make the following changes to the TMDL (presented in Table II-1):

- Remove one cancelled permit with a name change, and
- remove one withdrawn permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for FG in two AUs. This was originally presented in Table 17 in the original TMDL document. The two affected AUs in this update are included here as Table II-2.

In Table 18 of the original TMDL, the WLAs for permitted facilities are the sum of the individual WLAs and the allowance for FG within each AU. These overall numbers for the two AUs did not change, and again this results in no changes to the overall TMDL allocations.

Table II-1 - Changes to individual WLAs for the TMDL watersheds

Updates Table 13, p. 54-55 in the original TMDL document.

The WLA is expressed in billion MPN/day *E. coli*.

State Permit Number	Outfall	EPA Permit Number	AU	Permittee Name	Flow (MGD)	WLA	TMDL Comments
15936-001	001	TX0140708	1002_06	BASIN RV LLC	n/a	n/a	Permit withdrawn
14414-001	001	TX0125601	1004_01	242 LLC	n/a	n/a	Permit cancelled with updated name

Table II-2 - TMDL summary calculations for two AUs in the TMDL watersheds

Updates Table 17, p. 59 in the original TMDL document.

All loads expressed as billion MPN/day *E. coli*.

AU	Segment Name	TMDL	MOS	WLA WWTF	WLA SW	LA AU	LA TRIB	LA RES	LA TOTAL	FG
1002_06	Lake Houston	6,197	106.57	105.35	288.17	1,535.70	3,106.90	958.70	5,601.30	95.61
1004_01	West Fork San Jacinto River	2,779	88.77	102.07	196.81	1,294.21	44.86	958.7	2,297.77	93.58

Appendix III. Updates to Fifteen TMDLs for Indicator Bacteria in Watersheds Upstream of Lake Houston

Segments 1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011

This appendix provides updates to TMDLs previously submitted through the State's WQMP for: Watersheds Upstream of Lake Houston.

The report *Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston For Segment Numbers 1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011* was adopted by TCEQ on 04/06/11 and approved by EPA on 06/29/11. Upon EPA approval, the TMDLs became part of the State's WQMP.

The Texas WQMP has since been updated 40 times prior to this update for this TMDL. The previous updates have revised the list of individual WLAs in the original TMDL document. Additionally, TCEQ submitted four addenda to the original TMDL in the October 2013, October 2019, October 2020, and April 2022 WQMP updates. These addenda added 10 new AUs to the original TMDL project.

The purpose of this update is to make the following changes to the TMDL (presented in Table III-1):

- Add five new permits, and
- remove one cancelled permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for FG in eight AUs. This was originally presented in Table 18 in the original TMDL document. The eight affected AUs in this update are included here as Table III-2.

For AUs 1008_02, 1009_01, and 1009_02, the existing FG allocations were insufficient to cover the increased flow to the AUs for this update. To account for this, the total amount exceeded beyond the original FG allocation was added to the total TMDL allocation. This resulted in a change to the overall TMDL allocation for each of the three AUs, which have been updated in Tables III-2 and III-3. The overall numbers for the other AUs did not change and did not result in a change to the overall TMDL allocations.

Table III-1 - Changes to individual WLAs for the TMDL watershed

Updates Table 16, p. 49-56 in the original TMDL document.

The WLA is expressed in billion MPN/day *E. coli*.

State Permit Number	Outfall	EPA Permit Number	AU	Permittee Name	Flow (MGD)	WLA	TMDL Comments
16240-001	001	TX0143693	1008_02	PRAIRIE ESTATES AT WALLER LLC	0.6	1.431	New permit
16143-001	001	TX0142727	1008_02	QUADVEST, L.P	0.5	1.192	New permit
14828-001	001	TX0129771	1009_01	Barker Utilities GP LLC	n/a	n/a	Cancelled permit
16215-001	001	TX0143464	1009_01	PROGOLIS, L.P.	0.15	0.358	New permit
16223-001	001	TX0143537	1011_02	EAST MONTGOMERY COUNTY MUD NO. 13	0.6	1.431	New permit
16245-001	001	TX0143731	1011_02	SPLENDORA ACQUISITIONS LTD	0.7	1.669	New permit

Table III-2 - TMDL summary calculations for eight AUs in the TMDL watershed

Updates Table 18, p. 61 in the original TMDL document.

All loads expressed as billion MPN/day *E. coli*.

AU	Sampling Location	Segment Name	TMDL	WLA WWTF	WLA SW	LA	MOS	FG
1008_02	11314	Spring Creek	298.57	17.77	71.9	194.5	14.4	0.00
1008_03	11313	Spring Creek	1420	118.73	322	869	70.9	39.37
1008_04	11312	Spring Creek	1510	154.40	334	902	75.7	43.90
1009_01	11331	Cypress Creek	239.56	30.26	83.1	114.8	11.4	0.00
1009_02	11328	Cypress Creek	615.08	118.28	196	270	30.8	0.00
1009_03	11324	Cypress Creek	1340	202.04	415	574	67.0	81.96
1009_04	14159	Cypress Creek	1550	241.22	469	648	77.4	114.38
1011_02	14241	Peach Creek	422	16.34	34.5	348.5	21.1	1.56

Table III-3 - TMDL final calculations

Updates Table 19, p. 62 in the original TMDL document.

All loads expressed as billion MPN/day *E. coli*.

AU	TMDL	WLA $_{WWTF}$	WLA $_{SW}$	LA $_{TOTAL}$	MOS
1008_02	298.57	17.77	71.9	194.5	14.4
1009_01	239.56	30.26	83.1	114.8	11.4
1009_02	615.08	118.28	196	270	30.8

In addition, Table III-4 below provides an update to Table 11 found in the October 2013 addendum to this TMDL project (*Addendum One to Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston: Six Additional Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston for Segments 1008B, 1008C, 1008E, and 1011*). Two of the permits discussed earlier in this update also affect one AU in this addendum.

Table III-5 below provides updates to Table 12 found in the October 2013 addendum to this TMDL project. The addendum added six AUs that were not included in the original TMDL. The AU affected here (1011_01) was included as an upstream loading to 1011_02 in the original TMDL. Two of the permits (16223-001/TX0143537 and 16245-001/ TX0143731) affect the loading of 1011_01 as well as the original TMDL AU 1011_02.

In Table 13 of the October 2013 TMDL addendum, the WLAs for permitted facilities are the sum of the individual WLAs and the allowance for FG within the single affected AU. For AU 1011_01, the existing FG allocation was insufficient to cover the increased flow to the AU for this update. To account for this, the total amount exceeded beyond the original FG allocation was added to the total TMDL allocation. This resulted in a change to the overall TMDL allocation for the AU, which has been updated in Tables III-5 and III-6.

Table III-4 - Changes to individual WLAs in the Peach Creek watershed

Updates Table 11, p. 23 in the TMDL addendum document.

The WLA is expressed in billion MPN/day *E. coli*.

State Permit Number	Outfall	EPA Permit Number	AU	Permittee Name	Flow (MGD)	WLA	TMDL Comments
16223-001	001	TX0143537	1011_01	EAST MONTGOMERY COUNTY MUD No. 13	0.6	1.431	New permit
16245-001	001	TX0143731	1011_01	SPLENDORA ACQUISITIONS LTD	0.7	1.669	New permit

Table III-5 - TMDL summary calculations for one AU in the Peach Creek watershed

Updates Table 12, p. 26 in the TMDL addendum document.

All loads expressed as billion MPN/day *E. coli*.

AU	Stream Name	TMDL	MOS	WLA WWTF	WLA SW	LA AU	LA RES	LA TOTAL	FG
1011_01	Peach Creek	223.99	10.7	12.14	3.05	198.1	0.0	198.1	0.0

Table III-6 – TMDL addendum final calculations

Updates Table 13, p. 27 in the TMDL addendum document.

All loads expressed as billion MPN/day *E. coli*.

AU	TMDL	WLA_{WWTF}	WLA_{SW}	LA_{TOTAL}	MOS
1011_01	223.99	12.14	3.05	198.1	10.7

Appendix IV. Updates to One TMDL for Bacteria in Upper Oyster Creek

Segment 1245

This appendix provides updates to TMDLs previously submitted through the State's WQMP for: Upper Oyster Creek.

The report *One Total Maximum Daily Load for Bacteria in Upper Oyster Creek for Segment Number 1245* was adopted by TCEQ on 08/08/07 and approved by EPA on 09/28/07. Upon EPA approval, the TMDLs became part of the State's WQMP.

The Texas WQMP has since been updated 18 times prior to this update for this TMDL. The previous updates have revised the list of individual WLAs in the original TMDL document.

The purpose of this update is to make the following change to the TMDL (presented in Table IV-1):

- Add one new permit.

Note that this TMDL was written for *E. coli* and that it used the single sample criterion of 394 cfu/100 mL. All of the permitted facilities covered by the original TMDL and subsequent WQMP updates have also been given a daily average for *E. coli* of 126 cfu/100 mL consistent with standard bacteria permitting practices for the State of Texas. In addition, watershed stakeholders are meeting annually to discuss water quality in Upper Oyster Creek related to this TMDL project (both instream data as well as self-reported data from permitted facilities) and may recommend stricter permit limits for *E. coli* in the future if deemed necessary.

The changes reflected in this update resulted in an increase to the total TMDL allocation and WLA Continuous variable in Allocation Reach 2. This was originally presented in Table 11 in the original TMDL document, and the new allocations are updated here in Table IV-2. The increase to the total TMDL allocation is done to account for the increased flow caused by additional discharges into the watershed and is based on the TMDL allocation summary as presented in Table 4 of the April 2016 WQMP Update.

Table IV-1 - Changes to individual WLAs for the Upper Oyster Creek watershed

Updates p. 33-37 in the original TMDL document.

The WLA is expressed in cfu/day *E. coli*.

State Permit Number	Outfall	EPA Permit Number	Allocation Reach	Permittee Name	Flow (MGD)	WLA	TMDL Comments
16224-001	001	TX0143545	2	JDS NURSERY TRACT, LLC	0.2	2.98×10^9	New permit

Table IV-2 - TMDL summary calculations by allocation reach in the Upper Oyster Creek watershed

Updates Table 11, p. 37 in the original TMDL document.

All loads expressed as billion cfu/day *E. coli*.

Allocation Reach	TMDL	WLA Continuous	WLA Non-continuous	LA Other	MOS
2	1822.73	234.73	744.00	844.00	Implicit

Appendix V. Updates to Two TMDLs for Dissolved Oxygen in Upper Oyster Creek

Segment 1245

This appendix provides updates to TMDLs previously submitted through the State's WQMP for: Upper Oyster Creek.

The report *Two Total Maximum Daily Loads for Dissolved Oxygen in Upper Oyster Creek: Segment 1245* was adopted by TCEQ on 07/28/10 and approved by EPA on 09/21/10. Upon EPA approval, the TMDLs became part of the State's WQMP.

The Texas WQMP has since been updated 13 times prior to this update for this TMDL. The previous updates have revised the list of individual WLAs in the original TMDL document.

The purpose of this update is to make the following changes to the TMDL (presented in Table V-1):

- add one new permit.

The allocations presented in this update were verified as satisfactory using the QUAL2K model used in establishing the original TMDL. The relevant permit limits for the facility that increased its discharge are provided in Table V-2. The TMDL summary equations must also be updated for carbonaceous biochemical oxygen demand ($CBOD_5$; Table V-3) and ammonia nitrogen (NH_3-N; Table V-4) to reflect these changes.

Table V-1 - Changes to individual WLAs for the Upper Oyster Creek watershed

Updates Table 9, p. 29 in the original TMDL document.

Permittee Name	TCEQ Permit No. EPA Permit No. Outfall No.	AU	Final Permitted Discharge (MGD)	Allowable $CBOD_5$ Loading (kg/d) | (lb/d)	Allowable NH_3-N Loading (kg/d) | (lb/d)	TMDL Comments
JDS Nursery Tract, LLC	16224-001 / TX0143545 / 001	03	0.2	7.57 | 16.69	2.27 | 5.01	New permit

Table V-2 - Permitted loadings for individual WWTFs

Corresponds to Table 3, p. 13 in the original TMDL document.

Facility Name	TCEQ Permit No. EPA Permit No. Outfall No.	Final Permitted Discharge (MGD)	$CBOD_5$ (mg/L)	NH_3-N (mg/L)	Dissolved Oxygen (mg/L)
JDS Nursery Tract, LLC	16224-001 / TX0143545 / 001	0.2	10.0	3.0	6.0

Table V-3 - Summary of TMDLs for Upper Reach $CBOD_5$

Updates Table 13, p. 36 in the original TMDL document.

Source Category	Proposed (Full Permitted) Loading[1] (kg/d)	Allowable Loading[2] (kg/d)
1245_03:		
WLA	392.16	392.16
LA	96	96
Total Loading	**488.16**	**488.16**

Table V-4 - Summary of TMDLs for Upper Reach NH_3-N

Updates Table 14, p. 37 in the original TMDL document.

Source Category	Proposed (Full Permitted) Loading[1] (kg/d)	Allowable Loading[2] (kg/d)
1245_03:		
WLA	98.15	98.15
LA	3.69	3.69
Total Loading	**101.84**	**101.84**

1 Those facilities routing wastewater through polishing ponds are included in the total, assuming quality exiting the pond(s) is 1.3 mg/L $CBOD_5$ and 0.05 mg/L NH_3-N.

2 Allowable loading is determined using the QUAL2K model developed for the TMDL and existing/proposed discharges at limits necessary to meet the relevant dissolved oxygen criteria.

Note: As stated earlier, the allocations presented in this update were verified as satisfactory using the QUAL2K model used in establishing the original TMDL. The original water quality sampling for the project was completed in 2005, and since then conditions in the watershed have changed and there had been limited sampling to assess water quality. A new sampling project for Segment 1245 began in December 2015 and continued approximately monthly through August 2017. In addition to providing valuable information to concerned stakeholders in the watershed, these data are now being analyzed and a new modeling effort is underway.

Appendix VI. Addendum Two to Seven TMDLs for Indicator Bacteria in Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds

Adding one TMDL for 1004J_01

One TMDL for Indicator Bacteria in White Oak Creek

Introduction

TCEQ adopted *Seven TMDLs for Indicator Bacteria in Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds* (TCEQ, 2016) on August 24, 2016. EPA approved the TMDL on October 7, 2016. An addendum to the original TMDL was submitted to EPA through the October 2018 WQMP update (TCEQ, 2018a). That addendum added one AU. This document is the second addendum to the original TMDL report.

This second addendum includes information specific to one additional AU for White Oak Creek (AU 1004J_01; also referred to in this addendum as the TMDL watershed). This AU is located within the watershed of the approved original TMDLs for the East and West Forks of the San Jacinto River. The concentration of indicator bacteria in this additional AU exceeds the criterion used to evaluate support of the primary contact recreation 1 use.

This addendum details the development of the added TMDL allocation for this additional AU, which was not specifically addressed in the original TMDL report. For background or other explanatory information, please refer to the *Technical Support Document for One TMDL for Indicator Bacteria in White Oak Creek*[c] (Adams and Millican, 2022). Refer to the original, approved TMDL document for details about the overall project watershed as well as methods and assumptions used in developing the original TMDLs.

[c] www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/82g-as-474-white-oak-bacteria-tsd-2022-sept.pdf

Problem Definition

TCEQ first identified the bacteria impairment for White Oak Creek in the *2020 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2020). The impairment was identified again in the subsequent 2022 Texas Integrated Report (TCEQ, 2022a), the latest EPA-approved edition. The impaired AU is 1004J_01. The water body includes only one AU. The White Oak Creek watershed also includes the contributing subwatersheds of upstream, non-impaired AUs East Fork White Oak Creek (AU 1004A_01) and West Fork White Oak Creek (AU 1004B_01). Figure VI-1 shows the watershed added in this addendum in relation to the entire watershed of the original TMDLs, which is located within the Lake Houston watershed in the San Jacinto River Basin.

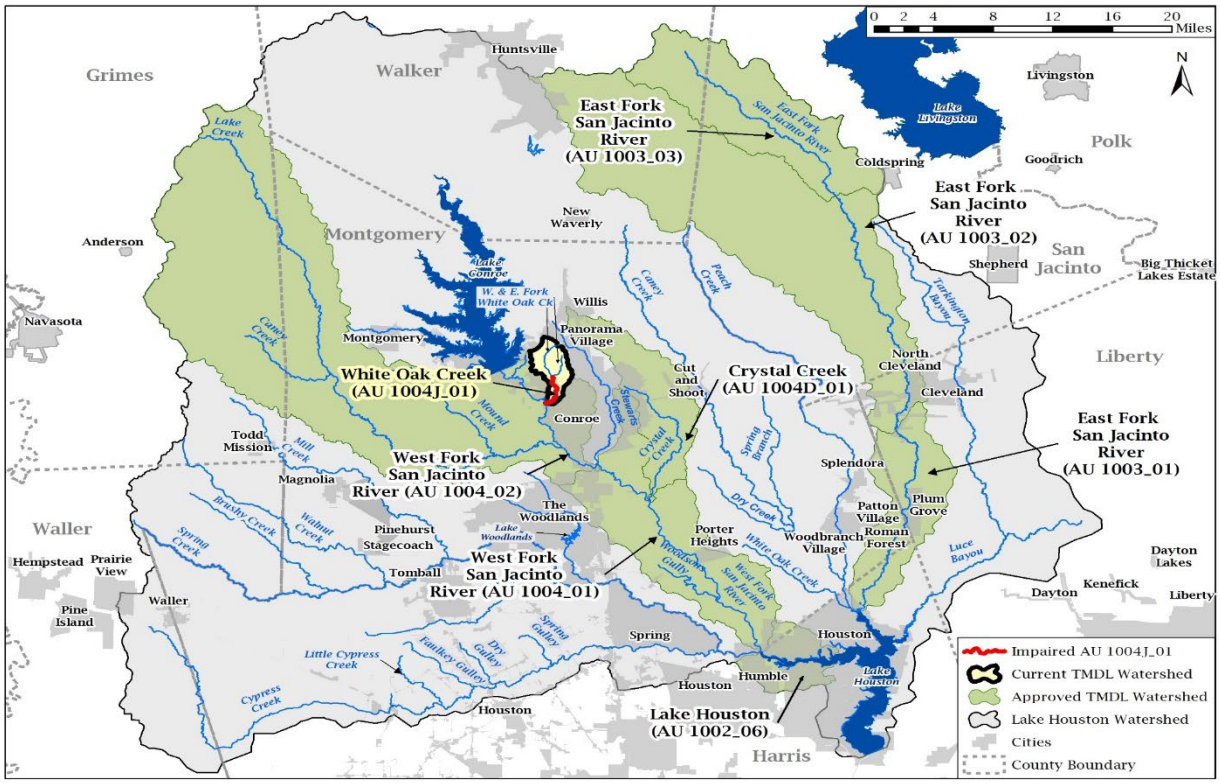

Figure VI-1. Map showing the previously approved TMDL watersheds and the White Oak Creek 1004J_01 watershed added by this addendum

The Texas Surface Water Quality Standards (TCEQ, 2018b) identify uses for surface waters and numeric and narrative criteria to evaluate attainment of those uses. The basis for the water quality target for the TMDL developed in this addendum is the numeric criterion for indicator bacteria from the 2018 Texas Surface Water Quality Standards. *Escherichia coli (E. coli)* is the indicator bacteria for assessing primary contact recreation 1 use in freshwater.

Table VI-1 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) station on the water body, as reported in the 2022 Texas Integrated Report (TCEQ, 2022a). The data from the assessment indicate nonsupport of the primary contact recreation 1 use for the AU, because the geometric mean concentration for *E. coli* exceeds the freshwater geometric mean criterion of 126 cfu/100 mL of water. Figure VI-2 shows the location of the TCEQ SWQM station that was used in evaluating water quality in the 2022 Texas Integrated Report for the water body added by this addendum.

Table VI-1. 2022 Texas Integrated Report summary

AU	TCEQ SWQM Station	Parameter	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
1004J_01	20731	*E. coli*	28	12/01/2013 – 11/30/2020	3,421.1

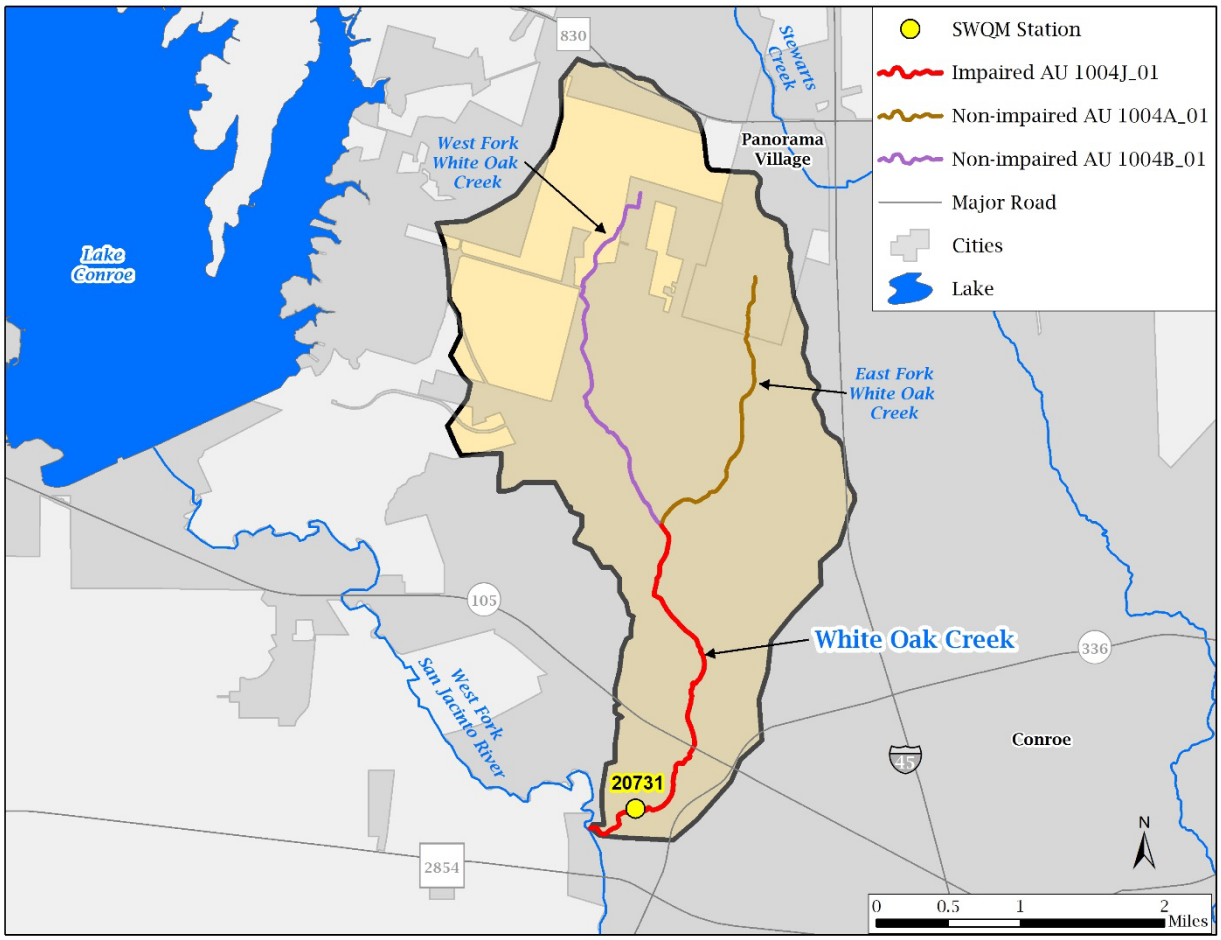

Figure VI-2. Active TCEQ SWQM station

Watershed Overview

White Oak Creek AU 1004J_01 is a tributary to the West Fork San Jacinto River (Segment 1004). The water body is approximately 3.0 miles long, drains 8.7 square miles (5,538 acres), and is located entirely within Montgomery County.

The 2022 Texas Integrated Report (TCEQ, 2022a) provides the following water body and AU description:

- White Oak Creek AU 1004J_01 – Perennial stream from the confluence with West Fork San Jacinto River upstream to the confluence with East Fork White Oak Creek and West Fork White Oak Creek in Conroe.

Climate

Weather data were obtained for the 10-year period from January 2012 through December 2021 from the the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information for the Conroe North Houston Regional Airport (NOAA, 2022). Data from this 10-year period indicate that the average monthly high temperature typically reaches a maximum of 94.6 °F in August, and the average monthly low temperature reaches a minimum of 38.9 °F in January (Figure VI-3). Annual rainfall averages 51.0 inches. The wettest month is May (6.9 inches) while February (2.9 inches) is the driest month, with rainfall occurring throughout the year.

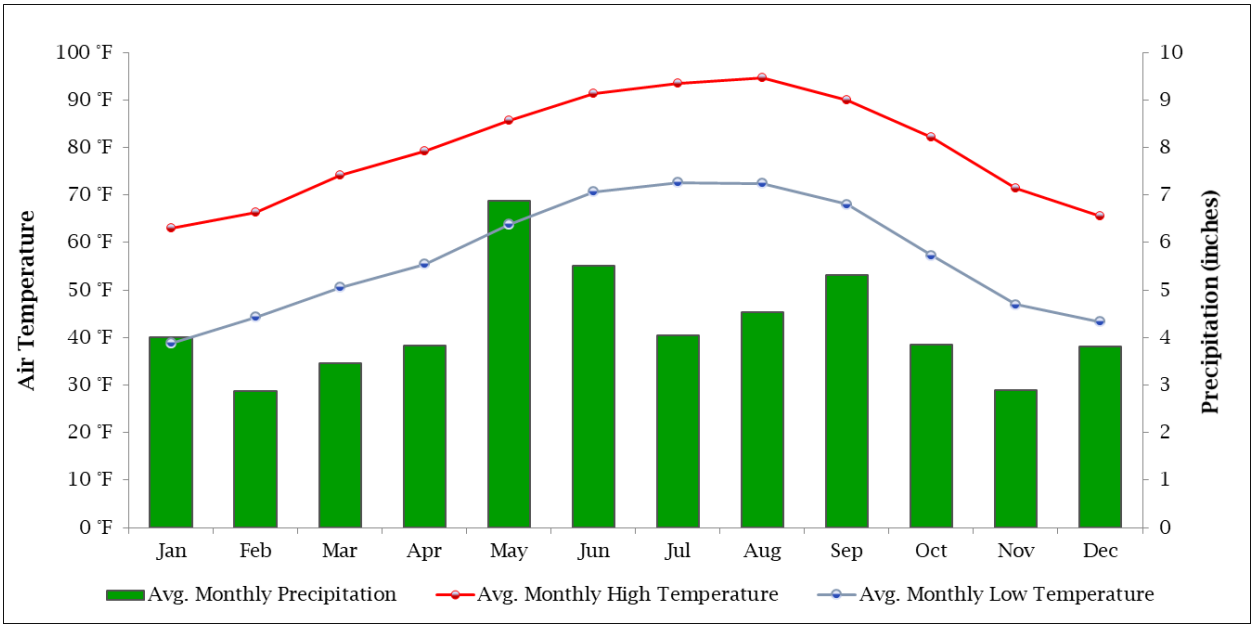

Figure VI-3. Average monthly temperature and precipitation (2012-2021) at the Conroe North Houston Regional Airport

Population and Population Projections

The TMDL watershed is located within Montgomery County. Current predominant population densities for this watershed are zero to two people per acre. According to the 2020 United States Census Bureau (USCB) data (USCB, 2021), the TMDL watershed had an estimated population of 9,645 in 2020.

A population projection through 2045 was developed using data from the H-GAC Regional Growth Forecast data (H-GAC, 2018) to be consistent with the original TMDLs. The forecasts include population projections for transportation analysis zones (TAZ), planning areas used by H-GAC to provide analyses at a local scale. H-GAC updates their regional growth forecast using inputs such as the latest available information on planned and announced developments, population and employment data, and feedback received from forecast users. Table VI-2 provides a summary of the population projection for the TMDL watershed.

Table VI-2. 2020 – 2045 population projection

Area	2020 Estimated Population	2045 Projected Population	Projected Population Increase	Percent Change
White Oak Creek Watershed	9,645	22,341	12,696	132%

The following steps detail the method used to estimate the 2020 and projected 2045 populations in the TMDL watershed.

1. Obtained 2020 USCB data at the block level.
2. Developed the 2020 watershed population using the USCB block level data for the portion of census blocks located within the watershed.
3. For the census blocks that were partially located in the watershed, estimated population by multiplying the block population to the proportion of its area in the watershed.
4. Obtained the 2018 H-GAC Regional Growth Forecast (tabular data) and associated TAZ (spatial data) to be used for population projections (H-GAC, 2018).
5. Joined population data for each TAZ in a geographic information system and located the relevant TAZs within the watershed.
6. For the TAZs that were partially located in the watershed, estimated population projections by multiplying the TAZ population to the proportion of its area in the watershed.
7. Subtracted the 2020 watershed population from the 2045 population projections to determine the projected population increase, then divided the projected population increase by the 2020 watershed population to determine the percentage population increase for the TMDL watershed.

Land Cover

The land cover data for the TMDL watershed were obtained from the United States Geological Survey (USGS) 2019 National Land Cover Database (NLCD; USGS, 2021). The land cover for the TMDL watershed is shown in Figure VI-4. A summary of the land cover data is provided in Table VI-3 and indicates that Evergreen Forest (33.76%) and Developed, Open Space (14.49%) are the dominant land covers in the TMDL watershed.

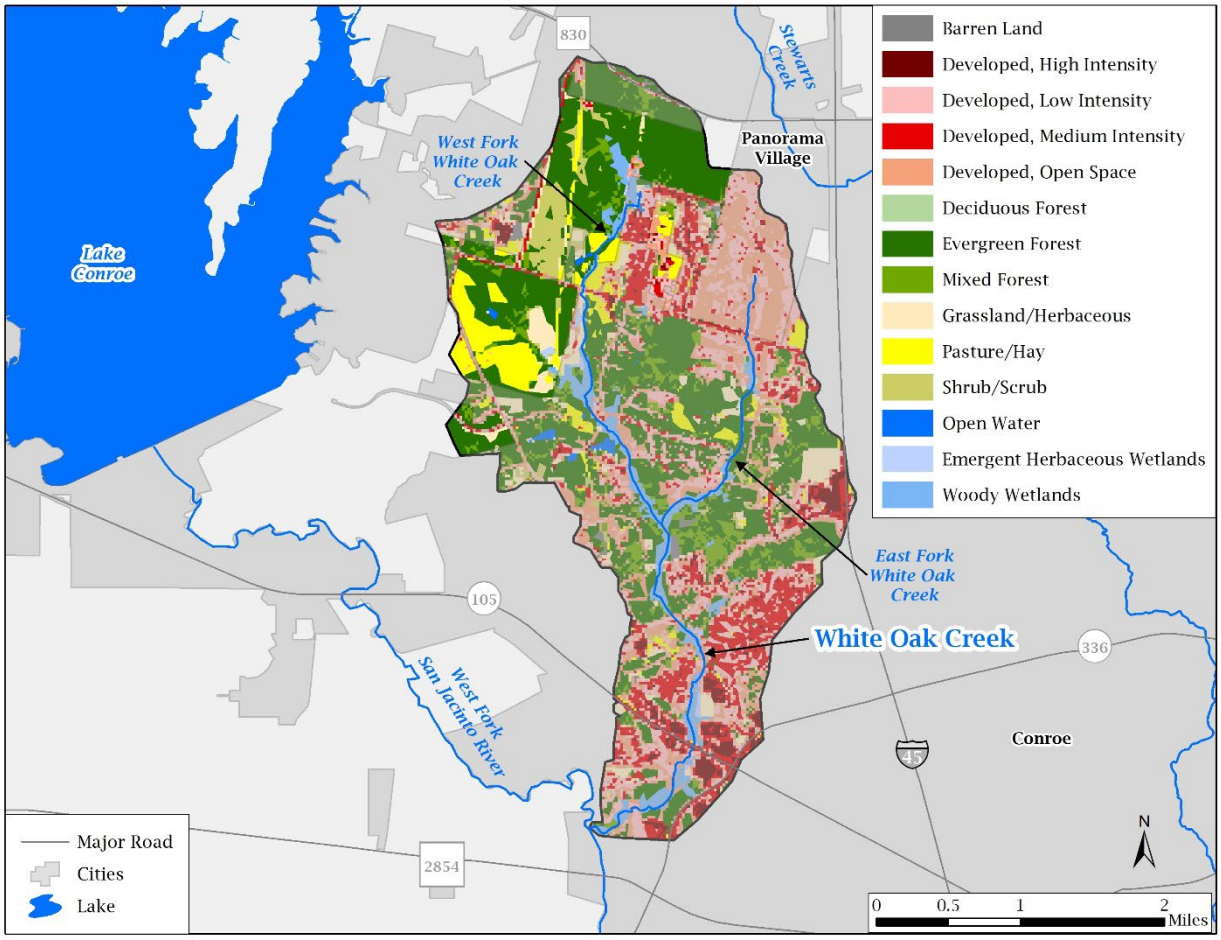

Figure VI-4. Land cover map showing classifications

Table VI-3. Land cover classification by area and percentage

2019 NLCD Classification	Area (Acres)	% of Total
Barren Land	26.04	0.47%
Developed, High Intensity	151.99	2.74%
Developed, Low Intensity	759.94	13.72%
Developed, Medium Intensity	598.24	10.80%
Developed, Open Space	802.59	14.49%

2019 NLCD Classification	Area (Acres)	% of Total
Deciduous Forest	1.25	0.02%
Evergreen Forest	1,869.45	33.76%
Mixed Forest	293.66	5.30%
Grassland/Herbaceous	265.90	4.80%
Pasture/Hay	325.92	5.89%
Shrub/Scrub	153.50	2.77%
Open Water	22.09	0.40%
Emergent Herbaceous Wetlands	21.72	0.39%
Woody Wetlands	245.91	4.44%
Total	**5,538.20**	**100%**

Endpoint Identification

The endpoint for the TMDL is to maintain the concentration of *E. coli* below the geometric mean criterion of 126 cfu/100 mL, which is protective of the primary contact recreation 1 use in freshwater.

Source Analysis

Pollutants may come from several sources, both regulated and unregulated. Pollutants in regulated discharges, referred to as "point sources," come from a single definable point, such as a pipe, and are regulated by permit under the TPDES program. WWTFs and stormwater discharges from industries, construction activities, and the separate storm sewer systems of cities are considered point sources of pollution.

Unregulated sources are typically nonpoint source in origin, meaning the pollutants originate from multiple locations and rainfall runoff washes them into surface waters. Nonpoint sources are not regulated by permit.

Except for WWTFs, which receive individual wasteload allocations (WLAs; see the Wasteload Allocation section), the regulated and unregulated sources in this section are presented to give a general account of the different sources of bacteria expected in the watershed. These are not meant to be used for allocating bacteria loads or interpreted as precise inventories and loadings.

Regulated Sources

Regulated sources are controlled by permit under the TPDES program. The regulated sources in the TMDL watershed include WWTF outfalls and stormwater discharges from municipal separate storm sewer systems (MS4s) and regulated construction activities.

Domestic and Industrial WWTFs

As of March 25, 2022, there was one domestic WWTF with a TPDES permit within the TMDL watershed (Table VI-4 and Figure VI-5).

Table VI-4. TPDES-permitted WWTF discharging in the TMDL watershed

AU	TPDES Number	NPDES[a] Number	Permittee	Outfall Number	Bacteria Limit (cfu/ 100 mL)	Primary Discharge Type	Daily Average Flow – Permitted Discharge (MGD[b])
1004J_01	WQ0011097001	TX0020206	City of Panorama Village	001	63	Treated domestic wastewater	0.4

[a]NPDES: National Pollutant Discharge Elimination System

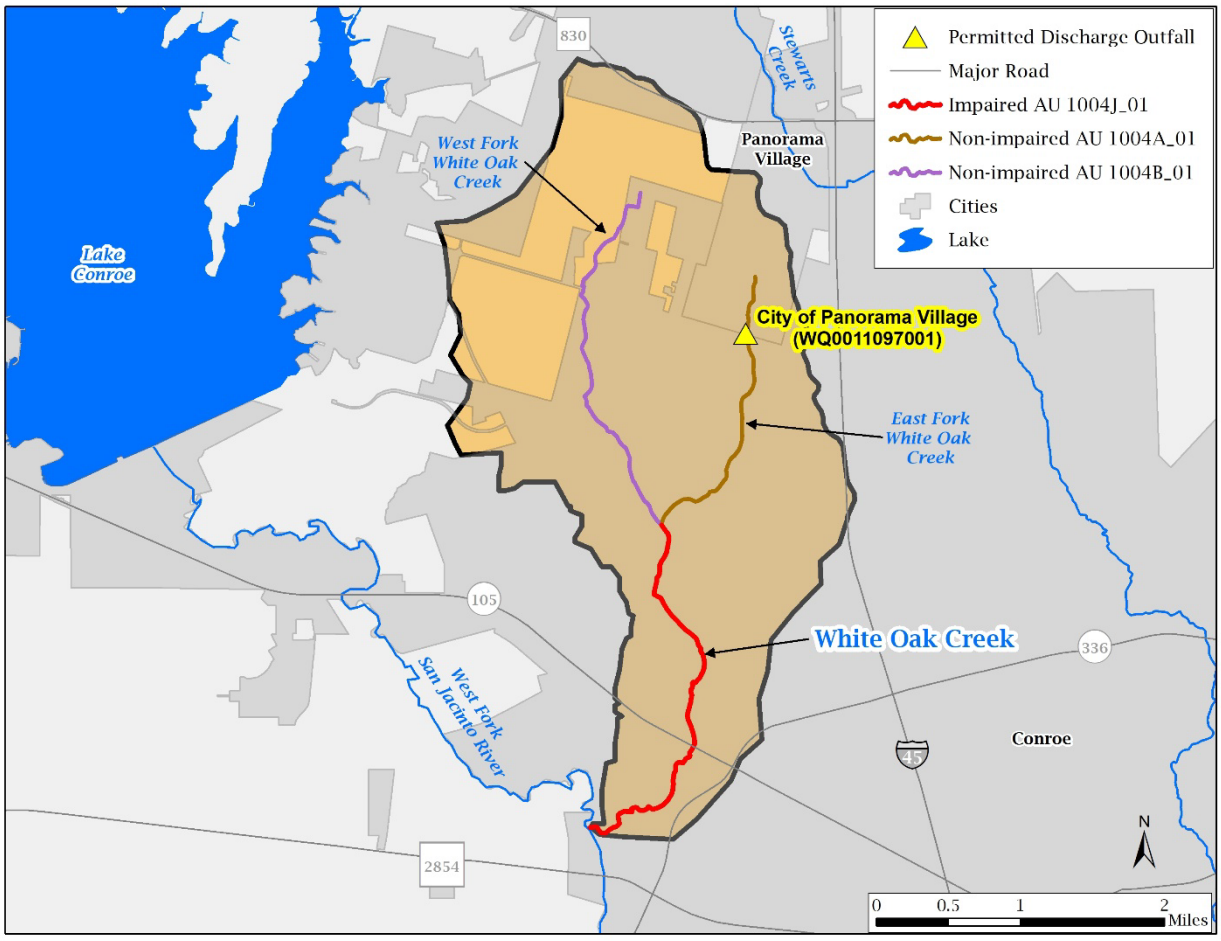

Figure VI-5. WWTF in the TMDL watershed

TCEQ/TPDES Water Quality General Permits

Certain types of activities are required to be covered by one of several TCEQ/TPDES wastewater general permits:

- TXG110000 – concrete production facilities
- TXG130000 – aquaculture production
- TXG340000 – petroleum bulk stations and terminals
- TXG640000 – conventional water treatment plants
- TXG670000 – hydrostatic test water discharges
- TXG830000 – water contaminated by petroleum fuel or petroleum substances
- TXG870000 – pesticides (application only)
- TXG920000 – concentrated animal feeding operations
- WQG100000 – wastewater evaporation
- WQG200000 – livestock manure compost operations (irrigation only)

A review of active general permit coverage (TCEQ, 2022b) in the TMDL watershed as of April 11, 2022, found no active general wastewater permit authorizations of the types described above.

Sanitary Sewer Overflows

A summary of sanitary sewer overflow (SSO) incidents that occurred during a six-year period from 2016 through 2021 in Montgomery County was obtained from TCEQ Central Office in Austin. The summary data indicated no SSO incidents had been reported within the TMDL watershed.

TPDES-Regulated Stormwater

When evaluating stormwater for a TMDL allocation, a distinction must be made between stormwater originating from an area under a TPDES-regulated discharge permit and stormwater originating from areas not under a TPDES-regulated discharge permit. Stormwater discharges fall into two categories:

1. Stormwater subject to regulation, which is any stormwater originating from TPDES-regulated MS4 entities, stormwater discharges associated with regulated industrial facilities, and construction activities.
2. Stormwater runoff not subject to regulation.

Discharges of stormwater from a Phase II MS4 area, regulated industrial facility, construction area, or other facility involved in certain activities must be covered under the following TCEQ/TPDES general permits:

- TXR040000 – Phase II MS4 General Permit for MS4s located in urbanized areas
- TXR050000 – Multi-sector General Permit (MSGP) for industrial facilities
- TXR150000 – Construction General Permit (CGP) for construction activities disturbing more than one acre or are part of a common plan of development disturbing more than one acre

A review of active stormwater general permit authorizations (TCEQ, 2022b) in the TMDL watershed as of April 11, 2022, found no active MSGP authorizations and six CGP authorizations within the watershed. There are currently one combined Phase I/II permit and three Phase II MS4 authorizations within the TMDL watershed (Table VI-5). Figure VI-6 shows the urbanized area defined by the USCB that accounts for MS4 coverage within the TMDL watershed.

Table VI-5. TPDES MS4 permits associated with the TMDL watershed

Entity	TPDES Permit	EPA ID	Authorization Type
Texas Department of Transportation	WQ0005011000	TXS002101	Combined Phase I and II MS4
Montgomery County	General Permit (TXR040000)	TXR040348	Phase II MS4
City of Conroe	General Permit (TXR040000)	TXR040441	Phase II MS4
City of Panorama Village	General Permit (TXR040000)	TXR040550	Phase II MS4

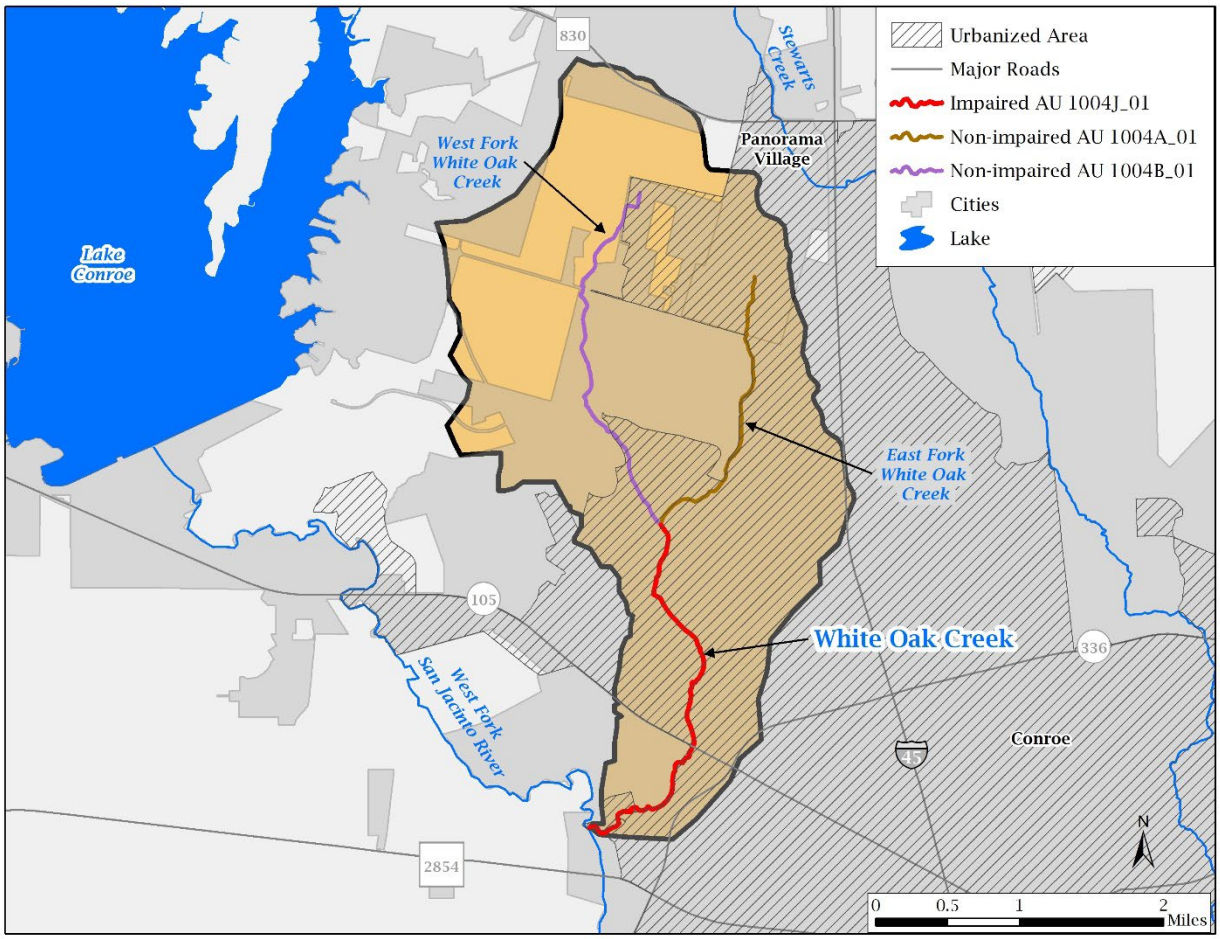

Figure VI-6. Regulated stormwater areas based on Phase I and Phase II MS4 permits as defined by the urbanized area

Illicit Discharges

Pollutant loads can enter water bodies from MS4 outfalls that carry authorized sources as well as illicit discharges under both dry- and wet-weather conditions. The term "illicit discharge" is defined in TPDES General Permit TXR040000 for Phase II MS4s as "Any discharge to a municipal separate storm sewer system that is not entirely composed of stormwater, except discharges pursuant to this general permit or a separate authorization and discharges resulting from emergency firefighting activities." Illicit discharges can be categorized as either direct or indirect contributions.

Unregulated Sources

Unregulated sources of bacteria are nonpoint and can originate from wildlife and feral hogs, various agricultural activities, agricultural animals, urban runoff not covered by a permit, failing on-site sewage facilities (OSSFs), and domestic pets.

Unregulated Agricultural Activities and Domesticated Animals

A number of agricultural activities that do not require permits can be potential sources of fecal bacteria loading. Livestock are present throughout the more rural portions of the project watershed.

Table VI-6 provides estimated numbers of selected livestock in the watershed based on the 2017 Census of Agriculture conducted by U.S. Department of Agriculture (USDA NASS, 2019). The county-level estimated livestock populations were reviewed by Texas State Soil and Water Conservation Board staff and were refined to better reflect actual numbers within the TMDL watershed. The refinement was performed by dividing the total area of suitable grazing land in the watershed by the total area of suitable grazing land in Montgomery County. This ratio was then applied to the county-level livestock data. These livestock numbers, however, were not used to develop an allocation of allowable bacteria loading to livestock.

Table VI-6. Estimated livestock populations

AU	Cattle and Calves	Hogs and Pigs	Goats and Sheep	Horses
1004J_01	109	9	21	21

Fecal bacteria from dogs and cats is transported to water bodies by runoff in both urban and rural areas and can be a potential source of bacteria loading. Table VI-7 summarizes the estimated number of dogs and cats within the TMDL watershed. Pet population estimates were calculated as the estimated number of dogs (0.614) and cats (0.457) per household (AVMA, 2018). The number of households in the TMDL watershed was estimated using 2010 Census household and population data (USCB, 2010) to obtain the ratio of people to households. This ratio was applied to the 2020 White Oak Creek population data (USCB, 2021) to estimate the number of households in the TMDL watershed. The actual contribution and significance of bacteria loads from pets reaching White Oak Creek is unknown.

Table VI-7. Estimated households and pet population

AU	Estimated Households	Estimated Dog Population	Estimated Cat Population
1004J_01	3,986	2,447	1,822

Wildlife and Unmanaged Animals

Fecal bacteria are common inhabitants of the intestines of all warm-blooded animals, including wildlife such as mammals and birds. In developing bacteria TMDLs, it is important to identify by watershed the potential for bacteria contributions from wildlife. Wildlife are naturally attracted to riparian corridors of water bodies. With direct access to the stream channel, the direct deposition of wildlife waste can be a concentrated source of bacteria loading to a water body. Fecal bacteria from wildlife are also deposited onto land surfaces, where they may be washed into nearby water bodies by rainfall runoff.

For feral hogs, a study by Timmons et al. (2012) estimated a range of feral hog densities within suitable habitat in Texas from 8.9 to 16.4 hogs per square mile. The average hog density (12.65 hogs/square mile) was multiplied by the hog-habitat area of 4.96 square miles in the TMDL watershed. Habitat deemed suitable for hogs includes the following classifications from the 2019 NLCD land cover: Forest, Wetlands, Pasture/Hay, Shrub/Scrub, and Grassland/Herbaceous. Using this methodology, the estimated feral hog population is 63 in the TMDL watershed.

For deer, the Texas Parks and Wildlife Department (TPWD) has published data showing deer population-density estimates by Deer Management Unit (DMU) and Ecoregion in the state (TPWD, 2021). The TMDL watershed is located within portions of DMU 14 and the DMU Urban Houston for which there is no deer density data. Due to the lack of deer density data for DMU Urban Houston, density data from DMU 14 was used to estimate deer populations for the TMDL watershed. For the 2020 TPWD survey year, the estimated deer population density for DMU 14 was 25.03 deer per 1,000 acres and applies to all habitat types within the DMU. Applying this value to the entire area of the TMDL watershed returns an estimated 139 deer within the TMDL watershed. The *E. coli* contribution from feral hogs and wildlife in the TMDL watershed could not be determined based on existing information.

Onsite Sewage Facilities

The estimated number of OSSFs in the TMDL watershed was determined using data supplied by the Houston-Galveston Area Council. These data indicate that there are 299 OSSFs located within the TMDL watershed (Figure VI-7). Several pathways of the liquid waste in OSSFs afford opportunities for bacteria to enter ground and surface waters, if the systems are not properly operating. Properly designed and operated, however, OSSFs would be expected to contribute virtually no fecal bacteria to surface waters (Weiskel et al., 1996).

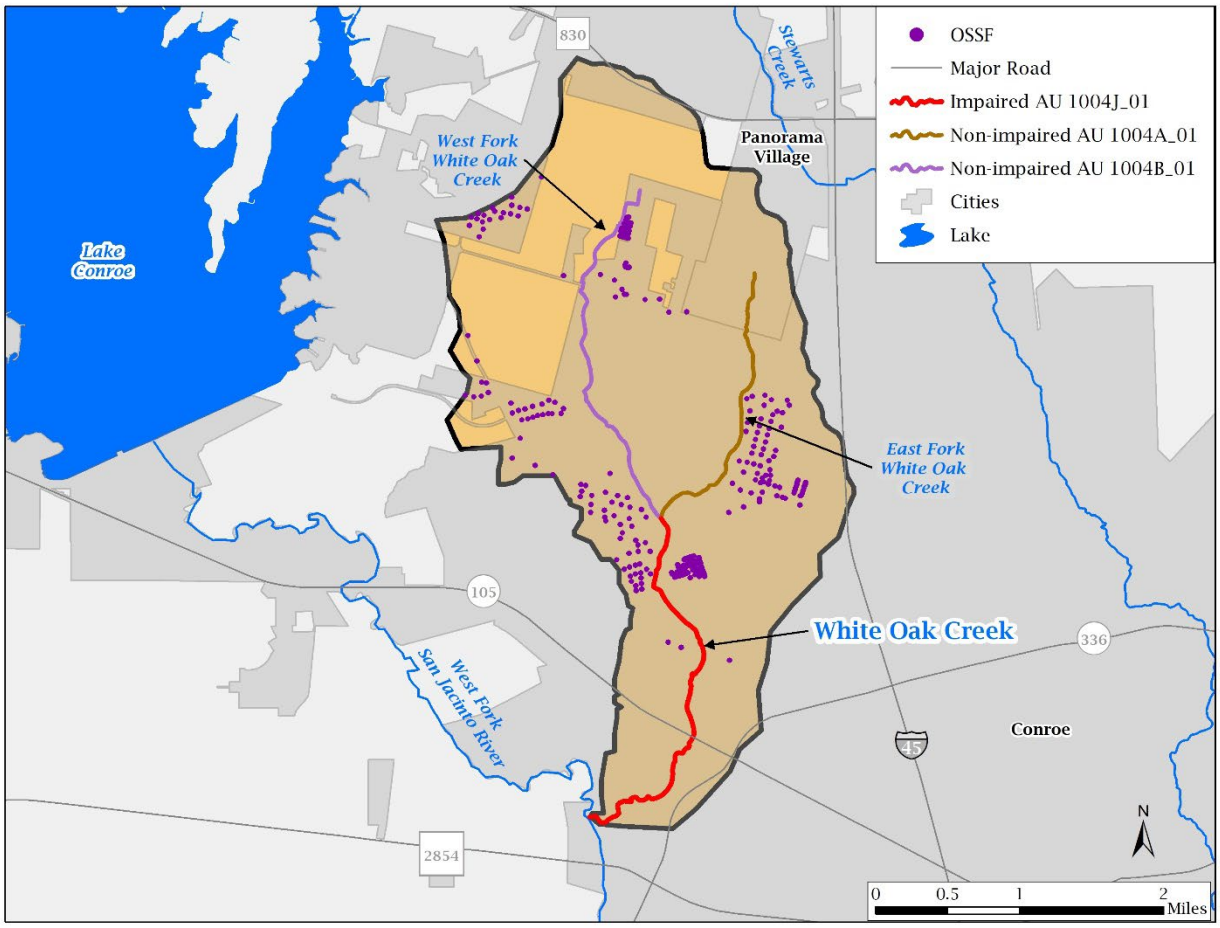

Figure VI-7. OSSFs in the TMDL watershed

Linkage Analysis

The load duration curve (LDC) method was used to examine the relationship between instream water quality and the source of indicator bacteria loads. Inherent to the use of LDCs as the mechanism of linkage analysis is the assumption of a one-to-one relationship between instream loadings and loadings originating from point sources as regulated and from the landscape as unregulated sources. Further, this one-to-one relationship was also inherently assumed when using the LDC to define the TMDL pollutant load allocation. The LDC method allows for estimation of TMDL loads by utilizing the cumulative frequency distribution of streamflow and measured pollutant concentration data (Cleland, 2003). In addition to estimating stream loads, this method allows for the determination of the hydrologic conditions under which impairments are typically occurring, can give indications of the broad origins of the bacteria (i.e., point or nonpoint source), and provides a means to allocate allowable loadings. The technical support document for this addendum (Adams and Millican, 2022) provides details about the linkage analysis along with the LDC method and its application.

The *E. coli* event data plotted on the LDC for TCEQ SWQM Station 20731 in Figure VI-8 show exceedances of the geometric mean criterion have commonly occurred regardless of streamflow conditions. The allowable load at the single sample criterion (399 cfu/100 mL) is included on the LDC for comparison with individual *E. coli* samples, although it is not used for assessment or allocation purposes.

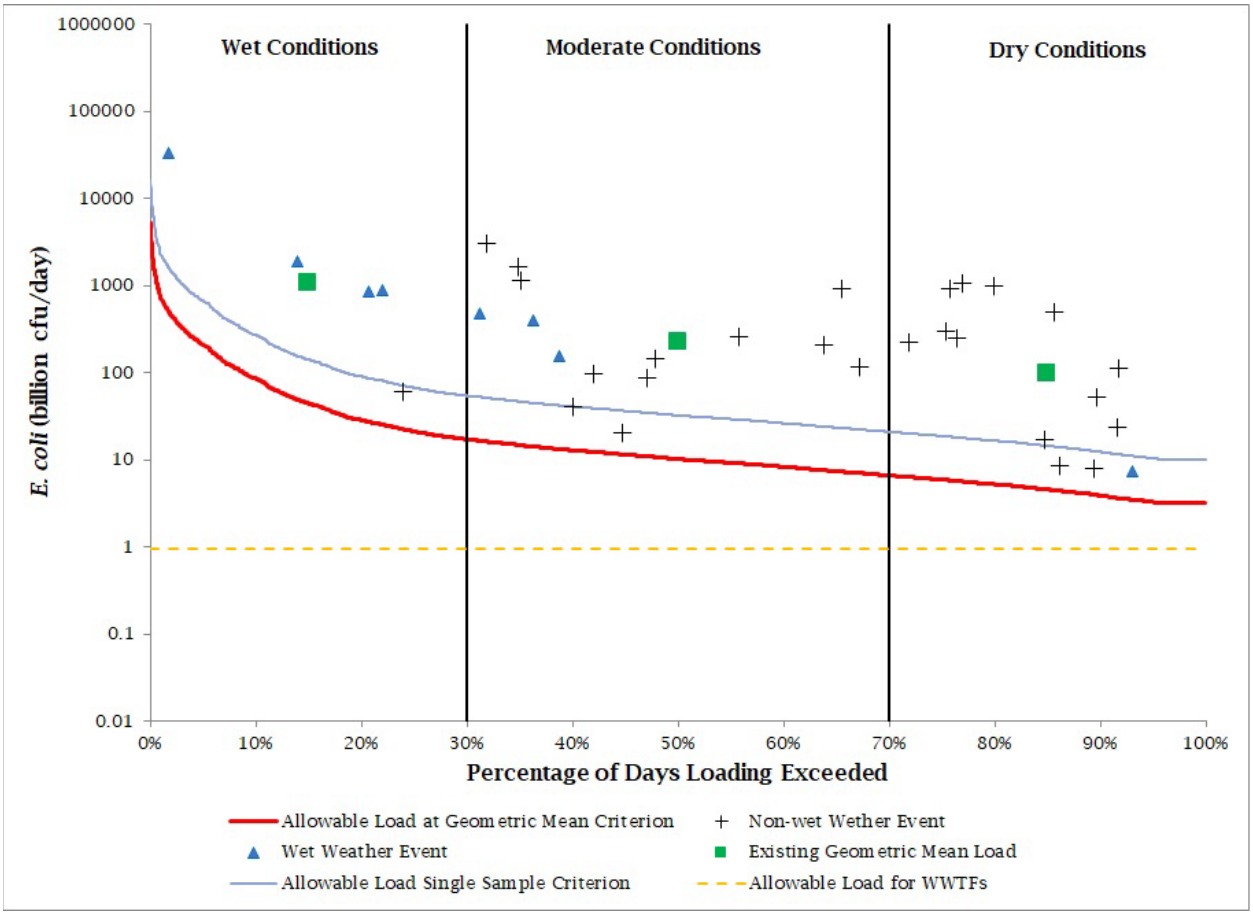

Figure VI-8. LDC for TCEQ SWQM Station 20731

Margin of Safety

The margin of safety (MOS) is designed to account for any uncertainty that may arise in specifying water quality control strategies for the complex environmental processes that affect water quality. Quantification of this uncertainty, to the extent possible, is the basis for assigning an MOS. The TMDL in this report incorporates an explicit MOS of 5% of the total TMDL allocation.

Pollutant Load Allocation

The TMDL represents the maximum amount of a pollutant that the stream can receive in a single day without exceeding water quality standards. The pollutant load allocations for the selected scenarios were calculated using the following equation:

TMDL = WLA + LA + FG + MOS

Where:

WLA = wasteload allocations, the amount of pollutant allowed by regulated dischargers

LA = load allocations, the amount of pollutant allowed by unregulated sources

FG = loadings associated with future growth from potential regulated facilities

MOS = margin of safety load

AU-Level TMDL Calculation

To be consistent with previously completed TMDLs in the original watershed, the TMDL for White Oak Creek was derived using the median flow within the "Wet Conditions" regime (or 15% load duration exceedance) of the LDC developed for TCEQ SWQM Station 20731. This station represents the location within White Oak Creek where an adequate number of *E. coli* samples was collected.

Margin of Safety Calculation

The TMDL in this report incorporates an explicit MOS of 5%.

Wasteload Allocation

The WLA is the sum of loads from regulated sources, which are WWTFs and regulated stormwater.

Wastewater Treatment Facilities

TPDES-permitted WWTFs are allocated a daily wasteload (WLA_{WWTF}) calculated as their full permitted discharge flow rate multiplied by one-half the instream geometric mean criterion. One-half of the water quality criterion (63 cfu/100 mL *E. coli*) is used as the WWTF target to provide instream and downstream load capacity and to be consistent with the original TMDL report. Table VI-8 presents the WLA for the WWTF (which is also the total allocation for the AU within the TMDL watershed).

Table VI-8. WLA for TPDES-permitted facility

AU	TPDES Number	Permittee	Bacteria Limit (cfu/100 mL *E. coli*)	Full Permitted Flow (MGD)	WLA_{WWTF} (billion cfu/day *E. coli*)
1004J_01	WQ0011097001	City of Panorama Village	63	0.40	0.954

Regulated Stormwater

Stormwater discharges from MS4, industrial, and construction areas are also considered regulated point sources. Therefore, the WLA calculations must also include an allocation for regulated stormwater discharges (WLA_{SW}). The percentage of the land area included in the project watershed that is under the jurisdiction of stormwater permits is used to estimate the amount of the overall runoff load that should be allocated as the permitted stormwater contribution in the WLA_{SW} component.

Acreages associated with MS4s as defined by the 2020 Conroe/The Woodlands urbanized area (2,888 acres) and CGP authorizations outside the urbanized area but within the TMDL watershed (281 acres) were calculated using geographic information system shapefiles (or the "area disturbed" listed for CGP authorizations). The percentage of land under the jurisdiction of stormwater permits in the TMDL watershed is 57.22%.

Load Allocation

The load allocation (LA) component of the TMDL corresponds to direct nonpoint runoff and is the difference between the total load from stormwater runoff and the portion allocated to WLA_{SW}.

Allowance for Future Growth

The FG component of the TMDL equation addresses the requirement of TMDLs to account for future loadings that might occur as a result of population growth, changes in community infrastructure, and development. Specifically, this TMDL component takes into account the probability that new flows from WWTF discharges may occur in the future. The assimilative capacity of water bodies increases as the amount of flow increases. The allowance for FG in this TMDL report will result in protection of existing uses and conform to Texas' antidegradation policy.

The FG component of the TMDL watershed was based on population projections and current permitted wastewater dischargers for the entire TMDL watershed. Recent population and projected population growth between 2020 and 2045 for the TMDL watershed are provided in Table VI-2. The projected population percentage increase within the watershed was multiplied by the corresponding WLA_{WWTF} to calculate future WLA_{WWTF}.

FG of existing or new point sources is not limited by this TMDL as long as the sources do not cause bacteria to exceed the limits. The assimilative capacity of water bodies increases as the amount of flow increases. Consequently, increases in flow allow for increased loadings. The LDC and tables in this TMDL report will guide determination of the assimilative capacity of the water body under changing conditions, including FG.

Summary of TMDL Calculations

Table VI-9 summarizes the TMDL calculations for the TMDL watershed. The TMDL was calculated based on the median flow in the 0-30 percentile range (15% exceedance, "Wet Conditions" regime) from the LDC developed for the TCEQ SWQM Station 20731. Allocations are based on the current geometric mean criterion for *E. coli* of 126 cfu/100 mL for each component of the TMDL (with the exception of the WLA_{WWTF} and FG terms, which use one-half the criterion).

Table VI-9. TMDL allocation summary

All loads expressed as billion cfu/day *E. coli*

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
White Oak Creek	1004J_01	44.397	2.220	0.954	22.867	17.097	1.259

The final TMDL allocations (Table VI-10) needed to comply with federal requirements include the FG component within the WLA_{WWTF} (40 CFR Section 103.7).

Table VI-10. Final TMDL allocation

All loads expressed as billion cfu/day *E. coli*

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
White Oak Creek	1004J_01	44.397	2.220	2.213	22.867	17.097

Seasonal Variation

Federal regulations require that TMDLs account for seasonal variation in watershed conditions and pollutant loading [40 CFR Section 130.7(c)(1)]. Analysis of the seasonal differences in indicator bacteria concentrations were assessed by comparing *E. coli* concentrations obtained from nine years (2013 through 2021) of routine monitoring data collected in the warmer months (April through September) against those collected during the cooler months (October through March), which maintains consistency with the previously completed TMDL addendum (TCEQ, 2018a). Differences in *E. coli* concentrations obtained in warmer versus cooler months were then evaluated by performing a Wilcoxon Rank Sum test (also known as the "Mann-Whitney" test). This analysis of *E. coli* data indicated that there was no significant difference (α=0.05) in indicator bacteria between cool and warm weather seasons for White Oak Creek (p=0.1256). Seasonal variation was also addressed by using all available flow and *E. coli*

records (covering all seasons) from the period of record used in LDC development for this project.

Public Participation

TCEQ maintains an inclusive public participation process. From the inception of TMDL development, the project team sought to ensure that stakeholders were informed and involved. Communication and comments from the stakeholders in the watershed strengthen TMDL projects and their implementation.

The technical support document for this TMDL addendum (Adams and Millican, 2022) was published on the TCEQ website on December 8, 2022. Project staff presented information about this addendum at the annual spring meeting of the Bacteria Implementation Group (BIG) in Houston on May 24, 2022. The public had an opportunity to comment on this addendum during the public comment period (February 17 through March 21, 2023) for the WQMP update in which this addendum is included. Notice of the public comment period for this addendum was emailed to stakeholders and posted on the TCEQ's TMDL Program News webpage.[d] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[e] TCEQ accepted public comments on the original TMDL report from March 6 through April 4, 2016. Six comments were submitted, and none of them referred directly to the AU in this TMDL addendum.

Implementation and Reasonable Assurance

The water body covered by this addendum is within the existing bacteria TMDL watershed for the East and West Forks of the San Jacinto River. That TMDL watershed, including White Oak Creek, is within the area covered by the implementation plan (I-Plan) developed by the BIG for bacteria TMDLs throughout the greater Houston area, which was approved by the TCEQ on January 30, 2013. The I-Plan outlines an adaptive management approach in which measures are assessed annually by the stakeholders for efficiency and effectiveness. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals and expresses stakeholder commitment to the process. Please refer to the original TMDL document for additional information regarding implementation and reasonable assurance.

[d] www.tceq.texas.gov/waterquality/tmdl/tmdlnews.html

[e] www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html

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