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AS-227

# Implementation Plan for Two Total Maximum Daily Loads for Indicator Bacteria in the Caney Creek Watershed

Assessment Units 1304\_01 and 1304A\_01



By Stakeholders of the Caney Creek Watershed  
and the Houston-Galveston Area Council

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and in large part on the recommendations of the  
Caney Creek Coordination Committee and other watershed stakeholders

Organizations that took part in the development of this document include:  
Texas State Soil and Water Conservation Board  
East Matagorda Bay Foundation  
Caney Creek Estates

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## Abbreviations

AA	authorized agent
AU	assessment unit
BMP	best management practice
CAFO	concentrated animal feeding operation
cfu	colony forming units
CMP	conservation management plan
CRP	Clean Rivers Program
<i>E. coli</i>	<i>Escherichia coli</i>
EIH	Environmental Institute of Houston
EPA	Environmental Protection Agency (United States)
EQIP	Environmental Quality Incentives Program
FG	future growth
FM	farm-to-market
FOG	fats, oils, grease, and wipes
H-GAC	Houston-Galveston Area Council
ICWW	Intracoastal Waterway
I-Plan	implementation plan
LA	load allocation
mL	milliliter
MOS	margin of safety
NRCS	Natural Resources Conservation Service
OSSF	on-site sewage facility
RUS	Rural Utilities Service
SARE	Sustainable Agriculture Research and Education
SEP	Supplemental Environmental Project
SSO	sanitary sewer overflow
SWCD	Soil and Water Conservation District
SWMU	subwatershed management unit
TCEQ	Texas Commission on Environmental Quality
TEEX	Texas A&M Engineering Extension Service
TGLO	Texas General Land Office
TMDL	total maximum daily load
TPWD	Texas Parks and Wildlife Department
TSD	technical support document
TSSWCB	Texas State Soil and Water Conservation Board

TWDB	Texas Water Development Board
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WEP	Water and Environmental Program
WLA	wasteload allocation
WQMP	water quality management plan
WWTF	wastewater treatment facility

## Executive Summary

In 2021, the Texas Commission on Environmental Quality (TCEQ) adopted *Two Total Maximum Daily Loads for Indicator Bacteria in the Caney Creek Watershed* (Segment 1304 and an associated unclassified water body, 1304A).

This implementation plan, or I-Plan:

- Describes the steps that watershed stakeholders and TCEQ will take toward achieving the pollutant reductions identified in the total maximum daily load (TMDL) report.
- Outlines the schedule for implementation activities.

The goal of this I-Plan is to restore the primary contact recreation 1 uses in assessment units (AUs) 1304\_01 and 1304A\_01 by reducing concentrations of bacteria to levels established in the TMDL. *Escherichia coli* (*E. coli*) and Enterococci are widely used as indicator bacteria to assess attainment of the contact recreation—*E. coli* in freshwater and Enterococci in saltwater. The criteria for assessing attainment of the contact recreation use are expressed as the number of bacteria, typically given as colony forming units (cfu). The primary contact recreation 1 use is not attained when the geometric mean of indicator bacteria samples exceeds the geometric mean criterion of 126 cfu per 100 milliliters (mL) for *E. coli* in freshwater or 35 cfu/100 mL for Enterococci in saltwater, including tidal water bodies.

One of the water bodies addressed by the TMDL—1304A\_01—will be delisted according to the *Draft 2022 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)* (TCEQ, 2022) as it was meeting the criteria established in the *Texas Surface Water Quality Standards* (TCEQ, 2018). This I-Plan will apply to 1304A\_01 (and all water bodies within the TMDL watershed) as a protective measure.

This I-Plan includes five management measures that will be used to reduce indicator bacteria in the Caney Creek watershed. Management measures are related to nonpoint sources (mostly unregulated), such as pet or wildlife fecal waste. Control actions are related to point sources (regulated discharges), such as implementing industrial or domestic wastewater treatment facilities (WWTFs) permits or municipal separate storm sewer systems and their associated stormwater management programs. No control actions are included in this plan.

## Management Measures

For each of the management measures chosen, this plan names the responsible parties, technical and financial needs, monitoring and outreach efforts, and a schedule of activities. Implementation of management measures will be

dependent upon the availability of funding. The management measures in this plan are:

- 1) Support land management initiatives.
- 2) Promote safe on-site sewage facility (OSSF) use and maintenance.
- 3) Promote feral hog management.
- 4) Improve WWTF and sanitary sewer collection system function.
- 5) Reduce stormwater sources such as pet waste and illegal dumping.

The stakeholders and TCEQ will review progress under TCEQ's adaptive management approach. Stakeholders may adjust the plan periodically based on progress reviews.

## Introduction

To keep Texas' commitment to restore and maintain water quality in impaired rivers, lakes, and bays, TCEQ works with stakeholders to develop an I-Plan for each adopted TMDL. A TMDL is a technical analysis that:

- Determines the amount of a particular pollutant that a water body can receive and still meet applicable water quality standards.
- Sets limits on categories of sources that will result in achieving standards.

This I-Plan is designed to guide activities that will achieve the water quality goals for the Caney Creek watershed as defined in the TMDL report. It is a flexible tool that governmental and nongovernmental organizations involved in implementation use to guide their activities to improve water quality. The participating partners may accomplish the activities described in the plan through rule, order, guidance, or other formal or informal action.

This I-Plan includes the following components:

- Description of management measures that will be implemented to achieve the water quality target.
- Schedule for implementing activities.
- A follow-up tracking and monitoring plan to determine the effectiveness of the management measures undertaken.
- Measurable outcomes and other considerations TCEQ and stakeholders will use to decide whether the I-Plan has been properly executed, water quality standards are being achieved, or the plan needs to be modified.
- Communication strategies TCEQ will use to share information with stakeholders.

- Review strategy that stakeholders will use to periodically review and revise the plan to ensure progress in improving water quality.

## Watershed Overview

The Caney Creek watershed lies in southeast Texas. The 303-square-mile area includes parts of three Texas counties: Brazoria, Matagorda, and Wharton. Caney Creek initially begins as an intermittent stream within the city limits of Wharton, traveling generally southeast through Wharton County to the Matagorda County line. By the time it reaches the county line, Caney Creek has become a perennial stream that meanders southeast through eastern Matagorda County before terminating south of the town of Sargent at the Intracoastal Waterway (ICWW). Water from Caney Creek then flows southwest in the ICWW to a point where the ICWW connects to East Matagorda Bay.

The Caney Creek watershed includes two classified segments, Caney Creek Tidal (1304) and Caney Creek Above Tidal (1305), and three unclassified water bodies, Linnville Bayou (1304A), Hardeman Slough (1305A), and Caney Creek Above Water Hole Creek (1305B) (Figure 1). Caney Creek Tidal begins near the town of Cedar Lane and Farm-to-Market (FM) 457 and traverses 36 miles southeast to the confluence with the ICWW (H-GAC, 2016). The tidal segment has a watershed area of 44 square miles. The tidal segment is broken into two AUs: 1304\_01 and 1304\_02. Three small towns are found along the tidal segment: Sargent, Hawkinsville, and Cedar Lane.

Linnville Bayou (1304A) is a freshwater tributary to Caney Creek Tidal and has a watershed area of 100 square miles. Linnville Bayou begins in southeastern Wharton County near the town of Newgulf as an intermittent stream and travels downstream for approximately 20.3 miles, much of it as the border between Matagorda and Brazoria counties, before terminating into Caney Creek Tidal (AU 1304\_02) in Matagorda County. Linnville Bayou has three AUs: 1304A\_01, 1304A\_02, and 1304A\_03. AU 1304A\_02 is located at the downstream end of the water body, and AU 1304A\_03 is located at the upstream end. Both of the unimpaired AUs are under a mile in length and are not labeled on the maps in this document because of the scale at which they are presented.

For this document, the TMDL watershed (the full Caney Creek watershed) is divided into three subwatersheds. The Caney Creek Tidal and Linnville Bayou subwatersheds include the TMDL water bodies. The Caney Creek Above Tidal subwatershed covers the remaining upstream portion of the TMDL watershed.

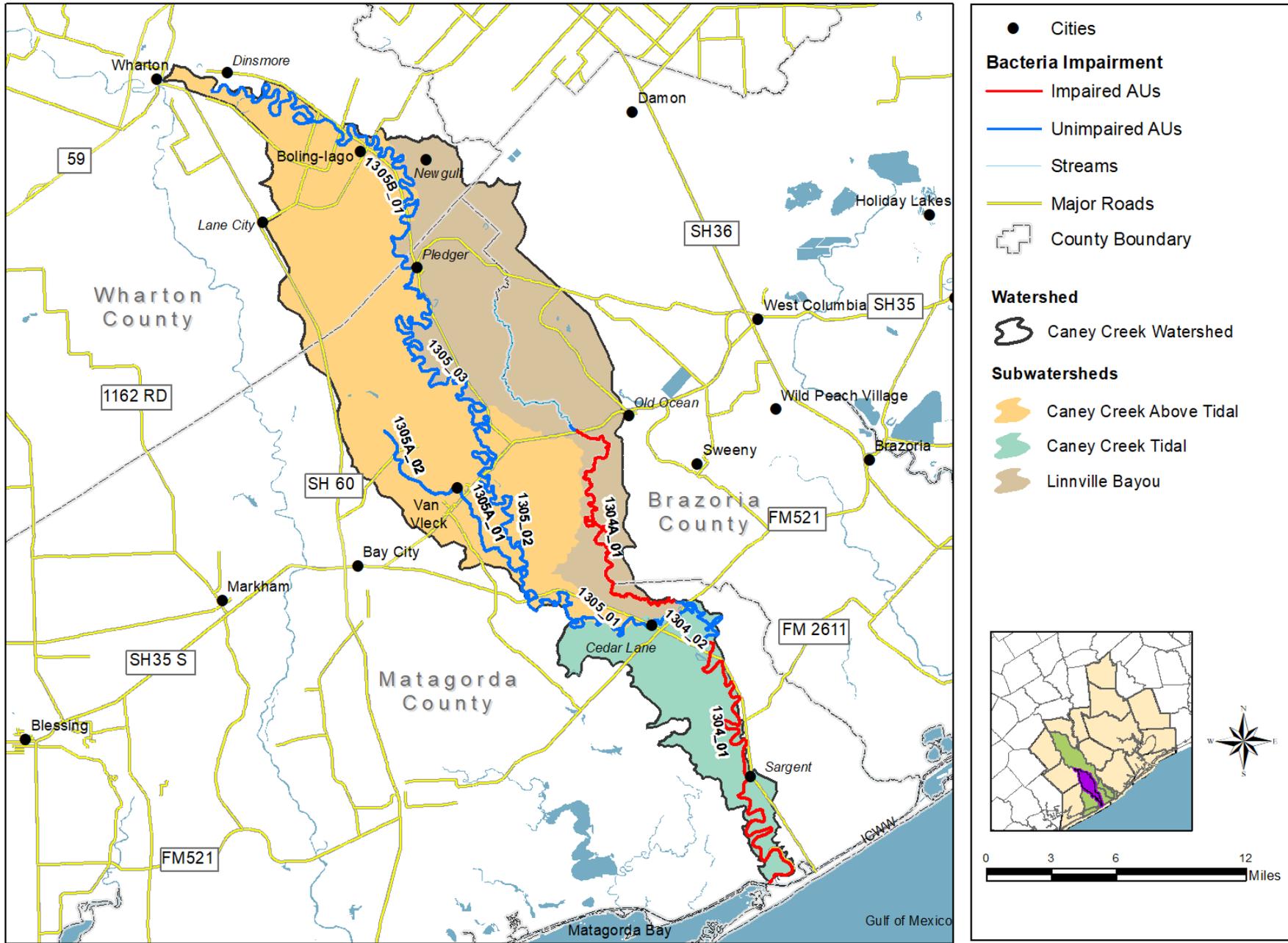


Figure 1. Map of the TMDL watershed

## Summary of TMDLs

Table 1 summarizes the allocations developed for *Two Total Maximum Daily Loads for Indicator Bacteria in the Caney Creek Watershed*. See the TMDL report for additional background information, including the problem definition, endpoint identification, source analysis, linkages between sources and receiving waters, and pollutant load allocations.

**Table 1. TMDL allocation summary for Caney Creek Tidal AU 1304\_01 and Linnville Bayou AU 1304A\_01**

AU	Indicator Bacteria	TMDL	MOS <sup>a</sup>	WLA <sub>WWTF</sub> <sup>b</sup>	WLA <sub>SW</sub> <sup>c</sup>	LA <sup>d</sup>	FG <sup>e</sup>
1304_01	Enterococci	387.70	2.32	0.45	0.93	383.85	0.15
1304A_01	<i>E. coli</i>	268.66	13.43	0.00	9.08	245.91	0.24

All loads are expressed in billion cfu/day.

<sup>a</sup>MOS: margin of safety

<sup>b</sup>WLA<sub>WWTF</sub>: wasteload allocation for WWTFs

<sup>c</sup>WLA<sub>SW</sub>: wasteload allocation for stormwater

<sup>d</sup>LA: load allocation

<sup>e</sup>FG: future growth

## Implementation Strategy

This I-Plan documents five management measures to reduce bacteria loads. Stakeholders selected management measures based on feasibility, costs, support, and timing. Activities may be phased in based on the needs of the stakeholders, availability of funding, and the progress made in improving water quality.

### Adaptive Implementation

All I-Plans use an adaptive management approach in which stakeholders periodically assess measures for efficiency and effectiveness. This adaptive management approach is one of the crucial elements of the I-Plan. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals and expresses stakeholder commitment to the process.

The stakeholders will periodically assess progress using the schedule of implementation, interim measurable milestones, water quality data, and the communication strategy included in this plan. If stakeholders find that there has been insufficient progress or that implementation activities have improved water quality, the implementation strategy can be adjusted.

## Source Load Calculations

The three main subwatersheds (Caney Creek Tidal, Linnville Bayou, and Caney Creek Above Tidal) are further divided into 11 subwatershed management units (SWMUs) principally covering each AU delineated for the Caney Creek watershed (Table 2, Figure 2). SWMUs are used to set management measure priorities. To attribute load reductions to identified sources within the watershed, the estimated source loadings (all nonpoint in origin) within each subwatershed were determined. The Houston-Galveston Area Council (H-GAC) did not use a modeling approach to generate source contributions but relied on landcover analysis for the Caney Creek watershed and source load calculations that have been developed in previous watershed-based plans where source modeling (e.g., SELECT) in the H-GAC region was used (H-GAC, 2018 and EPA, 2001).

**Table 2. AUs, SWMUs, and SWMU acreage**

AU	SWMU	SWMU Area (acres)
1305B_01	1	34,533
1305_03	2	27,959
1305_02	3	3,288
1305A_02	4	4,651
1305A_01	5	12,472
1305_01	6	18,510
1304A_03	7	34,320
1304A_01	8	29,624
1304A_02	9	97
1304_02	10	7,726
1304_01	11	20,474

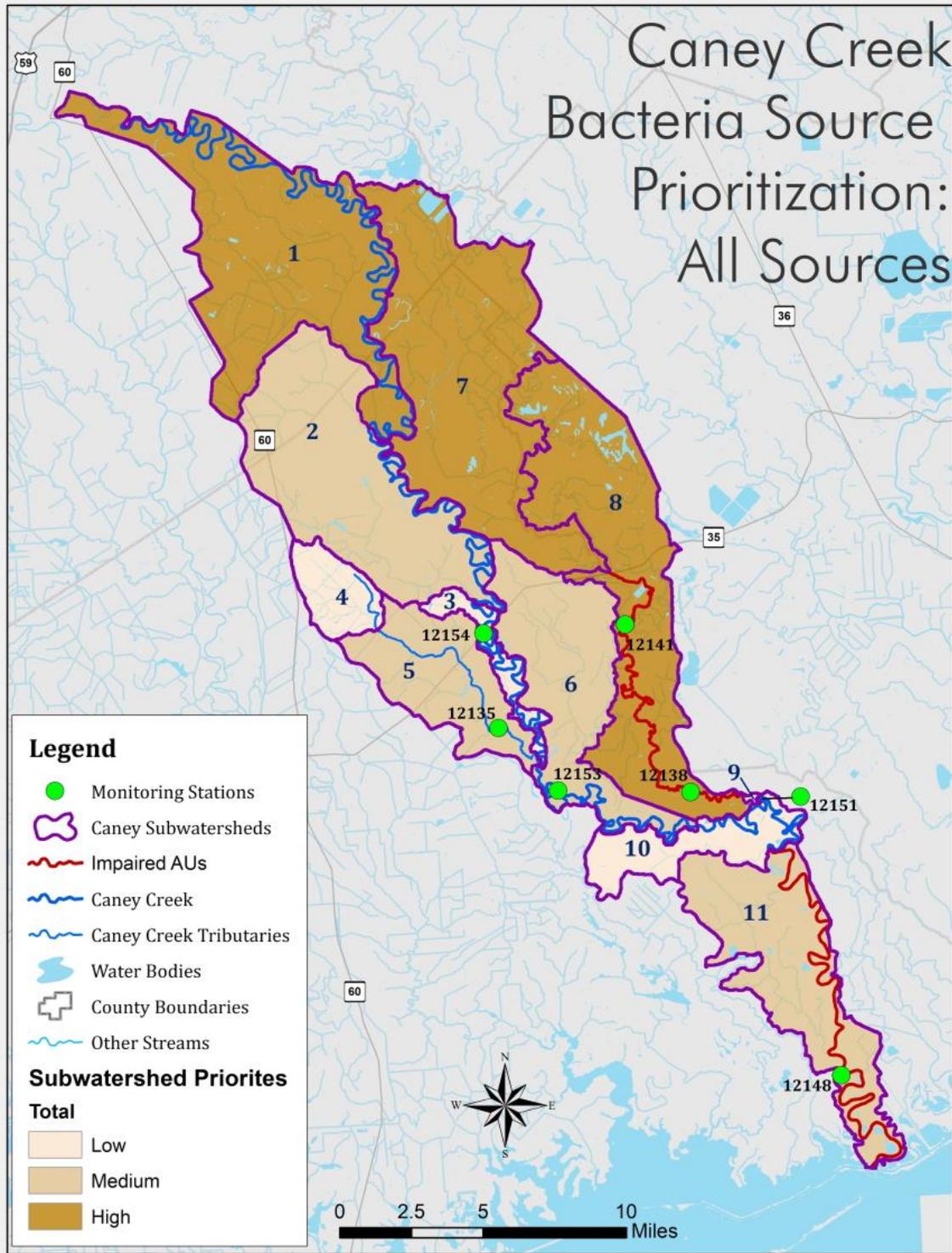


Figure 2. SWMUs showing priority areas for managing all sources

The source load calculation was carried out by multiplying the estimated total source population, described in the management measure sections, by the attributed load a representative unit (e.g., one OSSF) produced in a day (Teague, 2009; Table 3).

The loads in Table 3 were developed using *E. coli* (Teague, 2009; EPA, 2001; H-GAC, 2018). The representative units (Table 3) and their daily loads were applied uniformly across the watersheds regardless of which standard criterion was applicable, *E. coli* or Enterococci. Bacteria data collected in Caney Creek include both fecal indicator bacteria because the watershed has both fresh and tidal waters. Enterococci were collected in tidal water bodies (Segment 1304) and *E. coli* were collected in freshwater (all remaining water bodies). It was assumed that *E. coli* and Enterococci are present in all sources. Source loadings were determined using Table 3 and the estimated watershed source populations. The loads were then expressed in percentage load by source. The tables that follow include loadings in cfu per day of *E. coli* and not Enterococci, with the presumption that management measures will result in proportional bacteria reductions to both indicators, *E. coli* or Enterococci, as well as to any potential fecal pathogens.

**Table 3. Representative unit source loads**

Bacteria Source	Number in Watershed	Representative Unit	Representative Unit Daily Load (billion cfu/day)
Cattle	17,067	1 Cow	2.70
OSSF	3,844 (768 failing)	1 Failing OSSF	3.71
Feral Hogs	3,399	1 Feral Hog	4.45
Dogs	2,177	1 Dog	2.50
Deer	7,663	1 Deer	0.175

The estimated individual source loadings and total loading for all sources in each watershed can be found in Table 4. For this I-Plan, cattle were the only live-stock used, as they account for around 90% of the loadings from livestock. Using the information from Table 4, the percentage each source load contributes can be determined by dividing the individual source load by the total estimated source load for each watershed. Table 5 presents those percentages.

During TMDL development, the reduction of indicator bacteria needed to attain the contact recreation standards was determined. Table 6 provides the percentage reduction, and the load reduction needed within the Caney Creek Tidal, Linnville Bayou, and Caney Creek Above Tidal watersheds to meet the contact recreation standard (H-GAC, 2019).

Multiplying the load reduction values from Table 6 by the percentage source contribution (Table 5) yields the daily load reduction needed for each source and the total reduction by all sources for each watershed. The daily source load reduction values are presented in Table 7. To reach an annual source load reduction, each load is multiplied by 365. The load reduction values will be reviewed more closely within each management measure that follows.

No estimated loads were calculated for sanitary sewer overflows (SSOs). Only one SSO was reported by one collection system operator for the period of record that was used for development of the Caney Creek TMDL (H-GAC, 2019). This was not considered sufficient to estimate a load. However, while source reductions were not developed for SSOs, SSOs and wastewater in general are addressed in this I-Plan.

The source reductions and source unit reductions are estimates. They present one solution to meeting the contact recreation standard. In practice, implementing the I-Plan will likely produce opportunities to act on certain measures while others prove more difficult. Due to the availability of funding or other technical assistance, some actions might be more practical. Therefore, completing the actions within one management measure and expanding beyond the estimated reductions expressed for that measure might be used to alleviate another measure that is discovered to be more difficult to implement.

The amount of rural and natural land cover in the Caney Creek watershed would suggest a larger wildlife contribution, but no additional reliable data exists. Deer are used in this assessment as a surrogate for all wildlife. Efforts under the I-Plan to reduce indicator bacteria will need to account for the fact that no reduction measures will be implemented to address fecal sources from wildlife. Other actions will have to account for this loading. Riparian restoration efforts described in this document may reduce loading from wildlife.

**Table 4. Estimated source loadings of fecal indicator bacteria**

Watershed	Water Body ID	SWMU	Cattle Load	OSSF Load	Feral Hogs Load	Dogs Load	Deer Load	Total Load
Caney Creek Tidal	1304	10-11	5,920	1,100	2,440	284	348	10,092
Linville Bayou	1304A	7-9	15,700	323	5,400	548	469	22,440
Caney Creek Above Tidal	1305	1-6	24,500	1,420	7,290	4,610	524	38,344
<b>Total</b>			<b>46,120</b>	<b>2,843</b>	<b>15,130</b>	<b>5,442</b>	<b>1,341</b>	<b>70,876</b>

All loads are expressed in billion cfu/day.

**Table 5. Percentage source contribution of fecal indicator bacteria**

Watershed	Water Body ID	SWMU	Cattle % Load	OSSF % Load	Feral Hogs % Load	Dogs % Load	Deer % Load	Total % Load
Caney Creek Tidal	1304	10-11	58.68%	10.92%	24.14%	2.81%	3.45%	100.00%
Linville Bayou	1304A	7-9	69.92%	1.44%	24.11%	2.44%	2.09%	100.00%
Caney Creek Above Tidal	1305	1-6	63.88%	3.72%	19.01%	12.03%	1.37%	100.00%
<b>Total</b>			<b>65.05%</b>	<b>4.02%</b>	<b>21.35%</b>	<b>7.68%</b>	<b>1.89%</b>	<b>100.00%</b>

**Table 6. Estimated reductions in fecal indicator bacteria**

<b>Watershed</b>	<b>Estimated Loading of Bacteria</b>	<b>Percentage Reduction</b>	<b>Bacteria Reduction</b>
Caney Creek Tidal	3,848.06	85.39%	3,286.04
Linville Bayou	1,066.83	64.70%	690.23
Caney Creek Above Tidal	3,411.96	81.00%	2,763.75

All loads are expressed in billion cfu/day.

**Table 7. Estimated source load reductions**

<b>Watershed</b>	<b>Water Body ID</b>	<b>SWMU</b>	<b>Cattle Load Reduction</b>	<b>OSSF Load Reduction</b>	<b>Feral Hogs Load Reduction</b>	<b>Dogs Load Reduction</b>	<b>Deer Load Reduction</b>	<b>Total Load Reduction</b>
Caney Creek Tidal	1304	10-11	1,930	359	793	92.4	113	3,287.4
Linville Bayou	1304A	7-9	483	9.9	166	16.9	14.4	690.2
Caney Creek Above Tidal	1305	1-6	1,770	103	525	332	37.8	2,767.8
		<b>Total</b>	<b>4,183</b>	<b>471.9</b>	<b>1,484</b>	<b>441.3</b>	<b>165.2</b>	<b>6,745.4</b>

All loads are expressed in billion cfu/day.

## Activities and Milestones

To facilitate the development of the Caney Creek I-Plan, H-GAC, under contract with TCEQ, held a series of public meetings in the Caney Creek watershed from December 2017 through 2018. The public meetings were used to present general water quality information to Brazos-Colorado Coastal Basin stakeholders. The meetings provided information on water quality impairments, TMDL development, and typical management strategies. Attendees were encouraged to participate in future meetings in the Caney Creek watershed as coordination committee team members.

The Caney Creek coordination committee formed in January 2019 and continued to meet in 2020 and 2021. The group began to review water quality in the Caney Creek watershed and discuss appropriate management measure activities. Five Caney Creek coordination committee meetings were held prior to the development of this report. The implementation activities presented in this report represent the stakeholders' effort and are described in the following section.

The Caney Creek coordination committee met in July 2019, and members were asked to fill out a questionnaire which covered potential sources and management measures. The attendees were asked to determine if each fecal source was a concern and rank it on a high, medium, or low scale. A score of five was considered high, three was considered medium, and one was considered low.

Table 8 presents a summary of the questionnaire results covering nine key indicator bacteria sources traditionally found in Texas watersheds. Domesticated animals raised in the watershed ranked high, while feral hogs and OSSFs ranked as medium-high. Illegal dumping, poorly maintained sanitary sewer collection systems, and wastewater treatment were scored as medium. Concentrated animal feeding operations (CAFOs) and associated manure application were considered medium-low and pet waste ranked as low.

The Caney Creek watershed includes one CAFO. The CAFO is authorized by the CAFO general permit (TXG920000) to manage its wastes that can include fecal bacteria. Like WWTFs, if managed correctly, fecal bacteria from this CAFO are not expected to be a significant source. While CAFO and pet wastes were not considered a concern requiring separate management measures, the fecal source management activities for these sources were allocated to actions within one or more of the selected management measures.

The questionnaire results aided the coordination committee in developing detailed, consensus-based measures. The following sections describe the planned implementation activities.

**Table 8. Results of the stakeholder questionnaire**

Fecal Source	Concern	Score	Priority
Domesticated Animals	Y	4.7	1
OSSF	Y	4.3	2
Feral Hogs	Y	4.3	2
Dumping	Y	3.1	3
Collection System	Y	3.0	3
Wastewater	Y	2.7	3
CAFO	Y	2.4	4
Manure Application	N	1.6	4
Pet Waste	N	1.3	5

# Management Measures

This I-Plan includes five management measures.

- 1) Support land management initiatives.
- 2) Promote safe OSSF use and maintenance.
- 3) Promote feral hog management.
- 4) Improve WWTF and sanitary sewer collection system function.
- 5) Reduce stormwater sources such as pet waste and illegal dumping.

## Management Measure 1.

### Support Land Management Initiatives

The purpose of this management measure is to develop and implement strategies to reduce bacteria loading from livestock into water bodies, and to support nutrient enrichment reduction initiatives in priority areas (see Figure 3).

Livestock are present throughout the Caney Creek watershed. While modeling was not completed outside of a coarse analysis, stakeholders indicated that livestock are potentially a significant source of indicator bacteria, having ranked this source as the top priority (Table 8). Table 9 presents the estimated cattle population as provided in the Caney Creek technical support document (TSD; H-GAC, 2019). The Texas State Soil and Water Conservation Board (TSSWCB) staff reviewed the estimated cattle population numbers during the development of the TSD. As stated earlier, while other types of livestock are mentioned in the TMDL (horses, domesticated pigs, sheep, and poultry), cattle were the only livestock used for calculations in this I-Plan, as they account for the bulk of loadings from livestock. Additionally, actions taken to address cattle under this measure will also cover other livestock.

While the fate and transport of fecal bacteria deposited on upland surfaces is not always certain, practices that manage livestock behavior and time spent grazing, particularly in riparian pastures, can reduce potential bacteria loads reaching nearby water bodies. Livestock grazing behavior can be modified by the availability and location of food, shelter, and water. Cattle grazing is highly dependent upon proximity to these resources, especially water. Their fecal loading is also strongly tied to resource utilization as it is directly related to the amount of time an animal spends in an area. Therefore, reducing the amount of time livestock spend in riparian pastures through rotational grazing, adding alternative watering facilities, or moving supplemental feeding locations can directly reduce potential bacteria loads reaching nearby water bodies.

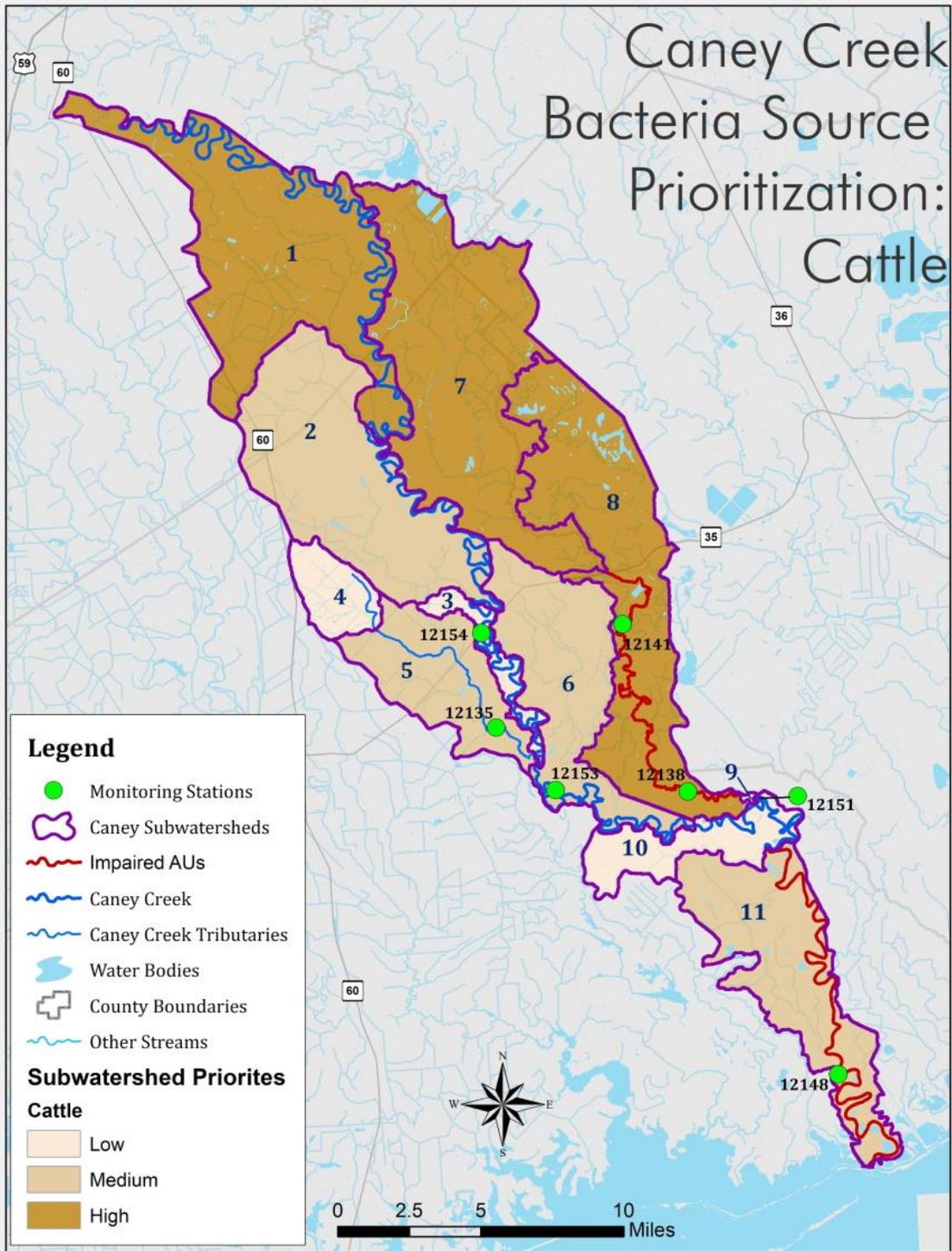


Figure 3. Priority areas for managing cattle

**Table 9. Cattle population and estimated daily bacteria load**

Watershed	Water Body ID	SWMU	Cattle Population	Representative Load	Estimated Daily Bacteria Load (Cattle)
Caney Creek Tidal	1304	10-11	2,194	2.7	5,920
Linville Bayou	1304A	7-9	5,804	2.7	15,700
Caney Creek Above Tidal	1305	1-6	9,069	2.7	24,500
<b>Total</b>			<b>17,067</b>	<b>2.7</b>	<b>46,100</b>

All loads are expressed in billion cfu/day.

Recommended Management Measure 1 activities include the promotion and implementation of voluntary water quality management plans (WQMPs), conservation management plans (CMPs), restoring riparian buffers, and providing technical assistance and outreach. The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and TSSWCB give technical and financial assistance to producers for planning and implementing best management practices (BMPs) that protect and improve water quality. NRCS offers a variety of programs to implement operation-specific conservation plans that will meet producer goals and outline how BMPs will be implemented. TSSWCB, through local Soil and Water Conservation Districts (SWCDs), gives technical and financial assistance to develop and implement WQMPs through planning, implementation, and maintenance of each practice.

Additionally, managing riparian corridors and drainage areas can improve water quality and address stormwater management concerns. Restoring tree canopies, natural vegetation, and wetlands can benefit water bodies by improving aquatic and adjacent habitats and serving as sinks for water quality pollutants including bacteria, total suspended solids, and nutrients. Implementation of Management Measure 1 can work in concert with the execution of Management Measure 5.

The goal of this management measure is to promote and establish at least six WQMPs and six CMPs, provide educational outreach, and complete one riparian corridor project.

## Education Component

Education is crucial to successfully implement Management Measure 1. A variety of educational workshops, trainings, and informational materials are currently available to ranchers and landowners, providing information on how to combine agricultural production with environmental actions. These actions may address water quality, reduce soil erosion and sedimentation, provide livestock waste management, and result in soil enhancements that can increase yields.

However, awareness of available resources and materials, management practices, and their benefits should be assessed to allow for adjustments that encourage adoption. Promotion methods include emails; targeted mailers advertising workshops and trainings; notices in newsletters and local newspapers; participation in local fairs and events; and coordination with school agricultural programs. Promotion efforts will be coordinated with TSSWCB, local SWCDs, drainage districts, NRCS, Texas A&M AgriLife Extension, schools, H-GAC, and other agencies as appropriate with a goal of increasing participation in the programs each year.

## Priority Areas

Priorities were assigned to subwatersheds based on land use and allocated loads taken from the TMDL. High-priority areas for implementing this measure are subwatersheds 1, 7, and 8. Medium-priority areas are subwatersheds 2, 5, 6, and 11. Subwatersheds 3, 4, 9, and 10 are low priority for implementation (Figure 3).

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts and as funds become available. The entities mentioned in this section provide resources of technical and financial assistance for Management Measure 1, but funding sources for this management measure are not necessarily limited to listed entities. This is not an exhaustive list and readers should consider whether they might have responsibility for implementing this management measure.

- **Drainage Districts** –Drainage districts present an opportunity along with other county agencies, local governments, and landowners to maintain and improve riparian zones. Drainage districts, with assistance from other stakeholders, identify drainage channels for restoration. There are three districts in the Caney Creek watershed: Wharton County Drainage District, Matagorda County Drainage District #1, and West Brazoria County Drainage District #11.
- **SWCDs** – SWCDs work with federal and state agencies, particularly the TSSWCB, providing technical assistance and funding for flood control, water quality enhancement, water supply, invasive species control, and other conservation initiatives. SWCDs will work with stakeholders to implement agriculture outreach, grazing management plans, and WQMPs.
- **Texas A&M AgriLife Extension** –Texas A&M AgriLife Extension and Extension agents will provide technical assistance and outreach to agriculture producers and landowners on a variety of topics, including the latest research in animal, crop, and soil science, and protection of the environment.

- **TSSWCB** -TSSWCB will work with stakeholders to provide outreach and technical assistance and expand the use of WQMPs.
- **NRCS** -NRCS will work with stakeholders to provide outreach and technical assistance and expand the use of CMPs.
- **United States Fish and Wildlife Service (USFWS)** -The San Bernard Wildlife Refuge holds conservation lands in the Linnville Bayou watershed, and is a stakeholder. Refuge staff can provide conservation assistance to implement riparian restoration.
- **Texas Parks and Wildlife Department (TPWD)** -TPWD is a stakeholder and can provide conservation assistance to implement riparian restoration.
- **Watershed Coordinator** - It is recommended that a watershed coordinator be retained to oversee the implementation of the Caney Creek I-Plan. The watershed coordinator would be charged to work with local stakeholders, identify technical and funding opportunities, coordinate with federal, state, and local partners to assist with implementation, and to track implementation success and consider actions or activities that need to be changed, including I-Plan revisions.
- **Landowners and Producers:** Landowners and producers may work with the NRCS and SWCDs as appropriate to develop WQMPs or CMPs and obtain funding to implement BMPs according to the site-specific plans.

### **Technical Assistance**

Developing and implementing practices to reduce runoff from agricultural lands requires substantial technical expertise. Technical assistance can be obtained from local SWCDs, local NRCS offices, and local Texas A&M AgriLife Extension offices. Producers requesting planning assistance may work with the local SWCD and local NRCS offices to define operation-specific management goals and objectives and develop management plans that prescribe effective practices that will achieve stated goals while also improving water quality.

### **Financial Assistance**

Federal, state, and local agencies, many of which are identified above, provide support to landowners and producers as they seek to implement BMPs in the Caney Creek watershed. Estimated costs for the voluntary Management Measure 1 activities are estimated to range from \$0 to \$1,000,000 within the first five years of implementation. Below are several common financial programs that might be used to implement Management Measure 1.

- **WQMP Program** - WQMPs are property-specific plans that outline the BMPs most appropriate to improve the quality of land and water on the

property. The TSSWCB may provide financial assistance to private property owners in implementing individual WQMPs, as funding allows.

- **Clean Water Act Section 319(h) Grant Program** – This EPA grant program, administered by TCEQ and TSSWCB, provides funding for implementation of nonpoint source management measures. The funds require a 40% match and may be used to support education programs, watershed implementation, riparian restoration, and technicians.
- **Sustainable Agriculture Research and Education (SARE)** – SARE provides grants and educational programs to advance agricultural innovation which promotes profitability, stewardship of the land, air, and water, and quality of life for farmers, ranchers, and their communities. Southern SARE is the regional component that includes Texas and grants go towards land, crop, and livestock management.
- **NRCS Agricultural Management Assistance** – The Agriculture Management Assistance program of the NRCS helps agriculture producers use conservation to manage risk and solve natural resource issues through natural resources conservation.
- **NRCS Conservation Stewardship Program** – The Conservation Stewardship Program of the NRCS helps agriculture producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resource concerns. Participants earn CSP payments for conservation performance — the higher the performance, the higher the payment.
- **Environmental Quality Incentives Program (EQIP)** – EQIP is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air, and related resources on agricultural land and non-industrial private forestland. An additional purpose of EQIP is to help producers meet federal, state, tribal, and local environmental regulations.

## Measurable Milestones

Contingent upon the receipt of proposed project funding, the measurable milestones are as follows.

- Number of grazing management plans developed.
- Number of WQMPs developed.
- Number of status reviews performed on existing WQMPs.
- Number of CMPs developed.

- Area or stream miles of preserved, protected, or enhanced riparian corridor.
- Number of education/outreach programs supported or implemented.

## Monitoring Component

Monitoring of this management measure will consist of using the Clean Rivers Program (CRP) data to monitor surface water quality and measure bacteria and nutrient loadings (especially in priority areas). The monitoring partner agencies for the Caney Creek watershed are H-GAC, Environmental Institute of Houston (EIH), and TCEQ Region 12 Office. Monitoring data collected by CRP will be evaluated by the watershed coordinator to assess impacts of this measure on surface water quality. The watershed coordinator will also work with the CRP partner to acquire funding or modify existing resources to expand monitoring efforts, if needed. The watershed coordinator will provide a five-year report summarizing all activities related to this management measure.

## Implementation Schedule

The implementation schedule is as follows. Contingent upon the receipt of proposed project funding, the responsible parties as identified above will:

### Year 1:

- Provide, at minimum, one riparian buffer (or related) workshop for drainage districts, local governments, and agriculture producers/landowners.

### Year 2:

- Provide, at minimum, one agriculture BMP (or related) workshop for agriculture producers/landowners.
- Identify partners, including drainage districts, for one demonstration riparian corridor project in coordination with Management Measure 5. Develop a proposal for a minimum of one available funding grant.

### Year 3:

- Develop, at minimum, two grazing management plans or WQMPs and two CMPs.
- Initiate one demonstration riparian corridor project in coordination with Management Measure 5.

### Year 4:

- Develop, at minimum, two additional grazing management plans or WQMPs and two CMPs.
- Continue development of one demonstration riparian corridor project.
- Provide, at minimum, one riparian buffer, agriculture BMP, or related workshop for drainage districts, local governments, and agriculture producers/landowners.

**Year 5:**

- Develop, at minimum, two additional grazing management plans or WQMP and two CMPs.
- Complete one demonstration riparian corridor project.
- Provide one five-year Management Measure 1 progress report.

## **Estimated Load Reductions**

Implementing grazing, cross fencing, watering facilities, nutrient management, and other BMPs identified by local SWCDs provides the potential for indicator bacteria loading reductions. The load reduction surrogate for this measure is based on the number of cattle within the Caney Creek watershed. Estimated indicator bacteria reductions for cattle populations are presented in Table 10. Cattle make up the bulk of the livestock population and will dominate this management strategy. Reducing fecal loads from cattle results in an estimated daily load reduction of 4,183 billion cfu/day or 1,526,795 billion cfu/year.

A subsequent step is taken to determine how this reduction may be implemented. A representative unit daily load is used (2.7 billion cfu/day for cattle; see Table 3) to determine the number of cattle to be managed under a WQMP or a CMP. Table 10 presents the calculation where the total daily load reduction needed is divided by the daily load per representative unit. This yields a total of 1,547 units needed to reduce loadings in the Caney Creek watershed by 4,183 billion cfu/day. This I-Plan is not recommending that this number of cattle be removed from the watershed. The units to be reduced are referring to the number of cattle to be managed under WQMPs or CMPs such that fecal loading from them would be prevented from entering Caney Creek or its tributaries.

In prior publications, TSSWCB and USDA NRCS determined that a plan would reasonably address 50 livestock units (H-GAC, 2018). The cattle unit load reduction can then be divided by 50 to arrive at the estimated number of WQMPs or similar plans that would be needed to reduce the load by 4,183 billion cfu/day. This gives an estimated 31 management plans needed to address the required reduction throughout the Caney Creek watershed (Table 10).

**Table 10. Estimated cattle bacteria load reduction, number to be managed, and management plans**

<b>Watershed</b>	<b>Water Body ID</b>	<b>SWMU</b>	<b>Total Estimated Bacteria Load Reduction (Cattle)</b>	<b>Representative Unit Daily Load</b>	<b>Cattle to be Managed</b>	<b>Management Plans</b>
Caney Creek Tidal	1304	10-11	1,930	2.7	714	14
Linnville Bayou	1304A	7-9	483	2.7	179	4
Caney Creek Above Tidal	1305	1-6	1,770	2.7	654	13
		<b>Total</b>	<b>4,183</b>	<b>2.7</b>	<b>1,547</b>	<b>31</b>

All loads are expressed in billion cfu/day.

Table 11 presents an overview of Management Measure 1.

**Table 11. Management Measure 1: Support land management initiatives**

**Causes and Sources:** Fecal deposition from cattle, horses, and sheep/goats in pastures, rangeland, and in water bodies.

Potential Load Reduction	Technical and Financial Assistance	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Party
1,526,795 billion cfu/year	<p><b>Technical:</b> Local SWCDs, NRCS offices, and Texas A&amp;M AgriLife Extension offices.</p> <p><b>Financial:</b></p> <ul style="list-style-type: none"> <li>• \$0-45,000 for WQMPs.</li> <li>• \$0-1,000,000 for CMPs.</li> <li>• \$0-10,000 for technical assistance workshops.</li> </ul>	Workshops, technical presentations, and one-on-one meetings. Local promotional outreach such as emails; targeted mailers; notices in newsletters and newspapers; participation in fairs and events; and coordination with school agricultural programs.	<ul style="list-style-type: none"> <li>• <b>Year 1:</b> Host at least one riparian buffer workshop.</li> <li>• <b>Year 2:</b> Host at least one agricultural BMP workshop. Develop proposal for one demonstration riparian corridor project and identify partners.</li> <li>• <b>Years 3-5:</b> Develop a minimum of two WQMPs and two CMPs per year. Initiate and complete one demonstration riparian corridor project.</li> <li>• <b>Year 4:</b> Host at least one riparian buffer workshop and at least one agricultural BMP workshop.</li> <li>• <b>Year 5:</b> Provide five-year Management Measure 1 progress report.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of workshops held.</li> <li>• Number of WQMPs completed.</li> <li>• Number of Status Reviews on existing WQMPs.</li> <li>• Number of CMPs completed.</li> <li>• Completion of demonstration riparian corridor project.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of technical assistance activities provided.</li> <li>• Number of plans completed.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Environmental:</b> CRP ambient monitoring data</li> <li>• <b>Programmatic:</b> Five-year report</li> </ul>	TSSWCB, NRCS, SWCDs, watershed coordinator; drainage districts, Texas A&M AgriLife Extension, TPWD, USFWS, landowners/producers

## **Management Measure 2.**

### **Promote Safe OSSF Use and Maintenance**

The purpose of this management measure is to develop and implement strategies that reduce fecal waste from failing OSSFs in priority areas (see Figure 4).

While source modeling was not completed for the Caney Creek watershed, stakeholders indicated that failing OSSFs were a medium-high concern as a potential source of fecal bacteria. When functioning properly, OSSFs are a viable wastewater treatment option, however, limited awareness and lack of maintenance can lead to system failures. A failing system would be a direct source of untreated or partially treated human fecal waste.

The number of OSSFs presented in the Caney Creek TSD are provided in Table 12. The total number includes those systems with permits (the OSSF estimate provided in the TMDL document) plus an estimated number that might be found in the Caney Creek watershed without a permit. The exact number of failing systems is unknown, but studies estimate the approximately 12% of systems are expected to be in failing condition (Reed, Stowe, and Yanke, 2001). However, considering the number of systems without a permit and the poorly draining coastal soils, a larger rate, 20%, was used in this I-Plan.

This management measure outlines the strategy to target priority areas within the Caney Creek watershed for education and engagement on appropriate maintenance of OSSFs, as well as identifying resources available to local governments and individuals to repair or replace failing OSSFs. In certain limited situations where conditions permit, OSSFs may be abandoned and left in place as wastewater is connected to a centralized wastewater system. An example of this was carried out for portions of Sargent.

It is recommended that a watershed coordinator work with authorized agents (AAs) to engage with communities and notify them of available workshops and trainings for homeowner OSSF maintenance. The watershed coordinator will also coordinate with H-GAC on potential sources of funding including the Supplemental Environmental Project (SEP) and other potential funding sources to provide financial support to remediate or replace failing OSSFs.

The goal of this management measure is to host three homeowner workshops or home inspector training courses and support nine homeowners through the SEP or similar program.

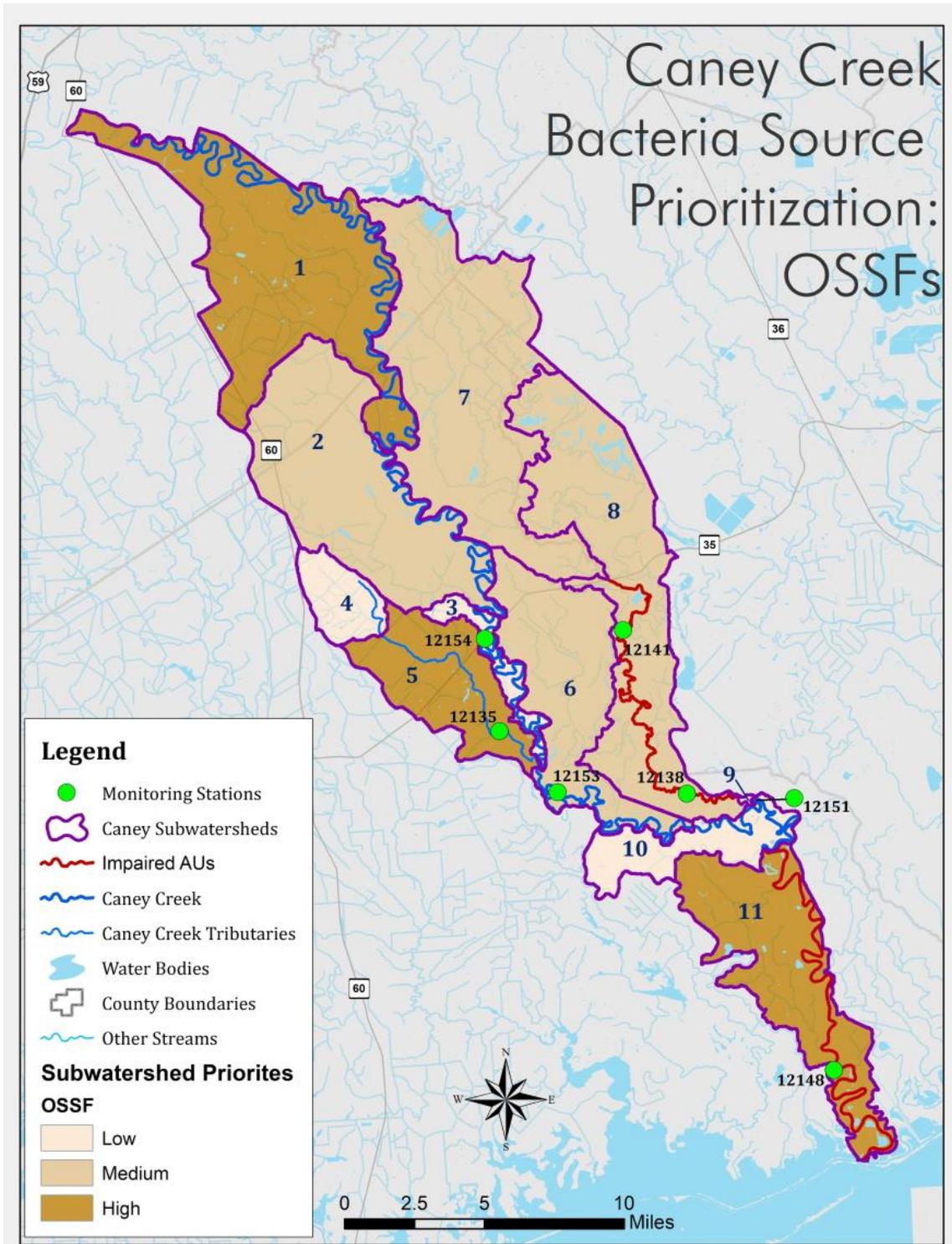


Figure 4. Priority areas for reducing or remediating failing OSSFs

**Table 12. Estimated number of OSSFs and daily bacteria load**

Watershed	Water Body ID	SWMU	Total Systems	Failing OSSFs (20% Rate)	Representative Load	Estimated Daily Bacteria Load (OSSFs)
Caney Creek Tidal	1304	10-11	1,486	297	3.71	1,100
Linville Bayou	1304A	7-9	437	87	3.71	323
Caney Creek Above Tidal	1305	1-6	1,921	384	3.71	1,420
		<b>Total</b>	<b>3,844</b>	<b>768</b>	<b>3.71</b>	<b>2,843</b>

All loads are expressed in billion cfu/day.

## Education Component

Given the finite amount of funding available through the programs listed in the financial assistance section below, homeowner education is crucial to successfully implement this management measure. A variety of educational workshops, trainings, and informational materials are currently available through the Texas A&M AgriLife Extension Office and H-GAC. These educational opportunities may address available financial resources for qualifying homeowners with failing OSSFs, training for home inspectors to conduct visual inspections, and other resource materials to encourage homeowners to maintain, repair, and replace their OSSFs as necessary. However, awareness of available resources and materials, management practices, and their benefits should be assessed to allow for adjustments that encourage adoption.

Promotion methods include emails; targeted mailers advertising workshops and trainings; notices in newsletters and local newspapers; participation in local fairs and events; and coordination with AAs. Promotion efforts will be coordinated with TSSWCB, TCEQ, Texas A&M AgriLife Extension, real estate agents or inspectors, H-GAC, and other agencies as appropriate with a goal of increasing participation in the programs each year.

## Priority Areas

Priorities were assigned to subwatersheds based on land use, location of permitted and grandfathered systems, and allocated loads taken from the TMDL. High-priority areas for implementing this measure are subwatersheds 1, 5, and 11. Medium-priority areas are subwatersheds 2, 6, 7 and 8. Subwatersheds 3, 4, 9, and 10 are low priority for implementation (Figure 4).

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts and as funds become available. The entities mentioned in this section provide resources of technical and financial assistance for Management Measure 2, but funding sources for this management measure are not necessarily limited to listed entities. This is not an exhaustive list and readers should consider whether they might have responsibility for implementing this management measure.

- **AAs** – Brazoria, Matagorda, and Wharton counties are the AAs designated by TCEQ to regulate OSSFs within each county’s portion of the Caney Creek watershed.
- **H-GAC** – H-GAC provides OSSF technical and outreach assistance to homeowners, realtors, and inspectors. Additionally, H-GAC manages an SEP for TCEQ addressing the maintenance, repair, and replacement of OSSFs.
- **Real Estate Agents or Inspectors** – Through real estate transactions, knowledgeable real estate agents and inspectors can educate prospective buyers on OSSF function and provide a point-of-sale inspection of the OSSF. Once inspected, repairs and replacements can be made as part of the transaction.
- **Texas A&M AgriLife Extension** – Texas A&M AgriLife Extension and Extension Agents provide technical assistance and outreach to homeowners and water professionals that address maintenance, repairs, and replacement of OSSFs.
- **Texas General Land Office (TGLO)** – TGLO provides funding and technical assistance to local governments and nonprofits in the coastal zone to address parks and open space access and nonpoint sources of pollution, including failing OSSFs.
- **USDA Rural Department** – The USDA Rural Utilities Service (RUS) administers programs that provide infrastructure or infrastructure improvements to rural communities.
- **Watershed Coordinator** – The watershed coordinator would work with local stakeholders to identify technical and funding opportunities, coordinate with federal, state, and local partners to assist with implementation, and track implementation success and adapt the plan as necessary.

### Technical Assistance

The repair and replacement of OSSFs requires licensed personnel and permits through respective county offices. Brazoria, Matagorda, and Wharton counties can assist with the permitting process within their respective jurisdictions. H-

GAC and Texas A&M AgriLife Extension offer education, programs, and training associated with OSSF maintenance, operations, and services. The design, construction, installation, and maintenance of new systems should be coordinated with local licensed service providers that can provide technical assistance to homeowners as needed.

### **Financial Assistance**

Federal, state, and local agencies provide support to address failing OSSF systems through technical assistance to improve maintenance, including holding tank pump outs and funding for repairs or replacements, and in limited cases providing connections to centralized wastewater treatment. Estimated costs for Management Measure 2 activities are estimated to range from \$0 to \$100,000/year within the first five years of implementation. Below are several common financial programs that might be used to implement Management Measure 2.

- **Coastal Zone Management Program** – TGLO, with funding from the National Oceanic and Atmospheric Administration’s Coastal Zone Management Program, provides funding assistance to local governments and nonprofits in the Texas coastal zone to address parks, open space access, and nonpoint sources of pollution, including failing OSSFs, that affect the Texas coastal zone and the Gulf of Mexico.
- **SEP** – The SEP program, administered by TCEQ, directs fines, fees, and penalties for environmental violations toward environmentally beneficial projects. H-GAC’s SEP provides funding for the inspection, tank pump out, repair, and replacement of failing conventional septic systems or aerobic OSSFs using monies from businesses or individuals that fail to comply with environmental laws. Funding is available to homeowners who meet certain income restrictions. No matching funds are required. Geographic restrictions may apply. H-GAC also augments the program with additional grant funding from local governments and private organizations.
- **Clean Water Act Section 319(h) Grant Program** – This EPA grant program, administered by TCEQ and TSSWCB, provides funding for implementation of nonpoint source management measures. The funds require a 40% match and may be used to fund OSSF education, repairs, and replacements.
- **Clean Water State Revolving Fund** – The Texas Water Development Board (TWDB) offers the loan program, authorized by the Clean Water Act, to serve low-cost financial assistance for planning, acquisition, design, and construction of wastewater, reuse, and stormwater infrastructure.
- **Water and Environmental Program (WEP)** – USDA RUS’s WEP provides technical assistance and financing to addressing water and wastewater infrastructure needs of rural communities with populations of 10,000 or

less. WEP provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas (USDA, 2019).

## Measurable Milestones

Contingent upon the receipt of proposed project funding, the measurable milestones are as follows.

- Number of homeowner workshops conducted.
- Number of home inspector trainings conducted.
- Number of homeowners with failing OSSFs supported through maintenance, repair, replacement, or abandonment (limited).

## Monitoring Component

Monitoring of this management measure will consist of using CRP data to monitor surface water quality and measure bacteria loadings (especially in priority areas). The monitoring partners for the Caney Creek watershed are H-GAC, EIH, and TCEQ Region 12 Office. Monitoring data collected by CRP will be evaluated by the watershed coordinator to assess impacts of this measure on surface water quality. The watershed coordinator will also work with the CRP partner to acquire funding or modify existing resources to expand monitoring efforts, if needed. The watershed coordinator will provide a five-year report summarizing all activities related to this management measure.

## Implementation Schedule

The implementation schedule is as follows. Contingent upon the receipt of proposed project funding, the responsible parties as identified above will:

### Year 1:

- Host one homeowner workshop.
- Support, at minimum, one homeowner within the high or medium priority areas through the SEP or similar program.

### Year 2:

- Host one home inspection training course for real estate agents and home inspectors.
- Support, at minimum, two homeowners within the high or medium priority areas through the SEP or similar program.

### Year 3:

- Support, at minimum, two homeowners within the high or medium priority areas through the SEP or similar program.

**Year 4:**

- Host one homeowner workshop or host one home inspector training course.
- Support, at minimum, two homeowners within the high or medium priority areas through the SEP or similar program.

**Year 5:**

- Support, at minimum, two homeowners within the high or medium priority areas through the SEP or similar program.
- Provide one five-year Management Measure 2 progress report.

## **Estimated Load Reductions**

By repairing or replacing failing OSSFs, promoting proactive homeowner maintenance, providing training opportunities and encouraging more inspections, the potential indicator bacteria loading reductions are estimated at 471.9 billion cfu/day or 172,244 billion cfu/year.

To express this reduction into more quantifiable terms, the OSSF load reductions were converted into unit reductions. The OSSF load reduction, 472 billion cfu/day, was divided by the representative unit daily load for OSSFs from Table 3, 3.71 billion cfu/day. (The representative unit daily load for failing OSSFs is not simply a measure of one unit but includes the concentration of indicator bacteria in one flush, the per capita daily discharge volume, and the number of persons per household. Each of these terms is multiplied together to get representative daily load for one failing OSSF.) This yields a total of 128 failing OSSFs that need to be repaired or replaced (Table 13).

Based on the estimate of 768 failing OSSFs (Table 12), 128 OSSFs is a conservative target reduction estimate. Addressing additional systems, more than the 128 estimated, will provide greater capacity for meeting the total bacteria reduction needed to meet water quality standards. This expanded capacity could be used to assist other, possibly more difficult to implement measures in meeting reduction targets.

Additionally, it is also important to note that the number of failing systems should not increase for this measure to be effective. After repairing or replacing 128 OSSFs, this management measure requires that the number of failing systems remain constant or decrease. The implementation of workshops and trainings will educate homeowners and home inspectors on proper OSSF maintenance with the goal of keeping the number of failing OSSFs from increasing.

**Table 13. OSSF load reduction and number to be managed**

<b>Watershed</b>	<b>Water Body ID</b>	<b>SWMU</b>	<b>Total OSSF Load Reduction</b>	<b>Representative Unit Daily Load</b>	<b>OSSFs to be managed</b>
Caney Creek Tidal	1304	10-11	359	3.71	97
Linnville Bayou	1304A	7-9	9.9	3.71	3
Caney Creek Above Tidal	1305	1-6	103	3.71	28
		<b>Total</b>	<b>471.9</b>	<b>3.71</b>	<b>128</b>

All loads are expressed in billion cfu/day.

Table 14 presents a summary of Management Measure 2.

**Table 14. Management Measure 2: Promote safe OSSF use and maintenance**

**Causes and Sources:** Human fecal sources from untreated or insufficiently treated household sewage discharged from failing OSSFs.

Potential Load Reduction	Technical and Financial Assistance	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Party
172,244 billion cfu/year	<p><b>Technical:</b> Brazoria, Matagorda, and Wharton counties for permitting; H-GAC and Texas A&amp;M AgriLife Extension for education, programs, and training.</p> <p><b>Financial:</b></p> <ul style="list-style-type: none"> <li>• \$0–10,000 for workshops and training events.</li> <li>• \$0–100,000 to repair, replace, or abandon OSSFs.</li> </ul>	Workshops, technical presentations, and one-on-one meetings. Local promotional outreach such as emails; targeted mailers; notices in newsletters and newspapers; participation in fairs and events; and coordination with AAs.	<ul style="list-style-type: none"> <li>• <b>Year 1:</b> Host one homeowner workshop.</li> <li>• <b>Years 1–5:</b> Address a minimum of nine OSSFs.</li> <li>• <b>Year 2:</b> Host one home inspector training course.</li> <li>• <b>Year 4:</b> Host one homeowner workshop or one home inspector training course.</li> <li>• <b>Year 5:</b> Provide five-year Management Measure 2 progress report.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of homeowner workshops and home inspector trainings held.</li> <li>• Number of OSSFs addressed.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of technical assistance activities provided.</li> <li>• Number of OSSFs addressed.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Environmental:</b> CRP ambient monitoring data</li> <li>• <b>Programmatic:</b> Five-year report</li> </ul>	Watershed coordinator, AAs, H-GAC, Texas A&M AgriLife Extension, real estate agents/inspectors, TGLO, USDA RUS

## **Management Measure 3.**

### **Promote Feral Hog Management**

The purpose of this management measure is to develop and implement strategies to reduce fecal deposition by feral animal populations, specifically feral hogs, in priority areas (see Figure 5).

Fecal bacteria are common inhabitants of the intestines of all warm-blooded animals. Feral hogs and most types of wildlife are attracted to water, increasing the likelihood of direct deposition of fecal bacteria into the water, and for fecal bacteria to be picked up off adjacent land during rainfall events.

While wildlife inhabits all parts of the Caney Creek watershed; areas that remain undeveloped are key reservoirs for wildlife. Developed areas account for less than 6% of the Caney Creek watershed, leaving large parts available for wildlife use. There are few data sources that consistently estimate wildlife population except for TPWD deer population estimates. Source loadings included deer as a source to serve as a surrogate for wildlife. However, Management Measure 3 does not make any recommendation for reducing indicator bacteria sources from deer or other native wildlife.

Management Measure 3 does recommend managing the feral hog population. TPWD considers feral hogs a nonnative, invasive species. They can adapt to a variety of habitats and have high reproductive rates. Feral hogs have been identified as a large contributor of fecal bacteria to impaired water bodies in Texas due to their tendency to wallow in mud and spend time in water. The population and estimated daily load for feral hogs is provided in Table 15. The feral hog population in this I-Plan is significantly greater than what was provided in the TMDL based on recent stakeholder observations and an update to a professional publication (Texas AgriLife Extension, 2012).

While source modeling was not completed for the Caney Creek watershed, stakeholders indicated that feral hogs were a medium priority and potential contributors of fecal bacteria to area water bodies.

The purpose of this management measure is to manage the feral hog population. There are numerous control efforts available to mitigate feral hog populations employed across the state. These measures, especially in priority areas, along with technical and financial assistance, are needed to reach the overall goal of this plan. Activities will be targeted towards priority areas where landowners should be contacted to discuss the economic savings of managing feral hogs, specific methods to do so, and available programs that can provide assistance.

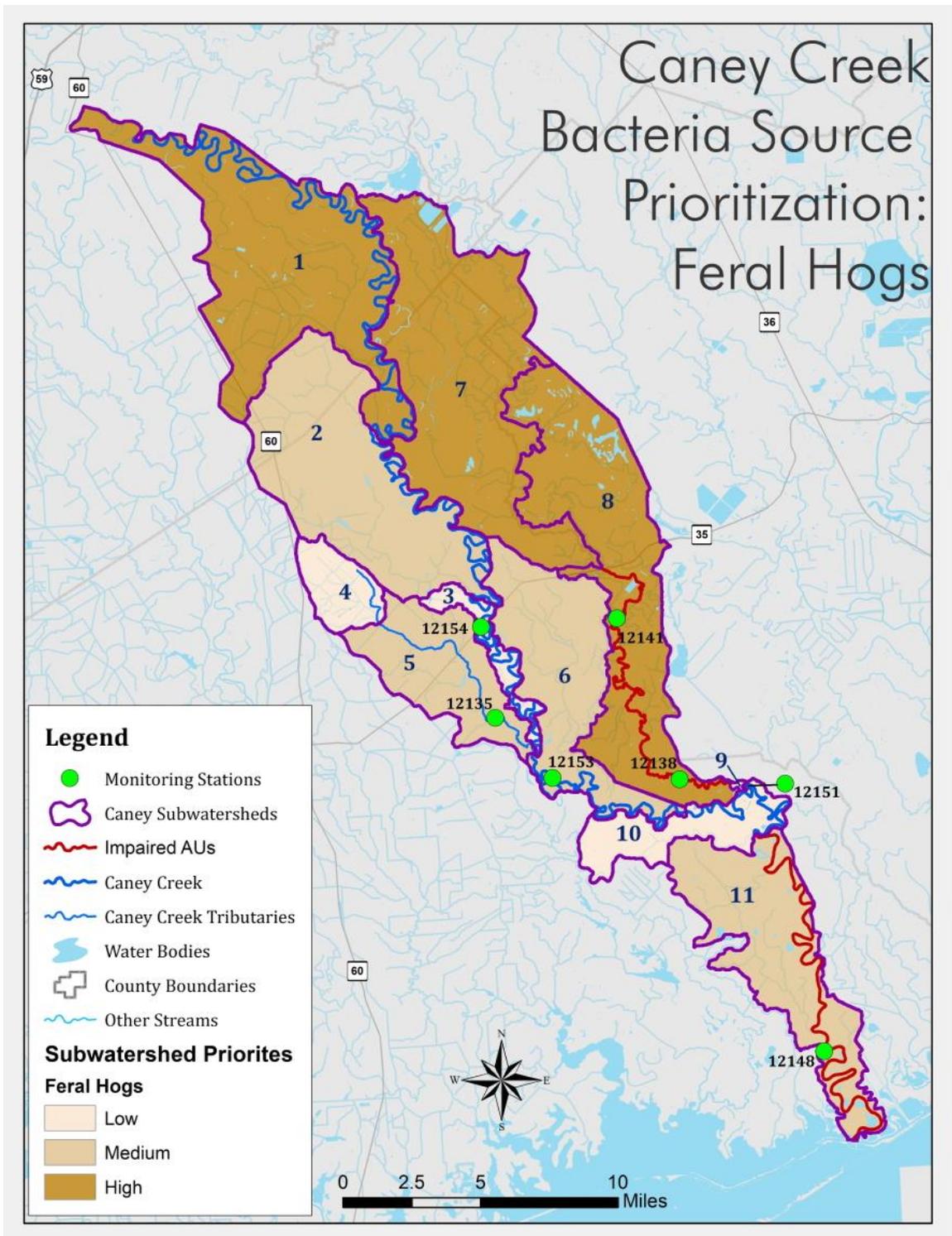


Figure 5. Priority areas for managing the feral hog population

**Table 15. Feral hog population and estimated daily bacteria load**

Watershed	Water Body ID	SWMU	Feral Hog Population	Representative Load	Estimated Daily Bacteria Load (Feral Hogs)
Caney Creek Tidal	1304	10-11	548	4.45	2,440
Linville Bayou	1304A	7-9	1,214	4.45	5,400
Caney Creek Above Tidal	1305	1-6	1,637	4.45	7,290
<b>Total</b>			<b>3,399</b>	<b>4.45</b>	<b>15,130</b>

All loads are expressed in billion cfu/day.

The promotion and implementation of BMPs focused on managing the feral hog populations within priority subwatersheds can lead to instream water quality improvements by minimizing fecal deposition.

The goal of this management measure is to coordinate feral hog outreach programs and conduct two feral hog workshops.

## Education Component

Education is crucial to successfully implement this management measure. A variety of educational workshops, trainings, and informational materials are available to residents, providing information about how feral hog populations degrade water quality. However, awareness of available resources and materials, management practices, and their benefits should be assessed to allow for adjustments that encourage adoption. Promotion methods include emails; targeted mailers advertising workshops and trainings; notices in newsletters and local newspapers; participation in local fairs and events; and coordination with school agricultural programs. Promotion efforts will be coordinated with TSSWCB, TCEQ, local Texas A&M AgriLife Extension offices, and other agencies as appropriate with a goal of increasing participation in the programs each year.

## Priority Areas

Priorities were assigned to subwatersheds based on land use for suitable habitat for feral hogs and allocated loads taken from the TMDL. High-priority areas for implementing this measure are subwatersheds 1, 7, and 8. Medium-priority areas are subwatersheds 2, 5, 6, and 11. Subwatersheds 3, 4, 9, and 10 are low priority for implementation (Figure 5).

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts and as funds become available. The entities mentioned in this section provide resources of technical and financial assistance for Management Measure 3, but funding sources for this management measure are not necessarily limited to listed entities. This is not an exhaustive list and readers should consider whether they might have responsibility for implementing this management measure.

- **Texas A&M AgriLife Extension** – Texas A&M AgriLife Extension and Extension Agents provide outreach and assistance on a variety of topics including feral hogs.
- **Watershed Coordinator** – The watershed coordinator would be charged to work with local stakeholders in the management of the feral hog population to identify technical and funding opportunities, coordinate with federal, state, and local partners to assist with implementation, and to track implementation success and consider actions or activities that need to be changed, including plan revisions.

### Technical Assistance

Numerous resources are available to assist landowners and managers in the management of feral hog populations. Texas A&M AgriLife Extension offers technical materials and workshops on feral hog impacts and control methods. TPWD also offers general information about identification and regulations regarding control measures for feral hogs.

### Financial Assistance

Federal, state, and local agencies provide support to entities and individuals as they seek to manage feral hog populations in the Caney Creek watershed. Estimated costs for Management Measure 3 activities are estimated to range from \$0 to \$15,000/year. Below is one common financial program that might be used to implement Management Measure 3.

- **Clean Water Act Section 319(h) Nonpoint Source Grant Program** – This EPA grant program, administered by TCEQ and TSSWCB, provides funding for implementation of nonpoint source management measures. The funds require a 40% match and may be used to fund feral hog education workshops and outreach programs.

## Measurable Milestones

Contingent upon the receipt of proposed project funding, the measurable milestones are as follows.

- Number of educational programs delivered per year.

- Number of educational materials developed and disseminated.
- Number of individuals reached.
- Number of feral hogs removed per year.

## **Monitoring Component**

Monitoring of this management measure will consist of using CRP data to monitor surface water quality and measure bacteria loadings (especially in priority areas). The monitoring partners for the Caney Creek watershed are H-GAC, EIH, and TCEQ Region 12 Office. Monitoring data collected by CRP will be evaluated by the watershed coordinator to assess impacts of this measure on surface water quality. The watershed coordinator will also work with the CRP partner to acquire funding or modify existing resources to expand monitoring efforts, if needed. The watershed coordinator will provide a five-year report summarizing all activities related to this management measure.

## **Implementation Schedule**

The implementation schedule is as follows. Contingent upon the receipt of proposed project funding, the responsible parties as identified above will:

### **Year 1:**

- Coordinate and schedule feral hog outreach programs.

### **Years 2 and 3:**

- Conduct a feral hog workshop.
- Track feral hog outreach efforts (materials created or disseminated or individuals reached), identify landowners and track implementation of voluntary control measures (fencing deer feeders, and others), including feral hog removal numbers.

### **Year 4 and 5:**

- Track feral hog outreach efforts (materials created or disseminated or individuals reached), identify landowners and track implementation of voluntary control measures (fencing deer feeders, and others), including feral hog removal numbers.
- Provide one five-year Management Measure 3 progress report.

## **Estimated Load Reductions**

By promoting the use of physical controls for feral hog management, such as fencing, educating residents on the effects of feral hog populations on water quality, and other controls, potential indicator bacteria loading reductions are estimated to be 1,484 billion cfu/day or 541,660 billion cfu/year.

The representative unit approach was applied to the feral hog load reduction by dividing the load reduction, 1,484 billion cfu/day, by the representative unit daily load for feral hogs, 4.45 billion cfu/day (Table 16). A total of 333 feral hogs were estimated for removal from the Caney Creek watershed to accomplish the potential load reduction.

As feral hog reproductive rates are quite high, the population after the removal of 333 feral hogs would need to be maintained. Studies by the Texas AgriLife Extension have suggested that the feral hog population needs to be culled each year by 50-70% to maintain the current level of feral hog population (Texas AgriLife Extension, 2012). Additional indicator bacteria removal capacity could be provided by increasing the number of feral hogs removed, addressing other feral animal populations, or expanding the indicator bacteria reduction from other management measure sources as documented by stakeholders.

**Table 16. Feral hog load reduction and feral hogs to be removed**

Watershed	Water Body ID	SWMU	Total Feral Hog Load Reduction	Representative Unit Daily Load	Feral Hogs to be Removed
Caney Creek Tidal	1304	10-11	793	4.45	178
Linnville Bayou	1304A	7-9	166	4.45	37
Caney Creek Above Tidal	1305	1-6	525	4.45	118
<b>Total</b>			<b>1,484</b>	<b>4.45</b>	<b>333</b>

All loads are expressed in billion cfu/day.

Table 17 presents a summary of Management Measure 3.

**Table 17. Management Measure 3: Promote feral hog management**

**Causes and Sources:** Direct and indirect deposits of feces from feral hogs.

Potential Load Reduction	Technical and Financial Assistance	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Party
541,660 billion cfu/year	<p><b>Technical:</b> Texas A&amp;M AgriLife Extension and TPWD offer technical materials and workshops.</p> <p><b>Financial:</b></p> <ul style="list-style-type: none"> <li>• \$0-15,000 for voluntary feral hog reduction measures.</li> <li>• \$0-10,000 for technical assistance such as workshops and other outreach programs.</li> </ul>	Workshops, technical presentations, and one-on-one meetings. Local promotional outreach such as emails; targeted mailers; notices in newsletters and newspapers; participation in fairs and events; and coordination with school agricultural programs.	<ul style="list-style-type: none"> <li>• <b>Years 1-5:</b> Track voluntary measures in coordination with landowners, including outreach efforts and feral hog control measures.</li> <li>• <b>Years 2-3:</b> Conduct one feral hog workshop.</li> <li>• <b>Year 5:</b> Provide five-year Management Measure 3 progress report.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of feral hogs removed each year.</li> <li>• Number of voluntary efforts implemented.</li> <li>• Complete a minimum of one feral hog program.</li> <li>• Successfully develop and disseminate outreach materials.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of technical assistance activities provided.</li> <li>• Number of feral hogs removed.</li> <li>• Tracking the amount of outreach materials delivered.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Environmental:</b> CRP ambient monitoring data</li> <li>• <b>Programmatic:</b> Five-year report</li> </ul>	Watershed coordinator, Texas A&M AgriLife Extension

## **Management Measure 4.**

### **Improve WWTF and Sanitary Sewer Collection System Function**

The purpose of this management measure is to develop and implement strategies that reduce fecal waste from WWTFs and sanitary sewer collection systems in priority areas (see Figure 6).

WWTFs collect and treat public wastewater, converting that wastewater into effluent before returning it to surface water or for other designated uses. Correctly functioning WWTFs contribute negligible amounts of bacteria to surface water, as defined by state-regulated permits.

While source modeling was not completed for the Caney Creek watershed, stakeholders indicated that failing WWTFs and collections systems were a medium priority as a fecal bacteria source to Caney Creek.

This management measure outlines the strategy to target priority areas to reduce the instances of WWTF and collection system failures through asset management programs, which require life-cycle continuous repair and replacement; supporting compliance and enforcement efforts; regionalization of smaller facilities with chronic problems (when appropriate); and supporting operator workshops and training programs.

The success of this management measure relies on the efforts of the permit holders continuing to implement their operational best practices. As noted previously, when operated properly, WWTFs are not likely to contribute high levels of indicator bacteria. This plan encourages the continued use of best practices and recommends developing long-term replacement strategies to prevent future SSOs.

The goal of this management measure is to develop and conduct a fats, oils, grease, and wipes (FOG) prevention campaign, two technical assistance workshops, and one general outreach workshop.

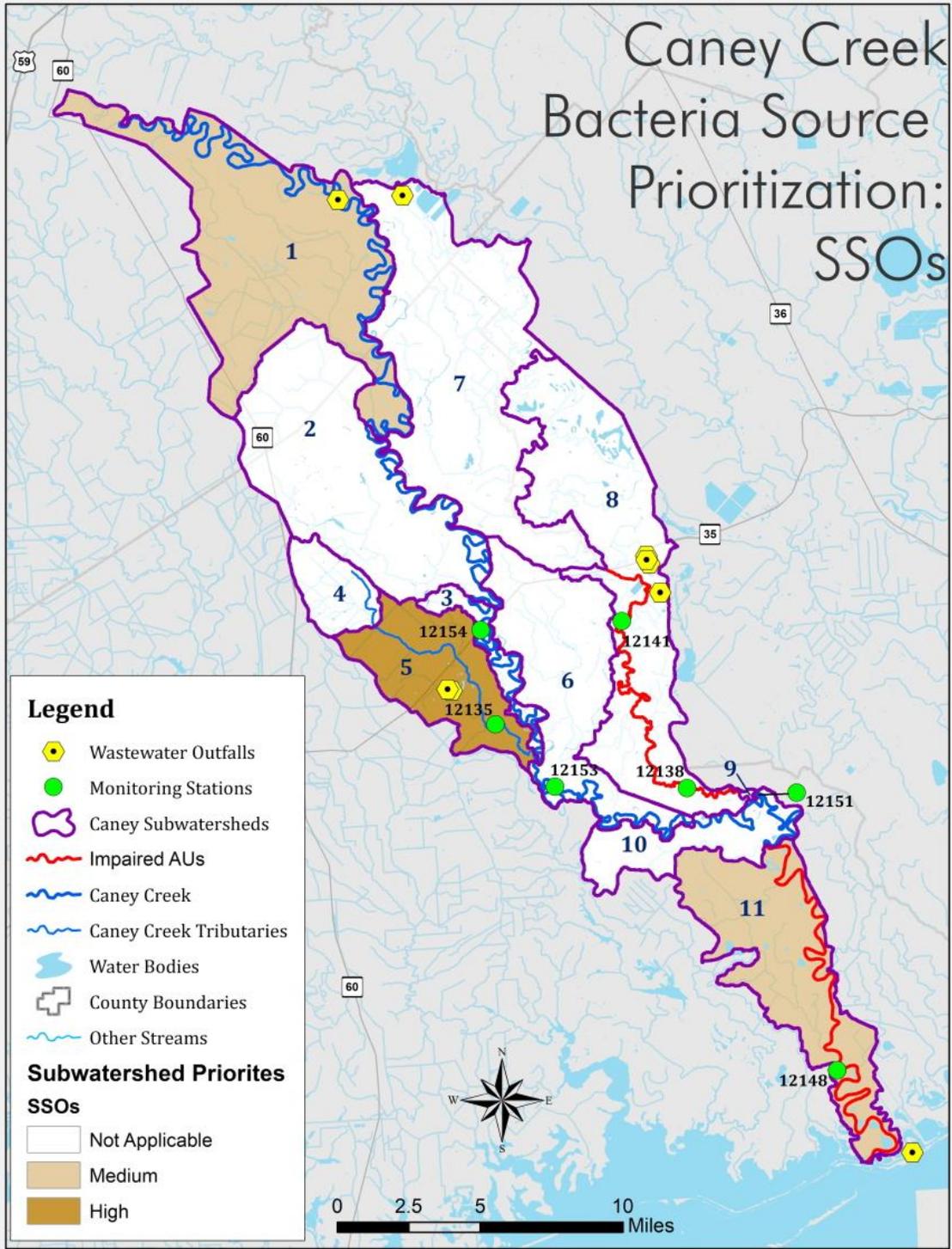


Figure 6. Priority areas for preventing and managing SSOs

## Education Component

Operator education, in the form of workshops and training programs, is crucial to successfully implement this management measure. WWTF operators, utilities, and subscriber system owners should provide FOG outreach to utility customers to reduce the number of sewer blockages. There are several regional FOG educational programs that target homeowners and business owners—particularly multifamily homes. “Cease the Grease” and “Protect Our Pipes” are just two of these that have ready-made informational flyers and brochures that can be adapted for the Caney Creek watershed.

## Priority Areas

Priorities were assigned to subwatersheds based on land use, wastewater treatment service area boundaries, reported SSOs, and allocated loads taken from the TMDL. The high-priority area for implementing this measure is subwatershed 5. Medium-priority areas are subwatersheds 1 and 11. Subwatersheds 2, 3, 4, 6, 7, 8, 9, and 10 are low priority for implementation (Figure 6).

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts and as funds become available. The entities mentioned in this section provide resources of technical and financial assistance for Management Measure 4, but funding sources for this management measure are not necessarily limited to listed entities. This is not an exhaustive list and readers should consider whether they might have responsibility for implementing this management measure.

- **Local Governments** - Local governments and political subdivisions of the state, including cities and municipal utility districts, hold wastewater permits that include indicator bacteria permit limits. Local governments also maintain the collection system. Routine maintenance of these complex systems requires the planning and dedication of enough resources to conduct inspections, life-cycle replacement costs, and continual training to prevent failures requiring repairs. Local governments holding stormwater permits are required to report annually on their efforts to inspect and continually maintain sanitary sewers within their jurisdictions to prevent SSOs.
- **TCEQ** - Oversees programs that address point sources of pollution impacting the waters of the state, including wastewater permits. This includes conducting inspections and enforcement of permit holders, setting rules and regulations, and requiring self-reporting by permit holders. TCEQ offers wastewater technical assistance and encourages the participation in its Sanitary Sewer Overflow Initiative Program. The Sanitary Sewer Overflow Initiative Program is a voluntary program which began in 2004 to address

an increase in SSOs due to aging collection systems throughout the state and encourage corrective actions. Participating operators are not subjected to formal enforcement by TCEQ for most SSO violations so long as an SSO plan is in place. Participation allows the operator to direct resources to corrective actions rather than towards penalties and ongoing SSOs will not affect the system's compliance-history rating.

- **Texas A&M Engineering Extension Service (TEEX)** – TEEX is the state extension agency that offers training programs and technical assistance to public safety workers, including those involved in water and wastewater.
- **USDA Rural Department** – The USDA RUS administers programs that provide infrastructure or infrastructure improvements to rural communities.
- **Water Professional Associations** – Water professional associations like the Association of Water Board Directors, Texas Water Utilities Association, Water Environment Association of Texas, and Water Environment Federation are sources of information and provide a forum through conferences and meetings to educate water districts on the latest technology, laws, and rules that can affect their daily operation.
- **Watershed Coordinator** – The watershed coordinator would be charged to work with local stakeholders on issues related to wastewater collection systems to identify technical and funding opportunities, coordinate with federal, state, and local partners to assist with implementation, and to track implementation success and consider actions or activities that need to be changed, including plan revisions.

### **Technical Assistance**

Numerous trade and professional associations as listed above along with TCEQ, EPA, and TEEX provide educational and technical assistance to utility districts and municipalities.

### **Financial Assistance**

Federal, state, and water professional associations provide support to wastewater operators, which can assist them to meet permit requirements. Management Measure 4 outreach activities are estimated between \$0 and \$30,000 each year. A range is provided for workshop costs as in some instances there might be no costs while in other instances there may be a cost for presenters, facility fees, certificates, or other charges that might be incurred. In some cases, a fee to attendees might offset these costs.

Permittee operation and maintenance costs covering infrastructure repair and replacement are highly variable and such costs are left to permittees to plan. The permittee might seek outside sources of funding. Some potential sources follow. Estimates are that mid-sized cities spend approximately \$1,000,000 to

\$5,000,000/year on addressing aging systems. The list found below is not an exhaustive funding list for Management Measure 4. Visit the funding resource pages for TCEQ (TCEQ, 2019) and EPA (EPA, 2019) for more extensive lists.

- **Clean Water State Revolving Fund** - TWDB offers the loan program, authorized by the Clean Water Act, to serve low-cost financial assistance for planning, acquisition, design, and construction of wastewater, reuse, and stormwater infrastructure.
- **WEP** - USDA RUS's WEP provides technical assistance and financing to addressing water and wastewater infrastructure needs of rural communities with populations of 10,000 or less. WEP provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas.

## Measurable Milestones

Contingent upon the receipt of proposed project funding, the measurable milestones are as follows.

- Development of a permittee list, with a focus on those with chronic problems, to invite to the technical assistance workshops.
- Reduction of the number of SSOs due to infrastructure repairs and replacements.
- Initiation of at least one FOG outreach campaign and general education workshop.
- Delivery of at least two operator trainings and workshops.

## Monitoring Component

Monitoring of this management measure will consist of using CRP data to monitor surface water quality and measure bacteria loadings (especially in priority areas). The monitoring partners are the H-GAC, EIH, and TCEQ Region 12 Office. Monitoring data collected by CRP will be evaluated by the watershed coordinator to assess impacts of this measure on surface water quality. The watershed coordinator will also work with the CRP partner to acquire funding or modify existing resources to expand monitoring efforts, if needed. The watershed coordinator will provide a five-year report summarizing all activities related to this management measure.

## Implementation Schedule

The implementation schedule is as follows. Contingent upon the receipt of proposed project funding, the responsible parties as identified above will:

### Year 1:

- Develop a target permittee list.

- Devise a FOG blockage prevention campaign.

**Year 2:**

- Conduct a technical assistance workshop on technology, rules and regulation changes, operation and maintenance, reuse, and program assistance.
- Conduct a FOG blockage prevention campaign.

**Year 3:**

- Conduct one home and business owner general outreach workshop.
- Conduct a FOG blockage prevention campaign.

**Year 4:**

- Conduct a technical assistance workshop on technology, rules and regulation changes, operation and maintenance, reuse, and program assistance.
- Conduct a FOG blockage prevention campaign.

**Year 5:**

- Provide one five-year Management Measure 4 progress report.
- Assess the FOG blockage prevention campaign.

## **Estimated Load Reductions**

SSOs were considered a source surrogate for this measure. There was only one reported SSO for the period studied for this plan, but SSOs are likely an under-reported source.

The implementation measures listed in this I-Plan, asset management, supporting compliance and enforcement efforts, and regionalization of smaller facilities (when and where appropriate), may reduce fecal waste by humans through improved WWTF operation and the sanitary collection system maintenance. As this measure was not assigned a source load reduction, any improvement in WWTF and collection system operation and maintenance will contribute to the success of this I-Plan and help to offset possible shortfalls in implementing other management measures.

Table 18 presents a summary of Management Measure 4.

**Table 18. Management Measure 4: Improve WWTF and sanitary sewer collection function**

**Causes and Sources:** Human fecal sources from SSO incidents and poorly maintained wastewater infrastructure.

Potential Load Reduction	Technical and Financial Assistance	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Party
Not estimated	<p><b>Technical:</b> Trade and professional associations, along with TCEQ, EPA, and TEEX.</p> <p><b>Financial:</b></p> <ul style="list-style-type: none"> <li>• \$0-30,000 for technical assistance workshops for WWTF and collection system operators.</li> <li>• \$0-15,000 for one FOG campaign workshop.</li> <li>• \$0-30,000 for FOG blockage prevention outreach campaign.</li> </ul>	Workshops, technical presentations, and one-on-one meetings. Distribution of informational flyers and brochures.	<ul style="list-style-type: none"> <li>• <b>Year 1:</b> Develop permittee list. Devise FOG blockage prevention campaign.</li> <li>• <b>Years 2 and 4:</b> Conduct technical assistance workshop for WWTF and collection system operators.</li> <li>• <b>Years 2-5:</b> Conduct and assess FOG blockage prevention campaign.</li> <li>• <b>Year 3:</b> Conduct one home and business owner general outreach/FOG campaign workshop.</li> <li>• <b>Year 5:</b> Provide five-year Management Measure 4 progress report, including assessment of the FOG blockage prevention campaign.</li> </ul>	<ul style="list-style-type: none"> <li>• List of permittees to include in technical assistance workshops.</li> <li>• Number of technical assistance workshops held.</li> <li>• Completion of home and business owner general outreach workshop.</li> <li>• Successful implementation of FOG campaign.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of technical assistance workshops held.</li> <li>• Number of FOG workshops held.</li> <li>• Number of individuals and organizations reached.</li> <li>• Number of wastewater infrastructure repairs made.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Environmental:</b> CRP ambient monitoring data</li> <li>• <b>Programmatic:</b> Five-year report</li> </ul>	Local governments, TCEQ, TEEX, USDA RUS, water professional associations, watershed coordinator

## **Management Measure 5. Reduce Stormwater Sources Such as Pet Waste and Illegal Dumping**

The purpose of this management measure is to develop and implement strategies to reduce stormwater sources of fecal wastes, including pet waste (see Figure 7) and illegal dumping in priority areas.

The Caney Creek watershed is considered rural, but there are small communities located along the waterway. The size and density of these communities are small, and the stormwater contribution is expected to be equally small. Source modeling was not completed for the Caney Creek watershed, and it is difficult to determine the potential stormwater sources of fecal waste attributed to these communities.

Pet waste is a common fecal source ascribed to stormwater. Due to a lack of other potential fecal source data, pet waste source loads (represented by dogs) are provided here as a surrogate for other potential stormwater sources (Figure 7). The estimated dog population taken from the Caney Creek TSD is presented in Table 19.

One purpose of this management measure is to reduce the amount of uncollected pet waste that can be transferred to water bodies in the project area. However, this strategy is less effective in rural communities where dogs are kept largely outside, and waste collection is not required by city or community ordinance.

Recognizing that domestic pets in rural portions of the Caney Creek watershed likely have larger areas to roam and that picking up pet waste is likely not feasible for all owners, management actions should target areas with denser housing and pet populations. Providing waste bag dispensers and collection stations in areas of higher pet density (parks and neighborhoods) encourages pet owners to pick up pet waste before it can be transported to water bodies. Addressing feral dog populations can assist with this measure.

Management Measure 5 also seeks to identify and reduce illegal dump sites where fecal wastes and other pollutants might be illegally released in the Caney Creek watershed. Local governments and stakeholders should assist in identifying and eliminating these potential sites.

Additionally, developing a stormwater demonstration project, like preserving and enhancing the riparian areas in coordination with Management Measure 1, can build the capacity to improve water quality and serve to encourage further use. Local governments and drainage districts can work together to enhance

current and future drainage projects by incorporating riparian zone management as identified in Management Measure 1.

The goal of this management measure is to install and maintain 12 pet waste stations, deliver education and outreach materials on pet waste, conduct a general stormwater education workshop, conduct illicit discharge and illegal dumping investigations, and complete one demonstration riparian corridor project in coordination with Management Measure 1.

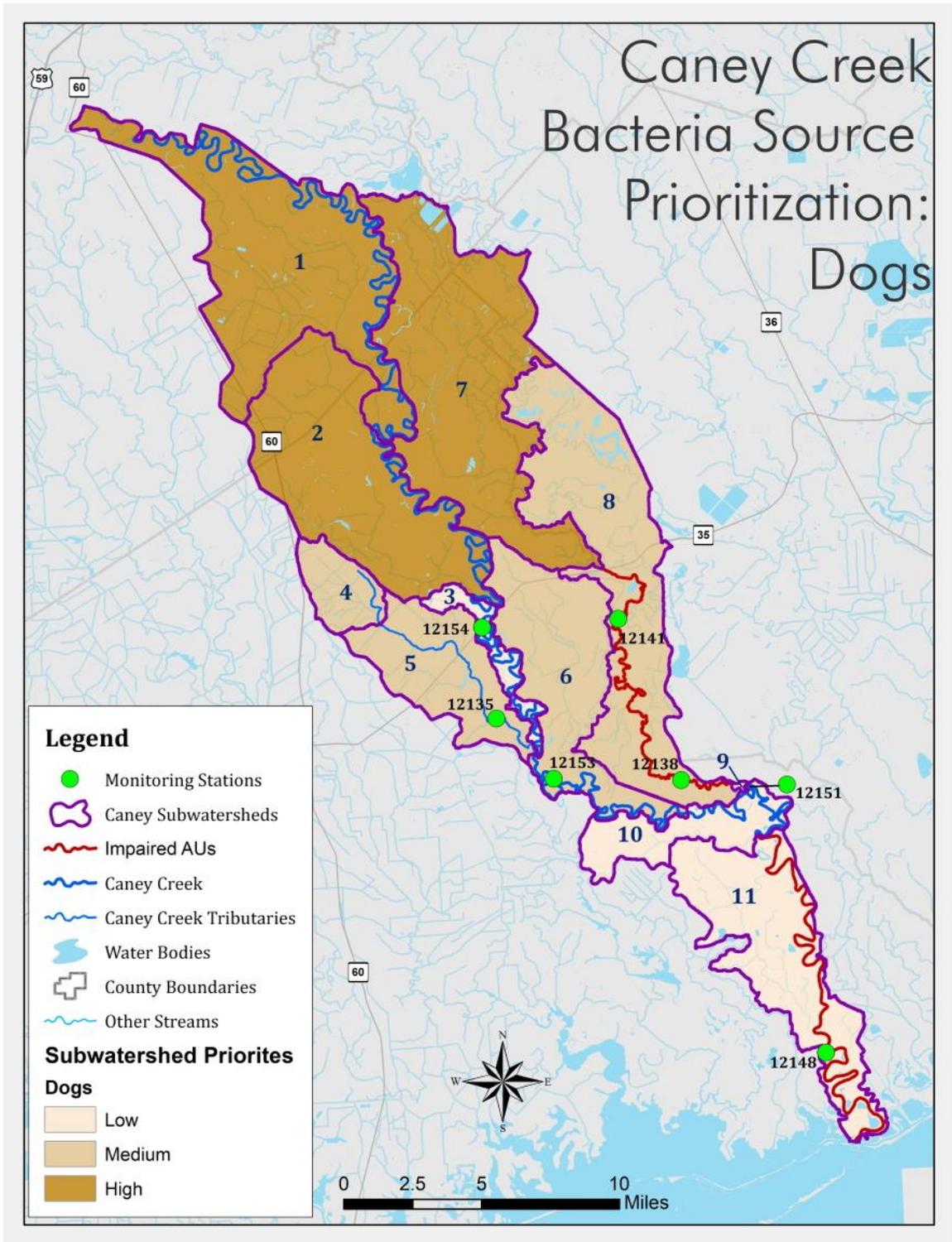


Figure 7. Priority areas for managing pet (dog) waste

**Table 19. Dog population and estimated daily bacteria load**

Watershed	Water Body ID	SWMU	Dog Population	Representative Load	Estimated Daily Bacteria Load (Dogs)
Caney Creek Tidal	1304	10-11	114	2.50	284
Linville Bayou	1304A	7-9	219	2.50	548
Caney Creek Above Tidal	1305	1-6	1,844	2.50	4,610
		<b>Total</b>	<b>2,177</b>	<b>2.50</b>	<b>5,442</b>

All loads are expressed in billion cfu/day.

## Education Component

Recognizing that enforcement of ordinances in primarily rural watersheds is problematic, education is crucial to successfully implement this management measure. The best means to reduce the potential for loading from pet waste is to provide education and outreach materials to pet owners about the negative impact it can have on area water bodies. Educational efforts could also present information about water quality degradation caused by illegal dumping and illicit discharges, as well as the benefits of riparian restoration efforts.

## Priority Areas

Priorities were assigned to subwatersheds based on human population distribution within the watershed and allocated loads taken from the TMDL. High-priority areas for implementing this measure are subwatersheds 1, 2, and 7. Medium-priority areas are subwatersheds 4, 5, 6, and 8. Subwatersheds 3, 9, 10, and 11 are low priority for implementation (Figure 7).

## Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts and as funds become available. The entities mentioned in this section provide resources of technical and financial assistance for Management Measure 5, but funding sources for this management measure are not necessarily limited to listed entities. This is not an exhaustive list and readers should consider whether they might have responsibility for implementing this management measure.

- **Local Governments** - Local governments can actively promote pet waste reduction measures by offering public education on the handling of pet wastes at apartments, parks, and other public spaces. Additionally, local governments can actively work with drainage districts and the Texas

Department of Transportation to enhance road and drainage projects to include the benefit of water quality features within the project.

- **Drainage Districts** - Drainage districts present an opportunity along with other county agencies, local governments, and landowners to maintain and improve riparian zones. Drainage districts, with assistance from other stakeholders, identify drainage channels for restoration. There are three districts in the Caney Creek watershed: Wharton County Drainage District, Matagorda County Drainage District #1, and West Brazoria County Drainage District #11.
- **H-GAC** - Manages pet waste outreach programs and coordinates pet waste reduction measures with other organizations. H-GAC has also been successful in applying grant funding to acquire pet waste stations for local communities. H-GAC can also provide planning assistance with road construction and other areas where water quality enhancements can be encouraged.
- **Texas A&M AgriLife Extension** - Texas A&M AgriLife Extension and Extension Agents provide outreach and assistance to a variety of topics including pet wastes and riparian zone management.
- **USFWS** -The San Bernard Wildlife Refuge holds conservation lands in the Linnville Bayou watershed, and is a watershed stakeholder. Refuge staff can provide conservation assistance to implement riparian restoration.
- **TPWD** -TPWD is a watershed stakeholder and can provide conservation assistance to implement riparian restoration.
- **Watershed Coordinator** - The watershed coordinator would be charged to work with local stakeholders regarding pet waste and illegal dumping to identify technical and funding opportunities, coordinate with federal, state, and local partners to assist with implementation, and to track implementation success and consider actions or activities that need to be changed, including plan revisions.

### **Technical Assistance**

H-GAC, EPA, and TCEQ have materials and resources for municipalities that manage and implement stormwater BMPs.

### **Financial Assistance**

Federal, state, and local agencies provide support to entities and individuals as they seek to reduce the amount of pet waste entering water bodies within the Caney Creek watershed. Contributions from local governments in terms of technical and financial assistance will be key to reducing pet wastes. Most pet waste stations are placed on public property, including parks. Estimated costs

for successfully carrying out Management Measure 5, ranging from \$0 to \$500,000 over five years. A range is provided for workshop costs as in some instances there might be no costs while in other instances there may be a cost for presenters, facility fees, certificates, or other charges that might be incurred.

- **Clean Water Act Section 319(h) Nonpoint Source Grant Program:** This EPA grant program, administered by TCEQ and TSSWCB, provides funding for implementation of nonpoint source management measures. The funds require a 40% match and may be used to fund pet waste management programs, illicit discharge investigations, stormwater education, and riparian restoration.
- **EPA Environmental Education Grants** – Under the Environmental Education Grant Program, EPA seeks grant proposals from eligible applicants to support environmental education projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens. This grant program provides financial support for projects that design, demonstrate, or disseminate environmental education practices, methods, or techniques as described in the Environmental Education Grant Program solicitation notices.
- **Urban Water Small Grants** – The objective of the Urban Waters Small Grants Program, administered by EPA, is to fund projects that will foster a comprehensive understanding of local urban water issues, identify and address these issues at the local level, and educate and empower the community. The Urban Waters Small Grants Program seeks to help restore and protect urban water quality and revitalize adjacent neighborhoods by engaging communities in activities that increase their connection to, understanding of, and stewardship of local urban waterways.
- **Clean Water State Revolving Fund** – TWDB offers the loan program, authorized by the Clean Water Act, to serve low-cost financial assistance for planning, acquisition, design, and construction of wastewater, reuse, and stormwater infrastructure that include stormwater BMPs.
- **WEP** – USDA RUS’s WEP provides technical assistance and financing to addressing water and wastewater infrastructure needs of rural communities with populations of 10,000 or less. WEP provides loans, grants and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas.

## Measurable Milestones

Contingent upon the receipt of proposed project funding, the measurable milestones are as follows.

- Number of pet waste stations installed.

- Number of educational materials developed and delivered.
- Number of workshops and trainings held.
- Number of illicit discharge and illegal dumping detection investigations completed.
- Area or stream miles of preserved, protected, or enhanced riparian corridor.

## **Monitoring Component**

Monitoring of this management measure will consist of using CRP data to monitor surface water quality and measure bacteria loadings (especially in priority areas). The monitoring partners are the H-GAC, EIH, and TCEQ Region 12 Office. Monitoring data collected by CRP will be evaluated by the watershed coordinator to assess impacts of this measure on surface water quality. The watershed coordinator will also work with the CRP partner to acquire funding to expand monitoring efforts, if needed. The watershed coordinator will provide a five-year report summarizing all activities related to this management measure.

## **Implementation Schedule**

The implementation schedule is as follows. Contingent upon the receipt of proposed project funding, the responsible parties as identified above will:

### **Year 1:**

- Identify willing local partners to develop and submit proposals for funding of pet waste stations and educational material delivery.
- Identify, with local community support, locations to conduct channel investigations for illicit discharges and illegal dumping.

### **Years 2 and 3:**

- Install and maintain at least three pet waste collection stations per year.
- Deliver education and outreach materials on pet waste to pet owners and local community residents.
- Identify partners for one demonstration riparian corridor project in coordination with Management Measure 1. Develop a proposal for a minimum of one available funding grant.
- Initiate one demonstration riparian corridor project in coordination with Management Measure 1.
- Provide a stormwater outreach event as part of a general workshop with local communities covering fecal bacteria, source identification, nutrient enrichment, and riparian corridor protection in conjunction with Management Measure 4.

**Year 4 and 5:**

- Install and maintain at least three pet waste collection stations per year.
- Deliver education and outreach materials on pet waste to pet owners and local community residents.
- Conduct illicit discharge and illegal dumping detection investigations.
- Complete one demonstration riparian corridor project.
- Provide one five-year Management Measure 5 progress report.

**Estimated Load Reductions**

Reducing pet wastes, removing illicit discharges and illegal dump sites, and increasing community outreach should help to reduce indicator bacteria sources and nutrient enrichment.

Pet numbers are used as a surrogate for the likely indicator bacteria reduction expected from Management Measure 5. By supporting the installation of pet waste disposal stations, increasing pet waste and illegal dumping education to local communities, and seeking opportunities to improve riparian corridors, potential indicator bacteria loading reductions are calculated to be 441.3 billion cfu/day or 161,075 billion cfu/year.

To convert the load reduction into relatable terms, the load reduction, 441.3 billion cfu/day was divided by the representative unit daily load from Table 3, 2.5 billion cfu/day. The results of this calculation found that 177 total units would need to be managed from the Caney Creek watershed (Table 20).

Management Measure 5 does not recommend the removal of 177 dogs. Rather, Management Measure 5 is seeking to change pet owner actions with 177 representing the removal of pet waste from the equivalent of 177 dogs through active collection and the installation of pet waste stations. With an average of 0.614 dogs per household (AVMA, 2018), approximately 288 households would need to remove the waste from their dogs to account for 177 dogs in the watershed. Additional reductions will come from addressing other stormwater sources (e.g., illegal waste dumping) and installing BMPs like restoring or enhancing riparian zones in coordination with Management Measure 1.

**Table 20. Estimated dog load reduction and waste removal**

<b>Watershed</b>	<b>Water Body ID</b>	<b>SWMU</b>	<b>Total Dog Load Reduction</b>	<b>Representative Unit Daily Load</b>	<b># of Dogs From Which Waste Would be Removed</b>
Caney Creek Tidal	1304	10-11	92.4	2.5	37
Linnville Bayou	1304A	7-9	16.9	2.5	7
Caney Creek Above Tidal	1305	1-6	332	2.5	133
		<b>Total</b>	<b>441.3</b>	<b>2.5</b>	<b>177</b>

All loads are expressed in billion cfu/day.

Table 21 presents a summary of Management Measure 5.

**Table 21. Management Measure 5: Reduce stormwater sources such as pet waste and illegal dumping**

**Causes and Sources:** Direct and indirect deposits of pet feces not properly disposed of by pet owners.

Potential Load Reduction	Technical and Financial Assistance	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Party
161,075 billion cfu/year	<p><b>Technical:</b> Materials and resources to manage and implement stormwater BMPs can be provided by H-GAC, EPA, and TCEQ.</p> <p><b>Financial:</b></p> <ul style="list-style-type: none"> <li>• \$0-10,000 for pet waste station installation.</li> <li>• \$0-10,000 for stormwater outreach.</li> <li>• \$0-500,000 to assist communities to identify opportunities to address stormwater and illegal dumping.</li> </ul>	Workshops, technical presentations, and one-on-one meetings.	<ul style="list-style-type: none"> <li>• <b>Year 1:</b> Identify local partners to develop and submit proposals for funding of pet waste stations and educational material delivery. Develop proposals for pet waste stations. Work with communities to identify locations to conduct channel investigations.</li> <li>• <b>Years 2-5:</b> Install and maintain at least three pet waste stations per year and distribute associated education and outreach materials. Plan and complete a stormwater/riparian demonstration project in coordination with Management Measure 1.</li> <li>• <b>Years 2-3:</b> Coordinate a stormwater outreach event as part of a watershed workshop.</li> <li>• <b>Years 4-5:</b> Conduct illicit discharge and illegal dumping detection investigations.</li> <li>• <b>Year 5:</b> Provide five-year Management Measure 5 progress report.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of pet waste stations installed.</li> <li>• Number of workshops held.</li> <li>• Completion of stormwater/riparian demonstration project.</li> <li>• Number of illicit discharge and illegal dumping detection investigations completed.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of pet waste stations installed.</li> <li>• Number of individuals, groups, or communities reached.</li> <li>• Completion of watershed workshop, stormwater/riparian demonstration project, and at least one illicit discharge and illegal dumping investigation.</li> <li>• Area or stream miles of preserved, protected, or enhanced riparian corridor.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Environmental:</b> CRP ambient monitoring data</li> <li>• <b>Programmatic:</b> Five-year report</li> </ul>	Watershed coordinator, local governments, drainage districts, H-GAC, Texas A&M AgriLife Extension, USFWS, TPWD

## Sustainability

TCEQ, responsible parties, and other stakeholders in TMDL implementation projects periodically assess the results of the planned activities, along with other information, to evaluate the effectiveness of the I-Plan. Responsible parties and other stakeholders evaluate several factors, such as the pace of implementation, the effectiveness of BMPs, load reductions, and progress toward meeting water quality standards.

The responsible parties and other stakeholders will track progress using both implementation milestones and water quality indicators. These terms are defined as:

- **Water Quality Indicator** – A measure of water quality conditions for comparison to pre-existing conditions, constituent loadings, and water quality standards.
- **Implementation Milestone** – A measure of administrative actions undertaken to cause an improvement in water quality.

## Water Quality Indicators

As a partner with the TCEQ CRP, H-GAC CRP will continue routine water quality monitoring during implementation as funding and resources allow. The indicators that will be used to measure improvement in water quality are *E. coli* in freshwater and Enterococci in saltwater.

## Implementation Milestones

Implementation tracking provides information that can be used to determine if progress is being made toward meeting goals of the TMDL. Tracking also allows stakeholders to evaluate actions taken, identify those that may not be working, and make any changes that may be necessary to get the plan back on target.

## Communication Strategy

TCEQ will work with responsible parties and other stakeholders to hold meetings or obtain annual I-Plan updates for up to five years, so stakeholders may evaluate their progress. Responsible parties and stakeholders will continue to provide annual updates and/or take part in any meetings over the five-year period to evaluate implementation efforts. At the completion of the scheduled I-Plan activities, stakeholders will assemble and evaluate the actions, overall impacts, and results of their implementation efforts.

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