Approved August 8, 2018

Implementation Plan for Five Total Maximum Daily Loads for Bacteria in the Lower San Antonio River Watershed

Segment 1901

Assessment Units 1901_01, 1901_02, 1901_03, 1901_04, 1901_05

Prepared by the San Antonio River Stakeholders

With Support from the TMDL Team, Water Quality Planning Division, Office of Water

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Distributed by the

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TMDL implementation plans are also available on the TCEQ website at:
<www.tceq.texas.gov/waterquality/tmdl/>

This plan is based in part on technical reports prepared for the TCEQ by: James Miertschin & Associates, Inc., "Modeling for Bacteria TMDL Development: Lower San Antonio River Segment 1901," and in large part the recommendations of the Lower San Antonio River Stakeholders, including the Technical Committee and Coordinating Committee.

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USDA Natural Resources Conservation Service
Texas State Soil and Water Conservation Board
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City of Goliad
Karnes County
Goliad County
Goliad Canoe Trail
Karnes County Soil and Water Conservation District
Goliad County Soil and Water Conservation District
ConocoPhillips
San Antonio River Environmental Advisory Committee
Texas Water Resources Institute

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Abbreviations

ac	acre
An.U	animal unit
AgriLife Extension	Texas A&M AgriLife Extension Service
AU	assessment unit
BMP	best management practice
BST	Bacterial Source Tracking
CCN	Certificate of Convenience and Necessity
CDF	Community Development Fund
cfu	colony-forming units
CIG	Conservation Innovation Grants
CRP	Clean Rivers Program
CSP	Conservation Stewardship Program
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
E. coli	*Escherichia coli*
EDAP	Economically Distressed Areas Program
EE	Environmental Education
EPA	Environmental Protection Agency (U.S.)
EQIP	Environmental Quality Incentives Program
FOTG	Field Office Technical Guide
gal	gallons
GIS	geographic information system
ha	hectare
HUD	U.S. Department of Housing and Urban Development
I-Plan	implementation plan
km	kilometer
LA	load allocation
LCRA	Lower Colorado River Authority
LID	low impact development
LSAR	Lower San Antonio River
mL	milliliter
MGD	million gallons per day
MOS	margin of safety
MPN	most probable number
MS4	municipal separate storm sewer system
NIFA	National Institute of Food and Agriculture
NIWQP	National Integrated Water Quality Program
NLCD	National Land Cover Database
NPS	nonpoint source
NRCS	Natural Resources Conservation Service
O&M	operation and maintenance
OSSF	on-site sewage facility
QAPP	Quality Assurance Project Plan
RCPP	Regional Conservation Partnership Program

RRC	Regional Review Committees
RUS	Rural Utilities Service
SARA	San Antonio River Authority
SSO	sanitary sewer overflow
SWCD	Soil and Water Conservation Districts
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TEEX	Texas A&M Engineering Extension Service
TMDL	total maximum daily load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TRWA	Texas Rural Water Association
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TWRI	Texas Water Resources Institute
TWS	Texas Wildlife Services
TxCDBG	Texas Department of Agriculture Community Development Block Grant
TxDOT	Texas Department of Transportation
U.S.C.	U.S. Code
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WLA	wasteload allocation
WQMP	Water Quality Management Plan
WQS	Water Quality Standards
WWD	Water and Waste Disposal
WWTF	wastewater treatment facility

Implementation Plan for Five TMDLs for Bacteria in the Lower San Antonio River

Executive Summary

On August 20, 2008, the Texas Commission on Environmental Quality (TCEQ) adopted *One Total Maximum Daily Load for Bacteria in the Lower San Antonio River* (Segment 1901). The total maximum daily load (TMDL) for bacteria in the Lower San Antonio River (LSAR) was approved by the U.S. Environmental Protection Agency (EPA) on October 20, 2008.

This implementation plan, or I-Plan:

- describes the steps that watershed stakeholders and the TCEQ will take towards achieving the pollutant reductions identified in the TMDL report, and
- outlines the schedule for implementation activities.

The ultimate goal of this I-Plan is to restore the primary contact recreation use in Segment 1901 by reducing concentrations of bacteria to levels established in the TMDL. The TMDL document was based on segment units (Segment 1901), but TMDLs are now developed for assessment units (AUs) within segments. This I-Plan will focus on the five impaired AU watersheds within the original segment. While two of the AUs were delisted in 2014, this plan addresses all five that were in the original TMDL.

The TMDL identified regulated and unregulated sources of indicator bacteria in the watershed that could contribute to water quality impairment. Regulated sources identified include wastewater treatment facilities (WWTFs) (eight in the LSAR watershed, five of which have discharge permits), sanitary sewer overflows (SSOs), dry weather discharges, and illicit discharges. There are no stormwater Phase I or II municipal separate storm sewer system (MS4) permits in these watersheds.

Unregulated sources that may contribute to the bacteria load in the watersheds include domestic animals (e.g., dogs, cats, chickens, etc.), livestock (e.g., cattle, horses, goats, etc.), neglected and failing on-site sewage facilities (OSSFs), and wildlife and other unmanaged animals (e.g., deer, feral hogs, grackles, and other birds). In addition, illicit dumping and unregulated urban stormwater have also been identified as potential contributors.

This I-Plan includes management measures and control actions that will be used to reduce bacteria in the LSAR watershed. Management measures are related to

managing nonpoint sources (unregulated), such as working to identify OSSFs in the watershed. Control actions are related to point sources (regulated discharges), such as monitoring and reducing industrial or domestic WWTF contributions.

Management Measures

1) *Develop and implement conservation plans in priority areas of the watershed; educate landowners on appropriate stocking rates and grazing plans.*
2) *Remove and manage feral hogs.*
3) *Identify, prioritize, and remediate OSSFs.*
4) *Coordinate efforts to reduce unauthorized discharges including SSOs; coordinate and expand efforts to reduce stormwater inflow and infiltration; reduce WWTF contributions by meeting half of the permitted bacteria limit; advocate for proper operation and maintenance (O&M) of sewer lines.*
5) *Restore and repair riparian zones; emphasize protection of riparian zones; advocate for educational and outreach materials.*
6) *Promote the improved quality and management of urban stormwater; coordinate with new development for reducing runoff pollutants; provide education programs on stormwater management; advocate for low impact development (LID) best management practices (BMPs).*
7) *Promote the reduction of illicit dumping and proper disposal of wastes; utilize San Antonio River Authority (SARA)'s Environmental Investigators.*
8) *Coordinate and expand existing water quality monitoring in the watershed.*
9) *Re-designate Cabeza Creek.*

Control Actions

1) *Improve monitoring of WWTF effluent to ensure permit compliance.*
2) *Improve and upgrade WWTFs.*

For each of the measures and actions, this plan identifies an educational component, the responsible parties, technical and financial needs, measurable milestones assessed through monitoring and outreach efforts, estimated load reductions, and a schedule of activities. Implementation of the management measures will largely be dependent upon the availability of funding.

The stakeholders and TCEQ will review progress under the TCEQ's adaptive management process. The plan may be adjusted periodically as a result of progress reviews.

Introduction

To keep Texas' commitment to restore and maintain water quality in impaired rivers, lakes, and bays, the 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, and
- 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 LSAR 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 appropriate formal or informal action.

This I-Plan contains the following components:

3) a description of control actions and management measures that will be implemented to achieve the water quality target;
4) a schedule for implementing activities (Appendix A);
5) the legal authority under which the participating agencies may require implementation of the control actions;
6) a follow-up tracking and monitoring plan to determine the effectiveness of the control actions and management measures undertaken;
7) identification of measurable outcomes and other considerations the TCEQ and stakeholders will use to determine whether the I-Plan has been properly executed, water quality standards are being achieved, or the plan needs to be modified;
8) identification of the communication strategies the TCEQ will use to disseminate information to stakeholders; and
9) a review strategy that stakeholders will use to periodically review and revise the plan to ensure there is continued progress in improving water quality.

This plan also includes the nine key elements of a watershed-based plan including possible causes and sources of the impairment, management measure descriptions, estimated potential load reductions, technical and financial assistance needed, educational components for each measure, schedule of implementation, measurable milestones, indicators to measure progress, monitoring components, and responsible entities. These are outlined in the Nonpoint Source Program Grants Guidelines for States and Territories (EPA,

2013). Consequently, projects developed to implement nonpoint source elements of this plan that also meet the grant program conditions may be eligible for funding under the EPA's Section 319(h) incremental grant program.

Watershed Overview

The LSAR is 153 miles long, flows through Karnes and Goliad counties, and forms the boundary between Refugio and Victoria counties before reaching its confluence with the Guadalupe River near San Antonio Bay. The LSAR receives flows from two upstream segments: the Upper San Antonio River (Segment 1911) and Lower Cibolo Creek (Segment 1902). The total area of the LSAR watershed is approximately 1,628 square miles or 1,041,843 acres. Figure 1 shows the map of the watershed and impaired segment from the original TMDL. Figure 2 illustrates the AUs (in red) within that segment that are covered under this I-Plan. Figure 2 also includes regulated dischargers.

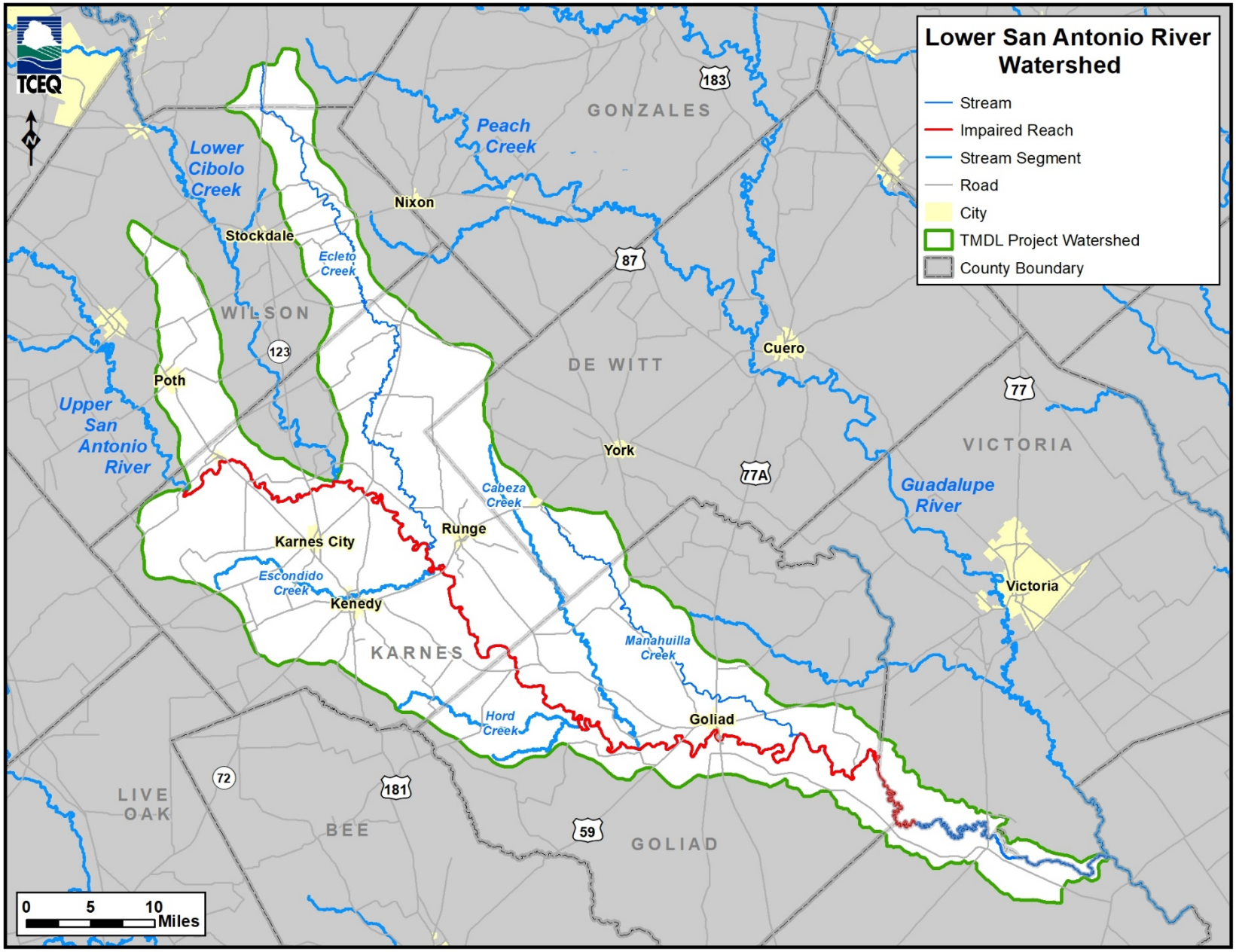

Figure 1. Map of original TMDL LSAR watershed

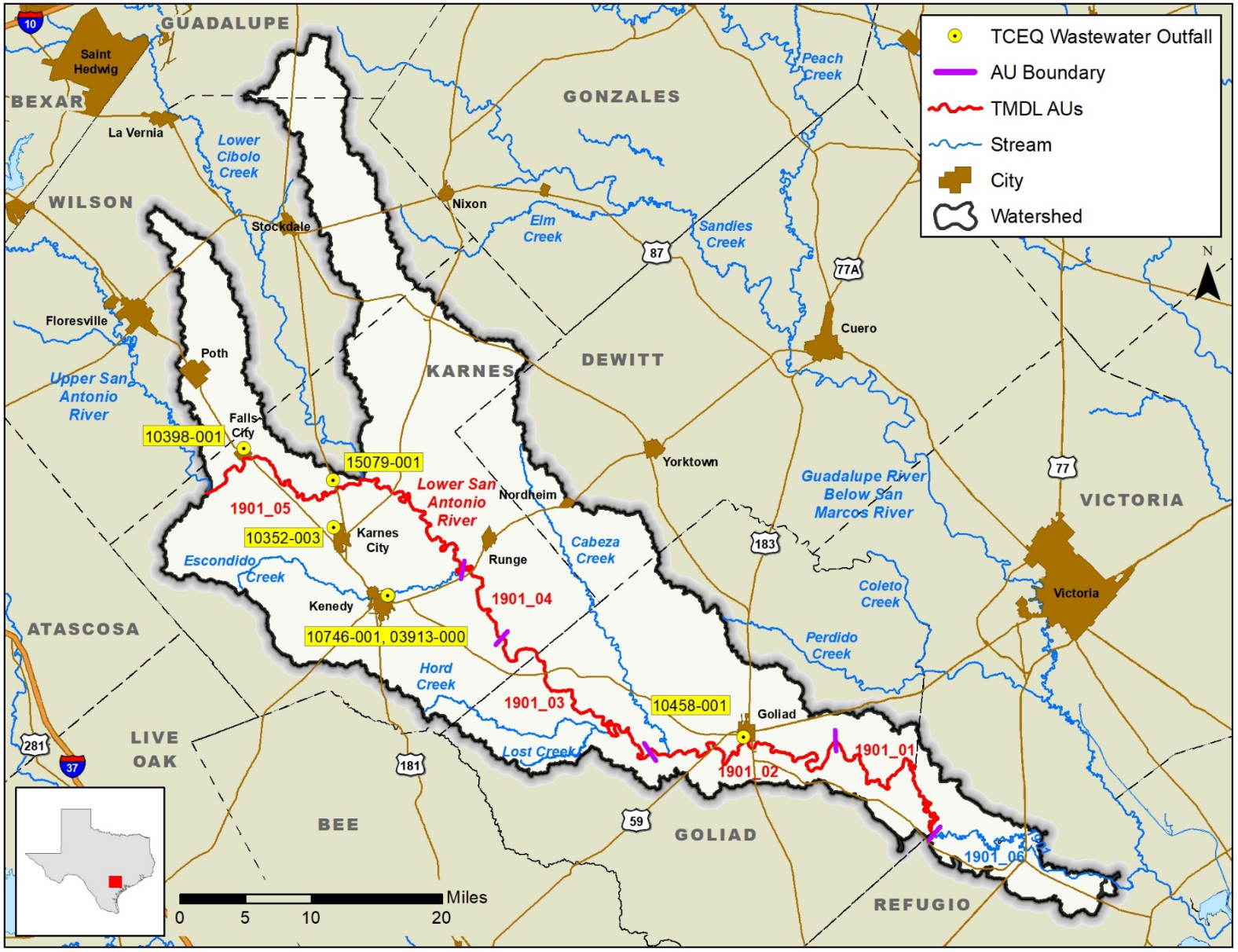

Figure 2. Map of the LSAR watershed

*AUs 1901_01 and 1901_05 were delisted in 2014, however are included in the I-Plan watershed

Land use data for the watershed were based on the 2011 U.S. Geological Survey (USGS) National Land Cover Database (NLCD). Urban areas (Open Space, High, Medium, and Low Developed) account for 5.61 percent of the watershed. Forests and shrublands account for about 39.07 percent of the watershed, and pastures and grasslands account for 44.51 percent of the watershed. Agricultural cultivated crops account for only 6.84 percent of the watershed. The remaining 3.97 percent of the watershed is made up of wetlands, barren earth, and open water. These land uses are shown in Table 1 and Figure 3.

Table 1. Land type within LSAR watershed by acreage

Classification	Acreage	Percent of Total
Open Water	2,721.40	0.26%
Developed Open Space	39,655.90	3.81%
Developed, Low Intensity	15,963.70	1.53%
Developed, Medium Intensity	2,405.60	0.23%
Developed, High Intensity	429.00	0.04%
Barren	9,640.10	0.93%
Deciduous Forest	72,470.00	6.95%
Evergreen Forest	2,303.10	0.22%
Mixed Forest	4,245.10	0.41%
Shrub/Scrub	328,126.60	31.49%
Grassland	51,659.60	4.96%
Pasture	412,085.70	39.55%
Cultivated Crops	71,223.20	6.84%
Woody Wetlands	24,969.80	2.40%
Emergent Herbaceous Wetlands	3,944.20	0.38%
Total:	**1,041,843.00**	**100.00%**

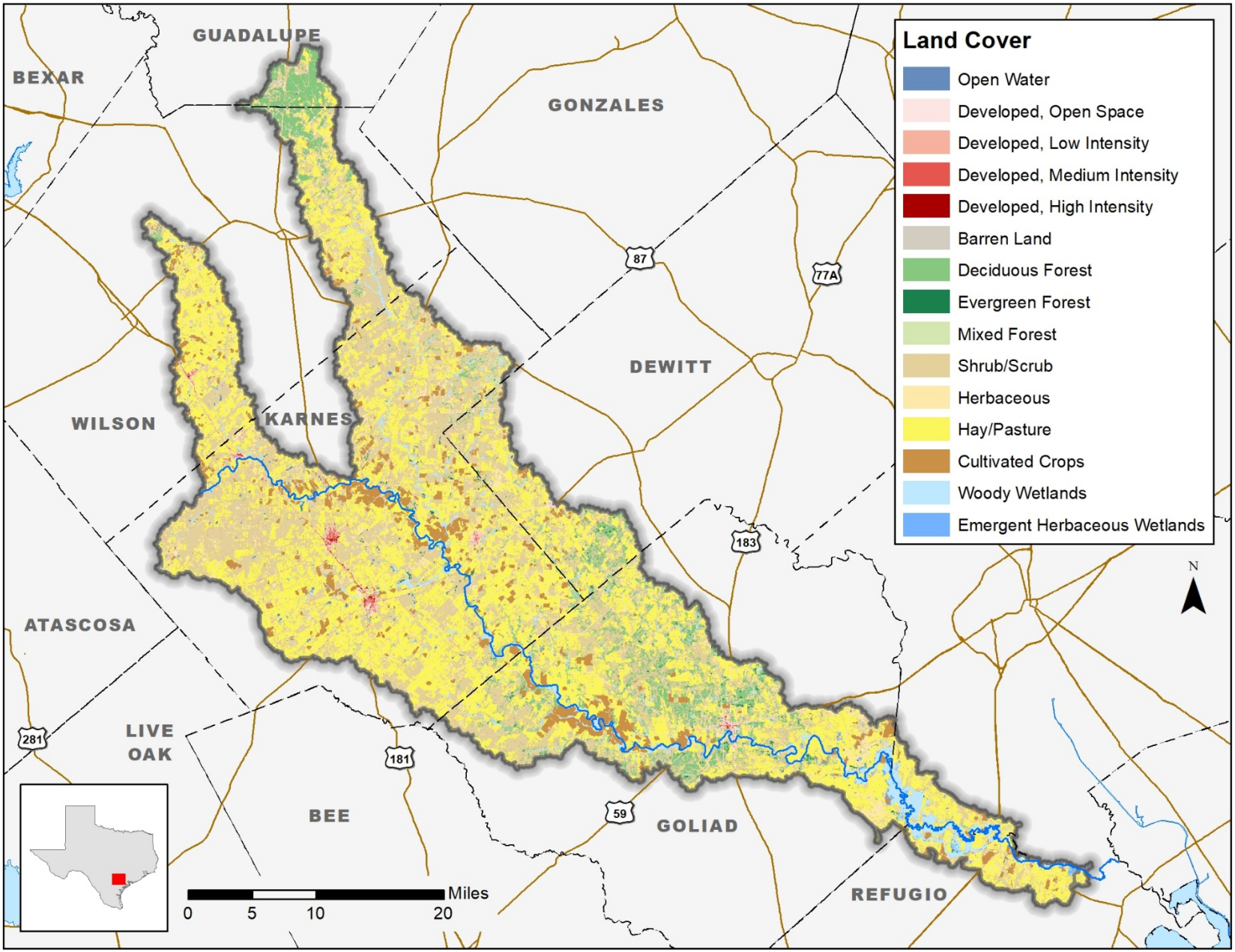

Figure 3. Land uses

Based on the 2010 U.S. Census data, Wilson County has a total population of 42,918, Karnes County has a total population of 14,824, and Goliad County has a population of 7,210 people in the LSAR watershed. Based on the 2016 Texas Water Development Board Regional Planning, populations are expected to increase by 75 percent to 136,623 people by the year 2070 (Table 2).

Table 2. 2020-2070 population projections

Counties	2020	2030	2040	2050	2060	2070
Wilson	54,266	66,837	79,044	90,016	100,411	109,771
Goliad	8,427	9,519	10,239	10,545	10,759	10,884
Karnes	15,456	15,938	15,968	15,968	15,968	15,968
Total	78,149	92,294	105,251	116,529	127,138	136,623

Summary of TMDL

This section summarizes the information developed for the TMDL titled *One TMDL for Bacteria in the Lower San Antonio River*, Segment 1901. Additional background information, including the problem definition, endpoint identification, source analysis, linkages between sources and receiving waters, and pollutant load allocations can be found in the TMDL report.

A TMDL estimates the maximum amount of a pollutant that a water body can receive daily without exceeding water quality standards. It also establishes pollutant contribution (i.e., allocation) levels from source categories that will result in achieving water quality standards. The 2008 TMDL pollutant load allocations were calculated using the following equation:

$$TMDL = \Sigma WLA + \Sigma LA + MOS$$

Where:

ΣWLA = sum of wasteload allocations (point source allocation)

ΣLA = sum of load allocations (nonpoint source allocation)

MOS = margin of safety

In this equation, the WLA and LA represent the maximum allowable point and nonpoint source contributions, respectively. The MOS is included to account for any uncertainty concerning the relationship between effluent limitations and water quality.

TMDLs are submitted for approval by the EPA, and are updated through the TCEQ's Water Quality Management Plan, which provides long-range planning

and technical information for management activities, as required under the Texas Water Code and federal Clean Water Act (CWA).

Pollutant Sources and Loads

Wasteload Allocation

The TMDL WLA represents the maximum allowable contribution from point sources. Several WWTFs discharge directly to the LSAR or one of its tributaries. To develop the WLA for this TMDL, a bacteria concentration of 126 cfu/100 mL, and the facility's total permitted flows were used. The current WWTF allocations for the LSAR watershed are shown in Table 3. There is no regulated stormwater in the watershed.

Wastewater Treatment Facilities

WWTFs regulated under the Texas Pollution Discharge Elimination System (TPDES) are allocated a daily waste load (WLA_{WWTF}), calculated as their full permitted discharge flow rate multiplied by the instream geometric criterion. This is expressed in the following equation:

WLA_{WWTF} = Criterion * Flow [million gallons per day (MGD)] * Conversion Factor

Where:

Criterion = 126 colony forming units (cfu)/100 milliliters (mL) for *Escherichia coli* (*E. coli*)

Flow = full permitted flow (MGD)

Conversion factor = 1.54723 cubic feet per second/MGD *283.168 100 mL/ft^3 * 86,400 seconds/day

Table 3. Current wasteload allocations for TPDES-regulated facilities (*E. coli* 10^9 cfu/day)

Point Source	Station	MGD	WLA*
Falls City	12794	0.0650	0.3
Karnes City	12793	0.5020	2.4
City of Kenedy	12793	2.0000	9.5
City of Goliad	12791	0.3500	1.6
South Central Water Company	12794	0.0125	0.06
		Total WLA (cfu/day) =	**13.86**

* permitted flow x water quality standard

Load Allocation

The LA is the sum of loads from unregulated sources. The LA was calculated as:

LA = TMDL - WLA - MOS

Where:

LA = allowable loads from unregulated sources within the AU

TMDL = total maximum daily load

WLA = sum of all WWTF loads

MOS = margin of safety

Margin of Safety

The MOS is a required component of the TMDL to account for any uncertainty concerning the relationship between effluent limitations and water quality. A 5 percent MOS was explicitly incorporated into this TMDL. There is also an implicit margin of safety built into the established water quality standards and criteria, which were developed using a low illness rate of less than 1 percent.

Total Maximum Daily Load

A TMDL is the sum of the individual WLAs for point sources, LAs for nonpoint sources and natural background conditions, and an MOS. The TMDL, which was adopted in 2008, was calculated as follows:

TMDL = WLA + LA + MOS

In this equation, the WLA and LA represent the maximum allowable point and nonpoint source contributions, respectively. The MOS is included to account for any uncertainty concerning the relationship between effluent limitations and water quality. Load allocations were calculated at four stations along the TMDL segment. However, the segment covered by the TMDL now encompasses five assessment units. The LSAR TMDLs for each station were based on the bacteria standard of 126 cfu/100mL (Tables 4-7).

Table 4. TMDL allocation summary for Station 12794 (*E. coli* 10^9 cfu/day)

	Flow Regime (percentile)				
	0-10	**10-40**	**40-60**	**60-90**	**90-100**
Waste Allocation (WLA)[1]	0.3	0.3	0.3	0.3	0.3
Load Allocation (LA)	9,334.1	2,439.9	1,364.9	878.7	495.6

[1] An additional WLA of 0.06 has been accounted for through a 2013 WQMP update.

	Flow Regime (percentile)				
	0-10	**10-40**	**40-60**	**60-90**	**90-100**
Margin of Safety (MOS)	491.3	128.4	71.8	46.3	26.1
TMDL (WLA+LA+MOS)	9,826	2,569	1,437	925	522

Table 5. TMDL allocation summary for Station 12793 (*E. coli* 10^9 cfu/day)

	Flow Regime (percentile)				
	0-10	**10-40**	**40-60**	**60-90**	**90-100**
Waste Allocation (WLA)[2]	11	11	11	11	11
Load Allocation (LA)	9,536.8	2,451.7	1,375.6	876.5	488.6
Margin of Safety (MOS)	502.5	129.6	73.0	46.7	26.3
TMDL (WLA+LA+MOS)	10,050	2,592	1,460	934	526

Table 6. TMDL allocation summary for Station 12791 (*E. coli* 10^9 cfu/day)

	Flow Regime (percentile)				
	0-10	**10-40**	**40-60**	**60-90**	**90-100**
Waste Allocation (WLA)	1.6	1.6	1.6	1.6	1.6
Load Allocation (LA)	9,745.7	2,496.7	1,407.2	888.8	502.2
Margin of Safety (MOS)	513.0	131.5	74.1	46.9	26.5
TMDL (WLA+LA+MOS)	10,260	2,630	1,483	937	530

Table 7. TMDL allocation summary for Station 12790 (*E. coli* 10^9 cfu/day)

	Flow Regime (percentile)				
	0-10	**10-40**	**40-60**	**60-90**	**90-100**
Waste Allocation (WLA)	0	0	0	0	0
Load Allocation (LA)	10,122.7	2,594.5	1,463	924.7	523.2
Margin of Safety (MOS)	532.8	136.6	77.0	48.7	27.5
TMDL (WLA+LA+MOS)	10,655	2,731	1,540	973	551

Implementation Strategy

This plan documents nine management measures and two control actions to reduce bacteria loads. Management measures were selected based on feasibility,

[2] An additional WLA of 0.9 has been accounted for through a 2012 WQMP update.

costs, support, and timing. Activities can be implemented in phases based on the needs of the stakeholders, availability of funding, and the progress made in improving water quality.

Adaptive Implementation

All I-Plans are implemented using an adaptive management approach in which measures are periodically assessed for efficiency and effectiveness. This adaptive management approach is one of the most important 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.

At annual meetings, the stakeholders will periodically assess progress using the schedule of implementation, interim measurable milestones, water quality data, and the communication plan included in this document. If periodic assessments find that insufficient progress has been made or that implementation activities have improved water quality, the implementation strategy will be adjusted.

Activities and Milestones

The LSAR stakeholder group directing the I-Plan formed Coordinating and Technical committees to determine appropriate activities and schedules to accomplish the management and control activities in the plan. Collectively, the LSAR stakeholder group held seven meetings between November 2016 and August 2017 to develop this I-Plan.

The stakeholder group developed detailed, consensus-based action plans, and these implementation activities are described in the following section.

Management Measures and Control Actions

Management Measures

1) *Develop and implement conservation plans in priority areas of the watershed; educate landowners on appropriate stocking rates and grazing plans.*
2) *Remove and manage feral hogs.*
3) *Identify, prioritize, and remediate OSSFs.*
4) *Coordinate efforts to reduce unauthorized discharges including SSOs; coordinate and expand efforts to reduce stormwater inflow and infiltration; reduce WWTF contributions by meeting half of the permitted bacteria limit; advocate for proper O&M of sewer lines.*

5) *Restore and repair riparian zones; emphasize protection of riparian zones; advocate for educational and outreach materials.*
6) *Promote the improved quality and management of stormwater; coordinate with new development for reducing runoff pollutants; provide education programs on stormwater management; advocate for LID BMPs.*
7) *Promote the reduction of illicit dumping and proper disposal of wastes; utilize SARA's Environmental Investigators.*
8) *Coordinate and expand existing water quality monitoring in the watershed.*
9) *Re-designate Cabeza Creek.*

Control Actions

1) *Improve monitoring of WWTF effluent to ensure permit compliance.*
2) *Improve and upgrade WWTFs.*

Management Measure 1

Develop and implement conservation plans in priority areas of the watershed; educate landowners on appropriate stocking rates and grazing plans.

Although land uses in a watershed change with time, the LSAR watershed continues to be dominated by shrubs, pasture, and cultivated crops. The majority of the agricultural interests within the watershed are cattle grazing operations; however, there are farming operations that cover portions of the watershed as well. The implementation of proven BMPs within priority subwatersheds can lead to instream water quality improvements by minimizing the deposition of fecal matter directly into ditches, creeks, rivers and in their riparian areas. Currently, 90 Water Quality Management Plans (WQMPs) and numerous conservation plans have been developed and implemented across the watershed. Establishing additional acreage under management practices and additional conservation plans in these watersheds is the primary goal of this management measure. To accomplish this goal, participating stakeholders will partner with state and federal agencies to garner the necessary technical and financial assistance, as resources are available, to implement these management practices under the appropriate programs requested by the landowner. Direct contact with landowners in priority areas will be made to discuss what a conservation plan is, its benefits, and other information necessary to inform landowners of the need for adoption of BMPs. Additionally, management practice field days will be held for the public to gain knowledge about how to implement particular BMPs throughout the watershed. Assistance at the local level may be needed to establish the necessary contacts.

Educational Component

Education is one of the most important components of this management measure. An intensive education and outreach program is needed to broadly promote the adoption of management practices through the appropriate programs. Awareness of the programs, management practices, and their benefits is often one of the largest factors affecting adoption of BMPs and should also be assessed to encourage adoption. Educational programs specific to some of the landowner interests currently exist and should also be utilized as a part of the education and outreach campaign. Existing programs, such as the Lone Star Healthy Steams Program, the Statewide Riparian and Stream Ecosystem Education Program, and SARA Programs including "Be Watershed Wise" and the *Creek Book* should be delivered in the watersheds to further promote the adoption of BMPs.

Priority Areas

Priority areas for the adoption of management practices in these watersheds will include areas with land uses that have the highest potential capacity for grazing livestock. Specific subwatersheds include AUs 1901_02, 1901_03, and 1901_04 (and all tributaries of these AUs).

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- **Local Stakeholders:**
  Local stakeholders will evaluate the option of adopting a conservation plan through a specific program of their choice, including, but not limited to, the programs listed below. If found feasible, the individual stakeholders will work with the appropriate agency to develop conservation plans to mitigate impacts to water quality. Stakeholders who adopt conservation plans should adhere to the requirements written into their specific conservation plan. The agencies listed below are responsible for helping stakeholders adopt and implement the conservation plans.

- **Texas A&M AgriLife Extension Service:**
  The Texas A&M AgriLife Extension Service (AgriLife Extension) provides quality, relevant outreach and continuing education programs and services to Texans. AgriLife Extension serves every county in Texas; information is provided by scientists and researchers at Texas A&M and other universities, and is made practical and relevant by AgriLife Extension educators or agents who work in each county. AgriLife Extension continually assesses and responds to educational needs identified by community residents, advisory committee members, volunteers, stakeholder groups, and representatives of organizations and agencies. AgriLife Extension education encompasses the broad areas of agriculture and natural resources, community economic

development, family and consumer sciences, and youth development programs such as 4-H.

Funded with Texas State Soil and Water Conservation Board (TSSWCB) CWA Section 319(h) nonpoint source grants, AgriLife Extension and the Texas Water Resources Institute (TWRI) have developed the Lone Star Healthy Streams – Grazing Cattle curriculum. This educational program is delivered statewide and serves as the foundation for landowners' understanding of the effects of grazing cattle on bacteria loading to streams and the BMPs designed to reduce bacteria from grazing cattle. It will be important to stress the impacts of overgrazing properties to landowners. The curriculum promotes the adoption of BMPs and participation in federal and state cost-share programs and should be delivered to stakeholders in the TMDL watershed. Upon request, TSSWCB and AgriLife Extension will deliver the program in the LSAR watershed.

TSSWCB and AgriLife Extension will deliver the program to cattlemen in the LSAR watersheds. More information on this project is available at: <grazinglands-wq.tamu.edu/>.

- **Texas State Soil and Water Conservation Board:**
  The TSSWCB is the lead agency in Texas responsible for planning, implementing, and managing programs and practices for preventing and abating agricultural and silvicultural (forestry-related) nonpoint source pollution (Texas Agriculture Code 2007). In accordance with this responsibility, the TSSWCB administers a certified WQMP Program that provides, through soil and water conservation districts (SWCDs), cost-share assistance for management practices on agricultural and silvicultural lands; however, not all WQMPs receive financial assistance.

  Each WQMP is developed, maintained, and implemented under rules and criteria adopted by the TSSWCB. A WQMP achieves a level of pollution prevention or abatement consistent with the state's water quality standards and is a site-specific plan designed to assist landowners in managing nonpoint source pollution from agricultural and silvicultural activities. WQMPs are traditional conservation plans based on the criteria outlined in the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Field Office Technical Guide (FOTG). The FOTG is the best available technology and is tailored to meet local needs. A WQMP includes appropriate land treatment practices, production practices, management measures, technologies, or combinations thereof. WQMPs are developed in cooperation with the landowner, with assistance from the NRCS, are approved by the local SWCD, and are certified by the TSSWCB. This way of preventing and abating nonpoint source pollution uses a voluntary approach while affording the landowner a mechanism for compliance with the state's water quality standards.

The TSSWCB regularly performs status reviews on WQMPs to ensure that the producers are implementing the measures described in the WQMP. The TSSWCB administers technical and financial assistance programs to assist producers in implementing their WQMPs. The TSSWCB utilizes both state funds and federal grants to implement the WQMP program. Several essential practices from the NRCS FOTG included in a WQMP have specific applicability to the bacteria reduction goals of this I-Plan. A grazing management system is a vital component of a WQMP for livestock operations. The TSSWCB, in collaboration with NRCS and the Karnes SWCD #343, Goliad SWCD #352, and Wilson County SWCD #301, will continue to provide technical assistance to landowners in developing and implementing WQMPs that include grazing management systems. The TSSWCB will develop WQMPs on 100 percent of the livestock operations in the LSAR watershed that request planning assistance through the SWCD. TSSWCB and the SWCDs will annually perform status reviews on at least 5 percent of all WQMPs in the LSAR watershed.

- **Soil and Water Conservation Districts:**
  An SWCD, like a county or school district, is a subdivision of state government. SWCDs are administered by a board of five directors who are elected by their fellow landowners. There are 216 individual SWCDs organized in Texas. It is through this conservation partnership that local SWCDs are able to furnish technical assistance to farmers and ranchers in the preparation of a complete soil and water conservation plan to meet each land unit's specific capabilities and needs. The LSAR watershed lies inside the Karnes SWCD #343, Goliad SWCD #352, and Wilson County SWCD #301.

- **U.S. Department of Agriculture NRCS:**
  The NRCS is a federal agency that works hand-in-hand with Texans to improve and protect their soil, water, and other natural resources. For decades, private landowners have voluntarily worked with NRCS specialists to prevent erosion, improve water quality, and promote sustainable agriculture. The NRCS provides conservation planning and technical assistance to landowners, groups, and units of government to develop and implement conservation plans that protect, conserve, and enhance their natural resources. When providing assistance, NRCS focuses on the sound use and management of soil, water, air, plant, and animal resources. NRCS ensures sustainability, allows for productivity, and respects the customers' needs. Conservation planning can make improvements to livestock operations, crop production, soil quality, water quality, and pastureland, forestland, and wildlife habitats. The NRCS also integrates ecological and economic considerations in order to address private and public concerns.

  The NRCS administers numerous Farm Bill programs authorized by the U.S. Congress that provide financial assistance for many conservation activities, including:

- Conservation Innovation Grants (CIG)
- Conservation Stewardship Program (CSP)
- Environmental Quality Incentives Program (EQIP)
- Regional Conservation Partnership Program (RCPP)
- Agricultural Conservation Easement Program
- USDA Conservation Reserve Program administered by USDA Farm Service Agency

EQIP and other programs were reauthorized in the federal Agricultural Act of 2014 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. People who are engaged in livestock or agricultural production on eligible land may participate in EQIP. EQIP offers financial and technical assistance to eligible participants for installation or implementation of structural and management practices on eligible agricultural land. EQIP also provides incentive and cost-share payments to implement conservation practices. EQIP activities are carried out according to a plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice(s) to address resource concerns. All practices are subject to NRCS technical standards described in the FOTG and adapted for local conditions. The local SWCD approves the plan.

Local work groups provide recommendations to NRCS on allocating EQIP county base funds and on resource concerns for other USDA Farm Bill programs. The LSAR watershed stakeholders are encouraged to participate in a local work group in order to promote the goals of this I-Plan, as compatible with the resource concerns and conservation priorities for EQIP.

Technical Assistance

The entities mentioned in the previous section provide resources of technical and financial assistance for Management Measure 1, but funding sources for this management measure need not be limited to these entities.

The agencies listed as responsible parties under Management Measure 1 will work with landowners to voluntarily implement management and conservation plans. Technical assistance to agricultural producers for developing management and conservation plans is provided through the TSSWCB's WQMP Program, which is funded through state general revenue. It is anticipated that other sources of funding will be required to implement the activities associated with Management Measure 1; it should also be noted that TSSWCB's WQMP Program is dependent on continued appropriations from the Texas Legislature.

Financial Assistance

This I-Plan targets the adoption and implementation of a total of 75 conservation plans and 6 education programs over a five-year period. Funding for implementation of the plans, either in the form of grants or through cost sharing incentives, is available through the agencies/entities listed under the descriptions provided previously in this section. The funding needed for education programs was estimated using an average cost of $50,000 per program.

TSSWCB and NRCS – Both agencies will continue to provide appropriate levels of cost-share assistance to agricultural producers that will facilitate the implementation of BMPs and conservation programs in the LSAR watershed, as described in Management Measure 1. Historically, according to TSSWCB data, conservation plan development and implementation in this watershed has been moderately low; as such, it is anticipated that additional levels of funding will be needed to meet implementation needs.

USDA Conservation Innovation Grants – The CIG is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, EQIP funds are used to award competitive grants to non–federal governmental or nongovernmental organizations, tribes, or individuals.

Conservation Stewardship Program – The CSP helps agricultural 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.

USDA-NRCS Environmental Quality Incentives Program – The EQIP is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. 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 nonindustrial private forestland. An additional purpose of EQIP is to help producers meet federal, state, tribal, and local environmental regulations.

Regional Conservation Partnership Program – The RCPP is a new, comprehensive, and flexible program that uses partnerships to stretch and multiply conservation investments and reach conservation goals on a regional or watershed scale. Through RCPP, NRCS and state, local, and regional partners coordinate resources to help producers install and maintain conservation

activities in selected project areas. Partners leverage RCPP funding in project areas and report on the benefits achieved.

Agricultural Conservation Easement Program – This program provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps Indian tribes, state and local governments, and nongovernmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands.

EPA/TCEQ/TSSWCB 319(h) – The EPA provides grant funding to Texas to implement the state's approved Nonpoint Source (NPS) Management Program. The EPA-approved state NPS Program provides the framework for determining which activities are eligible for funding under CWA Section 319(h). In general, these activities include non-regulatory programs and are related to controlling NPS pollution; EPA-approved NPS programs cover costs associated with technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific NPS projects.

USDA Sustainable Agriculture Research & Education – This program funds efforts that enhance the capabilities of Texas agricultural professionals in the area of sustainable agriculture. Grants and education are available to advance innovations in sustainable agriculture. The grants have contributed to an impressive portfolio of sustainable agriculture efforts across the nation.

USDA National Institute of Food and Agriculture Farm Business Management and Benchmarking Competitive Grants Program – This Competitive Grants Program provides funds to (1) improve the farm management knowledge and skills of agricultural producers; and (2) establish and maintain a national, publicly available, farm financial management database to support improved farm management.

USDA National Integrated Water Quality Program (NIWQP) – The NIWQP provides funding for research, education, and extension projects aimed at improving water quality in agricultural and rural watersheds. The NIWQP has identified eight themes that are being promoted in research, education, and extension. The eight themes are (1) animal manure and waste management; (2) drinking water and human health; (3) environmental restoration; (4) nutrient and pesticide management; (5) pollution assessment and prevention; (6) watershed management; (7) water conservation and agricultural water management; and (8) water policy and economics. Awards are made in four program areas: National Projects, Regional Coordination Projects, Extension Education Projects, and Integrated Research, Education, and Extension Projects. It is important to note that funding from this program is only available to universities.

EPA Environmental Education (EE) Grants – Under the EE 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, and/or disseminate environmental education practices, methods, or techniques as described in their Requests for Proposals.

EPA Targeted Watershed Grant Program – The Targeted Watersheds Grant Program is designed to encourage successful community-based approaches and management techniques to protect and restore the nation's watersheds. The Targeted Watersheds Grant program is a competitive grant program based on the fundamental principles of environmental improvement: collaboration, new technologies, market incentives, and results-oriented strategies. The Program focuses on multi-faceted plans for protecting and restoring water resources that are developed using partnership efforts of diverse stakeholders.

USDA-National Institute of Food and Agriculture (NIFA) Integrated Programs – NIFA Integrated Programs provide support for integrated research, education, and extension activities. Integrated, multi-functional projects are particularly effective in addressing important agricultural issues through the conduct of problem-focused research that is combined with education and extension of knowledge to those in need of solutions. These activities address critical national, regional, and multi-state agricultural issues, priorities, or problems. Integrated Programs hold the greatest potential to produce and disseminate knowledge and technology directly to end users while providing for educational opportunities to assure agricultural expertise in future generations.

USDA-NIFA Agricultural Food Research Initiative Competitive Fellowship Grants Program – The goal of this program is to provide funding for fundamental and applied research, extension, and education to address food and agricultural sciences. Six topic areas are eligible for funding: 1) plant health and production and plant products; 2) animal health and production and animal products; 3) food safety, nutrition, and health; 4) renewable energy, natural resources, and environment; 5) agriculture systems and technology; and 6) agriculture economics and rural communities.

Measurable Milestones

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

- number of landowners contacted,
- number of conservation plans developed,
- number of acres in conservation plans developed,
- number of education/outreach programs delivered, and

- number of materials developed and distributed.

Progress Indicators

Progress indicators for this management measure will consist of the following.

- Year 1 – develop 15 conservation plans in the LSAR watershed
- Year 2 – develop 15 additional conservation plans in the LSAR watershed; secure funding for an education campaign; initiate education campaign
- Year 3 – develop 15 additional conservation plans in the LSAR watershed; deliver 2 educational programs
- Year 4 – develop 15 additional conservation plans in the LSAR watershed; deliver 2 educational programs
- Year 5 – develop 15 additional conservation plans in the LSAR watershed; deliver 2 educational programs

Monitoring Component

Monitoring of this management measure will consist of utilizing the TCEQ's Clean Rivers Program (CRP) to monitor surface water quality and to measure bacteria loadings, especially in critical areas. Additional monitoring may be needed and should be developed under Management Measure 8 of this document.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Year 1:

As funding allows, the TSSWCB, AgriLife Extension, and NRCS will:

- develop 15 conservation plans in the LSAR watershed,
- promote existing conservation programs throughout the LSAR watershed, and
- pursue funding for educational programs, as documented with the successful submission of a CWA Section 319(h) grant proposal.

Year 2:

As funding allows, the TSSWCB, AgriLife Extension, and NRCS will:

- develop 15 additional conservation plans in the LSAR watershed and secure funding for an education campaign, and initiate the education campaign,
- continue promoting existing conservation programs (annually), and
- successfully secure funding for an educational campaign, and initiate the campaign.

Years 3-5:

As funding allows, responsible parties will:

- continue promoting existing conservation programs,
- develop 15 additional conservation plans in year 3, 15 additional plans in year 4, and an additional 15 plans in year 5 in the LSAR watershed,
- deliver 6 educational programs in the watershed (2 annually) to encourage the adoption of conservation plans, and
- in year 5, assess overall progress and if necessary, modify existing efforts or develop a new strategy for implementation.

Estimated Loading Reductions

Prescribed management will most effectively reduce direct deposition but will also reduce bacteria loads from the landscape. By implementing prescribed grazing, cross fencing, watering facilities, and other BMPs identified by local SWCDs, potential annual *E. coli* loading reductions are calculated to be $1.56x10^{15}$ cfu/year. See Appendix B for details.

Table 8. Management Measure 1: Develop and implement conservation plans in priority areas of the watershed; educate landowners on appropriate stocking rates and grazing plans

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
$1.56x10^{15}$ cfu/year	**Technical Assistance** – TSSWCB – AgriLife Extension – NRCS – SWCDs **Financial Assistance** – USDA CIG – CSP – RCPP – USDA-NRCS the EQIP – Conservation Stewardship Program – Regional Conservation Partnership Program – Agricultural Conservation Easement Program – EPA/TCEQ/TSSWCB 319(h) – USDA Sustainable Agriculture Research and Education – USDA-NIFA Farm Business Management and Benchmarking Program – USDA NIWQP – EPA EE Grants	An intensive education and outreach program is needed to broadly promote the adoption of BMPs through appropriate programs such as Lone Star Healthy Streams.	**Year 1** – Promote existing conservation programs – Develop 15 conservation plans in the LSAR watershed – Pursue funding for education programs and financial assistance **Year 2** – Continue promoting existing conservation programs – Develop an additional 15 conservation plans in the TMDL watershed – Secure funding for education campaign – Initiate education campaign	– Number of landowners contacted – Number of conservation plans developed – Number of educational materials developed – Number of educational programs delivered	**Years 1-3** – Develop 15 conservation plans in the LSAR watershed annually **Year 4** – Develop 15 additional conservation plans in the LSAR watershed **Year 5** – Develop 15 additional conservation plans in the LSAR watershed	TCEQ CRP and additional monitoring developed under Management Measure 8	– Local Stakeholders – AgriLife Extension – TSSWCB – NRCS – Karnes SWCD #343 – Goliad SWCD #352 – Wilson County SWCD #301

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
	– EPA Targeted Watershed Grants Program – NIFA Integrated Programs – USDA-NIFA Agricultural Food Research Initiative Competitive Fellowship Grant Programs		**Years 3-5** – Continue promoting existing conservation programs – Develop an additional 45 conservation plans in the TMDL watershed – Deliver education programs (6 total in years 3-5) – Assess overall strategy for implementation				

Management Measure 2

Remove and manage feral hogs.

Feral hogs have been identified as significant contributors of pollutants to surface water bodies. As feral hogs congregate around water resources to drink and wallow, the high concentration of feral hogs in riparian areas poses a threat to water quality. Fecal matter deposited directly in streams by feral hogs contributes bacteria and nutrients which pollute the state's water bodies. In addition, extensive rooting activities of groups of feral hogs can cause extreme erosion and soil loss. The destructive habits of feral hogs cause an estimated $52 million worth of agricultural crop and property damage each year in Texas. Also, it has been estimated that 60 to 70 percent of feral hogs would need to be removed annually to hold the population stable with no increase (Burns, 2011). Stakeholders in watersheds across the state, including the LSAR watershed, have recommended that efforts to control feral hogs be undertaken to reduce the population, limit the spread of these animals, and minimize their effects on water quality and the surrounding environment.

The purpose of this management measure is to manage the feral hog population in the TMDL watershed such that the current population does not increase. Without a significant removal of feral hogs from the watershed on an annual basis and sustained efforts to keep the population at a manageable level, water quality improvements may not be realized. Various control efforts are currently employed such as live trapping, shooting, hunting with dogs, aerial hunting, exclusion, and habitat management. The continuation and increased intensity of these practices, especially in priority areas, along with technical and financial assistance is needed to reach the overall goal of this I-Plan. Activities will be targeted towards priority areas where landowners should be contacted to discuss the economic savings of removing feral hogs, specific methods for doing so, and available programs that assist in feral hog removal.

To track progress of this management measure, the AgriLife Extension Feral Hog Reporting tool will be utilized in addition to other tracking techniques. Also, sightings of feral hogs are a notable indicator of the feral hog population. The reporting tool is an important instrument for identifying and controlling feral hog populations. The reporting tool can be found at <http://feralhogreports.tamu.edu/>.

SARA will work with AgriLife Extension to develop and host feral hog workshops that focus on teaching landowners, local governments, and government entities about feral hog biology, disease, regulations, and effective removal techniques. These programs will be offered in all of the counties that fall within SARA's jurisdiction.

SARA will also work with the USDA – Animal and Plant Health Inspection Service Wildlife Services and local landowners for active feral hog management. Under

this program, two Wildlife Service technicians were hired to work with landowners in SARA's jurisdiction, focusing on the education of feral hog removal techniques and the active removal of feral hogs.

Implementation for much of this management measure is dependent on available funding. Funding assistance will be needed for personnel, materials, and supplies for feral hog management activities and education.

Educational Component

Education and outreach for this management measure is needed to ensure that stakeholders understand the importance of feral hog removal and the economic savings that result from such removal. Some educational programs exist through AgriLife Extension and are discussed in the following description of responsible parties, but services offered by AgriLife Extension are statewide programs and funding for personnel is limited. Stakeholders would benefit greatly by receiving educational materials; therefore, a targeted campaign should be implemented consisting of multiple educational opportunities for stakeholders, including the development and tailoring of educational materials, and the dissemination of these materials. Additionally, an evaluation should be performed to gain an overall understanding of the economic losses faced by landowners and needs that exist for feral hog control services.

Priority Areas

Priority areas for this management measure are found where feral hogs have the highest potential for congregating based on land cover. The priority areas are the subwatersheds associated with the following AUs (Figure 4).

- AU 1901_05, from upstream end of segment to Escondido Creek;
- AU 1901_04, 9 miles downstream of Escondido Creek on San Antonio River;
- AU 1901_03, from 25 miles upstream of confluence with Manahuilla Creek to 9 miles downstream of confluence with Escondido Creek on San Antonio River;
- AU 1901_02, 25 miles upstream of confluence with Manahuilla Creek;
- AU 1901_01, 25 miles downstream of the confluence with Manahuilla Creek; and
- AU 1901_06, lower 31 miles of segment.

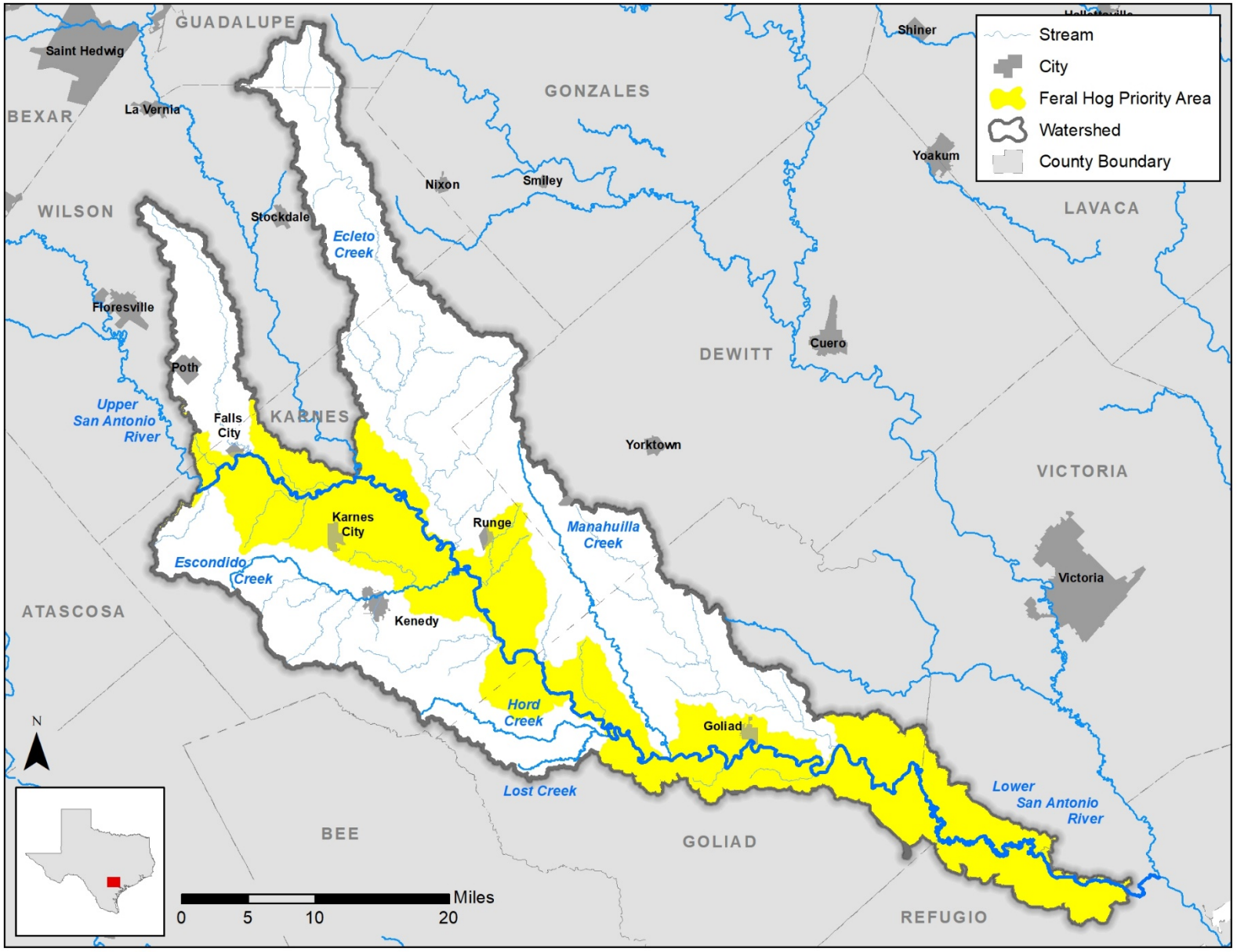

Figure 4. LSAR feral hog priority areas

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- **Stakeholders:**
  The LSAR watershed stakeholders will take advantage of services provided by SARA, Texas Wildlife Services (TWS), and AgriLife Extension by requesting feral hog management workshops for landowners, local governments, and other interested individuals as appropriate. Workshops will be heavily promoted in the AgriLife Extension newsletter, as well as in local newspapers and on radio stations. Management activities such as population control and exclusion measures can also be implemented by local governments as appropriate. If interest in workshops remains strong after the term of this I-Plan, AgriLife Extension will continue to arrange workshops throughout the TMDL watershed. Reports from the Texas Parks and Wildlife Department (TPWD) will be used to estimate the number of hogs killed based on the annual reports submitted to the department.

- **Texas A&M AgriLife Extension Service:**
  Funded with TSSWCB CWA Section 319(h) nonpoint source grants, AgriLife Extension and the TWRI developed the Lone Star Healthy Streams – Feral Hog curriculum. This education program is delivered statewide and serves as the foundation for educating landowners about the effect of feral hogs on bacteria loading in streams and also about control techniques designed to abate feral hogs and reduce their bacteria contributions.

  Concurrent with curriculum development, and with TSSWCB funding, AgriLife Extension has developed:

  - a series of publications addressing management strategies and techniques for feral hog control, and
  - an online feral hog activity reporting system to support identification of target areas for implementation of feral hog control activities, as mentioned above.

- **Texas Wildlife Services, Feral Hog Abatement Program:**
  With continuous efforts, feral hogs can be managed. TWS, through a cooperative agreement between AgriLife Extension and the USDA's Animal and Plant Health Inspection Service, provides statewide leadership in the science, education, and practice of wildlife and invasive species management (including feral hogs) to protect the state's agricultural, industrial, and natural resources, as well as the public's health, safety, and property (Texas Health and Safety Code Chapter 825).

Technical Assistance

TWS is available to provide assistance in addressing feral hog issues and will remain available to all citizens of the state. While direct control will be limited to availability of personnel in cooperative association areas (i.e., areas designated by groups of landowners to improve wildlife habitats and other associated wildlife programs), technical assistance can be provided to individuals on how to best resolve feral hog problems. Since 2008, the Texas Department of Agriculture (TDA) has awarded grants to TWS for feral hog abatement programs. The grants are used to carry out a number of specifically identified direct control projects where control efforts can be measured.

The TDA administers a County Hog Abatement Matching Program. The Program is designed to encourage counties across Texas to create partnerships with other counties, local governments, businesses, landowners, and associations to reduce feral hog populations and the damage caused by these animals in Texas.

County wildlife associations can assist landowners with educational outreach as well as technical guidance.

Financial Assistance

TWS, in addition to the assistance described above, anticipates that additional cooperative funding will be necessary to continue the focused feral hog control activities in the state.

Table 9 shows the estimated costs of removing 7,500 feral hogs from the TMDL watershed over a five-year period, or approximately 25% of the population, assuming the population remains relatively static. The number of feral hogs removed over this period of time was based on an assessment of the feasibility of implementing the aforementioned programs. Financial assistance can be pursued through TWS, TDA, and TSSWCB grants or other available opportunities.

Table 9. Estimated costs of Management Measure 2

Entity	Activities Needed	Estimated Costs
TWS AgriLife Extension Stakeholders SARA County wildlife associations USDA	Purchase additional feral hog control equipment	$5,000
	Formulate, maintain, and implement online tracking data management	$10,000
	Hunting and trapping	$15,000
	Regional trapper	$350,000
	Landowner voluntary aerial gunning events ($5,000 per event at 2 per year per county).	$70,000
AgriLife Extension and other educational entities	Feral Hog Workshops ($1,500 each at 1 annually)	$6,000

Measurable Milestones

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

- number of feral hogs removed from the watershed on an annual basis,
- number of education programs delivered,
- number of educational materials developed and disseminated, and
- number of individuals reached.

Progress Indicators

Progress indicators will consist of the following.

- Year 1 – a successful development and submittal of an education program proposal for feral hog management, a successful submittal of a proposal for local assistance, and the removal of 1,500 feral hogs from the TMDL watershed.
- Year 2 – funding secured for educational program, funding secured for local assistance, the education program initiated, and 1,500 feral hogs removed from the TMDL watershed.
- Years 3-4 – number of materials developed and disseminated, number of persons reached through education, and 3,000 additional feral hogs removed from the TMDL watershed.
- Year 5 – number of materials developed and disseminated, number of persons reached through education, and 1,500 additional feral hogs removed from the TMDL watershed.

Monitoring Component

Monitoring for this management measure will consist of utilizing the TCEQ CRP monitoring program, any expanded monitoring developed under Management Measure 8 of this I-Plan, and any expanded monitoring such as SARA Bacterial Source Tracking (BST).

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Year 1:

Responsible parties will, as funding allows:

- contact landowners in priority areas to discuss the economic savings of feral hog removal, the specific methods for doing so, and available programs that assist in feral hog removal;
- submit a proposal for both educational programs and local assistance; and
- continue existing methods of feral hog removal and report as appropriate.

Year 2:

Responsible parties will, as funding allows:

- secure funding for education and local assistance;
- begin developing and disseminating educational materials;
- begin providing assistance to landowners locally;
- continue contacting landowners in priority areas to discuss the economic savings of feral hog removal, specific methods for doing so, and available programs that assist in feral hog removal; and
- continue to remove feral hogs and report feral hog activity.

Years 3-4:

Responsible parties will, as funding allows:

- continue contacting landowners in priority areas to discuss the economic savings of feral hog removal, specific methods for doing so, and available programs that assist in feral hog removal;
- continue to disseminate educational materials;
- provide educational programs;
- continue providing local assistance;
- continue to remove feral hogs; and
- report feral hog removal and activity.

Year 5:

Responsible parties will, as funding allows:

- continue contacting landowners in priority areas to discuss the economic savings of feral hog removal, specific methods for doing so, and available programs that assist in feral hog removal;
- continue to disseminate educational materials;
- continue educational programs;
- continue providing local assistance;
- continue to remove feral hogs;
- report feral hog removal and activity; and
- assess strategy for the next phase of implementation.

Estimated Loading Reduction

The estimated load reduction for this management measure is 5.2×10^{13} cfu *E. coli* per year. See Appendix B for details.

Table 10. Management Measure 2: Remove and manage feral hogs

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
$5.2x10^{13}$ cfu/year	**Technical Assistance** – AgriLife Extension – TWS – TDA – SARA – USDA – TPWD – County wildlife associations **Financial Assistance** – TDA – TWS – TSSWCB 319 grants or other available opportunities	The AgriLife Extension Feral Hog Educational Program will provide multiple educational opportunities for stakeholders.	**Year 1** – Contact landowners – Submit proposals for educational programs and local assistance – Continue existing methods and report as appropriate **Year 2** – Secure funding for education and local assistance – Develop and disseminate educational materials – Begin providing assistance to landowners locally – Continue contacting landowners – Continue to remove feral hogs and report activity	– Number of feral hogs removed from the watershed on an annual basis – Number of education programs delivered – Number of individuals reached – Number of educational materials developed and disseminated	**Year 1** – Successful development and submittal of an educational program proposal for feral hog management – Successful submittal of a proposal for local assistance – Removal of 1,500 feral hogs from the TMDL watershed **Year 2** – Funding secured for educational program – Funding secured for local assistance – Educational program initiated – 1,500 feral hogs removed from the TMDL watershed	TCEQ CRP, and additional monitoring developed under Management Measure 8	– TWS Feral Hog Abatement Program – AgriLife Extension Stakeholders – SARA – County wildlife association – USDA – TPWD

			Years 3-4 – Continue contacting landowners – Continue to disseminate educational materials – Provide educational programs – Continue providing local assistance – Continue to remove feral hogs and report activity **Year 5** – Continue contacting landowners – Continue to disseminate educational materials – Provide educational programs – Continue providing local assistance – Continue removing feral hogs and reporting activity – Assess strategy for the next phase of implementation		**Years 3-4** – Number of materials developed and disseminated – Number of persons reached through education – 3,000 additional feral hogs removed from the TMDL watershed **Year 5** – Number of materials developed and disseminated – Number of persons reached through education – 1,500 additional feral hogs removed from the TMDL watershed.		

Management Measure 3

Identify, prioritize, and remediate OSSFs.

Failing OSSFs have been known to contribute to bacteria impairments in surface water bodies all over the state of Texas and the San Antonio River watersheds are no exception, with roughly 4,041 septic systems scattered throughout the LSAR watershed. In addition to the TCEQ, stakeholders in these watersheds have also identified OSSFs as a contributing factor; therefore, the purpose of this management measure is to improve the identification, inspection, pre-installation planning, education, operation, maintenance, and tracking of OSSFs in the watershed and to minimize potential negative water quality impacts from malfunctioning on-site systems.

Identifying OSSFs in the LSAR watershed is the first step in this process. Knowing the location of on-site systems will aid in the implementation efforts and will help achieve the goal of reducing *E. coli* loading to the LSAR. The initial step will be for responsible parties to collect geographic information system (GIS) information of known OSSFs in the watershed as well as known wastewater infrastructure information. This effort can be initiated using 911 address point files, Certificate of Convenience and Necessity (CCN) layers, and 2010 Census block data. Following this exercise, dwellings and other facilities not served by existing wastewater service providers can be identified and further investigated. As OSSFs are identified, they will be tracked using GIS to document pertinent information related to the installation, operation, maintenance, and performance history of the systems. This tracking system will establish the basis for identifying potential problem areas and aiding in prioritizing these areas for action.

Once identified, OSSFs will be inspected as time and funding allow. This process may be tied to a new request for a utility connection or the sale of a real estate property. Physical inspections are necessary to properly identify problematic OSSFs or clusters of failing OSSFs. The staff of Authorized Agents in the TMDL watershed available for inspections, typically county employees, also usually have many other obligations; therefore, these individuals have little, if any time, to perform systematic OSSF inspections. Additional funding is necessary to enable additional personnel to conduct these inspections. The inspections will provide critical input to the process of further refining priority areas of the watershed where repairs and replacements will be conducted first.

OSSF owners should be contacted to request permission to conduct inspections and also to provide the owners information regarding maintenance and replacements. These contacts will begin first in priority areas that have been identified (see Priority Areas section) and then will continue throughout the rest of the TMDL I-Plan watershed. Upon receiving permission to conduct an inspection, responsible parties, as funding allows, will conduct on-site

inspections and consult with the owner on methods for maintenance, repairs, and replacements, if the system is found to be failing. This process should continue throughout implementation of this I-Plan. It is estimated that funds will be needed to support additional personnel and to assist or incentivize septic system owners to repair or replace the OSSFs.

Educational Component

The level of general knowledge and understanding of operation and maintenance requirements for OSSFs is thought to be low throughout the TMDL I-Plan watershed. This deficiency in knowledge appears to apply not only to homeowners, but also to local authorities. Education and outreach for OSSFs is important in these watersheds and will be targeted to homeowners as well as local officials, as these officials have the ability to establish mechanisms that will mitigate pollution problems from OSSFs at community, county, watershed, and regional scales. Efforts must also be made to deliver educational materials on proper OSSF operation and maintenance to homeowners.

AgriLife Extension currently hosts education programs for homeowners about proper operation and maintenance requirements as well as providing an overview of general OSSF, collection and storage, pretreatment (and advanced pretreatment) components, disinfection, final treatment and dispersal, selection, and permitting. Information about this program can be found at <ossf.tamu.edu/>. As funding allows, this program will be delivered throughout the watershed to assist in meeting the educational requirements of implementing this plan.

Priority Areas

Priority areas for this management measure consist of the following (and are shown in Figure 5).

- City of Kenedy
- Karnes City
- City of Goliad

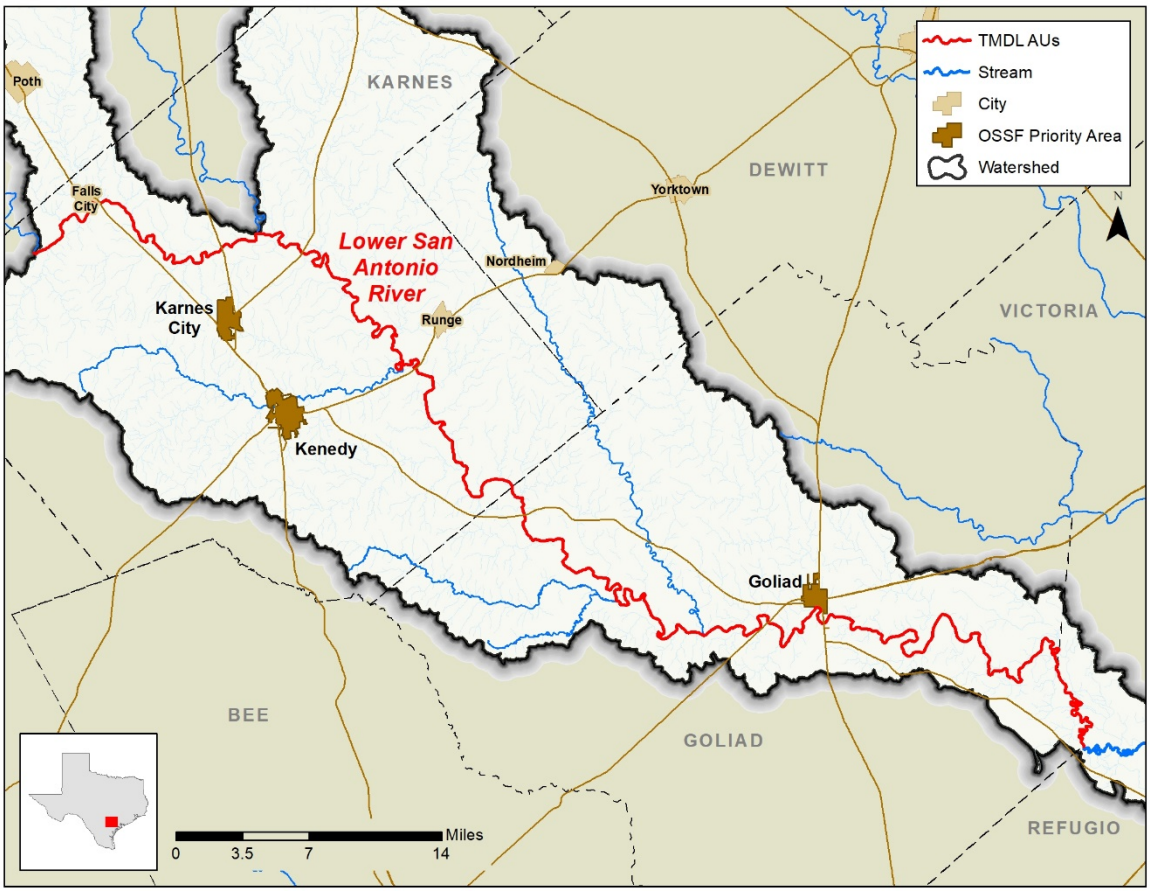

Figure 5. OSSF priority areas

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- **OSSF owners** will be responsible for making sure needed repairs or replacements are made on malfunctioning OSSFs as funding allows. Karnes and Goliad counties are Authorized Agents of the state and regulate OSSFs in their respective counties. Each county will be responsible for activities associated with this management measure within their respective jurisdictions.

Technical Assistance

TCEQ Regions 13 and 14 will, as resources are available, work to identify specific educational needs and help identify the technical and financial assistance needed to deliver these education programs locally. They will provide local governments with support and/or assistance in implementing activities covered in this management measure.

The TCEQ's Small Business and Local Government Assistance Program will provide, as resources are available, technical support to local governments to identify the best approach for addressing OSSF issues.

Financial Assistance

Table 11 shows the estimated costs of repairing or replacing malfunctioning OSSFs in the LSAR watershed. The estimates are based on the replacement of failing OSSFs, at an average cost of $8,000 per system. Additional funding is also needed, over a five-year period, for developing and implementing educational activities and programs designed to reduce and/or prevent OSSF failures in the TMDL watershed. Financial assistance can be pursued through TCEQ CWA Section 319(h) grants. The grants are competitive, however, and funding is dependent on Legislative appropriation.

Table 11. Estimated costs of Management Measure 3

Entity	Activities Needed	Estimated Costs
OSSF Owners TCEQ Authorized Agents Karnes and Goliad Counties	OSSF repair or replacement ($8,000 per system, six per year, for four years)	$192,000
Educational Entities	Educational and outreach events to: – Homeowners – Real estate companies	$75,000 ($35k for personnel, $25k educational materials, $15k for workshops)

Measurable Milestones

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

- number of OSSF owners contacted for inspections and/or outreach,
- number of OSSF inspections made,
- number of OSSF repairs or replacements, and
- number of educational materials developed and distributed.

Progress Indicators

Progress indicators for this management measure will consist of the following.

- Year 1 – develop and submit proposals to fund personnel to identify, inspect, and track OSSFs; and deliver one OSSF O&M workshop.

- Year 2 – 2 percent of OSSF owners contacted; inspection of 1 percent of all OSSFs in the TMDL watershed; repair or replacement of six failing OSSFs in the watershed; funding secured for additional inspection personnel and OSSF assistance/incentives and/or education programs;

initiation of educational programs; and maintenance of OSSF tracking system.

- Years 2-5 – 6 percent of OSSF owners contacted; inspection of 1 percent of all OSSFs in the watershed annually, in addition to those inspected in year 2; and repair or replacement of six failing OSSFs in the watershed each year.

Monitoring Component

Monitoring for this management measure will consist of utilizing TCEQ CRP monitoring and measuring bacteria loadings, especially in critical areas. Additional monitoring may be needed and should be developed under Management Measure 8 of this document.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Year 1:

As funding allows, responsible parties will:

- pursue funds for additional personnel, education, and OSSF repairs or replacements;
- identify and inspect OSSFs in close proximity to waterways;
- develop a single OSSF database that documents OSSF information;
- deliver OSSF O&M workshop;
- develop a tracking tool or update existing tracking tools for OSSFs; and
- begin contacting OSSF owners.

Years 2-5:

As funding allows, responsible parties will:

- secure funding for additional personnel, education, and OSSF replacements and repairs;
- initiate and continue educational programs;
- repair or replacement of OSSFs (six per year);
- continue tracking OSSFS;
- continue contacting OSSF owners; and
- inspect 1 percent of the estimated OSSFs in the LSAR watersheds each year (4 percent total over 4 years).

Estimated Load Reductions

Total load reductions from the replacement of failing OSSF systems depend on the amount of effluent discharged by the system and proximity of the system to

a water body. Assuming that six failing OSSFs are repaired or replaced annually for four years, the potential annual load reduction is 1.056×10^{13} cfu/year. See Appendix B for details.

Table 12. Management Measure 3: Identify, prioritize, and remediate OSSFs

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
$1.056x10^{13}$ cfu/year	**Technical Assistance** – TCEQ Regions 13 and 14 **Financial Assistance** – TCEQ CWA section 319(h) grants	AgriLife Extension workshops will provide OSSF O&M education for homeowners and elected officials.	**Year 1** – Pursue funds for additional personnel – Pursue funds for education – Pursue funds for OSSF repairs or replacements – Identify priority areas for inspections – Develop tracking tool – Begin contacting OSSF owners **Years 2-5** – Secure funding for additional personnel – Secure funding for education – Secure funding for OSSF repairs or replacements – Initiate educational programs – OSSF repairs or replacements – Continue tracking OSSF owners – Inspect 1% of estimated OSSFs each year	– Number of OSSF owners contacted – Number of OSSF inspections completed – Number of OSSFs repaired or replaced – Number of educational materials developed and distributed	**Year 1** – Develop and submit proposal to fund OSSF assistance and/or education programs – Development of a tracking system for OSSFs **Years 2-5** – 2% of OSSF owners contacted each year – 1% of OSSFs inspected each year – Secure funding for personnel and OSSF assistance and incentives – Initiation of education programs – Maintenance of OSSF tracking system – Six OSSFs replaced every year	– TCEQ CRP and additional monitoring developed under Management Measure 8	– OSSF Owners – City of Kenedy – Karnes City – City of Goliad – Karnes County – Goliad County

Management Measure 4

Coordinate efforts to reduce unauthorized discharges including SSOs; coordinate and expand efforts to reduce stormwater inflow and infiltration; reduce WWTF contributions by meeting half of the permitted bacteria limit; advocate for proper O&M of sewer lines.

This implementation measure focuses on reducing the amount of bacteria contributed by WWTFs to surface water in the TMDL I-Plan watershed. Currently, WWTFs are regulated under permits to discharge wastewater containing bacteria concentrations that do not exceed the surface water quality standard, which is 126 most probable number (MPN)/100 mL for *E. coli* for fresh water bodies. Keeping the concentration of bacteria in wastewater effluent below half of the permitted limits was part of the discussion at the various wastewater work group meetings and several of the WWTF operators considered adopting measures that would keep bacteria concentrations in the effluent of their facilities below half of the surface water quality standard for bacteria.

Through the implementation of this management measure, participating WWTFs will endeavor to keep bacteria concentrations in the effluent of their facilities below half of the surface water quality standard. In doing so, participating WWTFs will not exceed a bacteria concentration of 63 MPN/100mL for *E. coli* in their treated wastewater effluent. It should be noted that the adoption of half the permitted discharge limit is a voluntary measure undertaken by participating WWTFs.

In addition, participating WWTFs will begin televising wastewater lines with the assistance of SARA in order to identify issues with inflow and infiltration. This will also assist WWTFs to develop plans for proper O&M of sewer lines. WWTFs will also identify plant upgrades that need to be made at the treatment facility in order to reduce SSOs at the plant.

Educational Component

Education on WWTFs is needed for city personnel, as well as elected officials, for two reasons. First, it is important to educate elected officials, especially of non-participating jurisdictions, about the environmental and economic benefits of voluntarily reducing bacteria concentrations in treated wastewater effluent, so that better-informed fiscal decisions can be made at the local level. Second, it is important to educate WWTF operators and personnel about the capabilities of their respective WWTF systems and about methods and practices that can be adopted to maximize the treatment potential of each facility.

Priority Areas

Priority areas for this management measure will be all WWTFs within the LSAR watershed. The focus will be on those WWTFs located near the impaired water bodies, but should not be limited to just those facilities.

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- Falls City, City of Goliad, Karnes City, City of Kenedy, as well as the corporation of South Central Water Company will determine the feasibility of adopting the goal of keeping the concentration of bacteria in the wastewater discharge of WWTFs within their jurisdictions below half of the surface water quality standard. City of Runge, City of Nordheim, and City of Poth do not currently have discharge permits.

Technical Assistance

The Texas A&M Engineering Extension Service (TEEX) – This and other relevant organizations can provide technical assistance to the WWTF owners and operators in the LSAR watershed. TCEQ's Small Business and Local Government Assistance Program can also provide assistance, as resources are available, such as technical assistance to local governments for evaluating the capabilities and operating procedures of existing wastewater systems. TEEX provides education and training to wastewater operators and focuses training on optimizing treatment quality.

Financial Assistance

Existing local funding for improvements/upgrades may be used but it is likely that additional funds will be needed. There are no estimated costs for this management measure. Examples of potential funding sources include the following.

Texas Water Development Board (TWDB) Economically Distressed Areas Program (EDAP) – The EDAP provides financial assistance for water and wastewater infrastructure projects in economically distressed areas where water and wastewater services do not exist or systems do not meet minimum state standards.

USDA Rural Utilities Service – Water and Waste Disposal (RUS-WWD) – The RUS is amending its regulations related to 7 U.S. Code (U.S.C.) 1926(c) Section 306C of Consolidated Farm and Rural Development Act, WWD Loans and Grants Program, which provides water and waste disposal facilities and services to low-income rural communities whose residents face significant health risks. Specifically, RUS is modifying the priority points system in order to give additional priority points to colonias that lack access to water or waste disposal

systems and face significant health problems. The intent of the program is to ensure that the neediest areas receive funding.

EPA/TWDB Clean Water State Revolving Fund (CWSRF) – The CWSRF program provides low-interest loans for water and wastewater infrastructure projects that spread project costs over a repayment period of up to twenty years. Repayments are cycled back into the fund and used to pay for additional clean water projects.

Texas Department of Agriculture Community Development Block Grant (TxCDBG) Program for Rural Texas – The primary objective of the program is to develop viable communities by providing decent housing and suitable living environments, and expanding economic opportunities principally for persons of low-to-moderate income. Eligible applicants are non-entitlement cities under 50,000 in population, and non-entitlement counties that have a non-metropolitan population under 200,000 [and are not eligible for direct CDBG funding from U.S. Department of Housing and Urban Development (HUD)]. Applicants may apply for funding through any of the TxCDBG programs, and these funds can be used for water and wastewater improvements.

The Community Development Fund (CDF) – This is the largest fund category in the TxCDBG Program. This fund is available on a biennial basis for funding through a competition in each of the 24 state planning regions. Although most funds are used for public facilities (water/wastewater infrastructure, street and drainage improvements and housing activities), there are numerous other activities for which these funds may be used.

Measurable Milestones

Contingent upon the receipt of proposed project funding and feasibility of adoption, the measurable milestones are as follows:

- number of WWTFs that have adopted voluntary reductions in bacteria effluent concentrations to half of permitted bacteria limits,
- number of WWTFs that televise wastewater lines,
- number of WWTFs that upgrade facilities to minimize SSOs, and
- number of educational materials developed and delivered.

Progress Indicators

Progress indicators for this management measure consist of the following.

- Year 1 – work with TCEQ and TEEX to evaluate the possibility of meeting half the permitted amount of bacteria in treated effluent (progress will be measured on whether or not this option has been evaluated); grant proposals will be submitted to acquire the funding needed for education programs.

- Years 2 – SARA and WWTFs begin televising program and evaluating upgrades needed at the WWTFs to improve O&M of sewer lines and reduce SSOs.

- Years 3-5 – if WWTF owners determine that reaching treated effluent concentrations for bacteria that are half the Texas Surface Water Quality Standards concentration is feasible, their respective WWTFs will begin doing what is feasible to meet those goals; progress will also be measured by securing funds for relevant education programs and delivering education programs. WWTF will also see reductions in SSOs.

Monitoring Component

Monitoring for this management measure will occur at existing monitoring stations located downstream of the WWTFs, during TCEQ CRP monitoring. Additional monitoring may be needed and should be developed under Management Measure 8 of this document.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Year 1:

Responsible parties will:

- evaluate the option of treating bacteria in wastewater to half of the Texas Surface Water Quality Standards, and
- pursue funding for education programs.

Year 2:

Responsible parties will:

- televise wastewater lines
- identify WWTF upgrades needed

Years 3-5:

Responsible parties will:

- begin treating effluent wastewater to levels that are half of the Texas Surface Water Quality Standards bacteria concentrations (if feasible),
- initiate and deliver education programs (if funding is received), and
- reduce number of SSOs.

Estimated Load Reductions

Five WWTFs (Falls City, Karnes City, City of Kenedy, City of Goliad, and South Central Water Company) located in the LSAR watershed indicated that they would be willing to adopt the goal of treating bacteria in wastewater to levels that are half of the Texas Surface Water Quality Standard, which would result in

a reduction in the current loading of fecal bacteria into the LSAR. As a result, bacteria loading reductions were calculated and resulted in $2.88x10^{12}$ cfu/year, as shown in Appendix B.

Table 13. Management Measure 4: Coordinate efforts to reduce unauthorized discharges including SSOs; coordinate and expand efforts to reduce stormwater inflow and infiltration; reduce WWTF contributions by meeting half of the permitted bacteria limit; advocate for proper O&M of sewer lines

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
2.88×10^{12} cfu/year	**Technical Assistance** – TCEQ – TEEX **Financial Assistance** – TCEQ EDAP – USDA RUS-WWD loans and grants – EPA/TWDB CWSRF – TxCDBG	City personnel and elected officials will be educated on the reasons for voluntarily adopting reductions in effluent concentrations to half of permitted bacteria limits, and how to treat wastewater efficiently and identify noncompliance.	**Year 1** – Evaluate the option of treating effluent to meet half of permitted bacteria limits – Pursue funding for education programs **Year 2** – Televising of wastewater lines and identifying upgrades needed at WWTFs **Years 3-5** – Effluent will be treated to meet half the permitted limit for bacteria (if feasible) – Education programs will be developed and delivered (as funding allows)	– Number of WWTFs that have voluntarily adopted reductions of effluent bacteria concentrations to half of the permitted bacteria limits – Number of SSOs reduced over the years	**Year 1** – Ability to meet half the permitted bacteria limits in treated effluent evaluated – Pursued grant opportunities and/or education programs **Year 2** – Televised wastewater lines and identified upgrades at WWTFs; improved O&M of sewer lines **Years 3-5** – Treated effluent limits not exceeding half permitted effluent limits for bacteria – Developed and delivered education programs	TCEQ CRP and additional monitoring developed under Management Measure 8	– Falls City – City of Goliad – Karnes City – City of Kenedy – South Central Water Company – City of Runge – City of Nordheim – City of Poth – TCEQ – AgriLife Extension

Management Measure 5

Restore and repair riparian zones; emphasize protection of riparian zones; advocate for educational and outreach materials.

Changes in watershed hydrology and loss of vegetation in riparian zones has led to degradation of streams, including bank erosion, stream incision, and sediment accumulation. Appropriate management, protection, and restoration of riparian areas decrease bacteria and sediment loading to streams and rivers. A total of 460 stream miles have been assessed for stability and restoration potential by SARA throughout the San Antonio River basin. Out of the assessed miles, 49 percent of the streams were identified as warranting protection and preservation, 36 percent needing rehabilitation, and 14 percent needing a more intensive restoration. Rehabilitation and restoration efforts focus on creating a stable stream form which can safely convey both flow and sediment while at the same time establishing a protective riparian buffer zone. To accomplish this, structural and non-structural practices will be utilized to restore and protect the riparian zones.

To accomplish this goal, participating stakeholders will partner with local, state, and federal agencies to access the necessary technical and financial assistance in order to implement stream restoration projects in partnership with landowners. Outreach to landowners regarding best practices and potential restoration efforts will be conducted throughout the watershed with specific focus on the priority areas.

Educational Component

Education and outreach will be a key component needed to promote changes in practices and implementation of projects to restore and repair riparian zones. Existing programs, such as the Statewide Riparian and Stream Ecosystem Education Program, will continue to be delivered within the watershed in order to raise awareness of riparian processes and practices to protect riparian zones. Educational materials developed as part of SARA's "Be Watershed Wise" campaign will be maintained and utilized to promote awareness and adoption of best practices that protect and restore riparian areas. Another key educational item, SARA's *Creek Book*, will be utilized to increase awareness of the riparian zone's role in watershed health and safety.

Priority Areas

Education and outreach efforts will be implemented throughout the watershed in order to coordinate funding and technical assistance with receptive landowners for the implementation of best practices to protect riparian zones and restoration steps to repair riparian zones and prevent future erosion of the stream bed and banks. A map of these areas is shown in Figure 6.

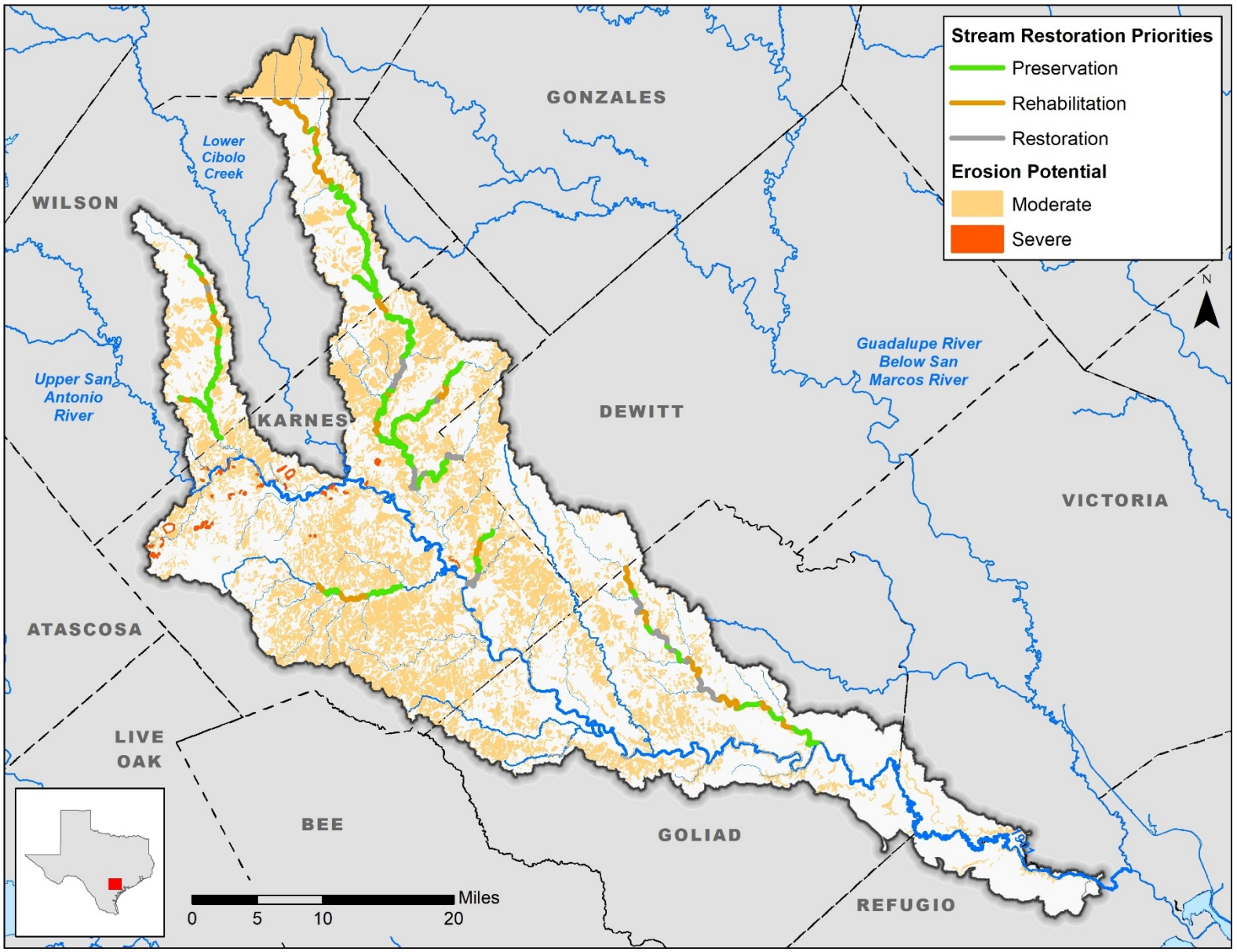

Figure 6. Stream restoration priority areas

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- **Local stakeholders and SWCDs** will evaluate options for implementing restoration practices through specific programs of their choice. If found feasible, the individual stakeholders will coordinate with the agencies listed below to develop and execute projects that protect, repair, and restore riparian zones.

Technical Assistance

Statewide Riparian and Stream Ecosystem Education Program

The Statewide Riparian and Stream Ecosystem Education Program is a partnership program that provides landowner education which increases knowledge of riparian function leading towards adoption of best practices to protect riparian zones and minimizes degradation of streams.

Texas Gulf Coast Stream and Wetland Initiative

The Resource Institute, with local participation from SARA, has received a grant through the RCPP to provide technical and programmatic assistance to landowners for the restoration of streams and wetlands on agricultural properties on the Texas Gulf Coast, including the LSAR watershed. The Resource Institute and SARA will conduct outreach to inform landowners of potential financial assistance available through the program and then assist the landowners in submitting an application, planning/designing, and constructing a restoration project.

Financial Assistance

The TSSWCB's WQMP Program – This program provides financial assistance to agricultural producers for developing management and conservation plans. The WQMP program is funded through state general revenue. It is anticipated that other sources of funding will be required to implement the activities associated with Management Measure 5; it should also be noted that TSSWCB's WQMP Program is dependent on continued appropriations from the Texas Legislature.

TSSWCB and local SWCDs (Karnes SWCD #343, Goliad SWCD #352, Wilson County SWCD #301), NRCS, and TPWD – These organizations will continue to provide appropriate levels of cost share assistance to agricultural producers that will facilitate the implementation of riparian protection BMPs and riparian restoration in the LSAR watersheds.

The RCPP – A new, comprehensive, and flexible program that uses partnerships to stretch and multiply conservation investments and reach conservation goals on a regional or watershed scale. Through the RCPP, USDA NRCS and state, local, and regional partners coordinate resources to help producers install and

maintain conservation activities in selected project areas. Partners leverage RCPP funding in project areas and report on the benefits achieved.

This I-Plan targets the adoption and implementation of a total of six conservation plans (with riparian restoration elements) and six education programs over a five-year period. Funding for implementation of the plans, either in the form of grants or through cost sharing incentives, is available through the agencies/entities listed under the descriptions provided previously in this section. The funding needed for education programs was estimated using an average cost of $50,000 per program, bringing the total cost to $600,000.

Measurable Milestones

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

- number of landowners contacted,
- number of conservation plans with riparian restoration elements identified, and
- number of education/outreach programs delivered and materials developed.

Progress Indicators

Progress indicators for this management measure will consist of the following.

- Year 1 – secure funding for an education campaign; initiate education campaign;
- Year 2 – host a landowner workshop through the Statewide Riparian and Stream Ecosystem Education Program;
- Years 3-5 – continue promoting existing conservation plans; develop two conservation plans each year in the LSAR watershed that implement BMPs designed to protect and restore riparian zones; deliver educational programs to encourage the adoption of conservation plans; and in year 5, develop two additional conservation plans in the LSAR watershed that implements BMPs designed to protect and restore riparian zones; assess progress and adjust strategy if necessary.

Monitoring Component

Monitoring for this management measure will consist of utilizing TCEQ CRP monitoring and measuring bacteria loadings.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Year 1:

As funding allows, the TSSWCB and local SWCDs (Karnes SWCD #343, Goliad SWCD #352, Wilson County SWCD #301), AgriLife Extension, and NRCS will:

- successfully secure funding for an educational campaign and initiate the campaign, and
- promote existing conservation programs throughout the LSAR watershed.

Year 2:

As funding allows, the TSSWCB and local SWCDs (Karnes SWCD #343, Goliad SWCD #352, Wilson County SWCD #301), AgriLife Extension, and NRCS will:

- continue promoting existing conservation programs.
- host a landowner workshop through the Statewide Riparian and Stream Ecosystem Education Program

Years 3-5:

As funding allows, responsible parties will:

- continue promoting existing conservation programs,
- develop two conservation plans per year in years 3-5 in the LSAR watershed,
- deliver educational programs in the watershed to encourage the adoption of conservation plans, and
- in year 5, assess overall progress (without quantifying load reductions) and, if necessary, modify existing efforts or develop a new strategy for implementation

Estimated Load Reductions

Load Reductions could not be calculated for this management measure.

Table 14. Management Measure 5: Restore and repair riparian zones; emphasize protection of riparian zones; advocate for educational and outreach materials

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
Load reduction could not be calculated for this measure	Technical Assistance – Statewide Riparian and Stream Ecosystem Education Program – The Resource Institute Financial Assistance – USDA-NRCS – RCPP – TSSWCB – SWCDs – TPWD	An intensive education and outreach program is needed to broadly promote the adoption of BMPs through appropriate programs such as the statewide Riparian and Stream Ecosystem Education Program.	**Year 1** – Secure funding for an educational campaign and initiate the campaign – Promote existing conservation programs throughout the LSAR watershed **Year 2** – Continue promoting existing conservation programs **Years 3-5** – Continue promoting existing conservation programs – Develop two conservation plans each year in LSAR – Deliver educational programs in the watershed to encourage the adoption of conservation plans – In year 5 assess overall progress without quantifying load reductions, and if necessary, modify existing efforts or develop a new strategy for implementation	– Number of landowners contacted – Number of conservation plans developed with riparian restoration elements – Number of education programs delivered and educational materials developed and distributed	**Years 1-2** – Secure funding and implement educational programs to outreach landowners **Years 3-5** – Develop conservation plans in the LSAR watershed	– TCEQ CRP – Additional monitoring developed under Management Measure 8	– Local Stakeholders – SARA – AgriLife Extension – TSSWCB – NRCS – Karnes SWCD #343 – Goliad SWCD #352 – Wilson County SWCD #301

Management Measure 6

Promote the improved quality and management of urban stormwater; coordinate with new development for reducing runoff pollutants; provide education programs on stormwater management; advocate for LID BMPs.

Bacteria sources, such as waste from pets, wildlife, and even humans, can be washed into storm drains and then discharged into local waterways. Because stormwater systems are designed to quickly and efficiently remove stormwater from developed areas, stormwater often bypasses the natural vegetative barriers that filter rainfall runoff over the land. Hence, bacteria loading may be more concentrated in stormwater than in other sources of streamflow. In the LSAR watershed, there are no large Phase I or small Phase II MS4 stormwater permits; therefore, urban stormwater is not regulated in the watershed. However, several local governmental entities in the watershed can make voluntary efforts to mitigate the effects of urban stormwater on water quality in the region. For example, the cities and counties can implement a Stormwater Management Plan that includes a sediment and erosion control plan as well as a public education program. Cities and counties can also provide information to developers on LID practices and structural stormwater BMPs.

Structural BMPs, such as modifications to stormwater outfalls designed to increase bacteria aeration, treatment by sunlight, or physical removal of contaminants, have the potential to reduce bacteria loading into waterways. Education and outreach regarding these BMPs may increase the likelihood of their adoption by local governments, leading to the development of local strategies to reduce bacteria loading in stormwater. Non-structural BMPs, such as municipal pet waste programs, though often rooted in local ordinances, also rely heavily on education and outreach for success. Therefore, education and outreach are a key short-term focus of this management measure; however, development of local strategies for adoption of urban BMPs is a long-term goal of Management Measure 6 and could result in potential pollutant loading reductions.

The long-term goal of this management measure is to decrease nonpoint source pollution from stormwater runoff in urban areas in the TMDL watershed, through the adoption of structural and non-structural urban BMPs and also through raising awareness among local residents about how urban stormwater impacts local water quality.

Educational Component

Targeting both homeowners and elected officials, educational and outreach programs will be delivered that highlight various practices designed to reduce the impact of stormwater on water quality; the programs will also be designed to help local governments develop strategies for reducing potential bacteria loadings to local water bodies from urban stormwater. Some local entities may

use this information and the technical and financial assistance provided by state and federal agencies to develop comprehensive urban stormwater assessments.

These programs will be implemented through a variety of methods including, but not limited to, public service announcements, utility bill inserts, other direct mailing, educational kiosks, and pet waste stations at parks and public environmental events (e.g., Earth Day Celebrations). These educational events will include seminars on LID and retrofitting strategies that can be implemented on existing stormwater structures or incorporated into the designs of new structures. These programs can lead to the selection of appropriate BMPs tailored to the specific needs of each municipality or CCN.

Priority Areas

Priority areas for this management measure consist of urban areas within the LSAR watershed. The focus should be on areas of the watersheds that discharge stormwater into or near the impaired AUs, but the effort should not be limited to those areas (Figure 7).

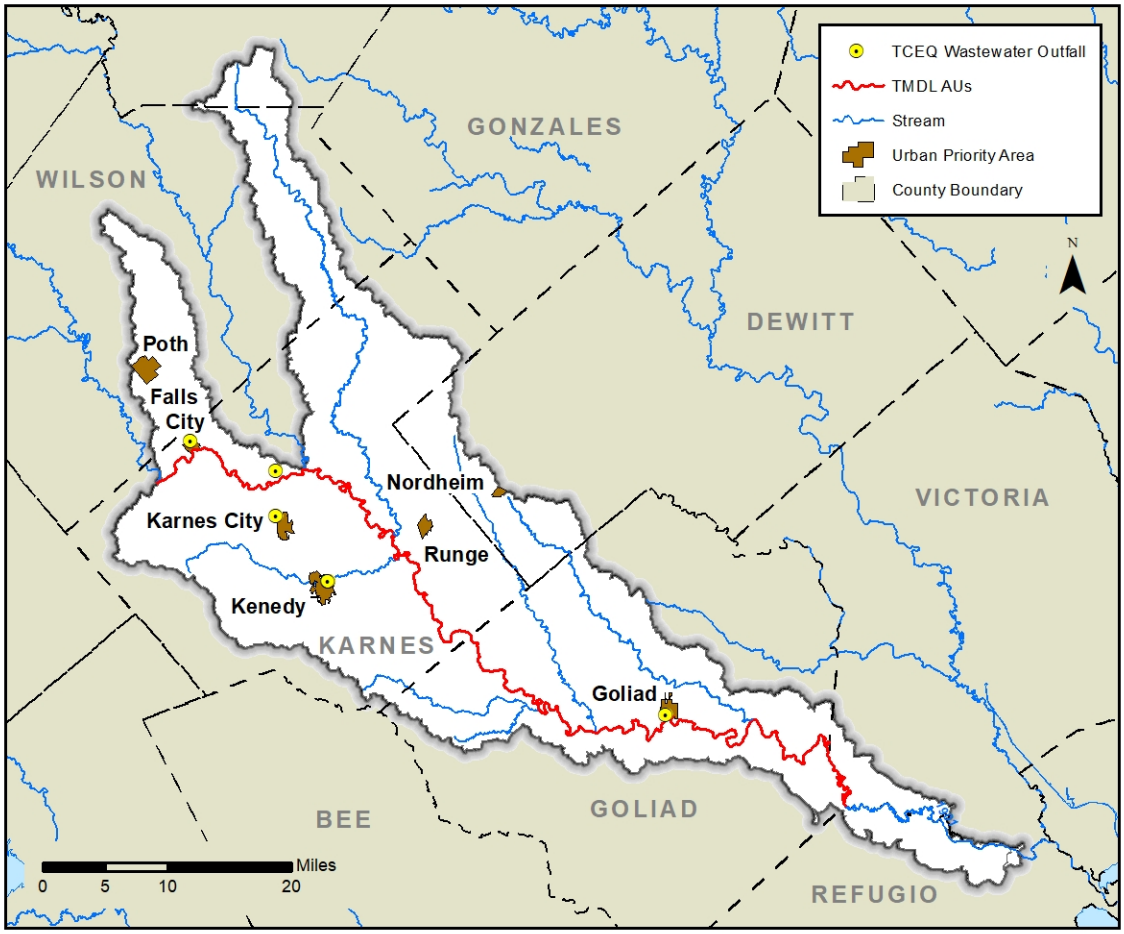

Figure 7. Urban priority areas

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- SARA, City of Kenedy, Karnes City, City of Goliad, Falls City, City of Runge, City of Poth, City of Nordheim, Wilson County, Karnes County, and Goliad County are responsible for pursuing funds to support educational activities and, once funds have been secured, the cities and service providers will conduct educational activities to raise awareness of the impacts of stormwater on local water quality. The cities and service providers will also identify locations for potential implementation of urban BMPs. An assessment will be completed with a comprehensive list of locations by county and, if found feasible, will prioritize and implement these BMPs. All entities will need to also coordinate closely with the Texas Department of Transportation (TxDOT) to identify connections with the larger storm drain systems in each of the counties.

Technical Assistance

SARA – Can provide workshops to the local entities, developers, and land owners on the design, construction, and maintenance of stormwater BMPs.

TCEQ Regions 13 and 14 – Will provide local governments with support and/or assistance in implementing activities covered in this management measure by providing general information on stormwater management, as resources are available.

Financial Assistance

EPA/TWDB CWSRF Program – The CWSRF program provides low-interest loans to local governments and service providers for infrastructure projects that include stormwater BMPs. The loans can spread project costs over a repayment period of up to twenty years. Repayments are cycled back into the fund and used to pay for additional projects.

CWA Section 319(h) NPS Grant Program – Local stakeholders should pursue funding for urban stormwater education and outreach and for urban BMP installation through the TCEQ's CWA Section 319(h) Grant Program.

EPA EE Grants – Under the EE 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, and/or disseminate environmental education practices, methods, or techniques as described in the EE Grant Program solicitation notices.

EPA Urban Water Small Grants Program – The objective of this program 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. In particular, 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.

Rebates and grants are also available from SARA for retrofitted and new constructed LID features.

Table 15 shows the estimated costs of implementing Management Measure 6. The estimates are based on:

1) conducting comprehensive stormwater assessments (one per county) over a five-year period, at a cost of $35,000 per assessment;
2) designing and submitting proposals for funding of BMP installations to cover 601 acres of urban land (1 proposal per CCN; $7,500 per design/proposal); and
3) conducting urban pollution workshops ($2,500 per workshop at 1 per CCN annually) over a five-year period.

Table 15. Estimated costs of Management Measure 6

Entity	Activities	Estimated Costs
Responsible Parties	Comprehensive urban stormwater assessment ($35,000 per assessment, for five counties)	$175,000
SARA, City of Kenedy, Karnes City, City of Goliad, Falls City, City of Runge, City of Poth, City of Nordheim, Wilson County, Karnes County, Goliad County, and Developers	Design and submittal of proposals for funding of BMP installation to cover 601 acres of urban land (one proposal per CCN; $7,500 per design/proposal for ten CCNs)	$75,000
Educational Entities	Urban pollution workshops ($2,500 per workshop at 1 per CCN annually)	$125,000

Measurable Milestones

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

- number of urban stormwater BMPs adopted,
- number of educational materials developed,

- number of comprehensive stormwater assessments developed, and
- number of individuals reached through educational activities.

Progress Indicators

Progress indicators for this management measure consist of the following.

- Year 1 – development and submittal of a grant proposal to fund urban stormwater education and planning; identified locations for potential urban BMP installation, if/where feasible.
- Year 2 – successfully secured funding for stormwater education and planning activities; initiation of education program for urban stormwater management development of education materials; initiation of BMP installation if/were feasible.
- Years 3-5 – continuation of educational and planning activities; number of contacts made through educational activities; completion of urban BMP installation in the LSAR watershed.

Monitoring Component

Monitoring for this management measure will consist of continuing TCEQ CRP monitoring at existing sites and an expanded monitoring program, if needed, developed under Management Measure 8 of this I-Plan.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Year 1:

As funding allows, responsible parties will:

- submit a proposal to fund urban stormwater education and planning
- identify the location of urban BMP installations
- host 10 urban pollution workshops

Year 2:

As funding allows, responsible parties will:

- secure funding for stormwater education and planning activities; initiate education programs for stormwater; develop educational materials and comprehensive stormwater assessments
- initiate the installation of BMPs, if/where feasible
- host 10 urban pollution workshops

Years 3-5:

As funding allows, responsible parties will:

- continue educational and planning activities
- complete urban BMP installation, if/where feasible
- host 10 urban pollution workshops per year

Estimated Load Reduction

A wide variety of BMPs are available to control and treat urban stormwater runoff. The actual load reduction achieved depends on the appropriateness of the BMP chosen, BMP design, site characteristics, and long term maintenance. The potential annual *E. coli* load reduction is estimated at 2.36×10^{13} cfu/year. See Appendix B for details.

Table 16. Management Measure 6: Promote the improved quality and management of stormwater; coordinate new development for reducing runoff pollutants; provide education programs on stormwater management; advocate for LID BMPs

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
$2.36x10^{13}$ cfu/year	**Technical Assistance** – TCEQ Regions 13 & 14 **Financial Assistance** – TCEQ CWA Section 319(h) grants – CWA State Revolving Funds – EPA EE Grants – EPA Urban Water Small Grants	This management measure includes education on the impacts of urban stormwater on bacteria loading to homeowners and elected officials via public service announcements, mailings, informational kiosks, and public events.	**Year 1** – Submit a proposal to fund urban stormwater education and planning – Identify the location of urban BMP installations – Host 10 urban pollution workshops **Year 2** – Secure funding for stormwater education and planning activities – Initiate education programs for stormwater – Develop educational materials and comprehensive stormwater assessments – Initiate the installation of BMPs if/where feasible. – Host 10 urban pollution workshops	– Number of urban stormwater BMPs adopted – Number of educational materials developed – Number of comprehensive stormwater assessments developed – Number of individuals reached through educational activities	**Year 1** – Development and submittal of a proposal to fund urban stormwater education and planning – Identified locations for potential urban BMP installations, if/where feasible **Year 2** – Secured funding for stormwater education and planning activities – Initiation of education program for urban stormwater management – Development of educational materials – Initiation of BMP installation, if/where feasible	– TCEQ CRP – Additional monitoring developed under Management Measure 8	– SARA – Falls City – Karnes City – City of Kenedy – City of Runge – City of Goliad – City of Nordheim – City of Poth – Wilson County – Karnes County – Goliad County

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
			Years 3-5 – Continue educational and planning activities – Complete urban BMP installation if/where feasible – Host 10 urban pollution workshops per year		**Years 3-5** – Continuation of educational and planning activities – Number of contacts made through educational activities – Completion of urban BMP installation in the LSAR watershed		

Management Measure 7

Promote the reduction of illicit dumping and proper disposal of wastes; utilize SARA's Environmental Investigators.

Due to oil and gas drilling activity associated with the Eagle Ford Shale, the population in the area of the LSAR watershed has increased substantially in recent years. A portion of the newly arrived population lives in portable buildings and recreational vehicles not connected to sewage systems. These portable homes contain portable bathrooms and as with any portable bathroom, there is a need to periodically dispose of the waste. Scattered throughout the area are disposal sites; however, there is often a fee for using these disposal facilities and as a result, the owners of the recreational vehicles sometimes dispose of their waste in or near local water bodies.

Illicit dumping has also been identified as a concern by the stakeholders. Trash, household items, waste, and animal carcasses have been known to be dumped into some local creeks, and during rain events, these items wash downstream onto neighboring lands.

Additionally, the LSAR watershed is a destination for many outdoor sportsmen. The prime natural habitat, large tracts of well managed land, and abundance of game animals make the area very attractive for hunters. A common practice for some that harvest game species in the watersheds is to dispose of the carcasses in low lying areas, away from well-traveled roads and prime recreational areas. Often, these areas are near local water bodies. Education on the proper disposal of animal carcasses is needed to reduce their disposal near local water bodies.

Challenges in enforcing illicit dumping include the lack of available personnel for education and enforcement, lack of equipment necessary to reduce dumping, lack of equipment available to monitor sites for enforcement, and other challenges unique to each specific area. The purpose of this management measure is to reduce the amount of illicit dumping occurring in and near local water bodies. Through various efforts, including education (for both local officials and residents), signage and cameras at water bodies, enforcement, and other efforts, illicit dumping in water bodies can be reduced. The responsible parties will develop a strategy to reduce illicit dumping and will implement the strategy in the LSAR watershed.

Educational Component

Education for both residents and local officials is important. Local officials need to understand the implications of illicit dumping and the strategies to reduce this local source of water pollution. A source of potential educational opportunities for local officials is the Texas Illegal Dumping Resource Center, which also provides continuing education units to individuals who are interested in receiving educational credits. Residents must also be educated, so

that the public understands the harmful effects of illicit dumping on local water bodies. Some possible methods of education could include, but are not limited to, signage at bridge crossings, educational inserts in water bills, and other methods designed to reach the population of interest. Additionally, there is a need for an educational campaign that informs recreational hunters and local landowners on the proper disposal of animal carcasses. Other targeted educational efforts should be conducted on the proper disposal of recreational vehicle waste. Educational materials can be developed and disseminated through a variety of resources including, but not limited to, feed stores, direct mailing, newspaper articles, magazine articles, and billboards.

Priority Areas

Specific priority areas for this management measure consist of bridge crossings within the respective jurisdictions of the responsible parties, as bridges tend to be a common site of illicit dumping. Furthermore, education about the proper disposal of animals and the dumping of waste from recreational vehicles should focus on areas where there is a high demand for hunting and high density of recreational vehicles.

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

The following counties and cities within these counties will be responsible for enforcing illicit dumping activities within their respective jurisdictions and for delivering educational programs:

- Karnes County
- Karnes City
- City of Kenedy
- City of Runge
- Goliad County
- City of Goliad
- Wilson County
- City of Poth
- Falls City
- City of Nordheim

Technical Assistance

AgriLife Extension County Extension Agents – Will assist in educational activities related to mitigation of illicit dumping and proper disposal of animal carcasses.

TCEQ Regions 13 and 14 – Will provide local governments with support for, and/or assistance with, efforts to mitigate illicit dumping in the TMDL watershed, as resources are available.

The TCEQ's Small Business and Local Government Assistance Program – Will provide technical assistance to local governments for developing the best approaches to reducing illicit dumping in the TMDL watershed, as resources are available.

SARA – Will assist with funding and coordinating educational workshops for local officials. SARA will also continue to fund Hazardous Household Waste pick-up events in each of the counties. SARA environmental investigators will be available for technical support for the local entities.

Financial Assistance

USDA Rural Utilities Service Water and Waste Disposal Loans and Grants – The USDA's RUS is amending its regulations related to WWD Loans and Grants Program (Section 306C of Consolidated Farm and Rural Development Act), which provides funding for WWD facilities and services for low-income rural communities whose residents face significant health risks. Specifically, RUS is modifying the priority points system in order to give additional priority points to colonias (low income, unincorporated rural communities in south Texas) that lack access to water or waste disposal systems and face significant health problems. The intent is to ensure that the neediest areas receive funding.

CWA Section 319(h) grant funds from TCEQ and/or TSSWCB – NPS grants can also be used to fund this Management Measure.

Table 17 shows the estimated costs of developing and implementing educational activities and programs designed to reduce illicit dumping by the target percentages over a five-year period.

Table 17. Estimated costs of Management Measure 7

Entity	Activities Needed	Estimated Costs
Responsible Parties: Cities, Counties, and SARA	Postage of three cameras and 30 signs at bridges, warning of fines for improper disposal	$48,000
Educational Entities	Outreach and Education	$115,000 (based on SARA spending $20k/year with 15% contingency, if they're doing the workshops)

Measurable Milestones

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

- number of complaints made to responsible parties,
- amount of illicitly dumped material removed from bridge crossings and illicit dump sites,
- number of cameras installed to deter illicit dumping,
- number of signs warning of fines for improper disposal,
- number of educational materials developed,
- number of workshops delivered, and
- number of educational materials disseminated.

Progress Indicators

Progress indicators for this management measure consist of the following.

- Year 1 – development and submittal of a grant proposal for additional personnel and educational programs, a 5 percent increase in the number of fines written for illicit dumping, and a 5 percent reduction in the number of reports/complaints to responsible parties;

- Year 2 – receipt of a grant award for additional personnel and an educational program; and an additional 5 percent reduction in the number of illicit dumping reports/complaints to responsible parties from the previous year;

- Years 3-4 – number of educational materials developed and disseminated; number of education programs delivered; number of warning signs posted; and an additional 5 percent annual reduction in the number of illicit dumping reports/complaints to responsible parties from the previous year; and

- Year 5 – number of educational materials developed and disseminated; number of education programs delivered; a 5 percent reduction in the number of illicit dumping reports/complaints to responsible parties from the previous year.

Monitoring Component

Monitoring for this management measure will consist of continuing TCEQ CRP monitoring at existing sites and an expanded monitoring program, if needed, developed under Management Measure 8 of this I-Plan.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Year 1:

As funding allows, responsible parties will:

- develop and submit a grant proposal in pursuit of funding for educational programs and additional personnel for illicit dumping mitigation activities;
- implement activities as resources allow; and
- increase the number of fines written by 5 percent in the first year of implementation, and reduce the number of reports of illicit dumping by 5 percent during each year of implementation.

Years 2-5:

- secure funding for additional personnel, education programs, and/or illicit dumping implementation activities; and
- initiate and implement educational program.

Estimated Load Reduction

A load reduction could not be calculated for this measure.

Table 18. Management Measure 7: Promote the reduction of illicit dumping and proper disposal of wastes; utilize SARA's Environmental Investigators

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
Load reduction could not be calculated for this measure	**Technical Assistance** – AgriLife Extension County Extension agents – TCEQ Regions 13 & 14 – TCEQ Small Business and Local Government Assistance **Financial Assistance** – USDA RUS WWD Loan and Grants – CWA 319 funds from TCEQ and/or TSSWCB	This management measure includes educating watershed residents and elected officials on illegal dumping, via the Texas Illegal Dumping Resource Center, but also possibly through other means, such as signage. It also includes educating local hunters on proper carcass disposal through education/ outreach programs and educational materials, such as pamphlets at local businesses.	**Year 1** – Develop and submit a grant proposal in pursuit of funding for educational programs, additional personnel, and activities associated with illicit dumping mitigation – Develop a strategy for how to best reduce illicit dumping – Implement activities as resources allow – Increase the number of fines written by 5% – Reduce the number of reports of illicit dumping by 5%	– Citations issued – Number of complaints made to responsible parties – Amount of pollution removed from bridge crossings and illicit dumping sites – Number of educational materials developed – Number of materials disseminated	**Year 1** – Development and submittal of a grant proposal for additional personnel and educational programs – A 5% increase in the number of fines written for illicit dumping – A 5% reduction in the number of reports/complaints to responsible parties **Year 2** – Awarded a grant for additional personnel and educational programs – A 5% reduction in the number of reports/complaints to responsible parties from the previous year.	– TCEQ CRP – Additional monitoring developed under Management Measure 8	– SARA – AgriLife Extension – TCEQ – Karnes County – Karnes City – City of Kenedy – City of Runge – Goliad County – City of Goliad – Wilson County – City of Poth – Falls City – City of Nordheim

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
			Years 2-5 – Secure funding for additional personnel, education programs, and/or illicit dumping implementation activities – Initiate and implement educational program		**Year 3-4** – Number of educational materials and programs developed and delivered – A 5% reduction in the number of reports/complaints to responsible parties from the previous year **Year 5** – Number of educational materials developed and disseminated – Number of education programs delivered – A 5% reduction in the number of reports/complaints to responsible parties from the previous year		

Management Measure 8

Coordinate and expand existing water quality monitoring in the watershed.

Maintaining a temporal and spatial surface water quality monitoring program in the watershed is a primary goal of the LSAR I-Plan work group. In support of the I-Plan, SARA will contribute water quality data to the I-Plan through its long-term monitoring programs. These programs currently incorporate 11 river and tributary water quality stations in the TMDL watershed. Data are used to identify trends and assess surface water quality compliance with the Texas Surface Water Quality Standards. Monitoring sites are evaluated annually, and based on analysis of data and resource availability, sites may be added or deleted. Five additional stations were added to the watershed monitoring schedule on September 1, 2017 (Figure 8). The five additional monitoring stations are on Cabeza Creek and will be used to assist the TCEQ in assigning an appropriate flow type classification for the water body (see Management Measure 9). In addition to surface water sampling, SARA also has a long-term instream stormwater monitoring program. This program has three automated stations in the Cibolo Creek watershed, a major tributary of the LSAR.

The overall purpose of this management measure is to develop a more refined understanding of the dynamics of bacteria loading in the LSAR watershed. Six AUs define the LSAR, Segment 1901. A map of the monitoring locations within the watershed is shown in Figure 8, and descriptions of the monitoring stations (from upstream to downstream) are shown in Table 19.

It should be noted the Guadalupe Blanco River Authority monitors Station 12790, San Antonio River FM 2506 east of Fannin. In addition, AU 1901_06 was not covered in the original TMDL. Additional AU and station information can be viewed at the CRP Coordinated Monitoring Schedule located at <https://cms.lcra.org/>.

Some stakeholders in the watershed have expressed concerns that Escondido Creek, a perennial tributary, is having a negative impact on the water quality of the LSAR. In response to these concerns, between November 2016 and April 2017, SARA conducted intensive sampling at 13 sites throughout the Escondido Creek watershed. Of the 13 sites, five were above the 126 cfu/100mL bacteria standard. BST was conducted on these five stations in an effort to identify possible bacteria loading sources and associated BMPs.

BST is an analysis employed to determine the specific origin of *E. coli* in the water column through a variety of methods. The two types of BST are library independent and library dependent. Library-dependent, a methodology that relies on in-field fecal sample collection from a given watershed to develop a reference library, was utilized in this study. BST results are presented in two formats: a three-way and seven-way split. The three-way split identifies isolates

as wildlife (e.g. opossum, feral hog, coyote, raccoon, etc.), livestock and domesticated animals (e.g. cattle, chicken, goat, etc.) or human, with a 100 percent rate of correct classification. As a result of the rate of correct classification, three-way results are the most robust and subsequently the most suitable for consideration in determining appropriate management measures.

Initial results from Escondido Creek show wildlife isolates as the most common, accounting for 50 percent of all isolates (Figure 9). Livestock and domesticated animals and human sources accounted for 30 percent and 7 percent respectively. The remaining 13 percent of isolates could not be identified with complete certainty and were subsequently reported as unidentified. Initial results from Escondido Creek are consistent with the larger dataset presented in Figure 10. These results are consistent with samples collected throughout the LSAR basin. LSAR sampling has been conducted since September 2013, resulting in a dataset of 406 isolates from ten locations (Figure 10). A map of the BST sampling locations on Escondido Creek is shown in Figure 11.

The data produced through SARA's monitoring programs will provide valuable information to state agencies and watershed stakeholders. This information will allow them to better manage local water resources and plan future improvements in water quality. Any additional monitoring projects identified will be conducted contingent upon the receipt of funding targeted specifically for additional water quality monitoring.

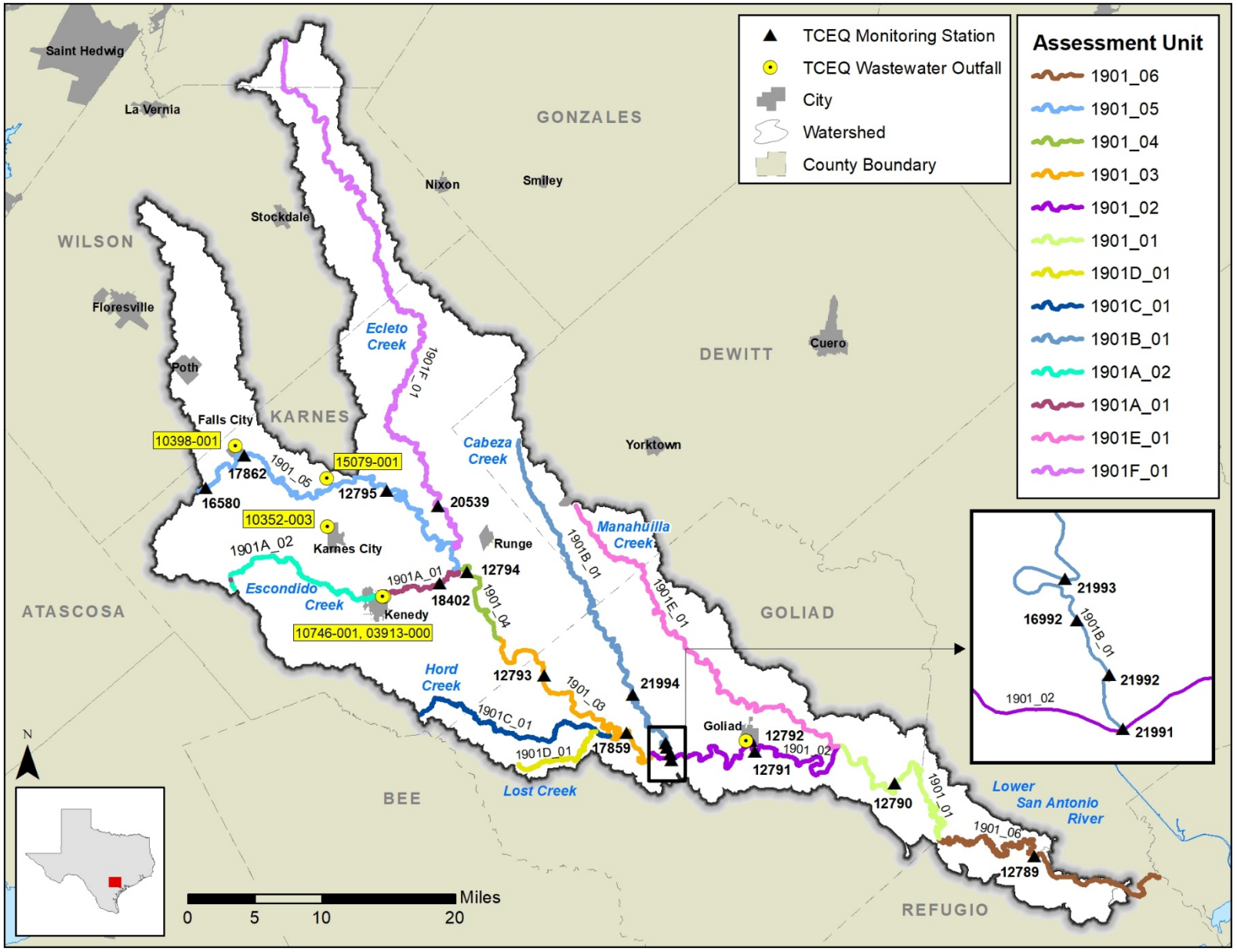

Figure 8. 2017-2018 San Antonio River monitoring locations within the I-Plan study area

Table 19. Monitoring station descriptions

Station Description	Station Number	Segment/AU
San Antonio River at US 77 on Refugio-Victoria County Line	12789	1901_06
San Antonio River FM 2506 east of Fannin	12790	1901_01
San Antonio River Bridge on US 77-A and 183 southeast of Goliad	12791	1901_02
San Antonio River at Southern Pacific Railroad Bridge in Goliad	12792	1901_02
San Antonio River at SH 239 west of Charco	12793	1901_03
San Antonio River at North Riverdale Road 15 km west of Goliad Texas	17859	1901_03
San Antonio River at SH 72 near Runge	12794	1901_04
San Antonio River at SH 80 southwest of Helena	12795	1901_05
San Antonio River at Conquista Crossing 2.4 km downstream of FM 791 southwest of Falls City	16580	1901_05
San Antonio River immediately upstream of US 181 0.5 km southeast of Falls City Texas	17862	1901_05
Escondido Creek at Karnes CR 331	18402	1901A_01
Cabeza Creek at FM 2043 1.6 km upstream of the San Antonio River Confluence 10.0 km west of Goliad Texas	16992	1901B_01
Cabeza Creek at San Antonio River Confluence approximately 1.74 km downstream of FM 2043	21991	1901B_01
Cabeza Creek approximately 1.86 km downstream of FM 2043	21992	1901B_01
Cabeza Creek approximately 2.05 km upstream of FM 2043	21993	1901B_01
Cabeza Creek at SH 239 in Goliad County	21994	1901B_01
Ecleto Creek at FM 81 424 meters east and 103 meters north to the intersection of Karnes CR 334 and FM 81	20539	1901F_01

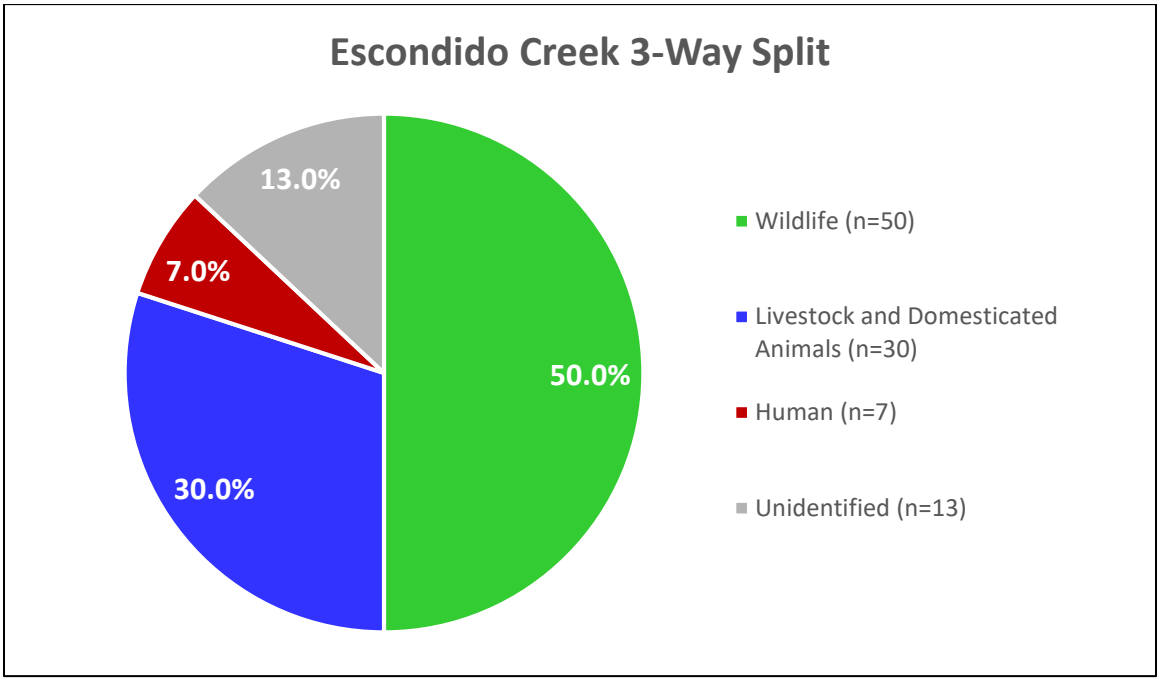

Figure 9. Source classification of *E. coli* isolates (n=100) from 10 samples, Escondido Creek

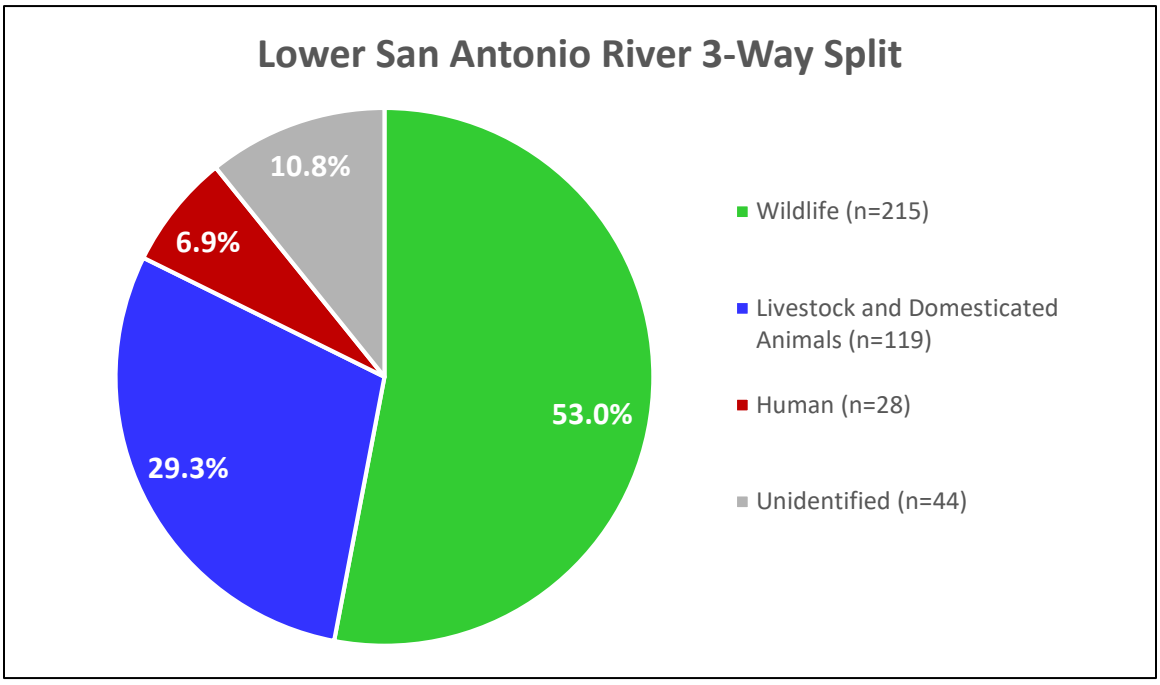

Figure 10. Source classification of *E. coli* isolates (n=100) from 10 samples, LSAR

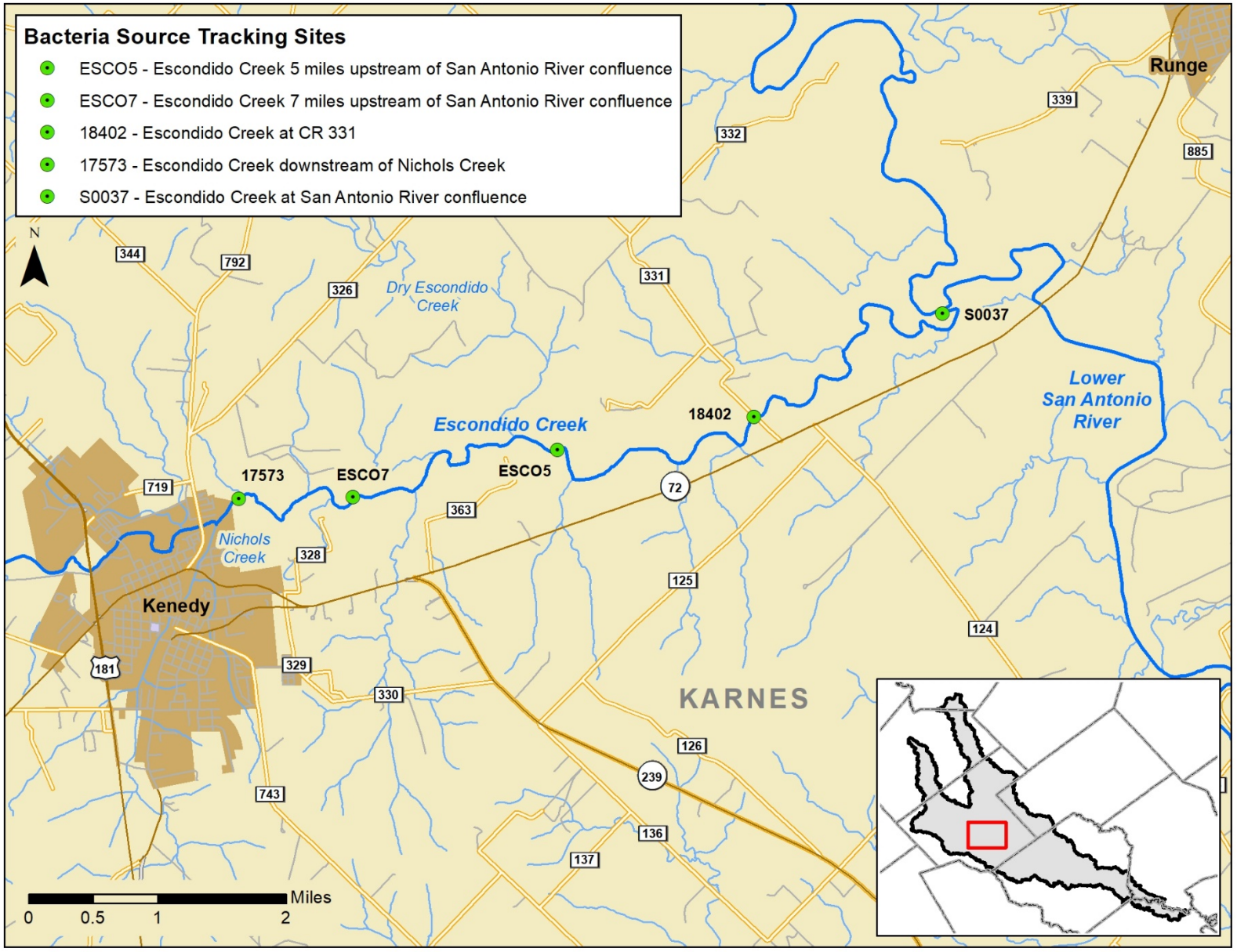

Figure 11. LSAR I-Plan BST site map

Educational Component

To help stakeholders access water quality data on the LSAR, a GIS water quality application is maintained on SARA's website located at <www.sara-tx.org>. Information on this page provides a visual display of the spatial data and associated information, including stations and station descriptions, all available water quality data and associated graphs, parameter criteria, and simple statistical parameter results. In addition to the website, stakeholders should be educated on the various types of monitoring, benefits of different monitoring frequencies, and identification of sites so that future projects or efforts can capture the effectiveness of the I-Plan.

Priority Areas

Priority areas for this management measure will be the impaired AUs of the LSAR and tributaries.

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- **Stakeholders**
  Local stakeholders will assist in determining and refining data and data quality objectives for future monitoring programs so that activities can be targeted in priority areas.

- **San Antonio River Authority**
  SARA will continue to monitor the LSAR watershed under the state's CRP and SARA Monitoring Programs, as funding allows.

- **TCEQ**
  The TCEQ's CRP will continue to support monitoring of the LSAR watershed.

Technical Assistance

SARA – Can provide monitoring services through TCEQ's CRP or through grant-funded projects, as funding allows. SARA can also provide technical assistance to other responsible parties.

The CRP – Can also provide further technical assistance in determining monitoring frequency and locations.

Financial Assistance

TCEQ and TSSWCB – The state's NPS funds may be used to provide additional monitoring in the LSAR watershed.

The SARA Stream Monitoring Programs – These programs may also be a source of funds to continue and to enhance monitoring efforts.

Measurable Milestones

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

- conducting an annual basin water quality monitoring program according to the established TCEQ-approved CRP quality assurance project plan (QAPP) and the Coordinated Monitoring Schedule located at the Lower Colorado River Authority (LCRA) site: <https://cms.lcra.org/Default2.aspx>;
- transferring routine water quality data to the TCEQ Surface Water Quality Monitoring Information System (SWQMIS) three times a calendar year;
- publishing an annual Basin Highlight Report that discusses water quality concerns affecting human health and aquatic health. Potential sources of pollution will be evaluated according to available water quality information;
- conducting the CRP Environmental Advisory Steering Committee to enhance stakeholder knowledge and involvement; and
- developing additional water quality monitoring projects and funding sources, as needed.

Progress Indicators

Progress indicators for this management measure consist of the following.

Years 1-5

- completion of annual water quality monitoring program, as funding and environmental conditions allow;
- acceptance of water quality data into SWQMIS;
- publication of an annual Basin Highlight Report; and
- completion of the annual CRP Steering Committee Meeting.

Monitoring Component

Monitoring for this management measure will occur at existing TCEQ CRP stations; however, monitoring projects can be developed under this management measure that may identify additional monitoring sites as needed.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Years 1-5:

- conduct SARA Monitoring Programs sampling and data submittal according to established QAPPs and Coordinated Monitoring Schedule located at <cms.lcra.org/Default2.aspx>; and
- develop QAPPs for additional projects, as needed.

Estimated Load Reduction

A load reduction was not calculated for the measure.

Table 20. Management Measure 8: Coordinate and expand existing water quality monitoring in the watershed

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
Load reduction could not be calculated for this measure	**Technical Assistance** – SARA – TCEQ – Local Stakeholders **Financial Assistance** – TCEQ and TSSWCB-CWA Section 319(h) NPS fund programs – SARA Stream Monitoring Program	This management measure includes educating stakeholders about ongoing water quality monitoring, TCEQ Integrated Reports, and how to access water quality data on SARA's website.	**Years 1-5** – Conduct annual basin water quality monitoring program according to the established TCEQ-approved CRP QAPP and the Coordinated Monitoring Schedule – Transfer routine water quality data to the SWQMIS three times per calendar year – Develop QAPPs for additional projects, as needed – Publish annual Basin Highlight Report that discusses water quality concerns affecting human health and aquatic health. Potential sources of pollution will be evaluated according to available water quality information – Develop additional water quality monitoring projects and funding sources, as needed	Quarterly CRP Progress Reports	– Completed annual water quality monitoring program (if funding and environmental conditions allow) – Acceptance of water quality data into SWQMIS – Publication of annual Basin Highlight Report	– TCEQ CRP – SARA Stream Monitoring Programs – Any additional monitoring developed under Management Measure 9	– SARA – TCEQ CRP – Stakeholders

Management Measure 9

Re-designate Cabeza Creek.

Cabeza Creek is a tributary to the San Antonio River that joins with the main stem approximately 10 km west of Goliad, Texas, in Goliad County. The 2014 Texas Integrated Report describes Cabeza Creek as an intermittent water body with perennial pools. Data assessed in the 2014 Integrated Report showed a bacterial geomean of 552 cfu/100 mL, significantly higher than the 126 cfu/100 mL standard, resulting in a bacterial impairment for the segment.

According to the USGS National Hydrography Dataset, Cabeza Creek is more than 50 km long and starts approximately 16 km west of Yorktown, Texas, in Dewitt County. However, stakeholders expressed concerns that there are not perennial pools throughout the creek and the impairment inaccurately represented the extent of impaired waters. The station where bacterial samples were collected is approximately 1.6 km upstream of the LSAR confluence, and records indicate a lack of perennial flow even at this point. The purpose of this management measure is to accurately describe the flow type of the water body and identify if a break in flow type exists.

Sampling will be conducted between September 1, 2017 and August 31, 2018 at five stations (see Table 21 in Priority Areas for station descriptions). Each sampling effort will consist of field observations (e.g. current weather, observed recreation uses, wildlife or domesticated animal presence/absence, flow severity, etc.) and, if possible, an instream flow measurement. Sampling will take place every other month, resulting in six samples at each station in fiscal year 2018. Once the data set has been completed, SARA will share the results with the TCEQ, who will then determine if additional sampling is needed to accurately evaluate the flow type. The TCEQ Water Quality Standards (WQS) Team and Clean Rivers Program are aware of this effort.

Educational Component

Stakeholder input has been vital in moving this management measure forward and, it is vital that they are kept up to date on the status of the re-designation effort. In order to make this data, as well as all data gathered by SARA, available to the public, a GIS application is maintained on the SARA website and can be viewed at: <www.sara-tx.org/environmental-science/water-quality-data/>.

Priority Areas

Priority areas for this management measure are the five sampling stations shown in Figure 12 and described in Table 21; all stations are located in Goliad County.

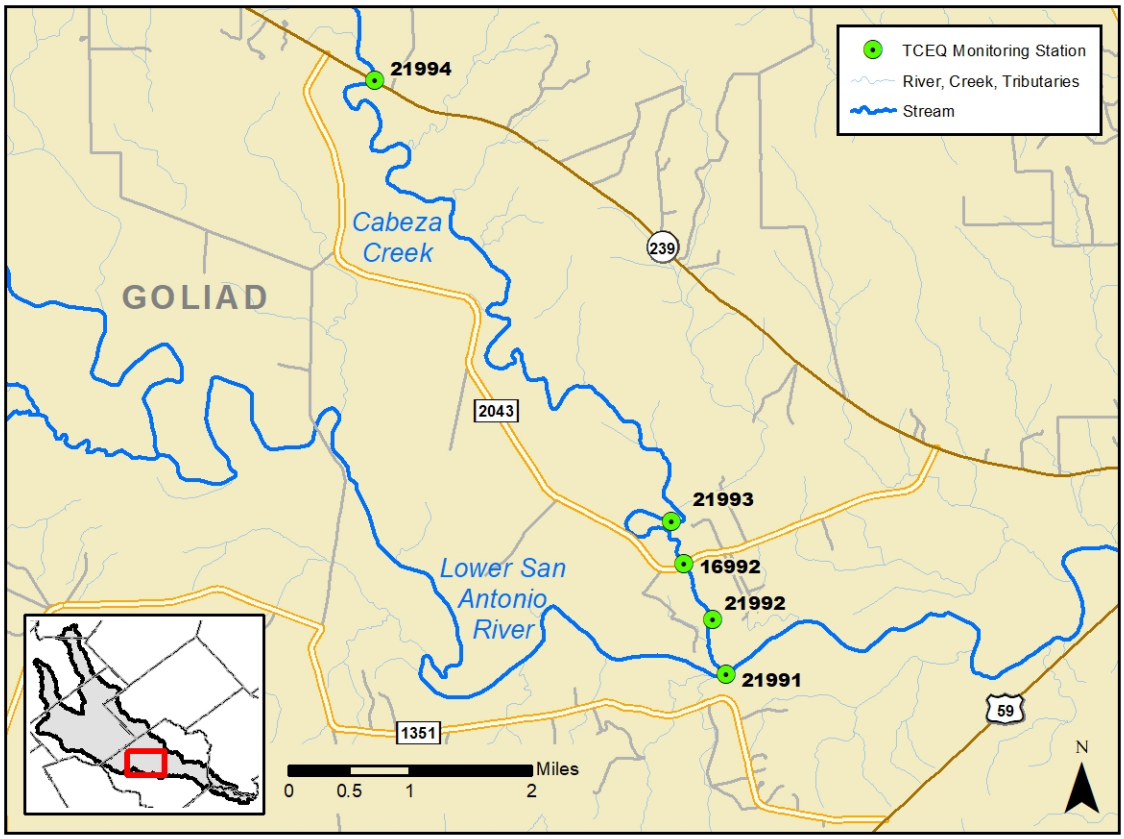

Figure 12. Cabeza Creek monitoring locations

Table 21. Monitoring location descriptions for Cabeza Creek

Station ID	Station Description	Latitude	Longitude
TCEQ_21991	Cabeza Creek at San Antonio River confluence approximately 1.6 km downstream from FM 2043	28.641910	-97.487847
TCEQ_21992	Cabeza Creek approximately 0.86 km downstream from FM 2043	28.648462	-97.489546
TCEQ_16992	Cabeza Creek at FM 2043 1.6 km upstream of San Antonio River	28.655138	-97.493360
TCEQ_21993	Cabeza Creek approximately 2.05 km upstream of FM 2043	28.660197	-97.494922
TCEQ_21994	Cabeza Creek at SH 939 in Goliad County	28.713240	-97.534410

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- SARA
- TCEQ

All field sampling will be conducted by staff from the Environmental Sciences Department at SARA. Once year one sampling is completed, SARA will summarize and submit data to the TCEQ CRP team. The TCEQ WQS team will then determine if adequate data to accurately assess the flow type of Cabeza Creek have been collected. If it is determined that additional data are needed, SARA staff will conduct an additional year of sampling. The final decision on the flow type of Cabeza Creek lies with the TCEQ.

Funding

Existing TCEQ CRP funding will be leveraged to complete re-designation sampling; SARA Stream Monitoring funds will supplement state funding as necessary.

Measurable Milestones

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

- number of sampling events conducted
- regulatory decision on flow status of Cabeza Creek

Progress Indicators

Progress Indicators will consist of the following.

- Year 1 – six field sampling events conducted by SARA in TCEQ fiscal year 2018 at five stations, submittal of data to CRP/WQS team and decision on inclusion of additional Cabeza Creek sampling in 2019 San Antonio River Coordinated Monitoring Schedule

- Years 2-3 – additional sampling (if deemed necessary) and decision on flow status of Cabeza Creek

Monitoring Component

Monitoring for this management measure will consist of field and flow observations/measurements under the TCEQ CRP monitoring program.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Year 1:

- SARA staff will conduct six field and flow sampling events at five stations
- Data will be submitted to the TCEQ CRP
- TCEQ will decide if additional field and flow sampling is necessary

Year 2:

- SARA staff will conduct six field and flow sampling events at five stations if deemed necessary by the TCEQ WQS Team.

Estimated Load Reduction

A load reduction was not calculated for the measure.

Table 22. Management Measure 9: Re-designate Cabeza Creek

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
Load reduction could not be calculated for this measure	**Technical Assistance** – SARA – TCEQ CRP **Financial Assistance** – SARA – Stream monitoring – TCEQ – CRP contract	Stakeholders will be informed about the status of this measure through the water quality GIS application hosted on the SARA website.	**Year 1** – SARA staff will conduct six field and flow sampling events at five stations – Data will be submitted to the TCEQ CRP – TCEQ WQS will decide if additional field and flow sampling is necessary **Year 2** – SARA staff will conduct six field and flow sampling events at five stations if deemed necessary by the TCEQ WQS group	– Routine sampling will occur every other month beginning in September 2017 – Data will be routinely uploaded to the online GIS application to allow for stakeholder access to the data	**Year 1** – Delivery of data to the TCEQ CRP group **Year 2** – Delivery of data to the TCEQ CRP/WQS group if additional sampling is conducted	Monitoring will occur at five TCEQ stations: – One previously established (TCEQ_16992) – TCEQ_21991 – TCEQ_21992 – TCEQ_21993 – TCEQ_21994	– SARA – TCEQ – CRP – TCEQ – WQS

Control Action 1

Improve monitoring of WWTF effluent to ensure permit compliance.

In November 2009, the TCEQ commissioners approved Rule Project No. 2009-005-309-PR. This rule requires the addition of bacteria limits for all TPDES domestic permits. The rule places *E. coli* discharge limits for wastewater discharged to freshwater and Enterococcus for wastewater discharged into saltwater. According to the rule, the bacteria limits are to be included in the permit during the permittee's next permit amendment or renewal. This rule is defined in Title 30, Texas Administrative Code, Chapter 309 and the frequency of testing is defined in Chapter 319.

Through this control action, each permit holder will continue to monitor for *E. coli* or Enterococcus concentrations in WWTF effluent as required by individual WWTF permits and any subsequent permit amendments or revisions. Each permit specifically outlines the effluent constituents that require monitoring as well as the monitoring frequency to which the permittee must adhere. If the permit does not specify a sampling frequency for bacteria, the permittee should begin sampling no less than once per quarter. The TCEQ reviews and documents compliance with individual permits. WWTF permits must be renewed by the permittee every five years.

Currently, there are five regulated WWTFs in the LSAR watershed; all are required to monitor for *E. coli*. Table 23 provides information regarding current bacteria targets and other parameter limitations for each individual WWTF.

Educational Component

The bulk of the educational needs related to this control action consist of training WWTF staff to properly collect and handle samples of treated effluent to get the most accurate analytical results possible. Additionally, elected officials should be educated about the importance of monitoring treated effluent and the potential impacts of permit noncompliance.

Priority Areas

Priority areas for this control action consist of the location of each WWTF and its respective outfall, but especially those WWTFs that discharge into or near the impaired water bodies, which include all facilities listed in Table 23.

Table 23. WWTF discharges

WWTF	Flow, MGD	BOD (mg, 5-day)	CBOD (mg, 5-day)	TSS Daily Average mg/L (lbs/day)	Ammonia Nitrogen (mg)	*E. coli*, cfu or MPN/100 mL Target[1]	pH[2]	Dissolved Oxygen mg/L
Falls City	0.0650	30	NA	90	NA	63	NLT 6.0 NGT 9.0	4.0
City of Goliad	0.3500	20	NA	20	NA	63	NLT 6.0 NGT 9.0	5.0
Karnes City	0.5020	NA	10	15	3	63	NLT 6.0 NGT 9.0	4.0
City of Kenedy	2.0000	NA	10	15	3	63	NLT 6.0 NGT 9.0	4.0
South Central Water Company	0.0125	10	NA	15	12	63	NLT 6.0 NGT 9.0	4.0

[1]These targets are voluntary and do not reflect the permitted *E. coli* values, nor the WLAs for these facilities.

[2] NLT = no less than; NGT = no greater than

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

The responsible parties for this control action are the owners and operators of WWTFs discharging treated wastewater to water bodies in the TMDL watershed, including Falls City, Karnes City, City of Kenedy, South Central Water Company, and City of Goliad. They will be responsible for maintaining compliance with the monitoring requirements specified in their respective TPDES permits.

Technical Assistance

TCEQ – Is responsible for monitoring permit compliance and enforcement and can also provide technical assistance to the WWTF owners and operators through the TCEQ's Small Business and Local Government Assistance Program as resources are available.

TEEX – Offers a Water and Wastewater Technical Assistance Program for small wastewater systems within the state. The program provides technical assistance and training to small wastewater systems to help correct operational problems common to small WWTFs. One-on-one technical assistance is available for these small wastewater systems to determine the causes of common performance problems and to ensure that the small wastewater systems are operating within permit requirements and in compliance with effluent limits.

Texas Rural Water Association (TRWA) – Has two wastewater training and technical assistance providers who assist wastewater system operators across the state. They provide training workshops across the state that include topics like wastewater operations and maintenance, testing procedures, rule updates, facility management, security, and other topics, as needed or requested, that relate to WWTF operations. TRWA staff also provide on-site technical assistance to non-profit wastewater systems, districts, and small cities with populations of less than 10,000. This technical assistance deals with operations, maintenance, collection systems, treatment facilities, rates, system management, rule changes, state laws, and other topics or issues that affect small wastewater systems.

Private firms – Offer on-site training to their customers as part of their water and wastewater treatment services. This is accomplished through hands-on instruction and seminars on basic water treatment practices and procedures-control testing, and the safe handling of chemicals.

Financial Assistance

TWDB EDAP - This program provides financial assistance to fund water and wastewater services in economically distressed areas, where services do not exist, or where these services do not meet minimum state standards.

USDA RUS-WWD Loans and Grants – The RUS is amending its regulations related to 7 U.S.C. 1926(c) Section 306C, WWD Loans and Grants Program, which funds construction of WWD facilities and services in low-income rural communities whose residents face significant health risks. Specifically, RUS is modifying the priority points system in order to give additional priority points to the colonias that lack access to water or waste disposal systems and that face significant health problems. The intent is to ensure that the neediest areas receive funding.

EPA/TWDB CWSRF – The CWSRF program provides low-interest loans for water and wastewater infrastructure projects that spread project costs over a repayment period of up to twenty years. Repayments are cycled back into the fund and are used to pay for additional clean water projects.

TxCDBG Program for Rural Texas – The primary objective of this program is to develop viable communities by providing decent housing and suitable living environments, and expanding economic opportunities principally for persons of

low-to-moderate income. Eligible applicants are non-entitlement cities under 50,000 in population and non-entitlement counties have a non-metropolitan population under 200,000 and are not eligible for direct CDBG funding from HUD may apply for funding through any of the TxCDBG programs. Funds can be used for water and wastewater improvements.

CDF – This is the largest fund category in the TxCDBG Program. This fund is available on a biennial basis for funding through a competition in each of the 24 state planning regions. The scoring of the applications is shared between the state and the 24 Regional Review Committees (RRCs), with the RRC having the predominate percentage of the total possible score. Although most funds are used for public facilities (water/wastewater infrastructure, street and drainage improvements and housing activities), there are numerous other activities for which these funds may be used.

Table 24 shows the estimated costs of providing education programs designed to train WWTF staff to properly collect and handle samples of treated effluent to get the most accurate analytical results possible. Additional education efforts include programs designed to educate elected officials about the importance of monitoring treated effluent and the potential impacts of permit noncompliance.

Table 24. Estimated costs of Control Action 1

Entity	Activities Needed	Estimated Costs
– Education providers – WWTF owners/operators – TEEX – TRWA	– Education for city personnel – Education for city officials – At least 1 event annually for the entire watershed	$25,000

Measurable Milestones

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

- number of scheduled WWTF sampling events not reported quarterly and/or annually, with the goal of reducing this number

Progress Indicators

- Year 1 – 5 percent reduction in the number of sampling events not reported,
- Year 2 – an additional 5 percent reduction in non-reported sampling events from previous year,
- Year 3 – an additional 5 percent reduction in non-reported sampling events from previous year,
- Year 4 – an additional 5 percent reduction in non-reported sampling events from previous year, and

- Year 5 – an additional 5 percent reduction in non-reported sampling events from previous year.

Monitoring Component

To ensure instream compliance with the standards for this management measure, TCEQ CRP monitoring stations will be utilized for measuring bacteria concentrations, especially in critical areas. Any monitoring completed by the facilities and shared with the TCEQ and SARA will also be utilized. Additional special monitoring may be needed and can be developed under Management Measure 8 of this document.

Implementation Schedule

All WWTF permittees will monitor effluent quality according to their permit requirements and will report monitoring results appropriately throughout the term of this implementation plan and beyond. Progress indicators will be tracked by the individual permittees and communicated to stakeholders annually.

Estimated Load Reduction

A load reduction was not calculated for the measure.

Table 25. Control Action 1: Improve monitoring of WWTF effluent to ensure permit compliance

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
Load reduction could not be calculated for this measure	**Technical Assistance** – TCEQ Permit Compliance assistance – TEEX-WWTF operation and maintenance – TRWA – sampling collection and handling – Private engineering firms **Financial Assistance** – TWDB EDAP – USDA RUS WWD Loans and Grants – TxCDBG – EPA/TWDB CWSRF	This control action includes training WWTF staff on proper effluent sampling, and educating elected officials on the importance of effluent monitoring.	Monitoring according to permit requirements	– Reducing the number of scheduled monitoring events not reported quarterly and annually	Annual 5% reductions in non-reported monitoring	TCEQ CRP	– Falls City – Karnes City – City of Kenedy – City of Goliad – South Central Water Company

Control Action 2

Improve and upgrade WWTFs.

All WWTFs in the LSAR watershed collect wastewater from small urban areas and treat the wastewater prior to discharging it into one of several receiving water bodies in the watershed. WWTF operators in the TMDL watershed recognize the importance of treating wastewater effluent to eliminate bacteria and are aware of recent changes to permit requirements. Some investments have already been made in improving WWTFs to treat bacteria.

The purpose of this management measure is to update WWTFs that are not currently treating their effluent to the lowest bacteria levels possible, so that bacteria treatment is optimized for each facility, as appropriate. Further, those WWTFs in the TMDL I-Plan watershed that currently treat bacteria to acceptable levels may need to improve/upgrade their treatment process to accommodate population growth, and to more efficiently treat effluent and reduce periodic exceedances. Responsible parties will identify whether or not bacteria treatment levels need to be improved in any of the WWTFs in the watersheds and will also identify the need to improve/upgrade the general treatment process at each facility. Also, as WWTF capacity is reached in some facilities, there may be a need to expand treatment capacity. Responsible parties will evaluate the inflow and capacity of each of these WWTFs and identify expansion needs. Following this assessment, responsible parties will pursue funding and make appropriate improvements/upgrades as funding allows.

Educational Component

Education for this control action will consist of general WWTF operator training, which can help facility staff identify malfunctioning equipment, determine the need for system upgrades, and anticipate and identify problems with plant capacity. Additionally, educating elected officials regarding the importance of efficient treatment processes will also be a critical component of this control action. Furthermore, responsible parties in the TMDL I-Plan watershed may need to be educated on how to pursue funds for making necessary upgrades and improvements. Each of the local WWTF managers will need to provide education for elected officials and parties participating in the I-Plan.

Priority Areas

Priority areas for this management measure will be the locations of each WWTF, but the highest priority will be given to those WWTFs that discharge into or near the impaired water bodies. In terms of temporal priority, first priority will be given to WWTFs that are currently not treating their wastewater effluent for bacteria effectively and/or are not meeting their permitted bacteria limits. Subsequent priority will be given to WWTFs where upgrades and improvements are needed, with special priority given to WWTFs that discharge in or near impaired water bodies in the LSAR watershed.

Responsible Parties and Funding

Each organization listed below will be responsible only for expenses associated with its own efforts.

- **SARA** has worked with stakeholders in the watershed, through the LSAR I-Plan Technical Committee, to identify wastewater treatment improvement needs in the TMDL watershed. A summary of these improvements is provided in Table 26. In the first two years of implementation of this I-Plan, the TCEQ and local stakeholders will assess these needs in sufficient detail to enable WWTF owners to submit applications for funding of WWTF enhancement projects.
- **South Central Water Company, Falls City, Karnes City, City of Kenedy, City of Runge, City of Nordheim, City of Poth, and City of Goliad** will be responsible for improving/upgrading their WWTFs to maintain compliance with permit requirements, as funding allows.

Technical Assistance

SARA – Offers technical assistance to all the municipalities in the LSAR watershed. SARA has operators and engineers available to assist with identifying operational and maintenance issues.

TCEQ – Is responsible for permit compliance, enforcement, and providing technical assistance to WWTFs as appropriate.

TEEX – Offers a Water and Wastewater Technical Assistance Program for small wastewater systems within the state. The program aims to provide technical assistance and training to small wastewater systems to help correct operational problems in small wastewater systems. TEEX staff are trained to identify problems with system performance and to ensure that the wastewater systems are running within permit requirements and in compliance with effluent limits.

TRWA – Has two wastewater training and technical assistance providers who assist wastewater system operators across the state. They provide training workshops across the state that include topics like wastewater operations and maintenance, testing procedures, rule updates, facility management, security, and other topics, as needed or requested, that relate to WWTF operations. TRWA also provides on-site technical assistance to non-profit wastewater systems, districts and small cities with populations of less than 10,000. This technical assistance deals with operations, maintenance, collection systems, treatment facilities, rates, system management, rule changes, state laws, and other topics or issues that affect small wastewater systems.

Private firms – Offer on-site training to their customers as part of their water and wastewater treatment services. This is accomplished through hands-on

instruction and seminars on basic water treatment practices and procedures-control testing, and the safe handling of chemicals.

Financial Assistance

Existing local funding for improvements/upgrades will be used, but it is likely that additional funds will be needed for this control action.

TWDB EDAP – this program provides financial assistance to fund water and wastewater services in economically distressed areas, where services do not exist, or where these services do not meet minimum state standards.

USDA RUS WWD Loans and Grants – The RUS is amending its regulations related to 7 U.S.C. 1926(c), Section 306C, WWD Loans and Grants Program, which funds construction of water and waste disposal facilities and services in low-income rural communities whose residents face significant health risks. Specifically, RUS is modifying the priority points system in order to give additional priority points to the colonias that lack access to water or waste disposal systems and that face significant health problems. The intent is to ensure that the neediest areas receive funding.

EPA/TWDB CWSRF – This program provides low-interest loans, for water and wastewater infrastructure projects, that spread project costs over a repayment period of up to twenty years. Repayments are cycled back into the fund and are used to pay for additional clean water projects.

TxCDBG Program for Rural Texas – The primary objective of this program is to develop viable communities by providing decent housing and suitable living environments and expanding economic opportunities principally for persons of low-to-moderate income. Eligible applicants are non-entitlement cities under 50,000 in population and non-entitlement counties have a non-metropolitan population under 200,000 and are not eligible for direct CDBG funding from HUD may apply for funding through any of the TxCDBG programs.

CDF – This is the largest fund category in the TxCDBG Program. This fund is available on a biennial basis through a competitive application process in each of the 24 RRC state planning regions with the RRC having the predominate percentage of the total possible score. Although most funds are used for public facilities (water/wastewater infrastructure, street and drainage improvements and housing activities), there are numerous other activities for which these funds may be used.

Table 26. Improvement needs and estimated costs for WWTFs

Entity	Activities Needed*	Estimated Costs
Falls City	TBD	TBD
Karnes City	TBD	TBD
City of Kenedy	Bar screen and grit removal system, clarifier, propeller mixes, aeration basin, pumps, flowmeter gauge, piping changes, and lift station telemetry system	$225,000
City of Runge	Rehabilitation of 2 lift stations, 2 submersible pumps, 3-inch valves, 4-inch piping, replacement of control system, 2 power generators, wet well cover and hatch, new alarm system, security fencing and gates, access drives, new manholes, and replacing 1,200 feet of 6- and 8-inch pipe with 10-inch high-density polyethylene piping	$225,000
City of Goliad	TBD	TBD
City of Nordheim	TBD	TBD
City of Poth	TBD	TBD
South Central Water Company	TBD	TBD
For all responsible parties	Education for city employees, elected officials, etc. Estimated $2,000 for one event annually for each entity	$80,000

*The list of activities shown is intended to be as comprehensive as possible, but other activities/projects and entities may require funding beyond what is shown.

TBD – to be determined

Measurable Milestones

Contingent upon the receipt of proposed project funding, the measurable milestones for this control action consist of:

- number of upgraded WWTFs,
- amount of expanded wastewater treatment capacity in the TMDL watershed, and
- successfully secured funds for treatment improvements as appropriate.

Progress Indicators

Progress indicators for this control action consist of the following.

- Years 1-2 – identification of wastewater treatment improvement needs; and
- Years 3-5 – as funding allows, make upgrades/improvements to WWTFs to ensure adequate treatment of effluent for bacteria.

Monitoring Component

TCEQ CRP monitoring stations will be utilized for measuring instream bacteria loadings, especially in critical areas. Additional special monitoring may be needed and can be developed under Management Measure 8 of this document.

Implementation Schedule

Contingent upon the receipt of proposed project funding, the implementation schedule is as follows.

Years 1-2:

As funding allows, responsible parties will:

- identify WWTFs with substandard bacteria treatment systems;
- pursue technical assistance as appropriate;
- identify improvements that can be made in treating wastewater effluent for bacteria;
- identify potential capacity and expansion needs; and
- pursue funding for upgrades/improvements.

Years 3-5:

As funding allows, responsible parties will:

- begin making upgrades to WWTFs with substandard bacteria treatment levels;
- improve bacteria treatment levels and processes at some facilities; and
- expand treatment capacities at facilities that are running at or near their current capacity.

Estimated Load Reduction

A load reduction was not calculated for the measure.

Table 27. Control Action 2: Improve and upgrade WWTFs

Potential Load Reduction	Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Entity
Load reduction could not be calculated for this measure	**Technical Assistance** – TCEQ Permit compliance assistance – TEEX-WWTF operation and maintenance – TRWA and private engineering firms – general civil engineering services **Financial Assistance** – TWDB EDAP – CWSRF – TxCDBG – Existing local funding for wastewater improvements	This control action includes training WWTF staff on identification of malfunctioning equipment, updated processes and practices, as well as capacity issues. It also includes educating elected officials on the importance of efficient and effective WWTF treatment.	**Years 1**-2 – Identify WWTFs with substandard bacteria treatment systems – Identify improvements that can be made in treatment and WWTF expansion needs – Pursue technical and financial assistance **Years 3-5** – Begin making upgrades and improvements to WWTFs – Assess and expand capacities	– Number of upgraded WWTFs – Number of improvements to treatment systems – Amount of expanded capacity – Successful securing of funds for upgrades, improvements and expansions as appropriate	– Identification of wastewater bacteria treatment needs at WWTFs in the TMDL watershed – As funding allows, make upgrades and improvements to WWTFs to ensure adequate treatment of effluent	– TCEQ CRP	– Falls City – Karnes City – City of Kenedy – City of Goliad – City of Runge – City of Nordheim – City of Poth – South Central Water Company

Sustainability

The TCEQ and 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. Stakeholders evaluate several factors, such as the pace of implementation, the effectiveness of BMPs, load reductions, and progress toward meeting water quality standards. The TCEQ will document the results of these evaluations and the rationale for maintaining or revising elements of the I-Plan.

The TCEQ and 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 Milestones** – A measure of administrative actions undertaken to effect an improvement in water quality.

Water Quality Indicators

Water quality monitoring staff from SARA and the TCEQ will monitor the status of water quality during implementation. Additional funding will be sought to conduct supplemental monitoring in the watershed.

The CRP currently incorporates 11 river and tributary water quality monitoring stations in the watershed. Data are used to identify trends and assess compliance with the Texas Surface Water Quality Standards. Monitoring sites are evaluated annually, based on analysis of data and resource availability. To expand water quality monitoring in the watershed, beginning September 1, 2017, five additional stations will be added to the watershed monitoring schedule. The five additional monitoring stations are on Cabeza Creek and will be used to assist the TCEQ in assigning an appropriate flow-type classification for the water body (see Management Measure 9). The purpose of this monitoring is to ensure that adequate *E. coli* data are collected in each of the impaired AUs to determine water quality standards attainment. The indicators that will be used to measure improvement in water quality are improvements to bacteria levels at the stations mentioned above.

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 which may not be working, and make any changes that may be necessary to get the plan back on target.

Schedules of implementation activities and milestones for this I-Plan are included in Appendix A.

Communication Strategy

The TCEQ will host annual meetings for up to five years so stakeholders may evaluate their progress. Stakeholders and responsible parties will continue to take part in annual 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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Appendix A.
I-Plan Matrix

Table A-1. Management Measure 1 implementation schedule and tasks: Develop and implement conservation plans in priority areas of the watershed; educate landowners on appropriate stocking rates and grazing plans

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	TSSWCB, SWCDs, AgriLife Extension, and NRCS	– Promote existing conservation programs through the LSAR watershed	– Management practice field days held in the LSAR watershed
	TSSWCB, SWCDs, and NRCS	– Participate in the development of 15 conservation plans in the LSAR	– Fifteen conservation plans developed and implemented annually in the LSAR watershed
	SWCDS and AgriLife Extension	– Pursue funding for educational programs as documented with the successful submissions of a CWA Section 319(h) grant proposal	– Funding attained
2	TSSWCB, SWCDs, AgriLife Extension, and NRCS	– Continue promoting existing conservation plans	– Fifteen conservation plans developed and implemented annually in the LSAR watershed
	TSSWCB, SWCDs, and NRCS	– Participate in the development of 15 additional conservation plans in the LSAR watershed	– Riparian and Stream Ecosystem Management education program delivered
	TSSWCB, SWCDs, AgriLife Extension, and NRCS	– Successfully secure funding for an educational campaign and initiate the campaign	– Funding secured for the educational campaign, and campaign initiated
3	TSSWCB, SWCDs, AgriLife Extension, and NRCS	– Continue promoting existing conservation plans, and participate in the development of 15 additional conservation plans in the LSAR watershed	– Fifteen conservation plans developed and implemented annually in the LSAR watershed
	AgriLife Extension	– Deliver two educational programs to encourage the adoption of conservation plans	– Two educational programs delivered
4	TSSWCB, SWCDs, AgriLife Extension, and NRCS	– Continue promoting existing conservation plans, and participate in the development of 15 additional conservation plans in the LSAR watershed	– Fifteen conservation plans developed and implemented annually in the LSAR watershed
	AgriLife Extension	– Deliver two educational programs to encourage the adoption of conservation plans	– Two educational programs delivered
5	TSSWCB, SWCDs, AgriLife Extension, and NRCS	– Continue promoting existing conservation plans	– Fifteen conservation plans developed and implemented annually in the LSAR watershed

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
5, cont.	AgriLife Extension	– Participate in the development of 15 additional conservation plans in the LSAR watershed	– Conservation plans developed and implemented
	AgriLife Extension	– Deliver two educational programs to encourage the adoption of conservation plans	– Two educational programs delivered
	TSSWCB, SWCDs, AgriLife Extension, and NRCS	– Assess overall progress and, if necessary, modify existing efforts or develop a new strategy of implementation regarding conservation plans	– Progress assessment completed, efforts modified if needed

Table A-2. Management Measure 2 implementation schedule and tasks: Remove and manage feral hogs

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Contact landowners in priority areas to discuss the economic savings of feral hog removal, specific methods for doing so, and available programs that can assist	– Successful submittal for local assistance
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Submit a proposal for both educational programs and local assistance	– Successful development and submittal of an educational program proposal for feral hog management
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue existing methods of feral hog removal and report as appropriate	– The removal of 1,500 feral hogs from the TMDL watershed
2	USDA, SARA, TWS, AgriLife Extension, and County wildlife associations	– Secure funding for educational and local assistance	– Funding secured for local assistance
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Begin developing and distributing educational materials	– Educational materials developed and distributed
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Begin providing assistance to landowners locally	– Assistance received by local landowners
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue contacting landowners in priority areas to discuss the economic savings of feral hog removal, specific methods, and available programs to assist	– Local landowners contacted
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue removing feral hogs and report activity	– 1,500 feral hogs removed from the TMDL watershed

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
3	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue contacting landowners in priority areas to discuss the economic savings of feral hog removal, specific methods, and available programs to assist	– Local landowners contacted
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue to distribute educational materials and hold educational programs	– Educational materials distributed, and educational programs provided
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue to provide local assistance, removing feral hogs, and reporting activity	– 1,500 feral hogs removed from the TMDL watershed
4	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue contacting landowners in priority areas to discuss the economic savings of feral hog removal, specific methods, and available programs to assist	– Local landowners contacted
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue to distribute educational materials and hold educational programs	– Educational materials distributed, and educational programs provided
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue to provide local assistance, removing feral hogs, and reporting activity	– 1,500 feral hogs removed from the TMDL watershed
5	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue contacting landowners in priority areas to discuss the economic savings of feral hog removal, specific methods, and available programs to assist	– Local landowners contacted
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue to distribute educational materials and hold educational programs	– Educational materials distributed, and educational programs provided
	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Continue to provide local assistance, removing feral hogs, and reporting activity	– 1,500 feral hogs removed from the TMDL watershed

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
5, cont.	USDA, SARA, TWS, AgriLife Extension, TPWD, and County wildlife associations	– Assess strategy for the next phase of implementation	– Strategy for the next phase of implementation assessed

Table A-3. Management Measure 3 implementation schedule and tasks: Identify, prioritize, and remediate OSSFs

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Pursue funds for additional personnel, education, and OSSF repairs/replacements	– Develop and submit proposals to fund personnel to identify, inspect, and track OSSFs
	AgriLife Extension and counties	– Identify and inspect OSSFs in close proximity to waterways	– Repair or replacement of six failing OSSFs in the LSAR watershed
	AgriLife Extension and counties	– Develop a single OSSF database that documents OSSF information	– OSSF database developed
	AgriLife Extension	– Develop a tracking tool or update existing tracking tools for OSSFs	– Tracking tool developed
	AgriLife Extension and counties	– Begin contacting OSSF owners	– 2% of OSSF owners contacted
2	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Secure funding for additional personnel, education, and OSSF repairs/replacements	– Funding secured
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Initiate and continue educational programs	– Educational programs initiated
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Begin repair or replacement of six OSSFs per year	– Repair or replacement of six failing OSSFs in the LSAR watershed
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Continue contacting owners and tracking OSSFs	– Funding secured for additional inspection personnel and OSSF assistance/incentives and/or educational programs, in addition to the maintenance of the OSSF tracking system
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Inspect 1% of the estimated OSSFs in the TMDL watershed	– Inspection of 1% of all OSSFs in the TMDL watershed
3	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Secure funding for additional personnel, education, and OSSF repairs/replacements	– 6% of OSSF owners contacted

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
3, cont.	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Initiate and continue educational programs	– Educational programs initiated and materials distributed
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Repair or replacement of six OSSFs	– Repair or replacement of six failing OSSFs in the LSAR watershed
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Continue contacting owners and tracking OSSFs	– OSSF owners contacted
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Inspect 1% of the estimated OSSFs in the TMDL watershed	– Inspection of 1% of all OSSFs in the TMDL watershed
4	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Secure funding for additional personnel, education, and OSSF repairs/replacements	– 6% of OSSF owners contacted
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Initiate and continue educational programs	– Educational programs initiated and materials distributed
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Repair or replacement of six OSSFs	– Repair or replacement of six failing OSSFs in the LSAR watershed
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Inspect 1% of the estimated OSSFs in the TMDL watershed	– Inspection of 1% of all OSSFs in the TMDL watershed
5	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Secure funding for additional personnel, education, and OSSF repairs/replacements	– Funding secured for additional personnel, education, and OSSF replacements/upgrades
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Initiate and continue educational programs	– Educational programs initiated and materials distributed
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Repair or replacement of six OSSFs	– Repair or replacement of six failing OSSFs in the LSAR watershed
	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Continue contacting owners and tracking OSSFs	– OSSF owners contacted

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
5, cont.	AgriLife Extension, Authorized Agents, counties, and OSSF owners	– Inspect 1% of the estimated OSSFs in the TMDL watershed	– Inspection of 1% of all OSSFs in the TMDL watershed

Table A-4. Management Measure 4 implementation schedule and tasks: Coordinate efforts to reduce unauthorized discharges including SSOs; coordinate and expand efforts to reduce stormwater inflow and infiltration; reduce WWTF contributions by meeting half of the permitted bacteria limit; advocate for proper O&M of sewer lines

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	TCEQ, AgriLife Extension, and WWTFs	– Evaluate the option of treating bacteria in wastewater to half of the Texas Surface Water Quality Standards	– Worked with TCEQ and TEEX to evaluate the possibility of meeting half the permitted amount of bacteria in treated influent
	AgriLife Extension and WWTFs	– Pursue funding for educational programs	– Funding for educational programs secured
2	AgriLife Extension and WWTFs	– If found feasible, begin treating effluent wastewater to levels that are half of the Texas Surface Water Quality Standards bacteria concentrations – Begin televising program and evaluating upgrades needed at the WWTFs to improve O&M of sewer lines and reduce SSOs	– Reached treated effluent concentrations for bacteria that are half of the TCEQ standards – Number of WWTFs that televise wastewater lines
	TCEQ, AgriLife Extension, USDA, EPA, TxCDBG, and WWTFs	– If funding is received, educational programs shall be initiated	– Educational programs delivered
3	AgriLife Extension and WWTFs	– If found feasible, begin treating effluent wastewater to levels that are half of the Texas Surface Water Quality Standards bacteria concentrations	– Reached treated effluent concentrations for bacteria that are half of TCEQ standards, continue doing what is feasible to meet these goals
	TCEQ, AgriLife Extension, USDA, EPA, TxCDBG, and WWTFs	– If funding is received, educational programs shall be initiated	– Educational programs delivered
4	AgriLife Extension and WWTFs	– If found feasible, begin treating effluent wastewater to levels that are half of the Texas Surface Water Quality Standards bacteria concentrations	– Reached treated effluent concentrations for bacteria that are half of TCEQ standards, continue doing what is feasible to meet these goals
	TCEQ, AgriLife Extension and WWTFs	– If funding is received, educational programs shall be initiated	– Educational programs delivered

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
5	AgriLife Extension and WWTFs	– If found feasible, begin treating effluent wastewater to levels that are half of the Texas Surface Water Quality Standards bacteria concentrations	– Reached treated effluent concentrations for bacteria that are half of TCEQ standards, continue doing what is feasible to meet these goals
	TCEQ, AgriLife Extension and WWTFs	– If funding is received, educational programs shall be initiated	– Educational programs delivered

Table A-5. Management Measure 5 implementation schedule and tasks: Restore and repair riparian zones; emphasize protection of riparian zones; advocate for educational and outreach materials

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Successfully secure funding for an educational campaign	– Funding secured for educational campaign
	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Initiate an educational campaign	– Educational campaign initiated
2	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Continue promoting the existing conservation programs	– Hosted a landowner workshop through the Statewide Riparian and Stream Ecosystem Educational Program
3	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Continue promoting existing conservation plans	– Two additional conservation plans developed in the LSAR watershed which implement BMPs designed to protect and restore riparian zones
	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Deliver educational programs in the watershed to encourage the adoption of conservation plans	– Educational programs delivered to landowners
4	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Continue promoting existing conservation plans	– Two additional conservation plans developed in the LSAR watershed which implement BMPs designed to protect and restore riparian zones
	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Deliver educational programs in the watershed to encourage the adoption of conservation plans	– Educational programs delivered in the watershed to encourage the adoption of conservation plans
5	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Continue promoting existing conservation programs	– Two additional conservation plans developed in the LSAR watershed which implement BMPs designed to protect and restore riparian zones
	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Deliver educational programs in the watershed to encourage the adoption of conservation plans	– Educational programs delivered in the watershed to encourage the adoption of conservation plans

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
5, cont.	TSSWCB, AgriLife Extension, NRCS, TPWD, SARA, SWCDs, and local stakeholders	– Assess overall progress and, if necessary, modify existing efforts or develop a new strategy for implementation	– Strategy for the next phase of implementation assessed

Table A-6. Management Measure 6 implementation schedule and tasks: Promote the improved quality and management of urban stormwater; coordinate with new development for reducing runoff pollutants; provide education programs on stormwater management; advocate for LID BMPs

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	SARA, local cities and agencies	– Submit a proposal to fund urban stormwater education and planning	– Proposal developed and submitted to fund urban stormwater education and planning
	SARA, local cities and agencies	– Identify locations for urban BMP installation	– Locations identified for potential urban BMP installation if/where feasible
2	SARA, local cities and agencies	– Successfully secure funding for stormwater education and planning activities	– Development of stormwater education and planning activities
	SARA, local cities and agencies	– Initiate education programs for stormwater	– Initiation of education program for urban stormwater management
	SARA, local cities and agencies	– Develop educational materials and comprehensive stormwater assessments	– Educational materials developed
	SARA, local cities and agencies	– Initiate the installation of BMPs, if/where feasible	– Initiation of BMP installation if/where feasible
3	SARA, local cities and agencies	– Continuation of educational and planning activities	– Educational and planning activities continued
	SARA, local cities and agencies	– Completion of urban BMP installation if/where feasible	– BMPs completed
4	SARA, local cities and agencies	– Continuation of educational planning activities	– Educational and planning activities continued
	SARA, local cities and agencies	– Completion of urban BMP installation if/where feasible	– BMPs completed
5	SARA, local cities and agencies	– Continuation of educational and planning activities	– Educational and planning activities continued
	SARA, local cities and agencies	– Attainment local stakeholder contacts through educational activities	– Contacts made through educational activities
	SARA, local cities and agencies	– Completion of urban BMP installation if/where feasible	– BMPs completed

Table A-7. Management Measure 7 implementation schedule and tasks: Promote the reduction of illicit dumping and proper disposal of wastes; utilize SARA's Environmental Investigators

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	AgriLife Extension, SARA, counties, and cities	– Develop and submit a grant proposal in pursuit of funding for educational programs, additional personnel, and activities associated with illicit dumping mitigation	– Development and submittal of a grant proposal for additional personnel and educational programs
	AgriLife Extension, SARA, counties, and cities	– Develop a strategy for how to best reduce illicit dumping	– A 5% increase in the number of fines written for illicit dumping
	AgriLife Extension, SARA, counties, and cities	– Implement activities as resources allow	– A 5% reduction in the number of reports/complaints to responsible parties
2	AgriLife Extension, SARA, counties, and cities	– Secure funding for additional personnel, educational programs, and/or illicit dumping implementation activities	– Receipt of a grant award for additional personnel and an educational program
	AgriLife Extension, SARA, counties, and cities	– Initiate and implement educational programs	– An additional 5% reduction in the number of illicit dumping reports/complaints to responsible parties
3	AgriLife Extension, SARA, counties, and cities	– Continuation of educational and planning activities	– Educational and planning activities continued
	AgriLife Extension, SARA, counties, and cities	– Reduce the number of illicit dumping reports to responsible parties by 5%	– An additional 5% reduction in the number of illicit dumping reports/complaints to responsible parties
4	AgriLife Extension, SARA, counties, and cities	– Continuation of educational and planning activities	– Educational and planning activities continued
	AgriLife Extension, SARA, counties, and cities	– Reduce the number of illicit dumping reports to responsible parties by 5%	– An additional 5% reduction in the number of illicit dumping reports/complaints to responsible parties
5	AgriLife Extension, SARA, counties, and cities	– Continuation of educational and planning activities	– Educational and planning activities continued
	AgriLife Extension, SARA, counties, and cities	– Reduce the number of illicit dumping reports to responsible parties by 5%	– An additional 5% reduction in the number of illicit dumping reports/complaints to responsible parties

Table A-8. Management Measure 8 implementation schedule and tasks: Coordinate and expand existing water quality monitoring in the watershed

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	TCEQ, SARA, and local stakeholders	– Conduct an annual basin water quality monitoring program according to the established TCEQ-approved CRP QAPP and Coordinated Monitoring Schedule on the LCRA website	– Completed annual water quality monitoring program (as funding and environmental conditions allowed)
	TCEQ, SARA, and local stakeholders	– Transfer routine water quality data to the TCEQ SWQMIS three times each calendar year	– Water quality data accepted into SWQMIS
	TCEQ, SARA, and local stakeholders	– As funding allows and needs arise, develop QAPP for additional projects	– QAPPs developed
	TCEQ, SARA, and local stakeholders	– Publish annual Basin Highlight Report that discusses water quality concerns affecting human health and aquatic health. Potential sources of pollution will be evaluated according to available water quality information	– Basin Highlight Report published, and annual CRP Steering Committee meeting completed
	TCEQ, SARA, and local stakeholders	– As needed, development of additional water quality monitoring projects and funding sources	– Additional water quality monitoring projects developed, and funding acquired
2	TCEQ, SARA, and local stakeholders	– Conduct an annual basin water quality monitoring program according to the established TCEQ-approved CRP QAPP and Coordinated Monitoring Schedule on the LCRA website	– Completed annual water quality monitoring program (as funding and environmental conditions allowed)
	TCEQ, SARA, and local stakeholders	– Transfer routine water quality data to the TCEQ SWQMIS three times each calendar year	– Water quality data accepted into SWQMIS
	TCEQ, SARA, and local stakeholders	– As funding allows and needs arise, develop QAPPs for additional projects	– QAPPs developed
	TCEQ, SARA, and local stakeholders	– Publish annual Basin Highlight Report that discusses water quality concerns affecting human health and aquatic health. Potential sources of pollution will be evaluated according to available water quality information	– Basin Highlight Report published, and annual CRP Steering Committee meeting completed

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
2, cont.	TCEQ, SARA, and local stakeholders	– As needed, development of additional water quality monitoring projects and funding sources	– Additional water quality monitoring projects developed, and funding acquired
3	TCEQ, SARA, and local stakeholders	– Conduct an annual basin water quality monitoring program according to the established TCEQ-approved CRP QAPP and Coordinated Monitoring Schedule on the LCRA website	– Completed annual water quality monitoring program (as funding and environmental conditions allowed)
	TCEQ, SARA, and local stakeholders	– Transfer routine water quality data to the TCEQ SWQMIS three times each calendar year	– Water quality data accepted into SWQMIS
	TCEQ, SARA, and local stakeholders	– As funding allows and needs arise, develop QAPPs for additional projects	– QAPPs for additional projects developed
	TCEQ, SARA, and local stakeholders	– Publish annual Basin Highlight Report that discusses water quality concerns affecting human health and aquatic health. Potential sources of pollution will be evaluated according to available water quality information	– Basin Highlight Report published, and annual CRP Steering Committee meeting completed
	TCEQ, SARA, and local stakeholders	– As needed development of additional water quality monitoring projects and funding sources	– Additional water quality monitoring projects developed, and funding acquired
4	TCEQ, SARA, and local stakeholders	– Conduct an annual basin water quality monitoring program according to the established TCEQ-approved CRP QAPP and Coordinated Monitoring Schedule on the LCRA website	– Completed annual water quality monitoring program (as funding and environmental conditions allowed)
	TCEQ, SARA, and local stakeholders	– Transfer routine water quality data to the TCEQ SWQMIS three times each calendar year	– Water quality data accepted into SWQMIS
	TCEQ, SARA, and local stakeholders	– As funding allows and needs arise develop QAPPs for additional projects	– QAPPs for additional projects developed
	TCEQ, SARA, and local stakeholders	– Publish annual Basin Highlight Report that discusses water quality concerns affecting human health and aquatic health. Potential sources of pollution will be evaluated according to available water quality information	– Basin Highlight Report published, and annual CRP Steering Committee meeting completed

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
4, cont.	TCEQ, SARA, and local stakeholders	– As needed, development of additional water quality monitoring projects and funding sources	– Additional water quality monitoring projects developed, and funding acquired
5	TCEQ, SARA, and local stakeholders	– Conduct an annual basin water quality monitoring program according to the established TCEQ-approved CRP QAPP and Coordinated Monitoring Schedule on the LCRA website	– Completed annual water quality monitoring program (as funding and environmental conditions allowed)
	TCEQ, SARA, and local stakeholders	– Transfer routine water quality data to the TCEQ SWQMIS three times a calendar year	– Water quality data accepted into SWQMIS
	TCEQ, SARA, and local stakeholders	– As funding allows and needs arise, develop QAPPs for additional projects	– QAPPs for additional projects developed
	TCEQ, SARA, and local stakeholders	– Publish annual Basin Highlight Report that discusses water quality concerns affecting human health and aquatic health. Potential source of pollution will be evaluated according to available water quality information	– Basin Highlight Report published, and annual CRP Steering Committee meeting completed
	TCEQ, SARA, and local stakeholders	– As needed, development of additional water quality monitoring projects and funding sources	– Additional water quality monitoring projects developed, and funding acquired

Table A-9. Management Measure 9 implementation schedule and tasks: Re-designate Cabeza Creek

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	TCEQ and SARA	– SARA staff will conduct six field and flow sampling events at five stations; data will be submitted to the TCEQ CRP; and the TCEQ will decide if additional field and flow sampling is necessary	– Data delivered to the TCEQ CRP group
2	TCEQ and SARA	– SARA staff will conduct six field and flow sampling events at five stations if deemed necessary by the TCEQ CRP group	– Data delivered to the TCEQ CRP group, if additional sampling is conducted

Table A-10. Control Action 1 implementation schedule and tasks: Improve monitoring of WWTF effluent to ensure permit compliance

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	WWTFs, TEEX, and TRWA	– Train WWTF staff on proper effluent sampling	– Education programs/materials delivered to staff on proper effluent sampling
	WWTFs, TEEX, and TRWA	– Educate elected officials on the importance of effluent monitoring	– Education programs/materials delivered to elected officials
	WWTFs, TEEX, and TRWA	– A 5% reduction in the number of sampling events not reported	– A 5% reduction in the number of sampling events not reported
2	WWTFs, TEEX, and TRWA	– An additional 5% reduction in non-reported sampling	– A 5% reduction in the number of sampling events not reported
	WWTFs, TEEX, and TRWA	– Continue to train WWTF staff on proper effluent sampling	– Education programs/materials delivered to staff on proper effluent sampling
	WWTFs, TEEX, and TRWA	– Continue to educate elected officials on the importance of effluent monitoring	– Education programs/materials delivered to elected officials
3	WWTFs, TEEX, and TRWA	– An additional 5% reduction in non-reported sampling	– A 5% reduction in the number of sampling events not reported
	WWTFs, TEEX, and TRWA	– Continue to train WWTF staff on proper effluent sampling	– Education programs/materials delivered to staff on proper effluent sampling
	WWTFs, TEEX, and TRWA	– Continue to educate elected officials on the importance of effluent monitoring	– Education programs/materials delivered to elected officials
4	WWTFs, TEEX, and TRWA	– An additional 5% reduction in non-reported sampling	– A 5% reduction in the number of sampling events not reported
	WWTFs, TEEX, and TRWA	– Continue to train WWTF staff on proper effluent sampling	– Education programs/materials delivered to staff on proper effluent sampling
	WWTFs, TEEX, and TRWA	– Continue to educate elected officials on the importance of effluent monitoring	– Education programs/materials delivered to elected officials
5	WWTFs, TEEX, and TRWA	– An additional 5% reduction in non-reported sampling	– A 5% reduction in the number of sampling events not reported

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
5, cont.	WWTFs, TEEX, and TRWA	– Continue to train WWTF staff on proper effluent sampling	– Education programs/materials delivered to staff on proper effluent sampling
	WWTFs, TEEX, and TRWA	– Continue to educate elected officials on the importance of effluent monitoring	– Education programs/materials delivered to elected officials

Table A-11. Control Action 2 implementation and tasks: Improve and upgrade WWTFs

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
1	TCEQ, WWTF owners/operators	– Pursue technical assistance as appropriate	– Technical assistance received
	TCEQ, WWTF owners/operators	– Identify wastewater treatment improvement needs	– WWTFs with substandard bacteria treatment systems identified
	TCEQ, WWTF owners/operators	– Identify potential capacity and expansion needs	– WWTFs with lower capacity identified
	WWTF owners/operators	– Pursue funding for upgrades/improvements	– Funding secured for treatment improvement as appropriate
2	TCEQ, WWTF owners/operators	– Pursue technical assistance as appropriate	– Technical assistance received
	TCEQ, WWTF owners/operators	– Identify wastewater treatment improvement needs	– WWTFs with substandard bacteria treatment systems identified
	TCEQ, WWTF owners/operators	– Identify potential capacity and expansion needs	– WWTFs with lower capacity identified
	WWTF owners/operators	– Pursue funding for upgrades/improvements	– Funding secured for treatment improvement as appropriate
3	TCEQ, WWTF owners/operators	– As funding allows, make upgrades/improvements to WWTFs to ensure adequate treatment of effluent for bacteria	– Bacteria treatment levels and processes at selected facilities improved
	WWTF owners/operators	– Pursue funding for upgrades/improvements	– Funding secured for treatment improvement as appropriate
4	TCEQ, WWTF owners/operators	– As funding allows, make upgrades/improvements to WWTFs to ensure adequate treatment of effluent for bacteria	– Bacteria treatment levels and processes at selected facilities improved
	WWTF owners/operators	– Pursue funding for upgrades/improvements	– Funding secured for treatment improvement as appropriate
5	TCEQ, WWTF owners/operators	– As funding allows, make upgrades/improvements to WWTFs to ensure adequate treatment of effluent for bacteria	– Bacteria treatment levels and processes at selected facilities improved

Plan Year	Responsible Parties	Implementation Measure	Implementation Milestones
5, cont.	TCEQ, WWTF owners/operators	– Pursue funding for upgrades/improvements	– Funding secured for treatment improvement as appropriate

Appendix B.
Load Reduction Estimates

Load Reduction Estimates

Estimates for load reductions are based on the best available information regarding the effectiveness of recommended management, loading estimates informed by technical data sources, and local knowledge derived from stakeholder input. Real world conditions based on where implementation is completed will ultimately determine the actual load reduction achieved once complete. Stakeholder input was critical for deriving agricultural estimates, estimating existing management measures, and determining feasible management measures.

Agricultural Nonpoint Source Management Measures

Management Measure 1: Develop and implement conservation plans in priority areas of the watershed; educate landowners on appropriate stocking rates and grazing plans

Cattle Loadings

Stakeholder input was critical to develop livestock population estimates across the watershed. Based on suggestions from NRCS, the recommended stocking rate is 3 acres/animal unit (ac/An.U) for pasture and 7 ac/An.U for rangeland. Applying this estimate across appropriate land cover in the LSAR watershed generated an estimate of 192,223 cattle.

Using the SELECT methodology in the GIS analysis, potential *E. coli* loading from cattle was estimated across the watershed and for each subwatershed. The fecal coliform production rate was assumed to be 8.55×10^9 cfu/An.U×day^{-1} with the assumption that 1 An.U equals 1 cattle (Wagner and Moench, 2009). The conversion rate from fecal coliform to *E. coli* was assumed to be $\frac{126}{200}$ (Wagner and Moench, 2009). Therefore, the daily potential *E. coli* load from cattle was calculated as:

$$Potential\ Load = Head\ of\ Cattle \times \frac{8.55 \times 10^9 cfu\ fecal\ coliform}{Head \times day^{-1}} \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform}$$

Multiplied by 365 days/year, GIS analysis estimated a potential annual load of 3.78×10^{17} cfu/year across the entire watershed from cattle.

Load Reductions from Livestock Management

The potential load reduction that can be achieved by implementing conservation practices will depend on the specific BMPs implemented by each landowner, the number of cattle in each operation, existing practices, and existing land condition. The bacteria reduction efficiencies of several BMPs have been estimated in various research efforts and an estimated 69 percent median effectiveness for BMPs likely to be employed in the watershed was assumed (Table B-1).

Table B-1. Livestock management effectiveness

	Low	High	Median
Exclusionary Fencing[1]	30%	94%	62%
Filter Strips[2]	30%	100%	65%
Prescribed Grazing[3]	42%	66%	54%
Stream Crossing[4]	44%	52%	48%
Watering Facility[5]	51%	94%	72.5%

[1] Brenner et al. 1996, Cook 1998, Hagedorn et al. 1999, Line 2002, Line 2003, Lombardo et al. 2000, Meals 2001, Meals 2004, Petersen 2011

[2] Cook 1998, Coyne et al. 1995, Fajardo et al. 2001, Goel et al. 2004, Larsen et al. 1994, Lewis et al. 2010, Mankin and Okoren 2003, Roodsari et al. 2005, Stuntebeck and Bannerman 1998, Sullivan et al. 2007, Tate et al. 2006, Young et al. 1980

[3] Tate et al. 2004, EPA 2010

[4] Inamdar et al. 2002, Meals 2001

[5] Byers et al. 2005, Hagedorn et al. 1999, Sheffield et al. 1997

The total potential load reduction will be strongly influenced by the number of ranchers that participate and the number of cattle that will be impacted. Specific load reduction estimates are simply estimates that will strongly depend on the specific management practices implemented. Using the estimated 192,223 cattle in the watershed, there are an estimated 61 head per farm. Daily potential load reduction expected from cattle management practices were then estimated with:

$$Potential\ Load\ Reduction = Number\ of\ management\ plans \times \frac{cattle}{mgmt\ plan} \times \frac{8.55 \times 10^{9} cfu\ fecal\ coliform}{An.U \times day^{-1}} \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform} \times BMP\ reduction\ rate \times Proximity\ factor$$

The proximity factor is a percentage-based impact factor based on the assumed proximity of the management measures to the water body. Potential load reductions were calculated assuming that 15 farms would adopt 1 conservation

measure per year for five years. The total annual potential load reduction after 75 farms adopted conservation measures was 1.56×10^{15} cfu/year of *E. coli*.

Management Measure 2: Remove and manage feral hogs

Feral Hog Loadings

The feral hog population in the LSAR watershed is estimated to be 29,041 animals, which is estimated to be equivalent to 3,631 animal units. This population was derived using a density of 33.3 ac/hog and an animal unit conversion of 0.125 applied uniformly across deciduous forest, evergreen forest, mixed forest, shrub/scrub, grassland, pasture, cultivated crops, and woody wetlands identified in 2011 NLCD data (Wagner and Moench, 2009).

$$Potential\ Load = number\ of\ feral\ hogs \times \frac{0.125\ Animal\ Units}{feral\ hog} \times \frac{1.21 \times 10^{9} cfu\ fecal\ coliform}{An.U \times day^{-1}} \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform} \times 365\ Days$$

Table B-2. Estimated feral hog population of the LSAR watershed

Land Use Category LSAR	Acres	Density (ac/hog)	Feral Hog Pop	AU Conversion	Feral Hogs (AU)
Open Water	2,721	NA	NA	NA	NA
Developed Open Space	39,656	NA	NA	NA	NA
Developed, Low Intensity	15,964	NA	NA	NA	NA
Developed, Medium Intensity	2,406	NA	NA	NA	NA
Developed, High Intensity	429	NA	NA	NA	NA
Barren	9,640	NA	NA	NA	NA
Deciduous Forest	72,470	33.3	2,176	0.125	272
Evergreen Forest	2,303	33.3	69	0.125	9
Mixed Forest	4,245	33.3	127	0.125	16
Shrub/Scrub	328,127	33.3	9,854	0.125	1,232
Grassland	51,660	33.3	1,551	0.125	194
Pasture	412,086	33.3	12,375	0.125	1,547
Cultivated Crops	71,223	33.3	2,139	0.125	267
Woody Wetlands	24,970	33.3	750	0.125	94
Emergent Herbaceous Wetland	3,944				
TOTAL	1,041,844		29,041		3,631

Load Reductions from Feral Hog Management

The potential load reductions for feral hog management depend on how much the population can be directly reduced. Load reduction was calculated based on the number of hogs removed annually. Therefore, the same equation to calculate daily loading was used:

$$Potential\ Load\ Reduction = feral\ hogs\ removed \times \frac{1.21 \times 10^9 cfu\ fecal\ coliform}{An.U \times day^{-1}} \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform} \times 365\ Days$$

A goal established in SARA's Feral Hog Management Project is to remove 1,500 hogs from the watershed per year. Feral hog reproduction rates and annual feral hog hunting rates were not taken into account on the feral hog loading or reduction rate estimates.

The potential annual *E. coli* load reduction from feral hogs was estimated using:

$$\text{Annual Feral Hog } E.coli \text{ Load Reduction} = hogs\ removed\ \times 0.125 \times \frac{1.21 \times 10^9 cfu\ fecal\ coliform}{An.U \times day^{-1}} \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform} \times 365\ Days$$

Where:

0.125 = conversion factor to animal units

1.21 x 10^9 = average daily cfu fecal coliform production rate per hog animal units

0.63 = conversion factor to convert between fecal coliform and *E. coli* by dividing the current *E. coli* standard of 126 cfu by 200 mL fecal coliform.

365 = days per year

$$\text{Potential Annual Feral Hog } E.coli \text{ Load} - \text{LSAR} = = 29{,}042\ \times 0.125 \times \frac{1.21 \times 10^9 cfu\ fecal\ coliform}{An.U \times day^{-1}} \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform} \times 365\ Days = 1.0 \times 10^{15} \text{cfu } E.coli \text{ per year}$$

$$\text{Potential Annual Feral Hog } E.coli \text{ Load Reduction} - \text{LSAR} = \\ = 1500\ feral\ hogs\ removed\ \times 0.125 \times \frac{1.21 \times 10^{9} cfu\ fecal\ coliform}{An.U \times day^{-1}} \\ \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform}\ \times 365\ Days$$

The potential annual *E. coli* load reduction is estimated at 5.2x10[13] cfu *E. coli* per year.

Management Measure 3: Identify, prioritize, and remediate OSSFs

OSSF Loadings

Stakeholders estimated 4,041 OSSFs exist within the watershed based on TCEQ records for the watershed. For each address, the average number of persons per household was obtained using 2010 Census block data (2.4 people per household). The assumed fecal coliform concentration of a failing OSSF was 10×10[6] cfu/100 ml (EPA, 2001). A sewage discharge rate of 70 gallons (gal)/person day-1 was used (Borel, et. al., 2015). The OSSF failure rate was assumed to be 15 percent. The conversion rate from fecal coliform to *E. coli* was assumed to be $\frac{126}{200}$.

Daily potential load per household was calculated as:

$$Potential\ OSSF\ Load \\ = Number\ of\ OSSFs \times \frac{number\ of\ people}{household} \times \frac{70\ gal}{person \times day^{-1}} \\ \times 0.15\ Failure\ rate \times \frac{1 \times 10^{6}\ cfu\ fecal\ coliform}{100\ ml} \\ \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform} \times 3578.4\ {}^{mL}/_{gal}$$

Potential daily *E. coli* loading from OSSF failure was estimated as 1.81×10[12] cfu/day. Potential annual *E. coli* loading from OSSF failure was estimated as 6.59×10[14] cfu/year.

Load Reductions from Replacement of Faulty OSSFs

Total load reductions from the replacement of failing OSSF systems depend on the amount of effluent discharged by the system and proximity of the system to a water body. Because these actual values are not known before identification and replacement of a failing OSSF, approximate values are used to identify potential load reductions. For load reduction calculations, 2.4 people per household, a discharge rate of 70 gal/person day-1, and a fecal coliform concentration of 1×10[6] cfu/100 mL were assumed. Potential annual load reductions can be calculated as:

$$Potential\ Load\ Reduction = Number\ of\ OSSFs\ replaced\ per\ year \times \frac{2.4\ persons}{household} \times \frac{70\ gal}{person \times day^{-1}} \times \frac{1 \times 10^6\ cfu\ fecal\ coliform}{100\ mL} \times 3578.4\ {}^{mL}/_{gal} \times {}^{365\ days}/_{year}$$

Assuming that six failing OSSFs are repaired or replaced annually for four years, the potential annual load reduction is 1.056×10^{13} cfu/year.

Management Measure 4: Coordinate efforts to reduce unauthorized discharges including SSOs, coordinate and expand efforts to reduce stormwater inflow and infiltration; reduce WWTF contribution by meeting half of the permitted bacteria limit; advocate for proper O&M of sewer lines

WWTF Loadings

There are five WWTFs in the LSAR watershed with discharge permits for bacteria. Potential loadings for each WWTF were modeled at respective maximum discharge and an *E. coli* concentration of 126 cfu/100ml, although monitoring data indicate discharge concentrations are routinely quite low. Daily potential loading from WWTFs across the watershed was calculated as the sum of individual plant loadings, where individual plant loadings are calculated as:

$$Potential\ Load_{WWTP} = maximum\ permitted\ discharge\ ({}^{gal}/_{day}) \times \frac{126\ cfu\ E.coli}{100\ ml} \times 3785.2\ {}^{ml}/_{gal}$$

Potential daily *E. coli* loading is estimated at 1.58×10^{10} cfu/day and potential annual loading is estimated at 5.77×10^{12} cfu/year.

Load Reductions from WWTF Management Measures

Potential load reductions can be achieved through the reduction of the total effluent discharged into the LSAR and its tributaries. If WWTFs would aim for reducing their loading by half, then the potential load reduction is equivalent to 2.88×10^{12} cfu/year of *E. coli.*

$$Potential\ Load_{WWTP} = maximum\ permitted\ discharge\ ({}^{gal}/_{day}) \times \frac{63\ cfu\ E.coli}{100\ ml} \times 3785.2\ {}^{ml}/_{gal}$$

Management Measure 6: Promote improved quality and management of stormwater; coordinate with new development for reducing runoff pollutants; provide education programs on stormwater management; advocate for LID BMPs

Urban Stormwater Loadings

GIS analysis was used to calculate potential loadings from stormwater runoff across the watershed and within subwatersheds. According to NLCD land cover data, 18,798 acres in the watershed consist of high, medium, or low intensity developed cover. Assuming that a typical fecal coliform loading rate for urban runoff is 5.60×10^{9} cfu/hectare (ha) /year (Herrera, 2011), and a fecal coliform to *E. coli* conversion rate of $\frac{126}{200}$, potential urban runoff loading can be estimated by:

$$Potential\ Load = urban\ acreage \times \frac{5.60 \times 10^{9} cfu\ fecal\ coliform}{ha \times yr^{-1}} \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform} \times 0.404686\ {}^{ha}/_{ac}$$

An estimated potential annual *E. coli* load of 2.68×10^{13} cfu/year from urban runoff occurs across the watershed.

Load Reductions from Urban Stormwater BMPs

A wide variety of BMPs are available to control and treat urban stormwater runoff. The actual load reduction achieved depends on the appropriateness of the BMP chosen, BMP design, site characteristics, and long term maintenance. To estimate a load reduction potential, we assumed 50 additional acres of urban land cover would be treated by stormwater BMPs with an 88 percent *E. coli* reduction potential (as cited for dry basins in Center for Watershed Protection, 2007).

$$Potential\ Load\ Reduction = urban\ acreage \times \frac{5.60 \times 10^{9} cfu\ fecal\ coliform}{ha \times yr^{-1}} \times \frac{126\ cfu\ E.coli}{200\ fecal\ coliform} \times 0.404686\ {}^{ha}/_{ac} \times 0.88$$

The potential annual *E. coli* load reduction is estimated at 2.36×10^{13} cfu/year.

Appendix C. References

These are references for Appendix B, Load Reduction Estimates.

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