Watersheds Upstream of Lake Houston: A Community Project to Protect Recreational Uses

Fifteen TMDLs for Indicator Bacteria in Watersheds Upstream of Lake Houston[1]

Adopted April 6, 2011.

Approved by June 29, 2011.

Six Additional TMDLs for Indicator Bacteria in Watersheds Upstream of Lake Houston Added By Addendum I, October 2013[2]

Via the October 2013 Update to the Texas Water Quality Management Plan.

Approved by EPA February 14, 2014.

Two TMDLs for Indicator Bacteria in Brushy Creek and Spring Branch Added By Addendum II, October 2019[3]

Via the October 2019 Update to the Texas Water Quality Management Plan.

Approved by EPA March 11, 2020.

One Total Maximum Daily Load for Indicator Bacteria in Walnut Creek Added By Addendum III, October 2020[4]

Via the October 2020 Update to the Texas Water Quality Management Plan.

Approved by EPA March 8, 2021.

[1] https://www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/82-lake-houston-tmdl-adopted.pdf
[2] https://www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/82a-lake-houston-tmdl-addendum-one.pdf
[3] https://www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/82-lake-houston-tmdl-addendum-two.pdf
[4] https://www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/82-lake-houston-tmdl-addendum-three.pdf

One TMDL for Indicator Bacteria in Caney Creek Added by this Addendum IV, April 2022

Via the April 2022 Update to the Texas Water Quality Management Plan (SFR-121/2022-03).

Approved by EPA August 11, 2022 (scroll to view or print this addendum).

Appendix VII. Addendum Four to Fifteen TMDLs for Indicator Bacteria in Watersheds Upstream of Lake Houston

Adding one Total Maximum Daily Load (TMDL) for AU 1010_03

One TMDL for Indicator Bacteria in Caney Creek

Introduction

Texas Commission on Environmental Quality (TCEQ) adopted *Fifteen TMDLs for Indicator Bacteria in Watersheds Upstream of Lake Houston* (TCEQ, 2011) on April 6, 2011. The United States Environmental Protection Agency (EPA) approved the TMDLs on June 29, 2011. This document is the fourth addendum to the original TMDL report.

This fourth addendum includes information specific to one additional assessment unit (AU) for Caney Creek (AU 1010_03; also referred to in this addendum as the TMDL watershed). This AU is located within the watershed of the approved original TMDLs for watersheds upstream of Lake Houston. 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 Total Maximum Daily Load for Indicator Bacteria in Caney Creek*[5] (Adams and Millican, 2021). 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.

Problem Definition

TCEQ first identified the bacteria impairment for Caney Creek AU 1010_03 in the *2018 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2019), and then in the subsequent 2020 Texas 303(d) List, the latest EPA-approved edition. Caney Creek (Segment 1010) contains four AUs; the impaired AU 1010_03 is addressed in this addendum, and AUs

[5] https://www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/42-as-463-caney-creek-tsd-addendum-4.pdf

1010_02 and 1010_04 were addressed in the original TMDL report. The subwatershed for just 1010_03 is located entirely within Montgomery County, while the entire TMDL watershed, including the drainage area of upstream AUs 1010_01 and 1010_02, is located in portions of Montgomery and Walker counties. Figure VII-1 shows the watershed added in this addendum in relation to the entire watershed of the original TMDLs, and also includes the area covered by the other addenda.

The Texas Surface Water Quality Standards (TCEQ, 2018) 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 VII-1 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) station on AU 1010_03, as reported in the 2020 Texas Integrated Report (TCEQ, 2020). 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 colony forming units per 100 milliliters (cfu/100 mL) of water. Figure VII-2 shows the location of the TCEQ SWQM station that was used in evaluating water quality in the 2020 Texas Integrated Report for the AU added by this addendum.

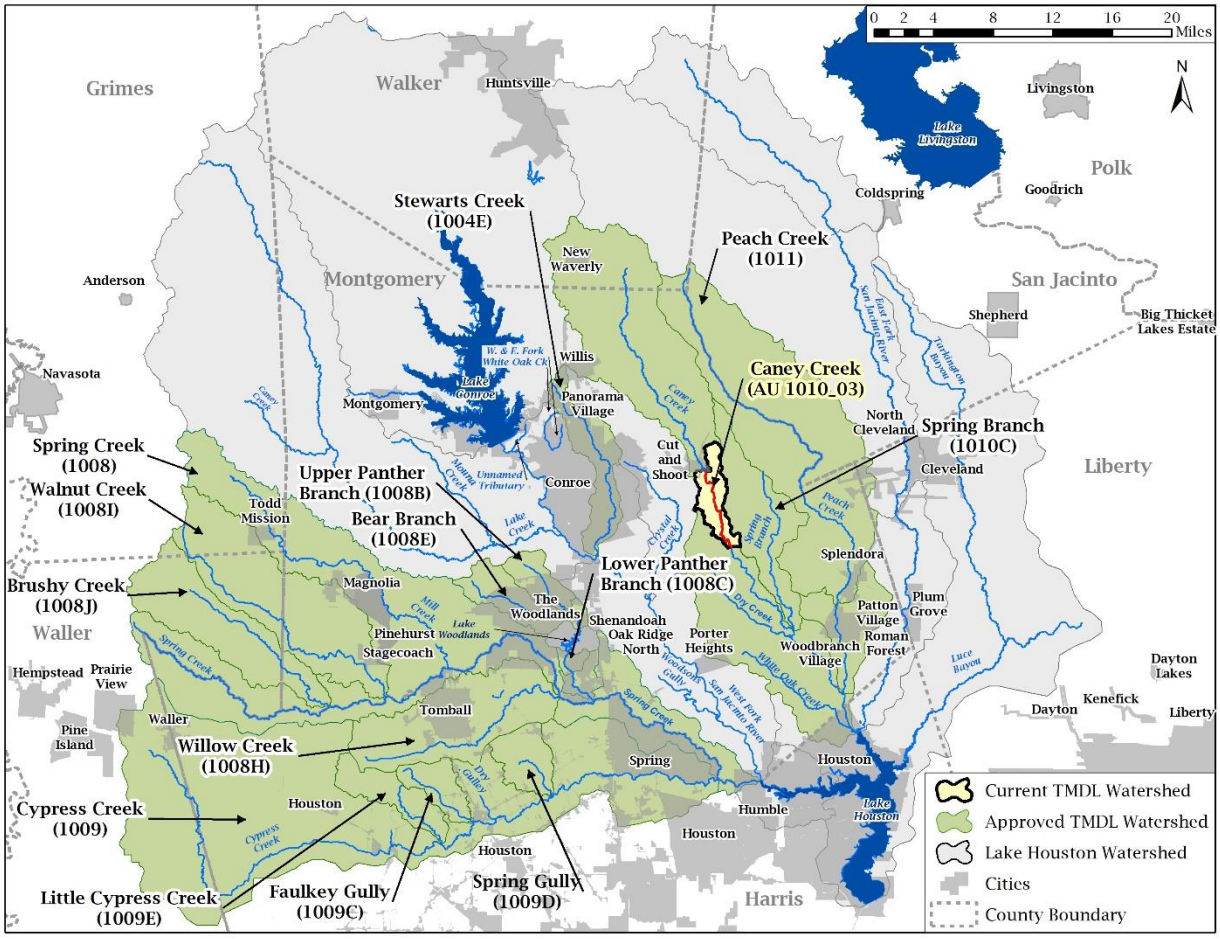

Figure VII-1. Map showing the previously approved TMDL watersheds and the Caney Creek AU 1010_03 subwatershed added by this addendum

Table VII-1. 2020 Texas Integrated Report summary for TMDL addendum watershed

AU	Station	Parameter	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
1010_03	11335	*E. coli*	29	12/01/2011 – 11/30/2018	221

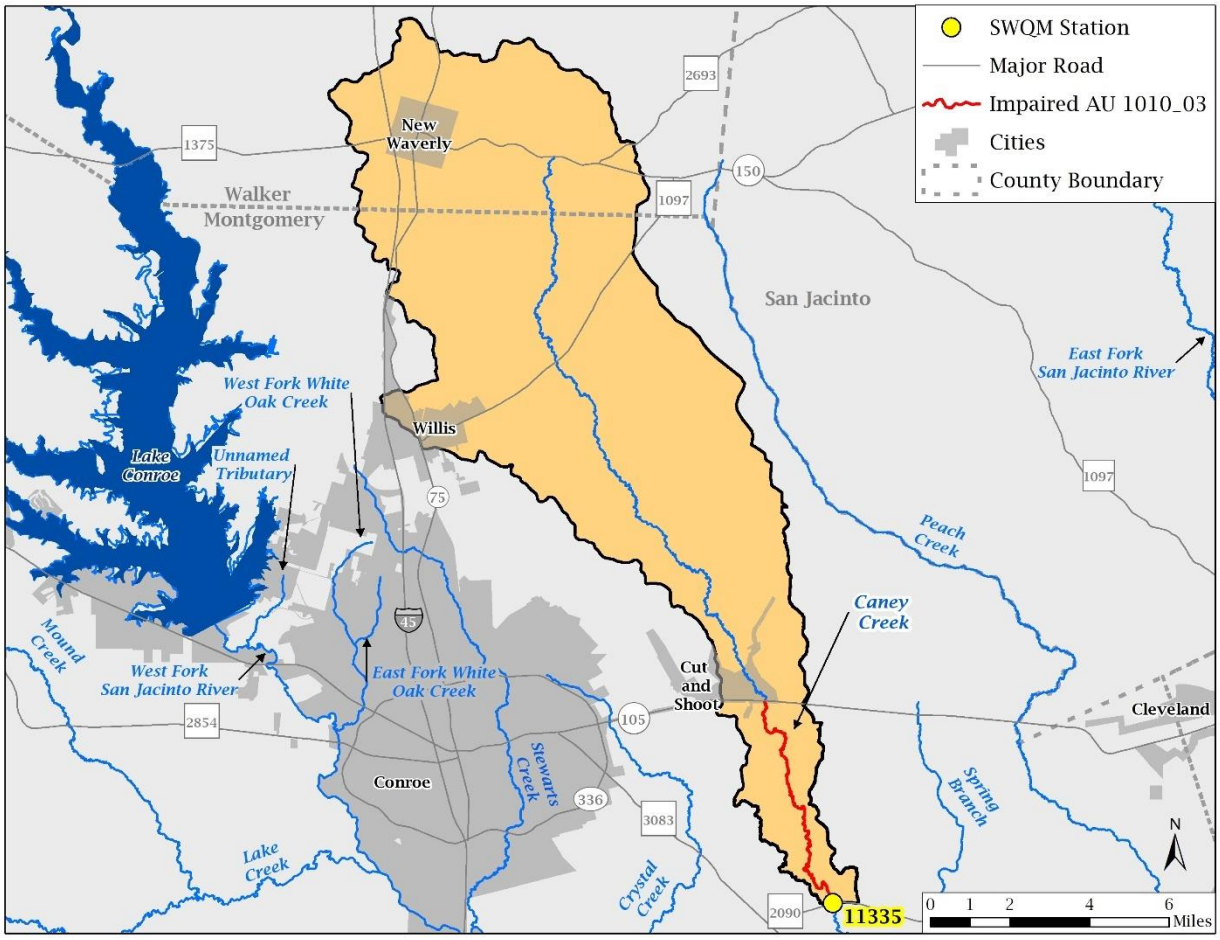

Figure VII-2. AU 1010_03 watershed showing the TCEQ SWQM station

Watershed Overview

Caney Creek (Segment 1010) is a tributary of the East Fork San Jacinto River (Segment 1003) and flows approximately 52 miles. AU 1010_03 is approximately eight miles long. While the subwatershed for just AU 1010_03 has an area of 10.1 square miles (6,448 acres), the entire AU 1010_03 watershed, including the drainage area of upstream AUs 1010_01 and 1010_02, drains an area of 104.7 square miles (67,002 acres). Using a watershed-based approach, the entire, 104.7 square mile watershed of Caney Creek AU 1010_03 will be considered in this report as the TMDL watershed for which the pollutant load allocations will be developed.

The 2020 Texas Integrated Report (TCEQ, 2020) provides the following segment and AU descriptions:

- 1010 (Caney Creek) – From the confluence with the East Fork San Jacinto River in Harris County to State Highway 150 in Walker County.

- AU 1010_03 – From State Highway 105 to Farm-to-Market 2090.

Watershed Climate

Weather data were obtained for the 15-year period from January 2006 through December 2020 from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center Database. The Conroe-North Houston Regional Airport weather station (USW00053902) located a few miles east of the watershed was used to retrieve the precipitation and temperature data (NOAA, 2021; Figure VII-3). Data from this 15-year period indicate that the average monthly high temperature typically reaches a maximum of 95.1 °F in August, and the average monthly low temperature reaches a minimum of 38.3 °F in January. Annual rainfall averages 46.6 inches. The wettest month is May (5.3 inches), while February (2.7 inches) is the driest month, with rainfall occurring throughout the year.

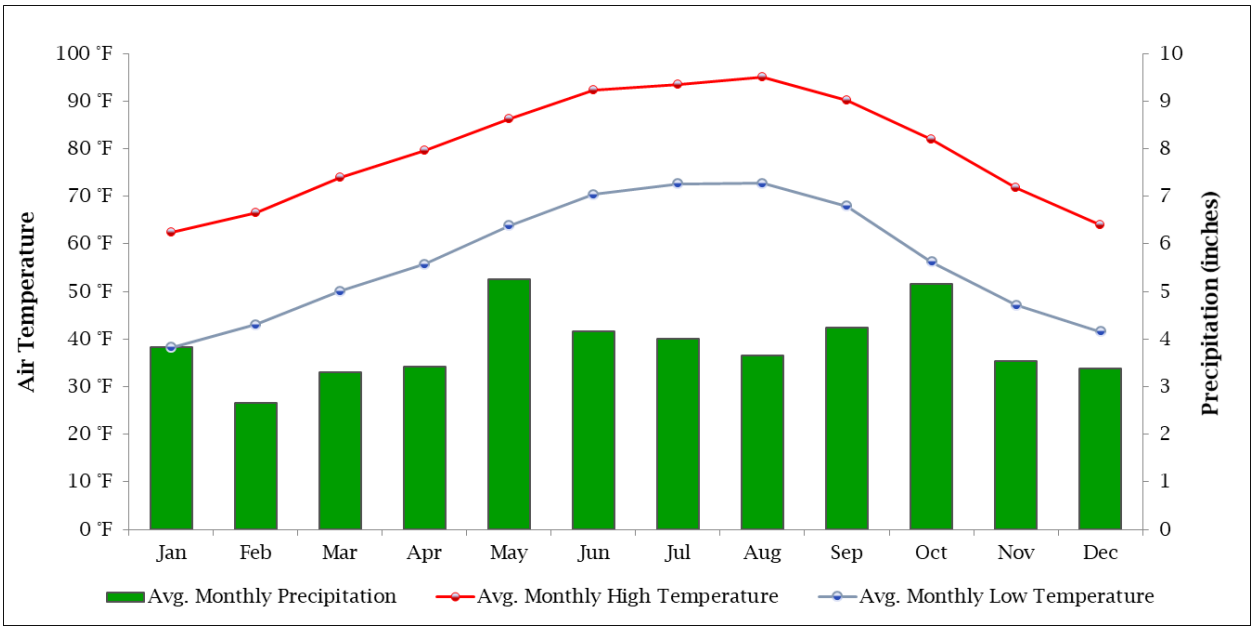

Figure VII-3. Average monthly temperature and precipitation (2006–2020) at the Conroe-North Houston Regional Airport weather station

Watershed Population and Population Projections

The TMDL watershed is located partially within Montgomery and Walker counties and includes portions of three municipal boundaries (Cut and Shoot, Willis, and New Waverly). According to the United States Census Bureau (USCB) 2010 Census (USCB, 2010), the TMDL watershed had an estimated population of 18,037 people in 2010.

The population projection in Table VII-2 is estimated from the Texas Water Development Board (TWDB) 2021 Regional Water Plan Population and Water Demand Projection data (TWDB, 2019a; TWDB, 2019b).

Table VII-2. Estimated 2010 population and 2070 population projection for the TMDL watershed

Area	2010 Estimated Population	2070 Projected Population	Projected Population Increase	Percentage Change
Entire Caney Creek (AU 1010_03) Watershed	18,037	89,993	71,956	399%

The following steps detail the method used to estimate the 2010 and projected 2070 populations in the TMDL watershed.

1. Obtained 2010 USCB data at the block level.
2. Developed the 2010 watershed population using the USCB block level data for the portions of Montgomery and Walker counties within the watershed.
3. For the census blocks that were partially located in the watershed, population was estimated by multiplying the block population to the proportion of its area in the watershed.
4. Obtained the TWDB Population Projections by Regional Water Planning Group for Region H. Projections for "County-Other" were used to determine population increases for the rural areas in Montgomery and Walker counties from 2010 to 2070 (TWDB, 2019a).
5. Located the relevant Water User Groups (WUGs) with areas within the watershed and determined the proportion of each WUG area within the watershed (TWDB, 2019b).
6. Calculated decadal percentage increases in population using the TWDB (2019b) decadal population projections for the portion of Cut and Shoot, New Waverly, and Willis WUGs between 2010 and. This projected increase was used to estimate population projections in these cities.
7. Summed the projected population increases obtained in steps 4 and 6 to the 2010 population of the watershed to obtain population projections for the watershed out to 2070.

Land Cover

The land cover data were obtained from United States Geological Survey (USGS) 2016 National Land Cover Database (NLCD) (USGS, 2019). The land cover for the TMDL watershed is shown in Figure VII-4. A summary of the land cover data is provided in Table VII-3 and indicates that the dominant land covers in the TMDL watershed are Pasture/Hay (28.2%) and Evergreen Forest (28.1%).

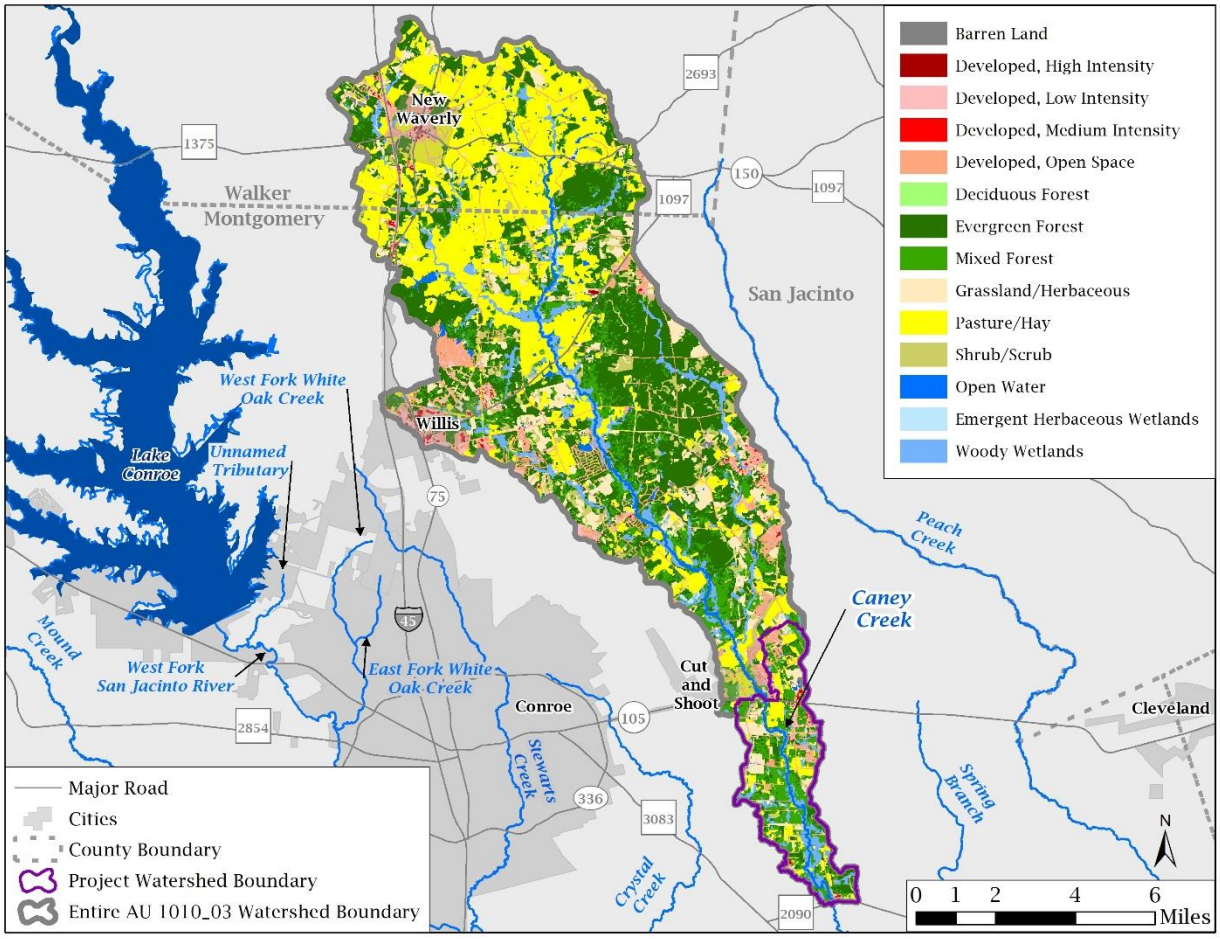

Figure VII-4. 2016 land cover

Table VII-3. Land cover summary

2016 NLCD Classification	Area (Acres)	Percentage of Total
Barren Land	132.8	0.2%
Developed, High Intensity	116.7	0.2%
Developed, Low Intensity	2,374.9	3.5%
Developed, Medium Intensity	427.9	0.6%
Developed, Open Space	4,846.1	7.2%
Deciduous Forest	66.8	0.1%
Evergreen Forest	18,813.4	28.1%
Mixed Forest	7,290.78	10.9%
Grassland/Herbaceous	5,452.4	8.1%

2016 NLCD Classification	Area (Acres)	Percentage of Total
Pasture/Hay	18,888.5	28.2%
Shrub/Scrub	2,855.1	4.3%
Open Water	422.1	0.6%
Emergent Herbaceous Wetlands	289.4	0.4%
Woody Wetlands	5,025.2	7.5%
Total	**67,002**	**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 Texas Pollutant Discharge Elimination System (TPDES) program. Wastewater treatment facilities (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 stormwater discharges from industries, regulated construction activities, and municipal separate storm sewer systems (MS4s).

Domestic and Industrial WWTFs

As of August 23, 2021, there were 10 WWTFs with TPDES permits within the TMDL watershed (Table VII-4 and Figure VII-5). All the facilities treat solely domestic wastewater.

Table VII-4.TPDES-permitted WWTFs discharging in the TMDL watershed

AU	TPDES Number	NPDES[a] Number	Permittee	Outfall Number	Bacteria (*E. coli*) Limits (cfu/100 mL)	Primary Discharge Type	Daily Average Flow – Permitted Discharge (MGD[2])
1010_03	WQ0012204001	TX0083216	Conroe Independent School District (ISD)	001	63	Treated domestic wastewater	0.02
1010_03	WQ0014285001	TX0124281	C & R Water Supply Inc.	001	63	Treated domestic wastewater	0.30
1010_03	WQ0015261001	TX0135453	Crystal Springs Water Co., Inc.	001	63	Treated domestic wastewater	0.325
1010_03	WQ0015689001	TX0138568	Crockett Martin Corp.	001	63	Treated domestic wastewater	0.025
1010_03	WQ0016005001	TX0141399	Crystal Springs Water Co., Inc.	001	63	Treated domestic wastewater	0.75
1010_02	WQ0011715001	TX0068659	Texas National Municipal Utility District (MUD)	001	63	Treated domestic wastewater	0.225
1010_02	WQ0012670001	TX0092517	Quadvest, L.P.	001	63	Treated domestic wastewater	0.175
1010_02	WQ0015984001	TX0141224	Texas Campgrounds Club, Inc.	001	63	Treated domestic wastewater	0.04
1010_01	WQ0011020001	TX0056685	City of New Waverly	001	63	Treated domestic wastewater	0.088
1010_01	WQ0011020002	TX0087831	City of New Waverly	001	63	Treated domestic wastewater	0.10

[a]NPDES: National Pollutant Discharge Elimination System

[2]MGD: million gallons per day

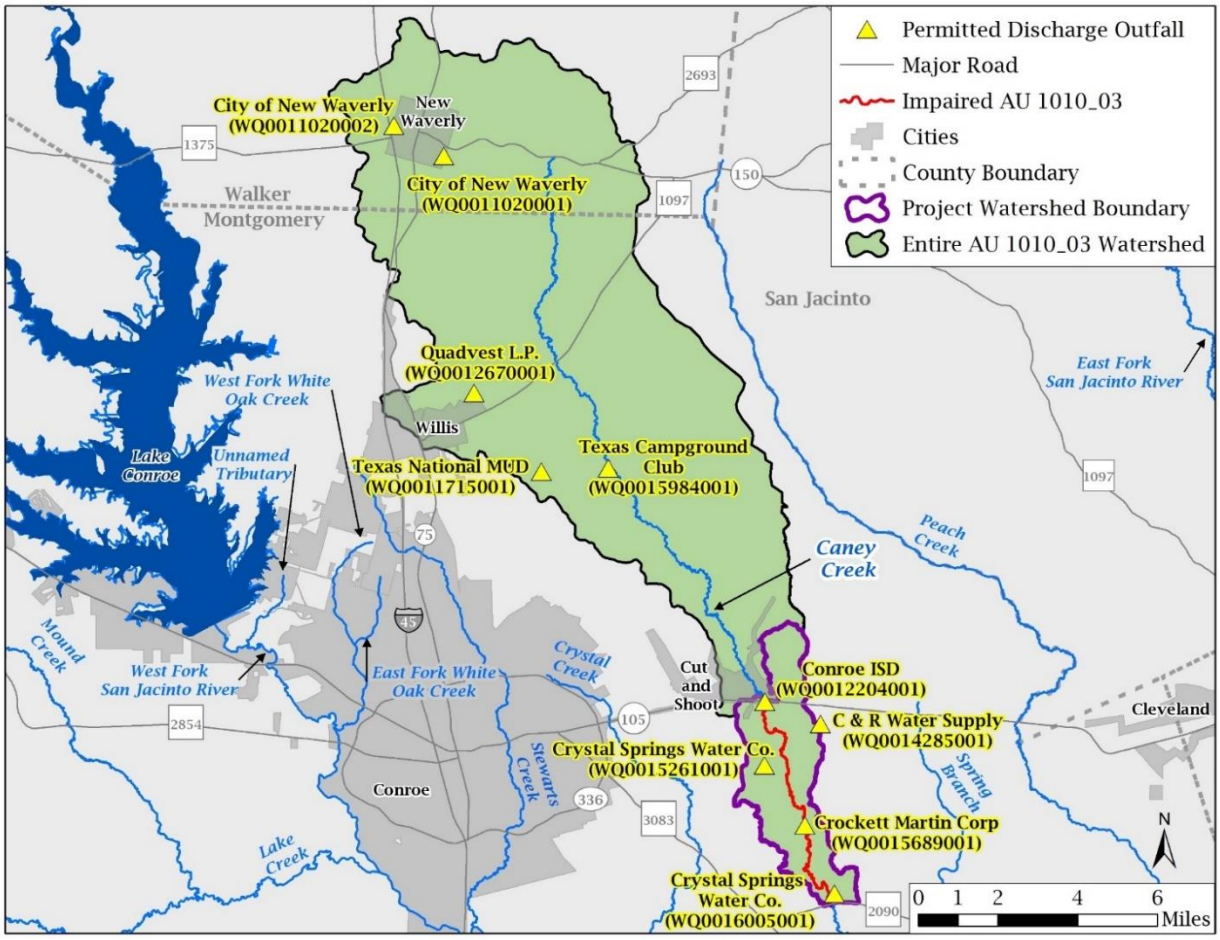

Figure VII-5. WWTFs in the TMDL watershed

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, 2021) in the TMDL watershed, as of June 2, 2021, found one concrete production facility covered by the general permit. The same review revealed one pesticide permittee covered by the general permit. This facility and pesticide management area do not have bacteria reporting requirements or limits in their permits. Pesticide application in the pesticide management areas is assumed to contain inconsequential amounts of indicator bacteria; therefore, it was unnecessary to allocate bacteria loads to them. No other active wastewater general permit authorizations were found in the TMDL watershed.

Sanitary Sewer Overflows

A summary of sanitary sewer overflow (SSO) incidents that occurred during a four-year period from 2016 through 2019 in the TMDL watershed was obtained from the TCEQ Central Office in Austin. The summary data indicated 15 SSO incidents had been reported within the TMDL watershed. The SSOs with reported volumes had a total discharge of 36,327 gallons with a minimum of one gallon and a maximum of 24,000 gallons.

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 municipal MS4 entities, stormwater discharges associated with regulated industrial activities, 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, 2021) in the TMDL watershed as of September 14, 2021, found two active MSGP authorizations within the watershed and 17 CGP authorizations. There are currently two Phase II MS4

authorizations and one combined Phase I/Phase II permit within the TMDL watershed (Table VII-5). Figure VII-6 shows the urbanized area defined by USCB that accounts for MS4 coverage within the TMDL watershed.

Table VII-5. TPDES MS4 permit associated with the TMDL watershed

Entity	TPDES Permit	NPDES Permit	Authorization Type
Texas Department of Transportation	WQ0005011000	TXS002101	Combined Phase I/II
Montgomery County	General Permit (TXR040000)	TXR040348	Phase II
City of Willis	General Permit (TXR040000)	TXR040538	Phase II

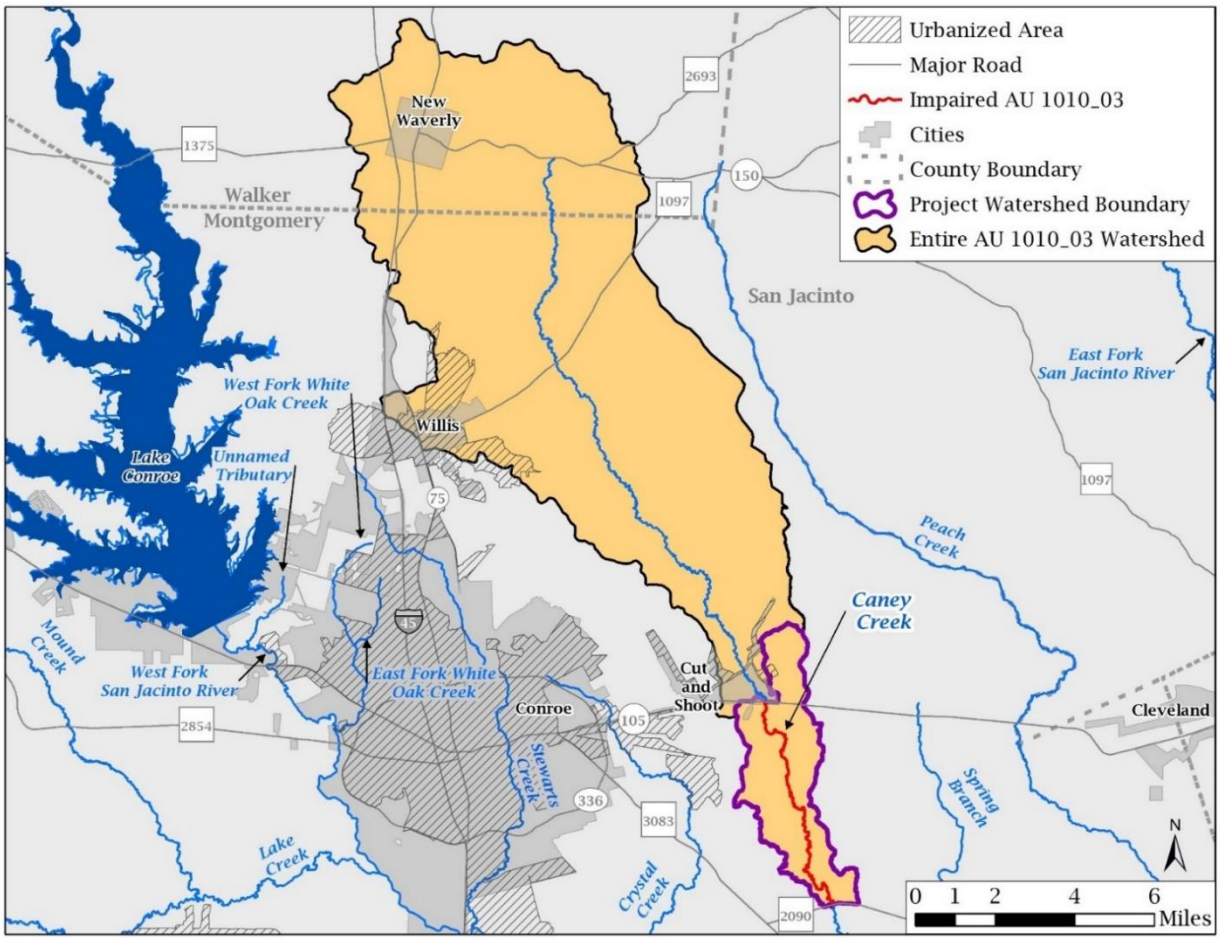

Figure VII-6. Regulated stormwater area based on urbanized area within the TMDL watershed

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 or small 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, land application fields, 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 TMDL watershed.

Table VII-6 provides estimated numbers of selected livestock in the TMDL watershed based on the 2017 Census of Agriculture conducted by U.S. Department of Agriculture (USDA NASS, 2019). The county-level estimated livestock populations for Montgomery and Walker counties were reviewed by Texas State Soil and Water Conservation Board staff and were distributed by dividing the suitable livestock land cover (Pasture/Hay, Grassland/Herbaceous, Shrub/Scrub, plus Deciduous, Evergreen and Mixed Forests) area of the watershed within each county by the total suitable livestock land cover area of each 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 VII-6. Estimated livestock populations

AU	Cattle and Calves	Hogs and Pigs	Poultry	Goats and Sheep	Horses
1010_03 (entire watershed)	3,352	152	3,758	422	437

Fecal bacteria from dogs and cats is transported to streams by runoff in both urban and rural areas and can be a potential source of bacteria loading. Table VII-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 data (USCB, 2010). The actual contribution and significance of bacteria loads from pets reaching the water bodies in the watershed is unknown.

Table VII-7. Estimated households and pet population

Estimated Households	Estimated Dog Population	Estimated Cat Population
6,214	3,815	2,840

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 (8.9 to 16.4 hogs/square mile). The average hog density (12.65 hogs/square mile) was multiplied by the hog-habitat area (91.69 square miles) in the TMDL watershed. Habitat deemed suitable for hogs followed as closely as possible to the land cover selections of the study and include from the 2016 NLCD land cover: Deciduous Forest, Evergreen Forest, Mixed Forest, Emergent Herbaceous Wetlands, Woody Wetlands, Pasture/Hay, Shrub/Scrub, and Grassland/Herbaceous. Using this methodology, there are an estimated 1,160 feral hogs in the TMDL watershed.

For deer, the Texas Parks and Wildlife Department (TPWD) 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 the deer population for the watershed. For the 2020 TPWD survey year, the estimated deer population density for DMU 14 was 25.03 deer/1,000 acres and applies to all habitat types within the DMU area. Applying this value to the entire area of the watershed returns an estimated 1,677 deer within the TMDL watershed.

Onsite Sewage Facilities

The estimated number of OSSFs in the TMDL watershed was determined using data supplied by H-GAC for Montgomery and Walker counties. These data indicate that there are 1,981 OSSFs located within the TMDL watershed (Figure VII-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.

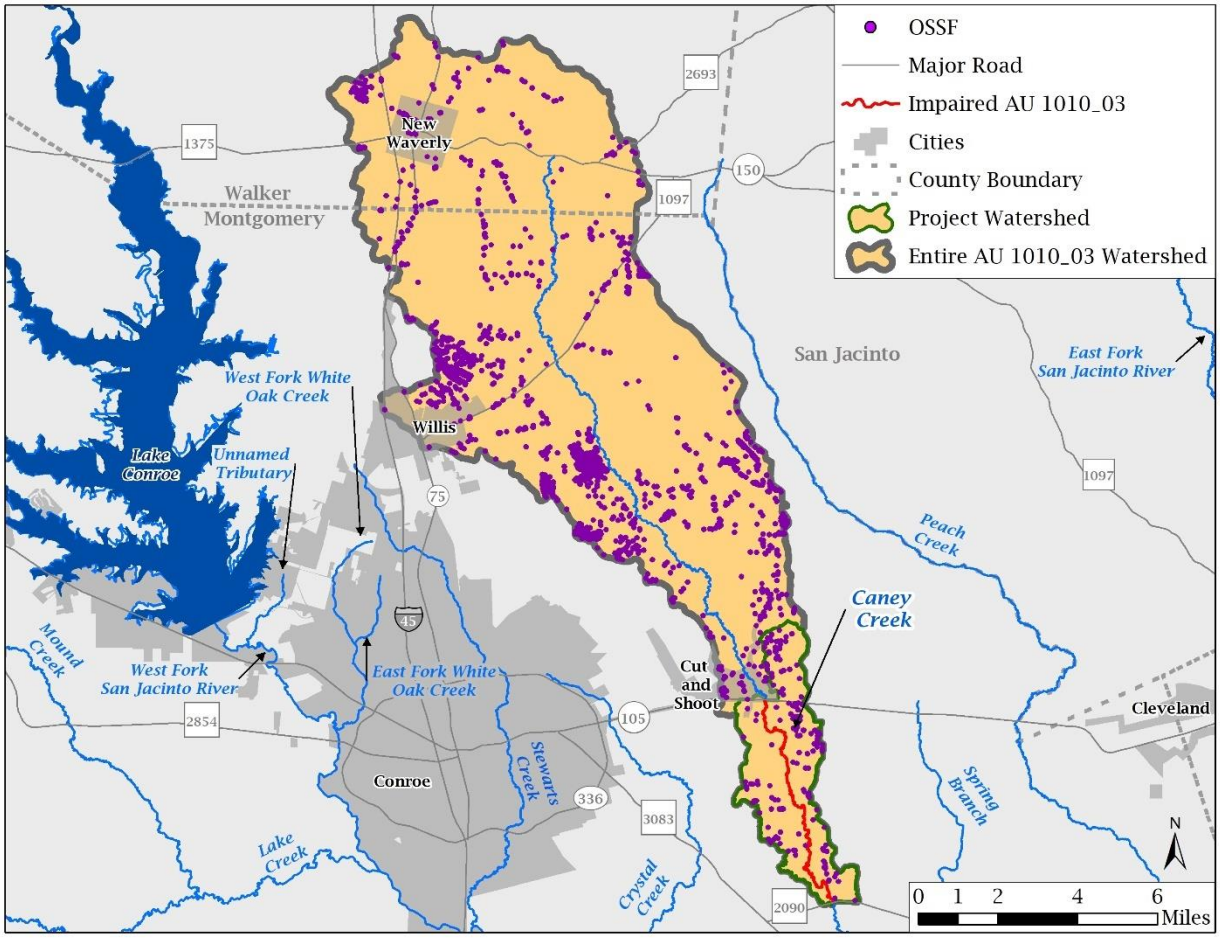

Figure VII-7. OSSFs located within the TMDL watershed

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, 2021) provides details about the linkage analysis along with the LDC method and its application.

The *E. coli* data plotted on the LDC for TCEQ SWQM Station 11335 in Figure VII-8 show exceedances of the geometric mean criterion have occurred under all three flow regimes, especially during Wet Conditions. There is some moderation of the elevated loadings under Moderate and Dry Conditions for the project watershed. The geometric means of the measured data for each flow regime generally support the observation of decreasing concentration with decreasing flow, and under Dry Conditions the data indicate the geometric mean is below the geometric mean criterion (126 cfu/100 mL). 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.

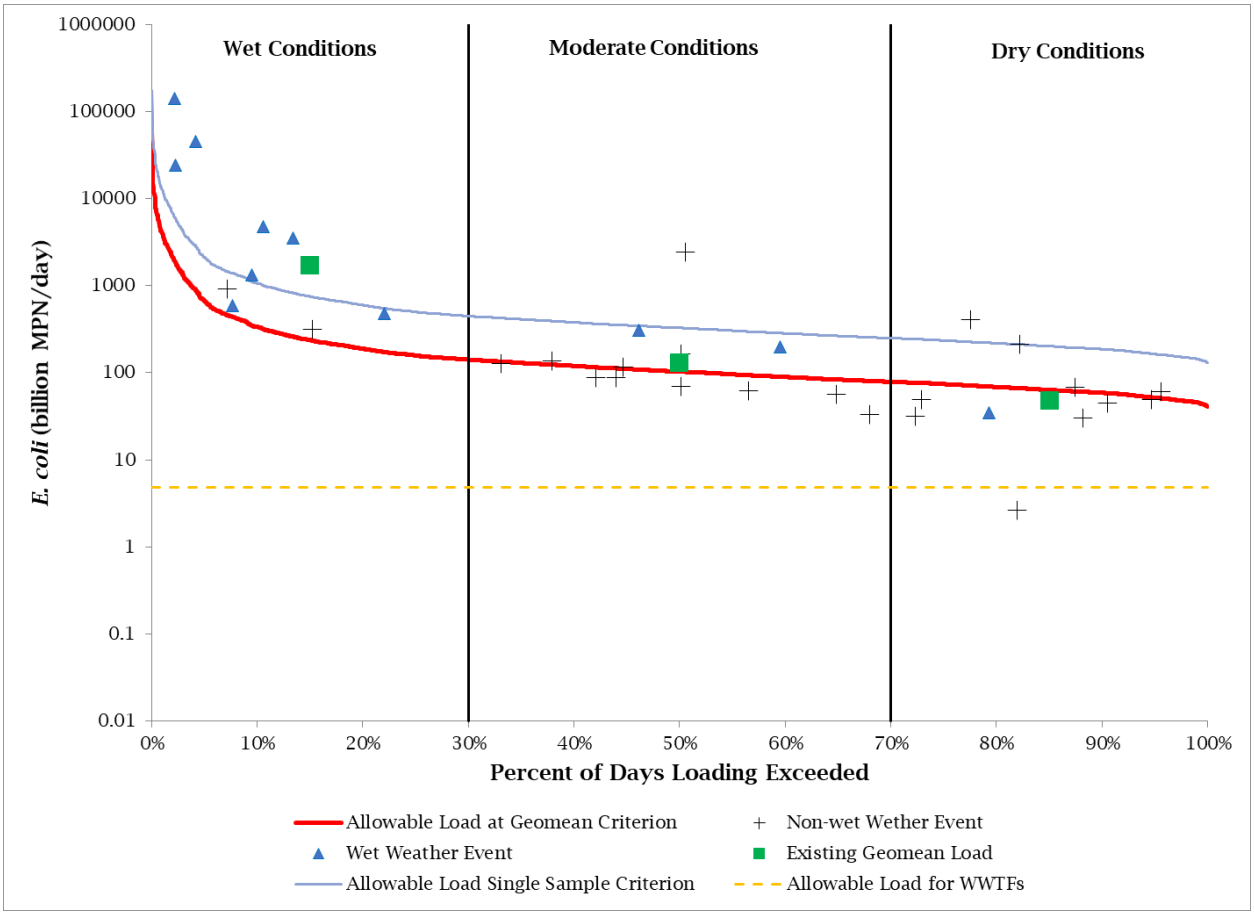

Figure VII-8. LDC at SWQM Station 11335

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 Caney Creek AU 1010_03 was derived using the median flow within the Wet Conditions flow regime (or 15% load duration exceedance) of the LDC developed for TCEQ SWQM Station 11335 (located at the watershed outlet). This station represents the location within Caney Creek AU 1010_03 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 VII-8 presents the WLA for each WWTF and the resulting total allocation for the AU within the TMDL watershed.

Table VII-8. WLAs for TPDES-permitted facilities

AU	TPDES Number	Permittee	Bacteria Limit (cfu/100 mL *E. coli*)	Full Permitted Flow (MGD)	WLA_{WWTF} (billion cfu/day *E. coli*)
1010_03	WQ0012204001	Conroe ISD	63	0.02	0.048
1010_03	WQ0014285001	C & R Water Supply Inc.	63	0.30	0.715
1010_03	WQ0015261001	Crystal Springs Water Co., Inc.	63	0.325	0.775

AU	TPDES Number	Permittee	Bacteria Limit (cfu/100 mL *E. coli*)	Full Permitted Flow (MGD)	WLA_{WWTF} (billion cfu/day *E. coli*)
1010_03	WQ0015689001	Crockett Martin Corp.	63	0.025	0.060
1010_03	WQ0016005001	Crystal Springs Water Co., Inc.	63	0.75	1.789
1010_02	WQ0011715001	Texas National MUD	63	0.225	0.537
1010_02	WQ0012670001	Quadvest, L.P.	63	0.175	0.417
1010_02	WQ0015984001	Texas Campgrounds Club, Inc.	63	0.04	0.095
1010_01	WQ0011020001	City of New Waverly	63	0.088	0.210
1010_01	WQ0011020002	City of New Waverly	63	0.10	0.238
			Total	**2.048**	**4.884**

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 TMDL 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 (2,607 acres), MSGP authorizations (49 acres), CGP authorizations (1,608 acres), and concrete production facilities (55 acres) were calculated using geographic information system shapefiles as well as aerial imagery by measuring the estimated disturbed area at each facility location (or the "area disturbed" listed for CGP authorizations). The percentage of land under the jurisdiction of stormwater permits in the TMDL watershed is 6.45%.

Load Allocation

The load allocation (LA) component of the TMDL corresponds to runoff or direct deposition from unregulated sources.

Allowance for Future Growth

The future growth (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 2010 and 2070 for the TMDL watershed are provided in Table VII-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 VII-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 flow regime) from the LDC developed for TCEQ SWQM Station 11335. 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 VII-9. TMDL allocation summary for AU 1010_03

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

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
Caney Creek	1010_03	237.441	11.872	4.884	12.977	188.219	19.489

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

Table VII-10. Final TMDL allocation for AU 1010_03

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

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
Caney Creek	1010_03	237.441	11.872	24.373	12.977	188.219

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 10 years (2010 through 2019) of routine monitoring data collected at one SWQM station (11335) in the warmer months (May-September) against those collected during cooler months (November-March). The months of April and October were considered transitional between warm and cool seasons and were excluded from the seasonal analysis. Differences in seasonal concentrations were then evaluated with a Wilcoxon Rank Sum test (also known as the "Mann-Whitney" test). The analysis of *E. coli* data indicated that there was no significant difference in indicator bacteria between the cool and warm weather seasons (α=0.05) for Caney Creek. 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, 2021) was published on the TCEQ website on March 11, 2022. Project staff presented information about this addendum at the annual spring meeting of the the Bacteria Implementation Group (BIG) in Houston (held online) on May 25, 2021. The public had an opportunity to comment on this addendum during the public comment period (May 6 through June 7, 2022) for the Water Quality Management Plan (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 TMDL Program News webpage.[6] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[7] TCEQ accepted public comments on the original TMDL report from November 19 through December 20, 2010. Two comments were submitted, and neither of them referred directly to the AU in this TMDL addendum.

[6] https://www.tceq.texas.gov/waterquality/tmdl/tmdlnews.html
[7] https://www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html

Implementation and Reasonable Assurance

The AU covered by this addendum is within the existing bacteria TMDL watersheds upstream of Lake Houston. That TMDL watershed, including Caney Creek AU 1010_03, 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 commission 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.

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