Lavaca River Above Tidal and Rocky Creek: A Community Project to Protect Recreational Uses

Two Total Maximum Daily Loads for Indicator Bacteria in Lavaca River Above Tidal and Rocky Creek[1]

Adopted August 14, 2019.

Approved by EPA October 25, 2019.

One TMDL for Lavaca River Above Tidal Added by this Addendum I, January 2022

Via the January 2022 Update to the Texas Water Quality Management Plan (SFR-121/2022-02).

Approved by EPA June 8, 2022 (scroll to view or print this addendum).

[1] https://www.tceq.texas.gov/assets/public/waterquality/tmdl/108lavaca/108-lavaca-tmdl-bacteria-adopted-approved.pdf

Appendix VIII. Addendum One to Two TMDLs for Indicator Bacteria in Lavaca River Above Tidal and Rocky Creek

Adding One Total Maximum Daily Load (TMDL) for 1602_02

One TMDL for Indicator Bacteria in Lavaca River Above Tidal

Introduction

Texas Commission on Environmental Quality (TCEQ) adopted *Two TMDLs for Indicator Bacteria in Lavaca River Above Tidal and Rocky Creek* (TCEQ, 2019a) on August 14, 2019. The United States Environmental Protection Agency (EPA) approved the TMDLs on October 25, 2019. This document is the first addendum to the original TMDL report.

This first addendum includes information specific to one additional assessment unit (AU) for Lavaca River Above Tidal (AU 1602_02; also referred to in this addendum as the TMDL watershed). This AU is located within the watershed of the approved original TMDLs for Lavaca River Above Tidal and Rocky Creek. 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 Lavaca River Above Tidal*[2] (Jain and Schramm, 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 Lavaca River Above Tidal in the *2008 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2020). The bacteria impairment was

[2] https://www.tceq.texas.gov/assets/public/waterquality/tmdl/108lavaca/108-as-221-lavaca-river-addendum-tsd-2021october.pdf

subsequently identified through the 2012 Texas 303(d) List and then removed from the list in 2014. The impairment was identified again in the 2020 Texas 303(d) List, the latest EPA-approved edition. The Lavaca River Above Tidal (Segment 1602) contains two AUs; the impaired AU 1602_02 is addressed in this addendum and AU 1602_03 was addressed in the original TMDL. The TMDL watershed is primarily located in Lavaca County, with small portions of the watershed found in DeWitt, Fayette, Gonzales, and Jackson counties. Figure VIII-1 shows the watershed added in this addendum in relation to the entire watershed of the original TMDLs.

The Texas Surface Water Quality Standards (TCEQ, 2018a) 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 VIII-1 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) stations on AU 1602_02, 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 VIII-2 shows the locations of the TCEQ monitoring stations that were used in evaluating water quality in the 2020 Texas Integrated Report for the AU added by this addendum.

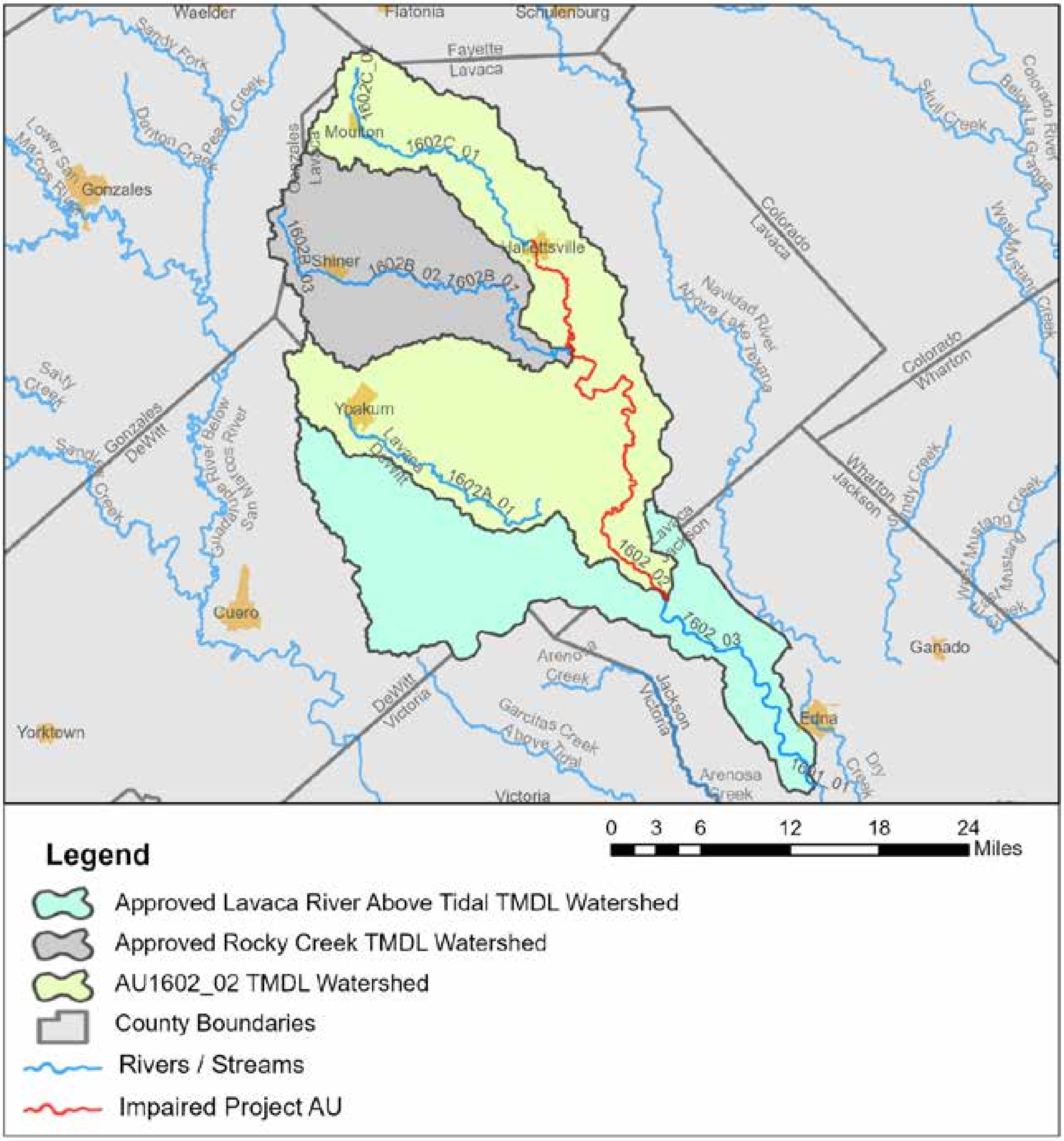

Figure VIII-1. Map showing the previously approved TMDL watersheds and the Lavaca River Above Tidal AU 1602_02 watershed added by this addendum

Table VIII-1. 2020 Texas Integrated Report summary for the TMDL watershed

AU	Station	Parameter	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
1602_02	12525, 12527	*E. coli*	45	12/01/2011 – 11/30/2018	202.74

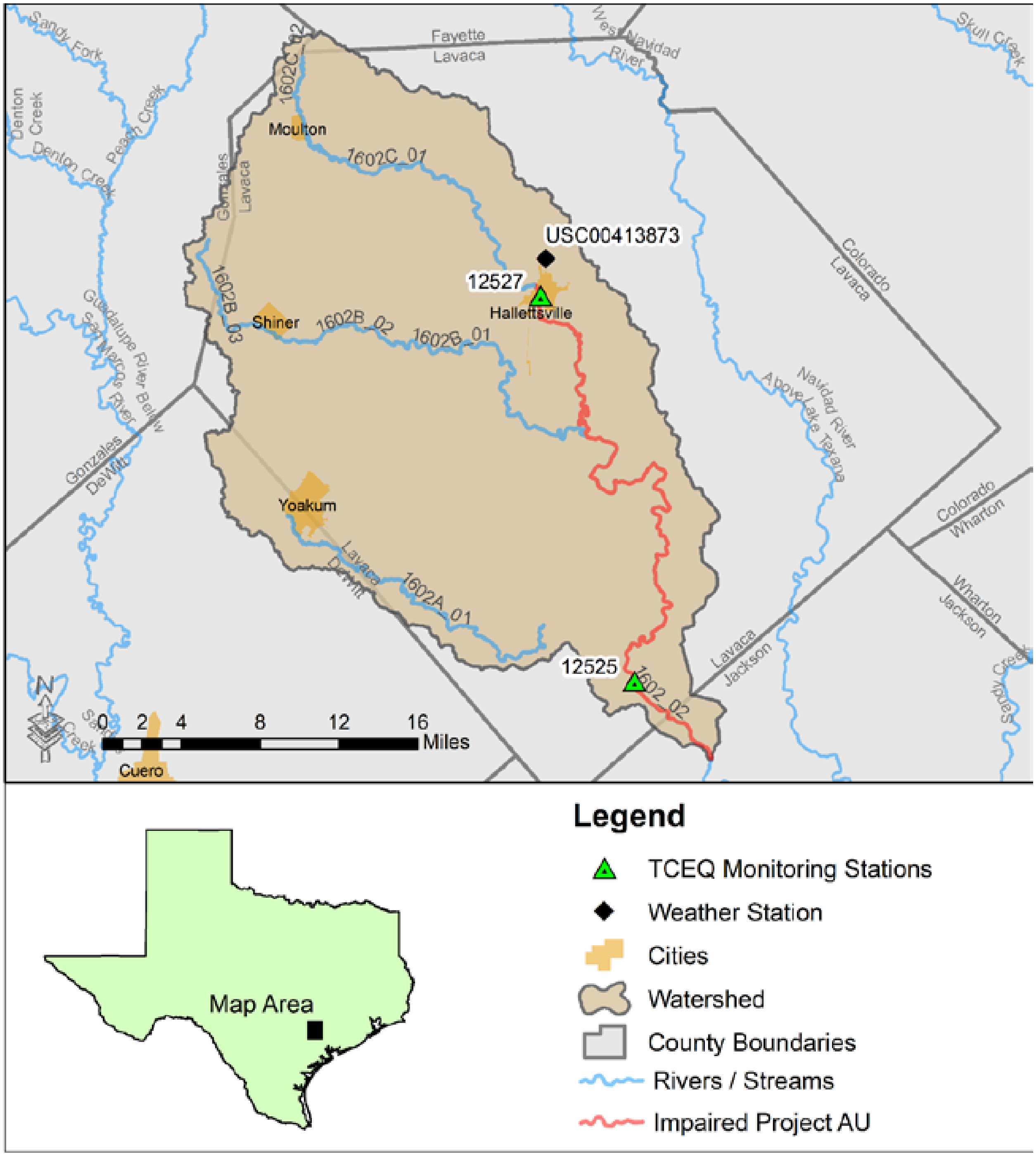

Figure VIII-2. AU 1602_02 watershed showing the TCEQ monitoring stations

Watershed Overview

The Lavaca River Above Tidal (Segment 1602) flows approximately 67 miles from the confluence of Campbell Branch west of Hallettsville in Lavaca County to Lavaca River Tidal (Segment 1601), 5.3 miles downstream of US 59 in Jackson County. This document addresses the contact recreation use impairment for the upstream AU of Lavaca River Above Tidal (AU 1602_02). The total drainage area for the TMDL watershed is 587 square miles in Gonzales, DeWitt, Fayette, Jackson, and Lavaca counties.

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

- 1602 (Lavaca River Above Tidal) – From a point 8.6 kilometers (5.3 miles) downstream of US 59 in Jackson County to the confluence of Campbell Branch west of Hallettsville in Lavaca County.
  - AU 1602_02 – From the confluence of Beard Branch upstream to the upper end of segment at the confluence of Campbell Branch in Hallettsville.

Watershed Climate

Weather data were obtained for the 16-year period from January 2005 through December 2020 from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center Database. The City of Hallettsville weather station (USC00413873) located within the TMDL watershed area (Figure VIII-2) was used to retrieve the precipitation and temperature data from 2005 through 2020 (NOAA, 2020; Figure VIII-3). Data from this 16-year period indicate that the average monthly high temperature typically reaches a maximum of 97.1 °F in August, and the average monthly low temperature reaches a minimum of 42.9 °F in January. Annual rainfall averages 35.1 inches. The wettest month is May (3.8 inches), while February (1.8 inches) is the driest month, with rainfall occurring throughout the year.

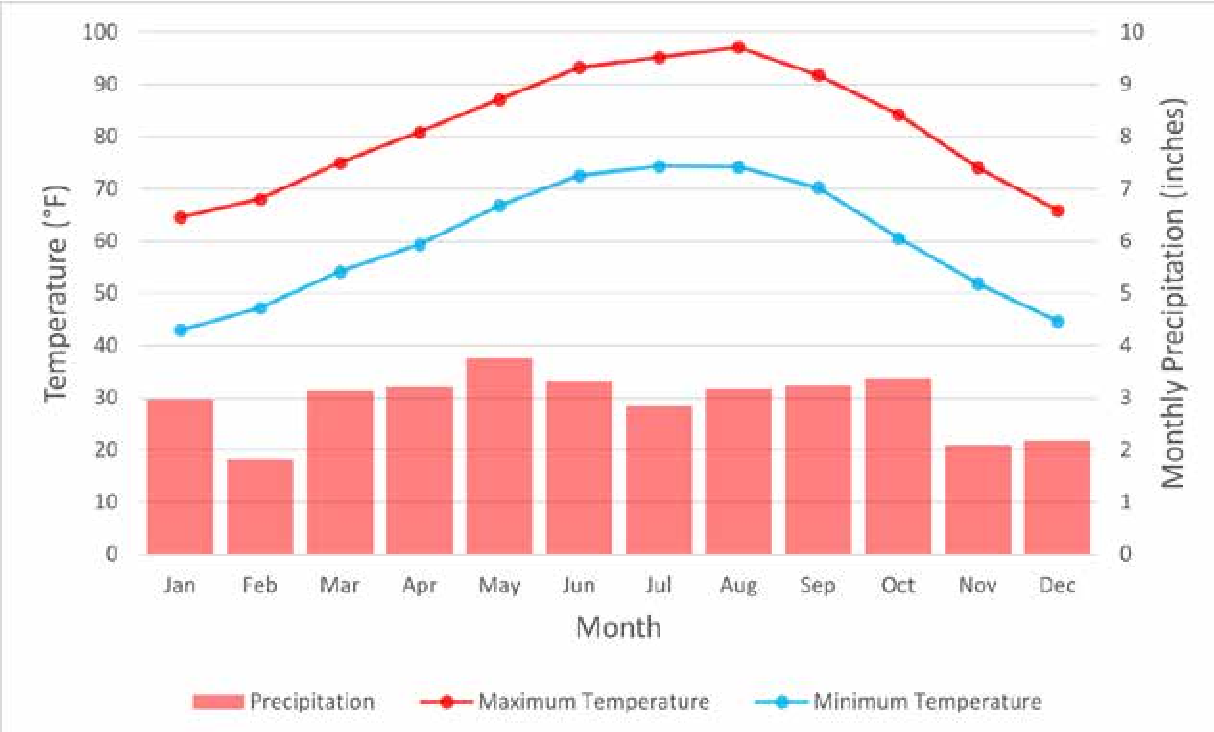

Figure VIII-3. Average monthly temperature and precipitation (2005–2020) at the City of Hallettsville weather station

Watershed Population and Population Projections

The TMDL watershed is primarily located in Lavaca County, with small portions of the watershed found in DeWitt, Fayette, Gonzales, and Jackson counties. According to the United States Census Bureau (USCB) 2010 Census (USCB, 2010), the TMDL watershed had an estimated population of 19,618 people in 2010.

Population projections in Table VIII-2 are estimated from the Texas Water Development Board (TWDB) 2021 Regional Water Plan Population and Water Demand Projection data (TWDB, 2019a; TWDB, 2019b; TWDB, 2019c) and historical population estimates (TWDB, 2017a; TWDB, 2017b).

Table VIII-2. Estimated 2020 population and 2070 population projection for the TMDL watershed

Area	2020 Estimated Population	2070 Projected Population	Projected Population Increase	Percent Change
Lavaca River Above Tidal (AU 1602_02) watershed	19,698	20,006	308	1.56%

The following steps detail the method used to estimate the 2020 and projected 2070 populations in the TMDL watershed.

1. The 2010 Census block population data were obtained for the five counties in the watershed (Gonzales, DeWitt, Fayette, Jackson, and Lavaca).
2. The 2010 watershed population was developed using the block level data for the portion of the five counties in 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. Lavaca County encompasses the majority of the watershed area and is expected to have no population growth (TWDB, 2019a).
5. The rural area population in DeWitt, Fayette, Gonzales, and Jackson counties only cover a small portion of the watershed population. The TWDB Population Projections by Regional Water Planning Group, regions K, L, and P, (TWDB, 2019b) provide projections for "County-Other" which were used to determine population projections for the rural areas in these counties.
6. The portion of City of Yoakum Water User Group (WUG) in DeWitt County has a projected population increase between 2010-2070 (TWDB, 2019c) and was used to estimate population projections in the City of Yoakum.
7. The 2010 populations for the above mentioned WUG (TWDB, 2017a) and "County-Other" (TWDB, 2017b) areas were obtained from historical population estimates provided by TWDB.
8. The projected percentage increases for the four "County-Other" areas in the watershed and the City of Yoakum were applied to their 2010 population estimates to obtain the decadal population projections for each of these areas in the watershed.
9. The projected population estimates obtained in Step 8 were summed and added to the static 2010 population of the rest of the Lavaca County in the watershed to obtain population projections for the watershed out to 2070.

Land Cover

The land cover data were obtained from the 2016 National Land Cover Database (NLCD; United States Geological Survey (USGS), 2019). The land cover for the TMDL watershed are shown in Figure VIII-4. A summary of the land cover data is provided in Table VIII-3 and indicates that the dominant land covers in the TMDL watershed are Hay/Pasture (60.15%), followed by Deciduous Forest (11.31%) and Shrub/Scrub (9.36%). The watershed is predominantly rural in land use, as only approximately 5% of the total watershed area is classified as Developed land cover (Open Space, Low Intensity, Medium Intensity, and High Intensity).

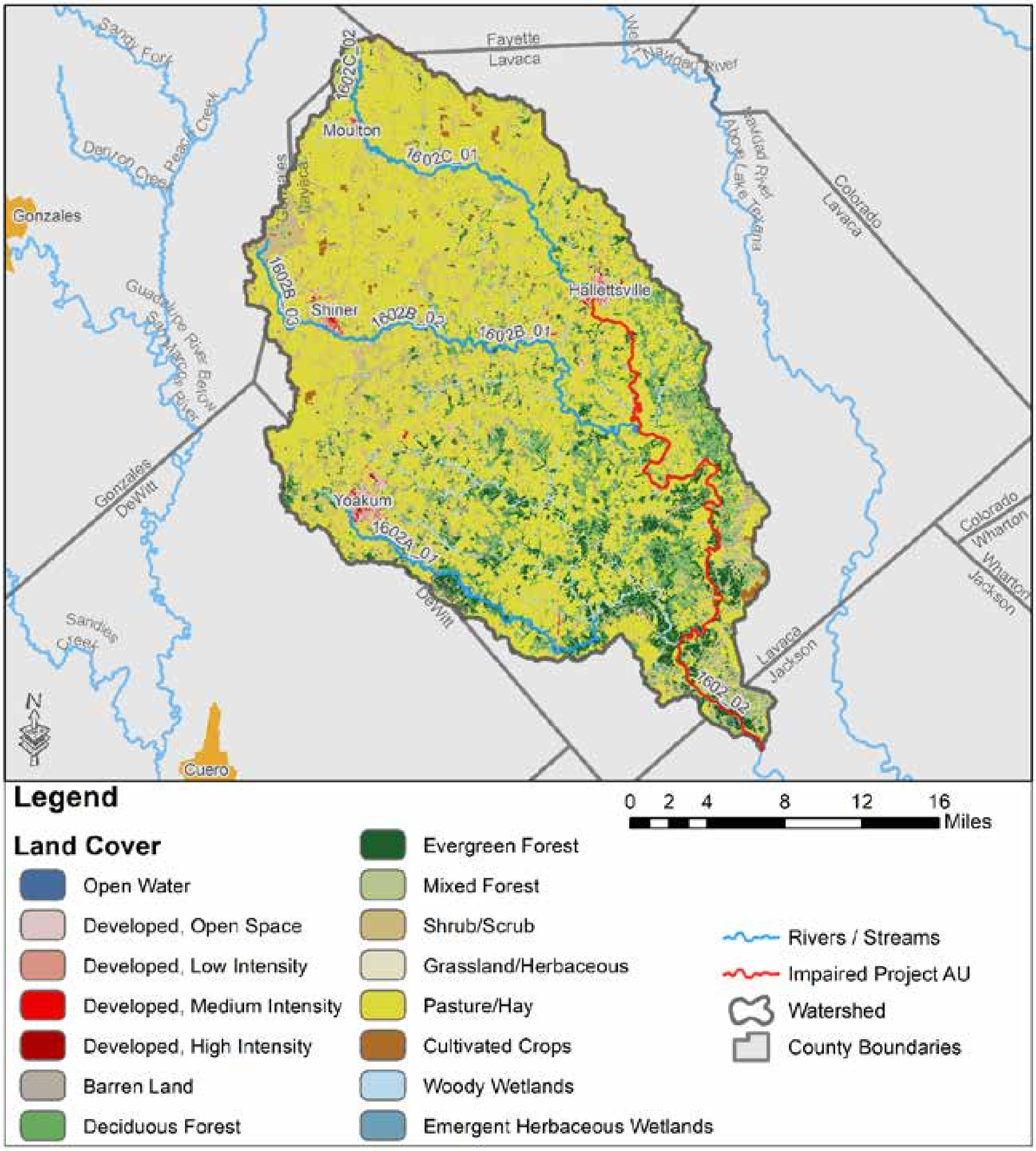

Figure VIII-4. 2016 land cover

Table VIII-3. Land cover summary

2016 NLCD Classification	Area (Acres)	% of Total
Open Water	813.52	0.22%
Developed, Open Space	14,462.32	3.85%
Developed, Low Intensity	3,016.76	0.80%
Developed, Medium Intensity	955.59	0.25%
Developed, High Intensity	346.69	0.09%
Barren Land	126.14	0.03%
Deciduous Forest	42,488.14	11.31%
Evergreen Forest	23,053.80	6.14%
Mixed Forest	13,811.38	3.68%
Shrub/Scrub	35,147.19	9.36%
Grassland/Herbaceous	1,860.07	0.50%
Pasture/Hay	225,978.32	60.15%
Cultivated Crops	2,635.24	0.70%
Woody Wetlands	10,347.83	2.75%
Emergent Herbaceous Wetlands	651.67	0.17%
Total	**375,694.64**	**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 WWTF outfalls and stormwater discharges from industries and regulated construction activities.

Domestic and Industrial WWTFs

As of December 2020, there were four WWTFs with TPDES permits within the TMDL watershed (Table VIII-4 and Figure VIII-5). All the facilities treat solely domestic wastewater.

Table VIII-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[b])
1602_02	WQ0010013001	TX0025232	City of Hallettsville	001	126	Treated domestic wastewater	0.8
1602C_02	WQ0010227001	TX0053287	City of Moulton	001	126	Treated domestic wastewater	0.242
1602B_02	WQ0010280001	TX0026042	City of Shiner	001	126	Treated domestic wastewater	0.85
1602A_01	WQ0010463001	TX0026034	City of Yoakum	001	126	Treated domestic wastewater	0.95

[a]NPDES: National Pollutant Discharge Elimination System

[b]MGD: million gallons per day

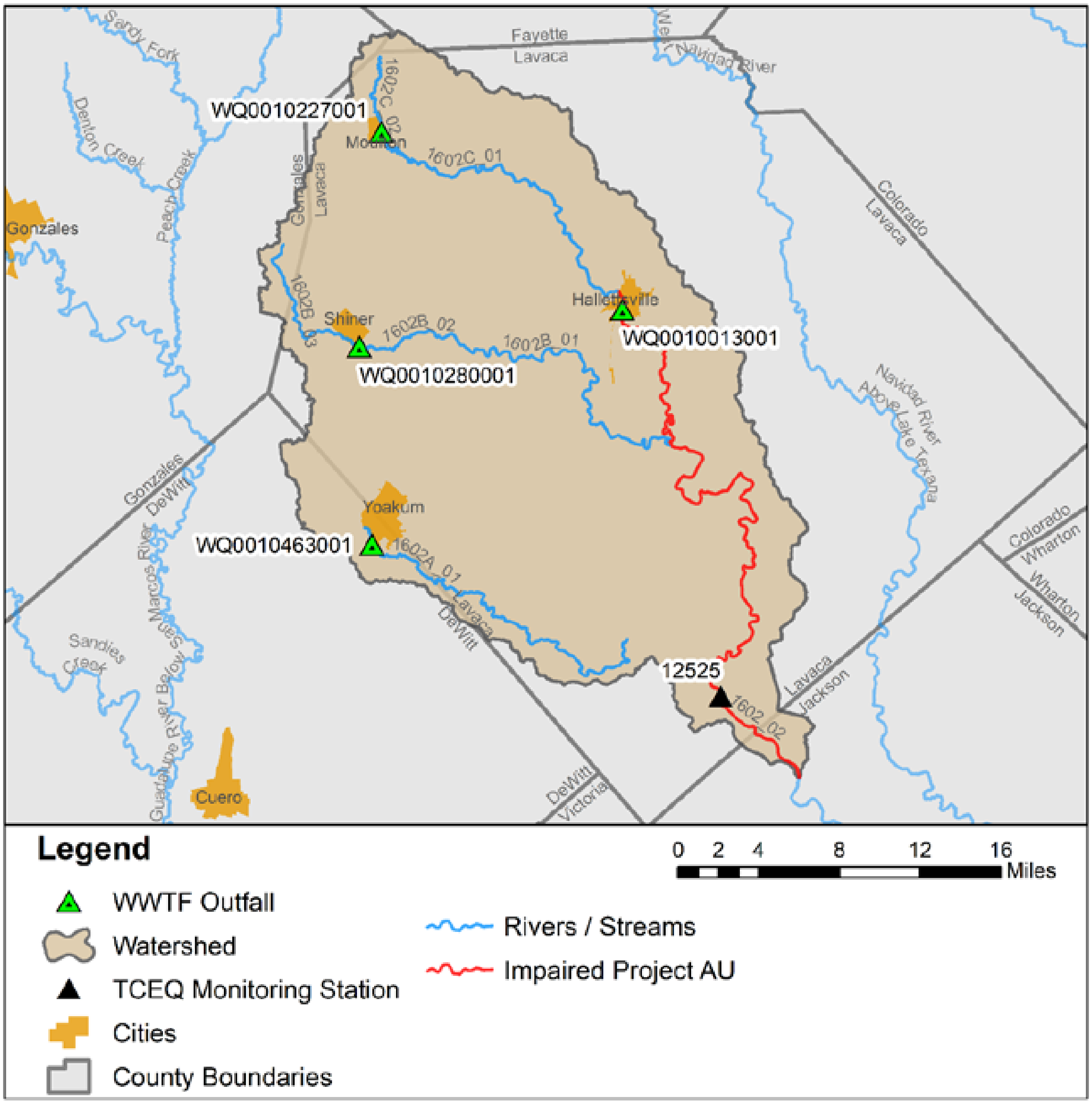

Figure VIII-5. WWTFs in the TMDL watershed

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, 2021a) in the TMDL watershed, as of December 2020, found two concrete production facilities covered by the general permit. The same review revealed one pesticide permittee covered by the general permit. These facilities and pesticide management areas 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 12-year period from 2009 through 2020 in the TMDL watershed was obtained from TCEQ Region 14 Office and Central Office in Austin (TCEQ, 2019b; TCEQ, 2021b). The summary data indicated nine SSO incidents had been reported within the TMDL watershed. Two SSOs had unknown discharge volumes, while the other seven had a total discharge of 12,600 gallons with a minimum of 100 gallons and a maximum of 5000 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 separate storm sewer system (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 small 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, 2021a) in the TMDL watershed as of February 27, 2021, found nine active MSGP authorizations within the watershed. A search of active, terminated, and expired CGP authorizations between January 2011 and December 2020 was conducted. On average 48.76 acres of land in the watershed were under CGP authorizations each year in the 10-year period.

The TMDL watershed does not include any active Phase II MS4 permits.

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. The TMDL watershed does not include any area covered by active Phase II MS4 permits.

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 VIII-5 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, 2019). The county-level estimated livestock populations were reviewed by Texas State Soil and Water Conservation Board staff and were distributed based on GIS calculations of grazeable land (Pasture/Hay, Shrub/Scrub, and Grassland/Herbaceous) in the watershed, based on the 2016 NLCD. These livestock numbers, however, were not used to develop an allocation of allowable bacteria loading to livestock.

Table VIII-5. Estimated livestock populations

AU	Cattle and Calves	Goats	Sheep	Horses
1602_02	48,839	717	378	813

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 VIII-6 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 VIII-6. Estimated households and pet population

Estimated Households	Estimated Dog Population	Estimated Cat Population
9,800	6,017	4,479

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.

The Texas Parks and Wildlife Department (TPWD) provided deer population-density estimates by Deer Management Unit (DMU) and Ecoregion in the state (TPWD, 2020). The TMDL watershed lies within DMU 11 (Post Oak Savannah), with an average deer density of 21 acres per deer in the suitable land cover over the period 2005-2019. Based on 355,973.63 acres of suitable land in the watershed (land covers classified in the 2016 NLCD as Pasture/Hay, Shrub/Scrub, Grassland/Herbaceous, Cultivated Crops, Forests, Wetlands), there are an estimated 16,951 deer in the watershed.

AgriLife Extension (2012) estimates one hog per 39 acres of suitable land cover as a statewide average density of feral hogs. This density was applied to the suitable land in the watershed (land covers classified in the 2016 NLCD as Pasture/Hay, Shrub/Scrub, Grassland/Herbaceous, Cultivated Crops, Forests, Wetlands), resulting in an estimated 9,128 feral hogs in the watershed.

Onsite Sewage Facilities

Estimates of the number of OSSFs in the TMDL watershed were determined by using the 911 addresses that lie outside of the Certificates of Convenience and Necessity boundaries (Gregory et al., 2014). Residential and business locations were selected from the 911 address points by using aerial imagery data. These sources indicate that there are 4,045 OSSFs located within the TMDL watershed. The OSSF density is shown in Figure VIII-6. 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.

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

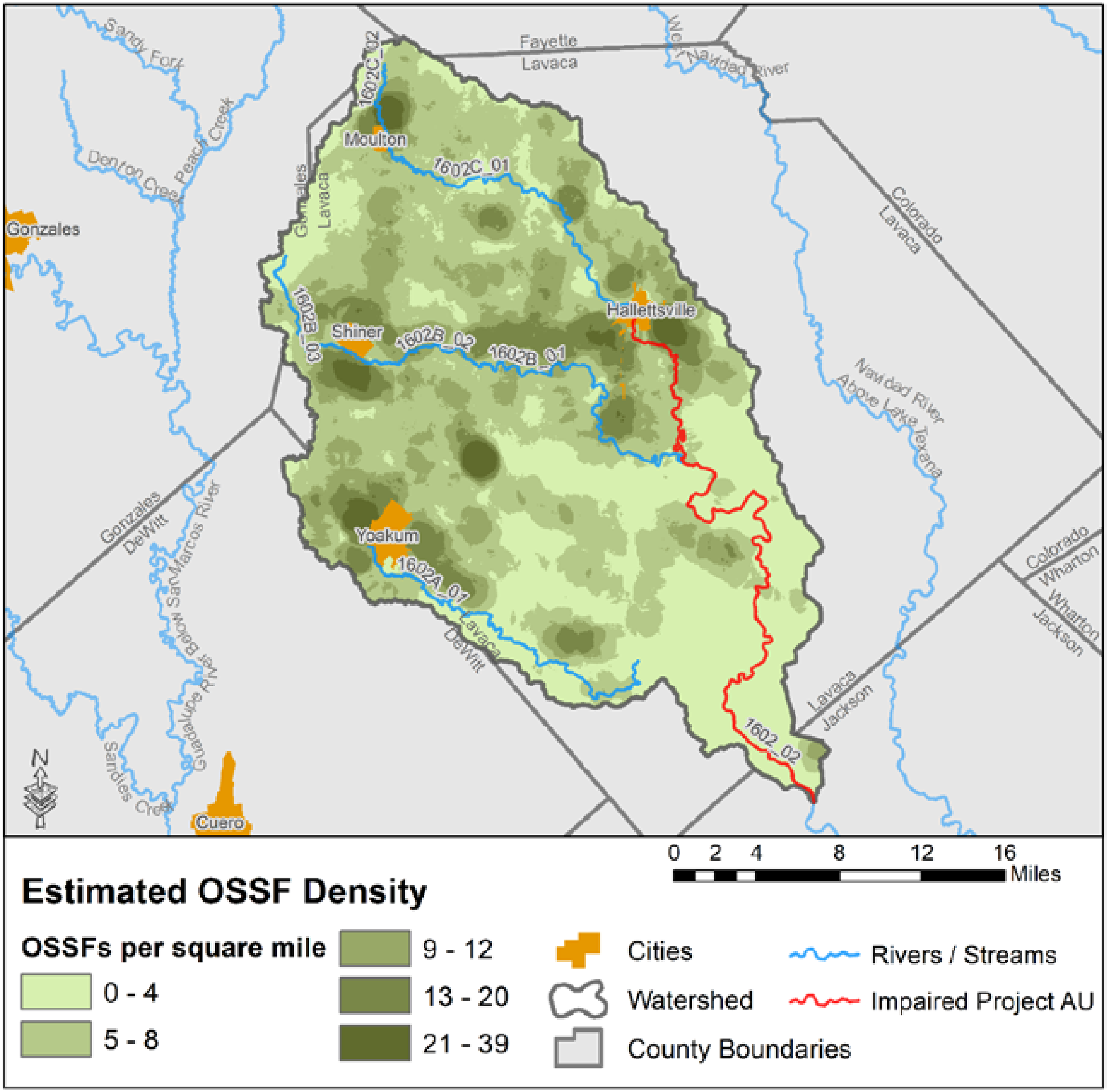

Figure VIII-6. OSSF density

The *E. coli* data plotted on the LDC for TCEQ Station 12525 in Figure VIII-7 show exceedances of the geometric mean criterion primarily occur under High Flows, Moist Conditions, Mid-range Flows, and Dry Conditions. However, bacteria loads are most elevated under the High Flows regime. Loadings fall below the geometric mean criterion under the Low Flows regime. 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.

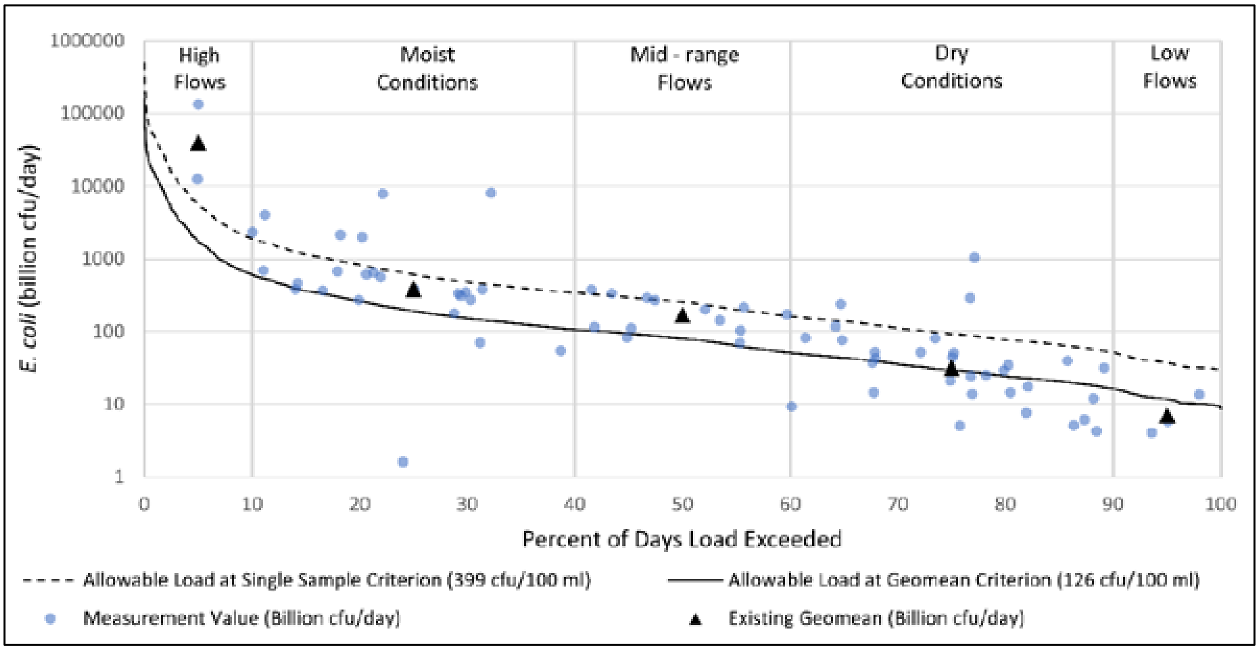

Figure VIII-7. LDC at SWQM station 12525

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 Lavaca River Above Tidal AU 1602_02 was derived using the median flow within the High Flows regime (or 5% flow) of the LDC developed for TCEQ Station 12525. This station represents the location within Lavaca River Above Tidal AU 1602_02 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 the instream geometric mean criterion. Table VIII-7 presents the WLA for each WWTF and the resulting total allocation for the AU within the TMDL watershed.

Table VIII-7. WLAs for TPDES-permitted facilities

AU	TPDES Number	Permittee	Bacteria Limit (cfu/100 mL)	Full Permitted Flow (MGD)	WLA_{WWTF} (billion CFU/day)
1602_02	WQ0010013001	City of Hallettsville	126	0.8	3.816
1602C_02	WQ0010227001	City of Moulton	126	0.242	1.154
1602B_02	WQ0010280001	City of Shiner	126	0.85	4.054
1602A_01	WQ0010463001	City of Yoakum	126	0.95	4.531
			Total	**2.842**	**13.555**

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.

The TMDL watershed does not contain any MS4 permits. Acreages associated with MSGP authorizations (155.66 acres), CGP authorizations (48.76 acres), and concrete production facilities (4.55 acres) were calculated using 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 0.06%.

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. Because of the uneven distribution of projected population growth within the TMDL watershed, FG was not based on the total watershed population growth presented in Table VIII-2. Three of the WWTFs (City of Moulton, City of Shiner, and City of Hallettsville) are not projected to be affected by population growth between 2020 and 2070, while the City of Yoakum is projected to have a population growth in the portion located in the DeWitt County. Therefore, the future growth is estimated for the City of Yoakum WWTF based on its projected population change 0f 3.07% within the TMDL watershed for the time period 2020-2070. In addition, the original TMDL included an estimate for a potential WWTF within the Rocky Creek watershed which is located within the TMDL watershed. It was estimated to serve half of the population in the Rocky Creek watershed that are currently not connected to the City of Shiner WWTF. The discharge was estimated by multiplying the estimated population served by 100 gallons per capita per day and converted to MGD. This FG estimation procedure is also included here to ensure consistency with the FG term calculated for the upstream AU 1602B_01 calculated in the previous TMDL. Together these yield a value of 0.2166 MGD of future additional permitted discharge from WWTFs.

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 VIII-8 summarizes the TMDL calculations for the TMDL watershed. The TMDL was calculated based on the median flow in the 0-10 percentile range (5% exceedance, High Flows regime) from the LDC developed for the TCEQ Station 12525. Allocations are based on the current geometric mean criterion for *E. coli* of 126 cfu/100 mL for each component of the TMDL.

Table VIII-8. TMDL allocation summary for AU 1602_02

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

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
Lavaca River Above Tidal	1602_02	1742.889	87.144	13.555	0.985	1640.172	1.033

The final TMDL allocations (Table VIII-9) needed to comply with federal requirements include the FG component within the WLA_{WWTF} (40 CFR Section 103.7).

Table VIII-9. Final TMDL allocation for AU 1602_02

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

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
Lavaca River Above Tidal	1602_02	1742.889	87.144	14.588	0.985	1640.172

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 16 years (2005 through 2020) of routine monitoring data collected 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 for the SWQM station 12525 indicated that there was no significant difference in indicator bacteria between the cool and warm weather seasons (W = 242.5, p = 0.5794) for the Lavaca River Above Tidal AU 1602_02. 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 (Jain and Schramm, 2021) was published on the TCEQ website on October 15, 2021. Project staff presented information about this addendum at the annual meeting of the Lavaca River Clean Rivers Program near Edna, Texas (held in person and online) on July 20, 2021. The public had an opportunity to comment on this addendum during the public comment period (February 11 through March 15, 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.[3] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[4] TCEQ accepted public comments on the original TMDL report from February 1 through March 5, 2019. No comments were submitted.

Implementation and Reasonable Assurance

The AU covered by this addendum is within the existing bacteria TMDL watershed for Lavaca River Above Tidal and Rocky Creek. That TMDL watershed, including Lavaca River Above Tidal AU 1602_02, is within the area covered by the implementation plan (I-Plan) developed by stakeholders for the TMDL watershed, which was approved by the Commission on August 14, 2019. 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.

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

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