Approved August 5, 2015

Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries

Segments 0508, 0508A, 0508B, 0508C, 0511, 0511A, 0511B, 0511C, and 0511E

Produced by the Orange County Stakeholder Advisory Group,
with cooperation from the Total Maximum Daily Load Program, Office of Water,
Texas Commission on Environmental Quality

Produced by the
Stakeholder Advisory Group for the Orange County TMDLs

Distributed by the
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, Texas 78711-3087

TMDL implementation plans are also available on the TCEQ Web site at:
<www.tceq.state.tx.us /waterquality/tmdl/>

This plan was produced by the Stakeholder Advisory Group for the Orange County Total Maximum Daily Loads. The organizations that participated in developing this plan include:

Sabine River Authority of Texas

City of Bridge City

City of Orange

City of Pinehurst

City of West Orange

Orange County Drainage District

Orange County Health Department

Orange County Water Control and Improvement District #2

Orangefield Water Supply Corporation

Texas Commission on Environmental Quality

Texas A&M Forest Service

Texas Parks and Wildlife Department

Texas State Soil and Water Conservation Board

Texas Wildlife Services

Contents

Figures

Tables

List of Abbreviations

AU	animal unit
BMPs	best management practices
BOD	biochemical oxygen demand
CAFO	concentrated animal feeding operation
cBOD	carbonaceous biochemical oxygen demand
cfu	colony-forming units
CRP	Clean Rivers Program
E. coli	*Escherichia coli*
EQIP	Environmental Quality Incentives Program
GIS	geographic information system
GLO	General Land Office
I&I	inflow and infiltration
ISD	Independent School District
LA	load allocation
mL	milliliter
MGD	million gallons per day
MOS	margin of safety
NH_3N	ammonia nitrogen
NPS	nonpoint source
NRCS	Natural Resources Conservation Service
OCHD	Orange County Health Department
OSSF	onsite sewage facility
SEP	Supplemental Environmental Project
SRA-TX	Sabine River Authority of Texas
SWCD	Soil and Water Conservation District
TCEQ	Texas Commission on Environmental Quality
TFS	Texas Forest Service
TMDL	total maximum daily load
TPWD	Texas Parks and Wildlife Department
TSS	total suspended solids
TSSWCB	Texas State Soil and Water Conservation Board
TXDOT	Texas Department of Transportation
USDA	Unites States Department of Agriculture
USEPA	United States Environmental Protection Agency
WCID	Water Control and Improvement District
WLA	waste load allocation
WWTF	wastewater treatment facility
WQMP	Water Quality Management Plan

Implementation Plan for Seventeen TMDLs for Adams Bayou, Cow Bayou, and Their Tributaries

Executive Summary

On June 13, 2007, the Texas Commission on Environmental Quality adopted *Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries*. The total maximum daily loads (TMDLs) were approved by the U.S. Environmental Protection Agency (USEPA) on August 28, 2007. The segments for which TMDLs were developed include 0508, 0508A, 0508B, 0508C, 0511, 0511A, 0511B, 0511C, and 0511E. This implementation plan:

- describes the steps the stakeholders and TCEQ will take to achieve the pollutant reductions identified in the TMDL report , and
- outlines the schedule for implementation activities.

This plan will be implemented by local stakeholders, the TCEQ, Texas State Soil and Water Conservation Board (TSSWCB), Sabine River Authority of Texas (SRA-TX), and other organizations. The ultimate goal of this implementation plan is to restore the contact recreation, aquatic life, and general uses of the subject waterways. These uses and the criteria for measuring them are defined in the *Texas Surface Water Quality Standards*.

The TMDL report identified a combination of point and nonpoint sources that contribute to the impairments. Nonpoint sources of pollution in the watershed include failing onsite sewage facilities (OSSFs) and other sources such as pastures, forests, and urban runoff. Wastewater treatment facilities (WWTFs) and illicit discharges were identified as the primary point sources. The loads from the combined sources exceed the assimilative capacity of the bayous and must be reduced or redirected in order to alleviate the impairments. No single source accounts for the majority of the impairments in all locations. Therefore, each of the sources must be addressed to achieve the environmental goal.

The best long-term solution for failing OSSFs would be to replace them with connections to a WWTF. Where that is not possible due to logistics or expense, the failing OSSFs must be repaired, replaced, or upgraded.

Managing nonpoint sources requires a broad approach that incorporates the perspectives of all stakeholders in developing solutions, encourages an integrated approach for funding, and supports a well-developed public communication and

education program. A sustained, consistent public education strategy will be necessary to achieve the pollutant load reductions identified in the TMDL report.

Reducing loads from point sources could require extensive and expensive upgrades in treatment facilities. The cost of installing conveyance systems to more suitable receiving waters is likely to be less expensive.

In 2008, a study was conducted to determine the feasibility of regionalizing wastewater treatment in the project area. SRA-TX, the cities of Orange, Pinehurst and Bridge City, the Orangefield Water Supply Corporation, and the Orange County Water Control and Improvement District (WCID) #2 were the main regional organizations involved in the study. Although there are significant advantages to regionalization, funding limitations to cover the large geographic area present significant challenges for implementation of the system. Because of the significant benefits expected from regionalization, stakeholders will actively pursue plans and funding to regionalize wastewater treatment and collection.

Implementation of this plan will be in two phases. Phase I will include all the measures and actions described below. If required, Phase 2 will be developed based on the outcome of the plan to create and fund a regional wastewater collection and treatment system (Management Measure 6). The stakeholders will reevaluate progress toward the environmental goal in the fourth year of implementation to determine whether a second phase and/or revisions to the implementation plan are needed. The plan for Phase 2, if needed, will be developed beginning in the fifth year of implementing this plan.

The TCEQ will assist the stakeholders in tracking the progress of this implementation plan in restoring the affected uses by facilitating annual meetings. The SRA-TX will, as funds are available, collect water quality data under the Texas Clean Rivers Program (CRP) protocols to identify trends and compliance with the water quality standards. The TCEQ will report information from the stakeholders' annual meetings on its website.

Management Measures (Voluntary Activities)

1. *Coordinate and expand efforts to reduce stormwater inflow and infiltration.*

2. *Continue development and implementation of Water Quality Management Plans (WQMPs) and other agricultural best management practices (BMPs) in priority areas.*

3. *Identify failing OSSFs, prioritize problem areas, and systematically work to bring all systems into compliance.*

4. *Continue promoting sustainable forestry practices.*

5. *Explore the feasibility of developing and adopting ordinances for improved stormwater runoff management that are consistent across the watershed.*

6. Plan for the regionalization of wastewater treatment.

Control Action (Regulatory Activities)

Reduce pollution from WWTFs by issuing, revising, and enforcing discharge permits; and by reducing or eliminating sanitary sewer overflows.

Introduction

In order to keep Texas' commitment to restore and maintain water quality in impaired rivers, lakes, and bays, stakeholders in TMDL watersheds establish implementation plans for each TMDL that is adopted. This implementation plan describes how stakeholders in the Adams Bayou and Cow Bayou watersheds (the plan watershed) will reduce pollutants to levels defined in the TMDL report adopted in 2007. 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
- § estimates how much the pollutant load must be reduced to comply with water quality standards.

This implementation plan is designed to reduce bacteria, namely *Escherichia coli* (*E. coli)*, and two constituents that lower dissolved oxygen and affect pH—carbonaceous biological oxygen demand (cBOD) and ammonia nitrogen (NH3N), as defined in the adopted TMDLs. Figure 1 shows the extent of the watersheds covered by this implementation plan and the segments within them. Table 1 summarizes the affected uses and the support status of each of the segments in the *2004 Texas Water Quality Inventory and 303(d) List*, also known as the Integrated Report.

The implementation plan is a flexible tool used to guide water quality management activities while adapting to changing circumstances. This implementation plan contains the following components:

1) A description of the control action and management measures that will be implemented to achieve the water quality target.
2) A schedule for implementing activities.
3) The legal authority under which the participating agencies may require implementation of the control action.
4) A follow-up tracking and monitoring plan to determine the effectiveness of the control action and management measures undertaken.
5) Identification of measurable outcomes and other considerations the stakeholders may use to determine whether the implementation plan has

been properly executed, water quality standards are being achieved, or the plan needs to be modified.

6) Identification of the communication strategies the stakeholders may use to disseminate information to stakeholders and other interested parties.

7) A review strategy that stakeholders will use to periodically review and revise the plan to ensure there is continued progress in improving water quality.

Figure 1. Map of the Plan Watershed

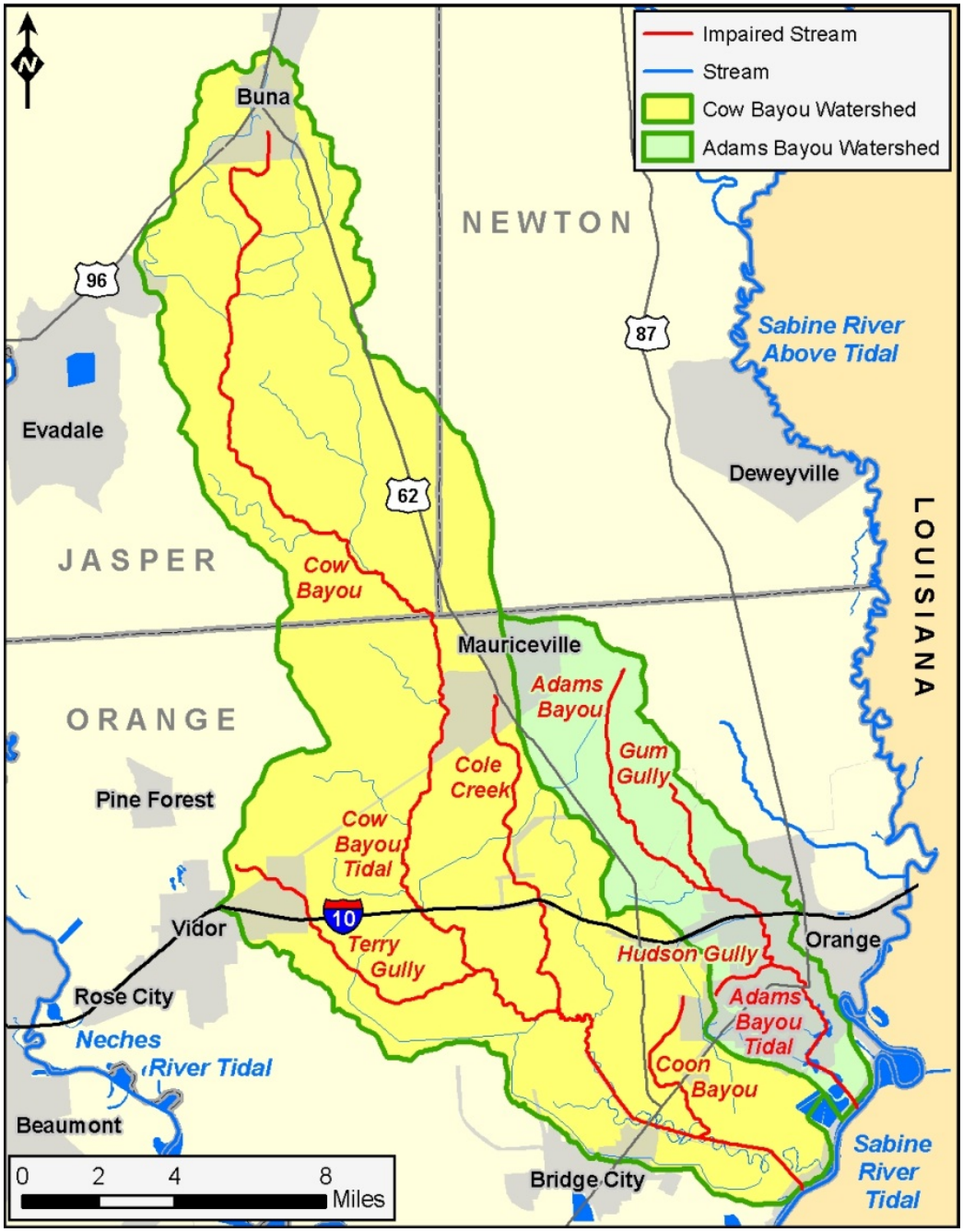

Table 1. Affected Uses and Support Status by Segment

Source: *2004 Texas Water Quality Inventory and 303(d) List*

Segment Number	Segment Name	Aquatic Life Use	Contact Recreation	General Use
0508	**Adams Bayou Tidal**	**Not supporting**	**Not supporting**	**Fully supporting**
0508A	Adams Bayou Above Tidal	Not supporting	Not supporting	Fully supporting
0508B	Gum Gully	Not supporting	Not supporting	Fully supporting
0508C	Hudson Gully	Not supporting	Not supporting	Fully supporting
0511	**Cow Bayou Tidal**	**Not supporting**	**Not supporting**	**Not supporting**
0511A	Cow Bayou Above Tidal	Not supporting	Fully supporting	Fully supporting
0511B	Coon Bayou	Not supporting	Not supporting	Fully supporting
0511C	Cole Creek	Not supporting	Not supporting	Fully supporting
0511E	Terry Gully	Fully supporting	Not supporting	Fully supporting

Watershed Overview

Adams Bayou Tidal (Segment 0508) and Cow Bayou Tidal (Segment 0511) cover approximately 51 and 194 square miles respectively, in the coastal area of the Sabine River Basin. Both segments consist of the lower portions of the bayous up to points just above Interstate-10 and are tidally influenced.

Tidal water bodies typically have limited assimilative capacity because of low flows and high dissolved solids. These conditions are worsened by high turbidity due to a heavy clay substrate and a large amount of detritus from the deciduous trees common in the area.

The watersheds cover portions of Orange, Jasper, and Newton counties. The Adams Bayou watershed includes portions of the cities of Orange, West Orange, Pinehurst, and Mauriceville. The Cow Bayou watershed includes portions of Bridge City, Vidor, Mauriceville, Evadale, and Buna. In 2010, the population of the Cow Bayou watershed (~25,600) was slightly higher than that of Adams Bayou (~18,300).

Summary of TMDLs

This section summarizes the TMDLs for the Adams Bayou and Cow Bayou watersheds. Additional background information can be found in *Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries* (TCEQ 2007).

Water quality impairments in Adams Bayou, Cow Bayou, and their tributaries were first listed by the TCEQ in the *2000 Texas Water Quality Inventory and 303(d) List* (TCEQ 2000). The TCEQ adopted the TMDL report on June 13, 2007. The USEPA approved the TMDLs on August 28, 2007, at which time they became part of the state's Water Quality Management Plan.

Source Analysis

Both point and nonpoint sources of pollution contribute to the impairments in Adams Bayou, Cow Bayou, and their tributaries. Tables 2 and 3 show the regulated dischargers in the watersheds.

Dissolved oxygen, bacteria, and pH impairments are more prevalent in the middle and upper reaches of the segments. However, most of the major wastewater dischargers are located in the lower reaches of the bayous, closer to the Sabine River. *E. coli* concentrations are elevated during low flow periods, and increase dramatically as a result of runoff events.

Except for NH_3N, nonpoint source contributions are greater than point sources in Adams Bayou Tidal. Point sources contribute a significant part of the total loads of cBOD in both Adams Bayou Tidal and Cow Bayou Tidal.

Point Sources

In the Adams Bayou watershed, there are currently four regulated wastewater discharges from four facilities. Three of the facilities are domestic WWTFs and one is industrial. Most of the dischargers are located in the lower reaches of the bayou. There are no concentrated animal feeding operations (CAFOs) in the Adams Bayou and Cow Bayou watersheds.

Cow Bayou has 20 regulated wastewater discharges from 15 facilities. Six of the discharges are from industrial facilities. Six of the nine domestic WWTFs discharge less than 0.1 million gallons per day (MGD). Most of the major discharges of wastewater are located in the lower stretch of Cow Bayou.

The regulated dischargers in both watersheds are shown in Tables 2 and 3.

Nonpoint Sources

Probable nonpoint pollution sources in the Adams Bayou and Cow Bayou watersheds include malfunctioning OSSFs, storm sewer overflows, urban runoff, pet and wildlife waste, and other natural sources.

Additional nonpoint sources in these watersheds include livestock, forest leaf-litter, human populations, and unauthorized discharges. These sources were found to be minor contributors to the overall load as compared to OSSFs and point sources.

Residential areas accounted for about one-third of the *E. coli* in Adams Bayou below Interstate 10. Pasture and forest areas had the largest load contributions in areas with the least populations.

Table 2. Domestic WWTF Dischargers

Watershed	Domestic Discharger	TCEQ Permit Number
Adams Bayou	Orange County	WQ0010240-001
	City of Pinehurst	WQ0010597-001
	City of Orange (Secondary outfall)	WQ0010626-001
Cow Bayou	City of Bridge City 001	WQ0010051.001
	Jasper WCID #1	WQ0010808-001
	Bayou Pines Park	WQ0011315-001
	TXDOT Comfort Station[1]	WQ0011457-001[1]
	Orangefield Water Supply Corp.[2]	WQ0014772-001[2]
	PCS Development Co.	WQ0011916-001
	Sabine River Authority Plant 1	WQ0012134-001
	Sunrise East Apartments	WQ0013488-001
	Waterwood Estates	WQ0013691-001

[1]TXDOT Orange County Comfort Station is no longer in operation, but was operable during the TMDL sampling efforts.

[2]The Orangefield Independent School District (ISD) discharge is now treated by the Orangefield Water Supply Corporation.

Table 3. Industrial Dischargers

Watershed	Industrial Dischargers and	TCEQ Permit Number
Adams Bayou	A. Schulman, Inc. (Inactive)	WQ0000337-000
Cow Bayou	Chevron Phillips Chemical, Orange	WQ0000359-000
	Firestone Polymers, Orange	WQ0000454-000
	Honeywell International Inc., Orange	WQ0000670-000
	Lanxess	WQ0001167-000
	Texas Polymer Services, Inc.	WQ0002835-000
	Printpack, Inc. Orange County	WQ0002858-000

Pollutant Load Allocation

The load allocation can be developed using the following equation:

TMDL = WLA + LA + MOS

Where:

WLA is the waste load allocation representing contributions from point source discharges

LA is the load allocation representing contributions from nonpoint source discharges

MOS is the margin of safety

Models created during development of the TMDL determined that cBOD and NH_3N were the two parameters most important in controlling dissolved oxygen levels in the bayous. For that reason, TMDLs were developed for cBOD and NH_3N reductions as the means of restoring support of the aquatic life.

The TMDLs were calculated based on average percent reductions from total existing loading to the water body. The water quality impairments are not uniformly distributed throughout the larger water bodies and pollutant loads are not mixed throughout the water bodies. Assimilative capacity may vary greatly with distance from the Sabine River. The load reductions described apply only to the case where a single uniform load reduction percentage is applied to all pollutant sources within the water body.

TMDLs for *E. coli*

The load reductions required in the Adams Bayou impaired segments to meet the geometric mean criterion for *E. coli* are in all cases greater than those required to meet the single sample criterion. Cow Bayou Tidal and Cole Creek are projected to meet water quality standards for contact recreation without load reductions.

TMDLs for cBOD, NH_3N, and pH

Load reductions required to meet dissolved oxygen criteria were similar throughout the Adams Bayou system. The source of low pH in Cow Bayou Tidal appears to be the degradation of organic matter, which is also the primary source of low dissolved oxygen levels. For this reason, it is expected that the same measures intended to increase dissolved oxygen levels will likely raise pH values to meet water quality standards.

A TMDL could not be established for cBOD in Cow Bayou. According to the models used in TMDL development, reducing cBOD loads, even up to 100

percent, would not improve dissolved oxygen levels or lead to attainment of the aquatic life use standard.

Although TMDLs were not established for total suspended solids (TSS) and phosphate phosphorus, Measure 3 in this implementation plan (OSSFs) is expected to reduce biochemical oxygen demand (BOD) in receiving waters. The adverse conditions commonly associated with excess nutrient input, including turbid water and episodes of low dissolved oxygen, should be mitigated by these nutrient reductions.

Implementation Strategy

The implementation strategy describes the actions that will be undertaken to achieve water quality standards in the Orange County area. The strategy specifies actions to meet the load allocations assigned to all point sources and nonpoint sources identified in the TMDL report. Action strategies were selected from a menu of possible measures based on an evaluation of feasibility, costs, support, timing, and other factors. Activities will be implemented in phases based on the stakeholders' assessment of progress.

Point sources will be reduced by directing discharges into other waterways that have the assimilative capacity to absorb the load. The stakeholders will also pursue a plan to regionalize wastewater facilities in the area. Regionalization could involve some or all of the current wastewater treatment facilities and would be aimed at converting OSSFs to the regional collection and treatment system.

The strategy for nonpoint sources includes identifying failing OSSFs and repairing or replacing them. Where possible, households on failing OSSF systems will be connected to a wastewater collection and treatment system.

OSSFs and other nonpoint sources are addressed by incorporating public communication and education programs, technical and financial assistance programs for agricultural producers, and existing programs for forestry.

Stakeholders will meet annually to assess progress using the schedule of implementation, interim measurable milestones, water quality data, and the communication plan included in this document. Based on the periodic assessments of progress, the implementation plan will be adjusted. If funding is found, the stakeholders may develop additional performance measure strategies and reports. The TCEQ will post progress information developed by the stakeholders on its website.

Adaptive Implementation

This implementation plan will be implemented using adaptive management concepts and assessment protocols. Adaptive management is a cyclical approach

described as "learning while doing." Initially, priority controls are identified and implemented. Priority controls are those which have a relatively high level of certainty in their benefits to water quality, relatively low costs, and/or are otherwise consistent with existing management practices in the watershed. Priority controls may be sufficient to resolve the water quality impairment, or, in more challenging situations, may only be sufficient to "move the watershed's water quality in the direction of reducing pollutant loads" (Shabman, L., et. al., 2007). The degree of effectiveness of priority controls depends upon the level of certainty about watershed processes, the magnitude of the water quality problems, and other factors.

In adaptive management, water quality control measures are periodically assessed for their achievement of interim and final goals. The final water quality goal of this implementation plan is attainment of the water quality standards. Interim water quality goals are a series of milestones that together form a progression toward meeting the standards. If periodic assessments find that water quality goals are not being achieved, the stakeholders will evaluate and deploy additional means for reducing pollutants in the watershed.

Management Measures for Nonpoint Sources

The management measures in this plan are expected to reduce pollutant loads from the subcategories of nonpoint source pollution identified in the TMDLs. The stakeholders are committed to implementing the six voluntary measures described below.

Measure 1: Stormwater

Coordinate and expand efforts to reduce stormwater inflow and infiltration.

This measure outlines a coordinated approach to minimize inflows and infiltration (I&I) of stormwater into wastewater collection systems in the watershed. I&I generally occur through a variety of avenues such as broken pipes, leaky manholes, or property owners who knowingly drain stormwater into sewer lines.

Excess water entering the sewer system can cause the system to become overloaded and lead to two primary problems:

1) Treatment capacity of wastewater treatment plants can be exceeded, leading to the discharge of improperly treated wastewater, or
2) Sewage conveyance systems can be overloaded, leading to sewage backup into private properties.

To address ordinary I&I problems, the organizations charged with managing the wastewater collection systems periodically conduct system evaluations, such as smoke tests or video inspections, to identify problem areas. Once identified, needed repairs or replacements are prioritized and repairs or replacements are carried out as funding allows.

Inflow issues arising from private property owners draining stormwater into the sewer system have been identified as a major problem throughout the Adams Bayou and Cow Bayou watersheds. Due to a variety of factors, excessive water often builds up on private properties across the watershed. When this happens, many property owners remove sewer-line clean-out covers and allow this water to drain into the sewer system. When enough people do this, the wastewater systems become overloaded, resulting in sewer system backups because the treatment capacity of the wastewater facility is exceeded. While the need to prevent flooding of private properties is understandable, draining this excess stormwater water into the sewer system is not acceptable.

A general lack of understanding by property owners regarding the correct management of stormwater is blamed for much of this activity. Many watershed residents are ill-informed about the problems that can result at other properties and facilities from their actions. Broad-based education and outreach is needed to address these and other stormwater management issues.

Accordingly, the stakeholders will continue activities to address I&I across the watershed and will increase the delivery of educational materials to targeted audiences. Education will be delivered through multiple avenues, including local media, local educational events (such as EcoFest, sponsored by Shangri La Botanical Gardens), homeowner's association meetings, and other sponsored events (such as cleanups and bulk trash collection). Local curriculum coordinators will be encouraged to evaluate and incorporate stormwater education into the curriculum of local schools.

Several of the responsible parties listed in Table 4 will work with other watershed organizations to expand educational activities. They will also work to coordinate their activities in order to increase awareness about stormwater issues, garner increased notice and media coverage, and explore the cost-effectiveness of creating media products.

The SRA-TX will, as resources are available, support efforts of the responsible parties to provide education and outreach materials.

Responsible Parties and Funding

Each party listed below will be responsible for implementing activities only within their respective jurisdictions.

§ City of Bridge City
§ City of Orange
§ City of Pinehurst
§ City of West Orange
§ Orangefield Water Supply Corporation
§ Orange County WCID #2 (West Orange)

Table 4. Activities to Reduce I&I Problems

Responsible Party	Continue Drainage Operations	Conduct Inspections	Maintain Educational Activities	Coordinate & Expand Educational Activities
City of Bridge City		√	√	√
City of Orange		√	√	√
City of Pinehurst		√	√	√
City of West Orange			√	√
Orangefield Water Supply Corporation		√		
Orange County WCID #2 (West Orange)		√	√	

Measurable Milestones

Year 1: As indicated in Table 4, the responsible parties will:

1) Conduct I&I inspections.
2) Make needed repairs or replacements of conveyance systems as funding allows.
3) Distribute educational information through available outlets and participate in local events.
4) Seek grants as well as funds for local Supplemental Environmental Projects (SEPs).
5) Individually or collectively meet with local curriculum coordinators to identify appropriate educational material for delivery in the local schools and discuss incorporating watershed stewardship and stormwater management education into school curricula.

Years 2 – 5: Continue activities 1 through 4 from year one and additionally:

1) Incorporate watershed stewardship and stormwater management education into local school curricula.

Table 5. Summary of Management Measure 1: Coordinate and expand efforts to reduce stormwater inflow and infiltration.

Causes and Sources: Stormwater from point and nonpoint sources

Potential Load Reduction: Not applicable. The volume of stormwater that bypasses the wastewater delivery system due to I&I is unknown, as is the bacterial concentration of that stormwater. Therefore, the potential load reduction cannot be estimated.

Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Parties
Technical: Trained personnel or contract services to continue sewer system I&I inspections **Financial**: § To conduct I&I inspections and to complete needed system repairs or replacements § To expand the delivery of educational materials to targeted audiences § To conduct watershed-wide cleanups and waste collection events	§ Inform property owners about the ramifications of improperly routing stormwater and alternative approaches they can use to avoid flooding on their properties § Educate the public at local education and outreach events such as EcoFest about potential impacts that stormwater can have on water quality § Identify and promote appropriate materials for educating students with local curriculum coordinators § Support education through citizen volunteer monitoring as funding allows	**Year 1**: Either collectively or individually, responsible parties discuss funding needs with local industry and make them aware of opportunities to apply SEP fund in the Adams Bayou and Cow Bayou watersheds **Years 1 – 5**: § Continue I&I inspections within their respective service areas and take action to address problem areas identified § Continue and/or expand delivery of education to targeted audiences § Work with curriculum coordinators in local school districts to identify appropriate educational material for delivery in the local schools	§ Continue I&I inspections § Repairs and replace conveyance systems as funding allows § Deliver educational materials delivered to multiple audiences across the watershed § Discussions held with local industry requesting SEP funds be spent to implement this plan § Discussions held with local curriculum coordinators to identify appropriate educational content § Seek grants as well as funds for local Supplemental Environmental Projects (SEPs)	§ Number of inspections completed § Number of repairs or replacements made § Number of educational materials delivered § Number of education and outreach events § Number of curriculum coordinators contacted § Number of curriculum-appropriate materials identified § Number of local industries contacted § Number of commitments from local industry to use SEP funding to implement the plan § Number of schools that have implemented watershed stewardship education in their curricula. § Number of grants or SEPs applied for or received.	§ Continue CRP monitoring as funding is available § Expand monitoring if funding found	See Table 4 for commitments by each responsible party § City of Bridge City § City of Orange § City of Pinehurst § City of West Orange § Orangefield Water Supply Corporation § Orange County WCID #2 (West Orange)

Measure 2: Agricultural Operations

Develop and implement WQMPs and other agricultural BMPs in priority areas.

Stakeholders will use a range of nonprofit and governmental programs to help landowners protect priority areas within the plan watershed. Although land uses in the watersheds have changed and continue to change, a large percentage of the Adams Bayou and Cow Bayou watersheds can still be characterized as rural or undeveloped.

Roughly 20 percent of the plan watershed is pasture or other grassland that is suitable for agricultural purposes. Grazing operations are the principal agricultural use in the watershed. The implementation of proven BMPs on priority operations is expected to reduce fecal deposition in riparian areas.

WQMPs and other activities implemented under this measure will help landowners to voluntarily protect riparian areas.

Measure 2.1: Develop and Implement WQMPs

A WQMP is a site-specific plan designed to assist landowners in managing nonpoint source pollution from agricultural and silvicultural activities. WQMPs are voluntary conservation plans based on the criteria outlined in the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Field Office Technical Guide (FOTG). Several practices from the NRCS FOTG are of specific applicability to the bacteria reduction goals of this implementation plan.

The TSSWCB administers a certified WQMP Program that provides, through local soil and water conservation districts, for the development and implementation of WQMPs for agricultural and silvicultural lands. A soil and water conservation district (SWCD), like a county, is a subdivision of state government. The Adams Bayou and Cow Bayou watersheds are within the Jasper–Newton SWCD #441 and the Lower Sabine–Neches SWCD #446.

WQMPs are developed in cooperation with landowners with assistance from the TSSSWCB, SWCD, and NRCS. They are approved by the local SWCD and are certified by the TSSWCB. The plans include appropriate land treatment practices, production practices, management measures, technologies, or combinations thereof to help landowners achieve a level of pollution prevention or reduction consistent with the state's water quality standards. The TSSWCB regularly performs status reviews on WQMPs to ensure that the producer is implementing the measures prescribed in the WQMP.

Grazing Management

A grazing management system will be a component of each WQMP developed for livestock operations in the watershed. Grazing management examines the intensity, frequency, duration, and season of grazing to promote ecologically and

economically stable relationships between livestock and forage species. The distribution of grazing animals is managed to maintain adequate and desired vegetative cover, including sensitive areas like riparian corridors. Livestock distribution is managed through cross-fencing, alternate water sources, supplemental feed placement, and shade or cover manipulation. The expected forage quality, quantity, and species are analyzed to plan for an appropriate forage-animal balance. Grazing management systems plan for potential contingencies such as severe drought, wildfires, or flooding in order to protect the resource, protect grazing animals, and reduce economic risk.

Technical Assistance

The TSSWCB, in collaboration with NRCS and the Jasper-Newton SWCD #441 and the Lower Sabine-Neches SWCD #446, will continue to provide technical assistance to landowners in developing and implementing WQMPs. TSSWCB will develop WQMPs on all livestock operations in the Adams Bayou and Cow Bayou watersheds whose owners request planning assistance through the SWCD. The TSSWCB will perform annual status reviews on at least 15% of all WQMPs in the Adams Bayou and Cow Bayou watersheds.

Financial Assistance

The Jasper-Newton SWCD #441 and Lower Sabine-Neches SWCD #446 are within a WQMP priority area and are eligible for financial assistance through the TSSWCB WQMP Program. The NRCS administers numerous Farm Bill programs authorized by the U.S. Congress that provide financial assistance to landowners, groups, and units of government to develop and implement conservation plans. Among those programs is the Environmental Quality Incentives Program (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.

Local Work Groups provide recommendations to the NRCS on allocating EQIP funds and resource concerns. Stakeholders will participate in the Local Work Group in order to promote Management Measure 2 as compatible with the resource concerns and conservation priorities for EQIP.

Measure 2.2: Protect riparian areas by managing land for wildlife

Texas Parks and Wildlife Department (TPWD) Private Lands Services provides private landowners with practical information about ways to manage wildlife resources consistent with other land use goals, to ensure plant and animal diversity, to provide aesthetic and economic benefits, and to conserve soil, water and related natural resources.

The TPWD Pineywood and Oak Prairie districts serve the Adams Bayou and Cow Bayou watersheds. Biologists of these TPWD districts will encourage landowners in the watershed to participate in the Private Lands program. After assessing a property's potential, a TPWD biologist will provide recommendations to the landowner. If requested, the biologist will help the landowner develop a written wildlife management plan.

Measure 2.3: Reduce feral hog populations

As feral hogs congregate in riparian areas to drink and wallow, their high numbers pose a threat to water quality. Feral hogs deposit fecal matter directly in streams and can cause extreme erosion and soil loss with their extensive rooting activities. The destructive habits of feral hogs cause an estimated $52 million worth of agricultural crop and property damage each year in Texas.

Stakeholders in the Adams Bayou and Cow Bayou watersheds will take steps to reduce the population and limit the spread of feral hogs, thereby minimizing their effects on water quality. Texas Wildlife Services, through cooperative agreements between the Texas A&M AgriLife Extension Service (AgriLife Extension) and the U.S. Department of Agriculture (USDA), provides statewide leadership in the science, education, and practice of managing wildlife and invasive species such as feral hogs.

AgriLife Extension has produced more than a dozen fact sheets addressing various aspects of feral hog management. While originally targeted to landowners in another watershed, these fact sheets are applicable statewide. Titles of some of the fact sheets include: Recognizing Feral Hog Sign; Corral Traps for Capturing Feral Hogs; Feral Hogs Impact Ground-nesting Birds; Feral Hog Laws and Regulations in Texas; Feral Hog Transportation Regulations; and Using Fences to Exclude Feral Hogs from Wildlife Feeding Stations. Texas Wildlife Services and AgriLife Extension will distribute these fact sheets within the watershed to support stakeholder efforts to manage feral hog populations.

AgriLife Extension has also developed a series of six publications that address management strategies and techniques for feral hog control and an on-line feral hog activity reporting system to help identify target areas for feral hog control activities.

Texas Wildlife Services will provide technical assistance about how to best resolve feral hog problems. Since 2008, the Texas Department of Agriculture has awarded grants from the state general revenue to Texas Wildlife Services for feral hog abatement programs where control efforts can be measured. Certain areas of the plan watershed have been targeted for funding because bacteria loading from feral hogs contribute to impaired water quality.

Measure 2.4: Deliver environmental stewardship courses locally

AgriLife Extension, an agency of the Texas A&M University System, provides quality, relevant, outreach and continuing education programs and services to Texans. AgriLife Extension will provide technical assistance to help:

- Consumers, homeowners, agricultural producers, communities, and irrigation districts understand and adopt BMPs to protect water quality.
- Landowners, professional ecosystem managers, community planners, and other interest groups become more knowledgeable, make informed decisions, and adopt BMPs that ensure the proper management of natural resources.

Funded by federal nonpoint source grants administered by the TSSWCB, AgriLife Extension, and the Texas Water Resources Institute developed several *Lone Star Healthy Streams* curricula focusing on proper grazing, feral hog management, and riparian area protection. These educational programs are being delivered statewide and promote the adoption of BMPs and participation in federal and state cost-share programs to reduce bacteria and other pollutant loading to area streams. Delivery of these programs in the Adams Bayou and Cow Bayou watersheds will raise landowner's awareness of BMP effectiveness, implementation costs, and their ability to reduce bacteria loadings.

In concert with curriculum development, AgriLife Extension is evaluating the effectiveness of selected BMPs in reducing bacteria loading from grazing cattle to streams. Initial results from this evaluation indicate that significant changes in animal behavior and subsequent reductions in fecal loading can be achieved through proper BMP implementation. Implementing well planned grazing plans in the Adams Bayou and Cow Bayou watersheds should therefore yield positive results.

Measure 2.5: Promote environmental stewardship

The responsible parties will use existing educational materials and avenues to promote environmental awareness and stewardship among area residents. Delivery methods will include workshops or events in or near the watershed, direct personal communication, and printed information.

Responsible Parties and Funding

- TSSWCB
- Jasper–Newton SWCD #441
- Lower Sabine–Neches SWCD #446
- NRCS
- Agrilife Extension
- Texas Wildlife Services
- TPWD

§ Local Landowners

The TSSWCB will provide technical assistance to agricultural producers in developing WQMPs. The TSSWCB utilizes both state general revenue and federal grants to fund the program. Historically, WQMP implementation in the plan watershed has been low; consequently, current funding should be sufficient to meet implementation needs in these watersheds. However, continued funding is dependent on appropriations from the Texas Legislature.

The NRCS will also provide appropriate levels of cost-share assistance to landowners to support the implementation of BMPs and WQMPs in the Adams Bayou and Cow Bayou watersheds. The NRCS expects that existing levels of financial assistance available through multiple Farm Bill programs should be sufficient to satisfy demand and need in the Adams Bayou and Cow Bayou watersheds, depending on continued appropriations from the U.S. Congress. The NRCS will catalogue the BMPs that have already been implemented in the plan watershed.

Cost share for implementing a wildlife management plan could be available through the TPWD's Landowner Incentive Program (LIP). Various USDA programs may also provide funding to eligible landowners.

Texas Wildlife Services will need additional cooperative funding to continue its direct control of feral hog control activities.

Grant funding will be necessary to deliver the *Lone Star Healthy Streams* curricula to residents of the Adams Bayou and Cow Bayou watersheds. The TSSWCB and AgriLife Extension can help the stakeholders identify and apply for grant funding to support education and outreach.

Measurable Milestones

Year 1: Responsible parties will work to:

1) Promote the availability of technical and financial assistance for the development and implementation of WQMPs, wildlife management plans, and/or a feral hog control program.
2) Undertake education and outreach activities to inform landowners about the availability, benefits, and need for conservation plans and good stewardship.
3) Begin developing and implementing conservation plans with willing landowners.

Year 2-5: Responsible parties will continue to work with landowners to:

4) Develop and implement conservation plans as requested by the landowners.

5) Provide education and outreach to targeted and general audiences.

Year 5:

6) The stakeholders and responsible parties will evaluate progress and assess the need for strategy revisions.

Table 6. Summary of Management Measure 2: Develop and implement WQMPs in priority areas of the watersheds

Causes and Sources: Livestock, forestry and wildlife nonpoint sources

Potential Load Reduction: Specific load reductions are not defined. The load reduction equation was developed based on site-specific scenarios and actual BMP implementation, using a modified equation from USEPA's 2001 *Protocol for Developing Pathogen TMDLs*. Appendix B provides calculation information; load reductions are expressed in cfu/day.

Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Parties
Technical: § Support from NRCS, SWCDs, and TSSWCB personnel for WQMP development **Financial**: § Funding for technical assistance; available through a variety of programs § Special funding, currently available, for the delivery of education and outreach in or near the watershed § Funding support for WQMPs; likelihood increased because the watershed lies in a WQMP priority area § Funding for disadvantaged producers who cannot compete with larger landowners; must be sought	§ Deliver workshops in or near the watershed that focus on proper land, livestock, and water stewardship § Use existing educational materials to provide pertinent information on management practices § Use existing informational avenues to promote the development of conservation plans § Deliver environmental stewardship courses locally	**Year 1**: § Promote the availability of conservation plans and deliver educational materials to landowners § Catalogue the BMPs that have already been implemented in the watershed § Begin developing conservation plans with willing landowners § Continue to educate residents through existing programs § Continue to conduct status reviews on existing WQMPs as appropriate and revise as needed **Year 2-5**: § Concurrently develop and implement conservation plans and continue education § Continue to conduct status reviews on existing WQMPs as appropriate and revise as needed **Year 5**: § Evaluate progress and reassess strategy § Continue educational activities	§ Promote the availability of conservation plans § Develop list of BMPs that have already been implemented in the watershed	§ Measurable improvements in water quality (both bacteria and dissolved oxygen) § Number of WQMPs developed and reviewed § Number of acres under conservation plans § Number and type of BMPs implemented § Number of educational programs and number of educational materials delivered § Number of attendees at educational events	§ SRA-TX will continue CRP monitoring as funding is available § Expand monitoring if funding found § Conduct status reviews of implemented WQMPs § Consider promoting volunteer monitoring (Texas Stream Team) in Year 5	§ All parties working cooperatively will prioritize areas for developing conservation plans § AgriLife Extension, NRCS, TSSWCB, and SWCDs will deliver education and outreach § SWCDs, TSSWCB, NRCS, and landowners will develop and implement WQMPs § TPWD will work with landowners to develop wildlife management plans § Texas Wildlife Services will assist landowners with feral hog management

Measure 3: OSSFs

Identify failing OSSFs, prioritize problem areas, and systematically work to bring all systems into compliance.

Responsible parties will improve the identification, inspection, pre-installation planning, education, operation, maintenance, and tracking of all OSSFs in the plan watershed to minimize the potential for pollution from malfunctioning systems.

The most recent data reported for OSSFs in the plan watershed was collected through the 1990 Census, which reported 888 OSSFs in the Adams Bayou watershed and 5,582 OSSFs in the Cow Bayou watershed. Additionally, 128 homes were not connected either to a public sewer system or an OSSF.

Soils in Adams Bayou and Cow Bayou watersheds are not conducive to conventional OSSFs. Almost all newer OSSFs (installed since 1991) are required to be aerobic systems due to the elevated possibility of failure with conventional systems. As indicated in the TMDL, almost all conventional OSSFs in the plan watershed are considered to be failing due to soil and groundwater conditions. Aerobic systems, though better suited to the area, also fail at significant rates when proper operation and maintenance is not carried out.

Measure 3.1: Identify and map all OSSFs in Orange County

The first step is to identify OSSFs in Orange County in the Adams Bayou and Cow Bayou watersheds. Orange County is an Authorized Agent and currently tracks the locations, ages, and types of OSSFs operating within the county. However, systems installed prior to 1991 were not well documented or not documented at all. Systems that have been in operation 20 years or more have an increased likelihood of failure; therefore, identifying the location of these older systems will aid in reducing potential *E. coli* loading.

After identifying all the OSSFs in operation within the watershed, the Orange County Health Department will collect GIS information about them. Using this information, the Orange County Health Department (OCHD) will map these OSSFs along with the extent of the current sewerage system. Basic data as the foundation for this mapping is available in 911 address point files, layers associated with certificates of convenience and necessity, and 2010 Census block data. After that, dwellings and other facilities not served by known systems will be identified.

In addition to mapping OSSF locations, the GIS will document pertinent information related to the installation, operation, maintenance, and performance history of all the systems. This GIS data will form the basis for identifying potential problem areas and prioritizing those areas for action.

The Texas General Land Office (GLO) is developing an inventory of OSSFs within the coastal zone under the state's Nonpoint Source Program and the Coastal Zone Act. A portion of Orange County does fall in the coastal zone designated in amendments to the Act.

The Stakeholder Advisory Group will coordinate with the GLO's project as appropriate to further the objectives of Management Measure 3.

Measure 3.2: Identify and prioritize problematic systems or system clusters

Once identified, the OCHD will inspect OSSFs as time and funding allow. Physical inspections are necessary to properly identify problematic OSSFs or clusters of OSSFs. Accurate information is critical to identifying priority areas of the watershed for repairs and replacements. Personnel currently employed by the county must use most of their time responding to complaints or permitting new systems. Additional funding is needed to add personnel who will gather information to prioritize problem areas, conduct proactive inspections, and work with system owners to bring deficient systems into compliance.

Measure 3.3: Promote environmental awareness and stewardship

Education and outreach will target landowners and local officials who have the ability to mitigate pollution problems from OSSFs at community, county, watershed, and regional scales. Many printed materials are currently available through AgriLife Extension about proper maintenance of the various OSSF systems currently in use. These materials will be delivered at events or workshops. They will also be given to owners at their homes and to officials at meetings to enable them to discuss options for managing sewage in their jurisdictions.

Responsible Parties and Funding

The listed parties will be responsible only for working to identify areas where improvements can be made. This measure does not include public funds for repairing or replacing OSSFs. Although additional funding is needed to fully implement this measure, that funding has not yet been obtained.

- § OCHD
- § TCEQ Region 10
- § Cities of Bridge City, Orange, Pinehurst, and West Orange
- § OSSF owners

OCHD personnel will be responsible for most of the activities associated with this management measure. The OCHD has the authority and jurisdiction for OSSFs in the county, including installation of new systems.

Cities throughout Orange County will assist in efforts to identify all OSSFs in the watershed by providing GIS information about known OSSF locations within their own jurisdictions, as well as the locations of existing wastewater conveyance systems.

The OCHD, SRA-TX, and TCEQ Region 10 will, as resources are available, work together to identify specific educational needs and seek the technical and financial assistance needed to deliver this education locally. When this is accomplished, all the responsible parties will work within their own jurisdictions to deliver educational information to targeted audiences. OSSF owners are responsible by Texas law for maintaining, repairing, and replacing their own systems using acceptable systems and practices.

Measurable Milestones

Year 1: The responsible parties will work to:

§ Identify and map OSSF locations throughout the watershed.
§ Prioritize areas for management by conducting system inspections.
§ Identify education and outreach needs.
§ Identify education and outreach needs and audiences to be targeted.
§ Coordinate with the GLO coastal zone project as appropriate.

Year 2 – 5: Using information obtained in year 1 through identification and prioritization efforts, the responsible parties will:

§ Conduct OSSF inspections.
§ Work with system owners to bring deficient systems into compliance.
§ Continue to identify and deliver education and outreach to targeted audiences.

Table 7. Summary of Management Measure 3: Identify OSSFs, prioritize problem areas, and systematically work to bring systems into compliance

Causes and Sources: Nonpoint sources from OSSFs

Potential load reduction: Estimates are per OSSF replaced or repaired. See Appendix B for equations and calculations.

***E. coli**:* 6.62 x10^10 cfu/day*;* **BOD**: 1.12 x10^5 mg/day; **TSS**: 4.64 x10^4 mg/day; **Ammonia**: 2.32 x10^4 mg/day; **Phosphate**: 9.94 x10^3 mg/day

Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Parties
Technical for: § Education of officials § GIS support for identifying & prioritizing subwatersheds § Training for inspections personnel **Financial to**: § Hire personnel or a contractor to do inspections, identify problems and priority areas, and conduct follow-up inspections after repairs or replacements § Help homeowner's complete repairs or replacements § Educate local officials about the importance of proper OSSF operation and maintenance § Cover costs of monitoring before and after repairs. § Pay in full for some replacements and repairs for underprivileged OSSF owners	§ Provide information on local organization websites that describes proper OSSF operation and maintenance, with links to resources § Deliver educational information to public officials § Distribute printed educational materials to targeted audiences	**Year 1**: § Map and prioritize focus areas for inspections § Educate local officials **Year 2-5**: § As funding allows, concurrently inspect systems in priority areas and bring them into compliance § Continue education and outreach for targeted audiences § Conduct pre- and post-repair water quality monitoring of OSSF effluent as funding and staff time allow	§ Establish priority areas for OSSF inspections § Begin inspecting OSSFs and labeling them for repair or replacement § Conduct outreach and education activities	§ Number of OSSF inspections conducted § Number of OSSF enforcement actions § Number of OSSF repairs and replacements completed § Number of educational events/ materials provided	§ SRA-TX will continue CRP monitoring as funding allows § Consider including volunteer monitoring at later date; e.g., 5 years after start of plan measures	§ OCHD will identify and prioritize subwatersheds; SRA–TX may assist with GIS analysis and mapping, as funding and resources allow § OCHD, TCEQ Beaumont Region, and contractors will do additional inspections of OSSFs as funding allows § OSSF owners will repair or replace their malfunctioning systems § OCHD and TCEQ will provide routine education and outreach. OCHD and SRA-TX may deliver educational materials § The Stakeholder Advisory Group will coordinate with the GLO's project as appropriate to further the objectives of Management Measure 3

Measure 4: Forestry Practices

Continue promoting sustainable forestry practices throughout the watershed.

Forestry is a major land use in the watershed and has been identified as a potential contributor to instream water quality problems. Responsible parties will work to educate foresters, landowners with forestry interests and other interested parties on the use of forestry BMPs to mitigate adverse water quality impacts.

More than 90 percent of forestry owners and operators in the watershed adhere to Texas forestry guidelines and employ BMPs. The Texas A&M Forest Service (TFS) promotes proper selection, installation, operation, and maintenance of forestry BMPs to landowners, loggers, and logging contractors. Use of many of these BMPs can directly affect instream water quality, especially establishment and maintenance of appropriately sized streamside management zones, stream crossings, and harvesting techniques.

The TFS will remain actively engaged in providing technical expertise about educational opportunities about forestry practices that improve water quality. Through these venues, stakeholders with forestry interests in the Adams Bayou and Cow Bayou watersheds will be educated about good forestry management practices that promote and sustain instream water quality.

Responsible Parties

The TFS will be responsible only for providing technical assistance and helping landowners find financial assistance. Landowners, loggers, and logging contractors will be responsible for voluntarily implementing these practices.

- TFS
- Local Landowners
- Loggers
- Logging Contractors
- Foresters

The TFS will continue to provide education to landowners, loggers, logging contractors, and others about proper forestry techniques and information on advancements in management strategies. The TFS will also notify stakeholders in the forestry industry about technical and financial assistance programs available. Technical assistance will be provided at the request of local landowners through existing programs, based on individual landowner management goals.

Local landowners are responsible for volunteering to receive technical assistance to improve management on their properties. In doing so, landowners must agree to the terms and conditions of an individual program and fulfill these terms.

Landowners are also responsible for participating in educational opportunities and applying what they learned to their lands.

Loggers and logging contractors are responsible for participating in educational opportunities and applying concepts they learned to lands that they manage.

Measurable Milestones

Year 1 – 5:

§ The TFS will continue to deliver technical assistance to forestry interests in or near the Adams Bayou and Cow Bayou watersheds.

§ Forest owners, managers, and harvesters will apply BMPs as appropriate to mitigate adverse effects on water quality.

Table 8. Summary of Management Measure 4: Continue promotion of sustainable forestry practices throughout the watershed

Causes and Sources: Nonpoint sources from agricultural and wildlife land uses

Potential Load Reduction: To be determined

Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Parties
Technical: § TFS will provide technical assistance to landowners, foresters, loggers, logging contractors and others as appropriate promoting sound forestry management practices that promote improved water quality § TFS will provide technical assistance as requested to landowners **Financial**: § When available, TFS will promote the availability of financial assistance to forestry interests in the watershed § Through existing Farm Bill programs, funds can be provided for voluntary reforestation efforts	TFS will provide education and outreach opportunities in and near the watershed to deliver needed CEUs to forestry stakeholders advising them on the proper installation, operation and maintenance of forestry BMPs.	**Years 1 - 5**: § TFS reaches out and provides education as appropriate in and near the watershed § Landowners and forestry managers voluntarily implement, operate, and maintain appropriate BMPs on forested lands in their care	§ Delivery of education and outreach in and near the watershed § Documentation of materials delivered § Documentation of landowner and forestry personnel participation § Documentation of BMP implementation through survey feedback	§ Number and type of BMPs implemented in the watershed § Number of landowners and managers participating in voluntary BMP adoption § Number of education and outreach programs delivered in or near the watershed § Number of attendees at events	§ Tracking of properties under management plans § Tracking number and types of BMPs implemented § Instream water quality improvements in portions of the stream near intensive forestry operations § CRP partners and volunteers conduct water quality monitoring as funding is available	§ TFS provides technical expertise for education and outreach activities § TFS tracks adoption of management plans and practices by landowners and forest managers § Landowners and forest managers implement practices to protect/restore water quality

Measure 5: Ordinances

In year 1, explore the feasibility of developing and adopting ordinances for improved stormwater runoff management that are consistent across the watershed. If determined feasible, work on ordinances in years 2 through 5.

Responsible parties in the watershed have identified the issues with managing stormwater runoff and will now outline a path for moving forward with developing and adopting ordinances that are consistent across the watershed. The stakeholders identified a need to better enforce stormwater runoff management; however, before enforcement, there must be an effective framework in place that explains the roles and enforcement mechanisms of the regulators and the regulated parties.

Within this overarching management goal, more specific needs can be addressed as they are identified. These may include needs such as evaluating the suitability of both planned and existing stormwater mitigation strategies and developing requirements for new development and re-development.

Representatives from responsible parties will convene and discuss the feasibility of developing a framework for ordinances that promote improved stormwater runoff management. If feasible, discussions will be continued as needed to collectively develop this framework. Realizing that each organization has its own specific needs and circumstances to address, the framework will remain flexible so that language for organization-specific ordinances can be adapted from this framework.

Ordinance development and adoption are separate activities. Language for a proposed ordinance is developed and presented to city council members for consideration and possible adoption. As a result, ordinance adoption directly depends on both public and political will and cannot be guaranteed.

Education is critical to effectively implement this management measure. Elected officials ultimately decide the fate of an ordinance and if it will be adopted. Therefore, ensuring that these officials understand the benefits of such ordinances is critical to their adoption.

Responsible Parties and Funding

All of the responsible parties listed will participate in discussions to develop a standardized ordinance framework for stormwater management across the watershed. Staff of the organizations will work to educate elected officials about the importance and benefits of developing and implementing stormwater management ordinances. The stakeholders do not anticipate that additional funding will be needed for developing the ordinance framework or specific ordinances. Funding needs may arise for educating elected officials.

- City of Bridge City
- City of Orange
- City of Pinehurst
- City of West Orange
- Orange County

Measurable Milestones

Year 1:

- Responsible parties will convene to discuss the feasibility of developing a uniform stormwater management ordinance framework.
- If feasible, they will proceed with developing this ordinance framework collectively.
- Staff of the responsible parties will educate local officials about the importance and benefits of such ordinances.

Years 2 – 5:

- If determined to be feasible in Year 1, responsible parties may begin to develop specific ordinance language to meet their respective stormwater management needs.
- Staff of the responsible organizations will educate local officials about the benefits of such ordinances.
- If feasible, ordinances will be drafted and brought before appropriate officials to consider for adoption.

Table 9. Summary of Management Measure 5: Explore the feasibility of developing and adopting consistent ordinances across the watershed to promote improving stormwater runoff management.

Causes and Sources: Nonpoint source pollution from stormwater

*Potential Load Reduction: c*annot be quantified until ordinances are established

Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Parties
Technical: § Exploring ordinance feasibility will consist mainly of discussions between responsible parties § Assistance may be required to deliver a large-scale education program to local officials **Financial**: § If a large scale education program is needed, funding will be needed to support its delivery	§ Staff will inform appropriate personnel and officials of the need for developing and implementing a consistent stormwater management ordinance framework § If framework developed, responsible parties will educate local officials on ordinance needs and use to gain their support for future ordinance development § As needed, a large scale educational program targeted toward local officials will be delivered to illustrate the need for proper stormwater management and its impacts on local water resources	**Year 1**: § Discuss the feasibility of developing a uniform ordinance framework § If feasible, continue discussions and proceed with developing this ordinance framework § Educate local officials about the benefits of ordinance development **Years 2 – 5**: § Begin to develop ordinance language and recommend to appropriate officials for consideration. § Continue educating local officials as needed § Upon development of ordinances, seek approval from local officials and begin implementation if approved	**Year 1**: § Discussions initiated to assess the feasibility of uniform ordinance framework development § Educational materials delivered to target audiences **Years 2 – 5**: If ordinance development determined feasible: § Develop uniform ordinance framework developed § Develop organization-specific ordinance language and recommend for adoption	§ Number of coordination discussions held § Number of educational events/ materials provided **Years 2 – 5:** If ordinance § Consistent stormwater ordinance framework established § Ordinance language developed § Number of draft ordinances § Number of ordinances adopted	§ CRP partners and volunteers conduct water quality monitoring as funding is available § Cities will conduct stormwater monitoring as required by stormwater permits	All parties are responsible for discussing and assessing the feasibility of developing a consistent framework. § If framework is feasible, all parties are responsible for developing the consistent ordinance framework § All parties are responsible for providing needing education to local officials § Individual governmental organizations are responsible for pursuing stormwater ordinance development, adoption, and implementation in their own jurisdictions § The Stakeholder Advisory Group will track progress of ordinance development and adoption in the various jurisdictions

Measure 6: Future WWTFs

Relocate wastewater outfalls to the Sabine River. Plan for the regionalization of wastewater treatment.

The Sabine River flows through our communities, into Sabine Lake, and from there to the Gulf of Mexico. The stakeholders listed in this implementation plan are committed to improving the quality of water reaching the Gulf. We believe the water quality improvements that could be realized from a regionalization project make it one of the best funding candidates available for the trustees of the federal Natural Resource Damage Assessment and Restoration Program. The NRDA Restoration Program is coordinating assessment, management, and funding for the restoration needed along the Gulf Coast after the Deepwater Horizon spill.

Point sources were found to be large contributors of loading to the impaired bayous, and they are continuous sources of loading across all flow regimes. The complete removal of their discharges would have a very definite, positive impact on water quality. Also, the best long-term solution for failing OSSFs would be to connect homes currently using them to a regional WWTF.

Measure 6.1: Relocate outfalls of existing facilities.

Where feasible, and in the absence of regionalization, wastewater outfalls at existing facilities that discharge to the bayous will be relocated to the Sabine River, which has better assimilative capacity than that of the bayous.

Measure 6.2: Plan for regionalizing wastewater treatment.

The stakeholders wish to form a regional wastewater authority to direct the process of regionalizing wastewater treatment and collection. The timing for implementation of a regional system is at a critical stage given the following factors.

- The existing facilities are aged. Original construction of many facilities goes back as far as the 1960s (Table 10).
- The existing plants will require significant capital investment over the next 30 years simply to maintain their existing conditions, without providing for increased flows or improving reliability in the collection system due to population growth or during wet weather.
- The TMDL does not allow for increase in waste loads, which affect permit limits. It is likely that the dischargers will need to make additional investments in existing plants to meet future growth and permit limits.
- The regional system would provide an alternative by which to mitigate failing septic systems. This benefit is especially critical to developed areas that do not have adequate space to replace failing OSSFs.
- The recent experience of flooding due to surge from Hurricane Ike indicates a need to construct new facilities that will mitigate damage from surges.

Table 10. Construction and improvement history for domestic WWTFs

Facility	Original Construction	Improvements
Bridge City	1977	1988
Orange	1965	1997
Pinehurst	1963	1985, 2004, 2008
OC WCID #2	1963	1985, 1997, 2004

The stakeholders will pursue a strategy for combining flows from five existing WWTFs into two larger facilities. The infrastructure needed to connect these regional wastewater treatment facilities would also provide access for several areas of Orange County where failing OSSFs could be connected to the regional system for wastewater treatment.

The first regional facility would use the existing City of Orange WWTF, which currently discharges treated wastewater by permit into the Sabine River. This WWTF would be upgraded to accommodate the wastewater flows from the City of West Orange and recently annexed areas in the City of Orange. This upgrade would remove point source discharges from Adams Bayou. A second, new regional WWTF would be built for treating wastewater from the City of Bridge City, City of Pinehurst, and Orangefield Water Supply Corporation (OWSC), thereby eliminating additional discharges from Adams Bayou and Cow Bayou.

Advantages of Regionalization

There are several significant advantages to regionalization. If the number of small dischargers could be reduced and funneled to a regional facility, loads to the bayous would be reduced. Total removal of existing point sources from Adams Bayou and Cow Bayou watersheds would result in an immediate and long term improvement in water quality. Sanitary sewer overflows could be reduced or eliminated.

Many of the smaller treatment facilities that would be replaced with a regional WWTF are unmanned much of the time. They are not given the same level of maintenance and daily monitoring a major regional facility would have. This would translate to better treatment of wastes and cleaner effluent.

The effluent from the regional facility would discharge to the Sabine River, which has a much greater assimilative capacity than the smaller, more slowly flowing bayous currently being utilized. Relocation of wastewater outfalls from current facilities from the bayous to the Sabine River could also accomplish the same goal, but may not be as cost effective or efficient as regionalization.

Another advantage is the expansion of a wastewater collection system to areas previously un-served where OSSFs are currently in use. The loading from this major nonpoint source category — the high failure rate of OSSFs documented in the region — would be reduced by moving wastewater from OSSFs to WWTFs.

Regionalization provides the following indirect benefits.

- Maintaining certified wastewater operators is, in general, more difficult for smaller operations. The regional system provides the opportunity to have staff with a wider range of operator certifications.
- Smaller cities may be able to retain current staff and focus on maintenance of the collection system.
- The regional system can be located central to expected areas of development.

Time Frame and Authority

A study in 2009 confirmed the feasibility of regionalizing wastewater collection and treatment in the project area (Regional Wastewater Study for Eastern Orange County, Texas, 2009). A regional system could be implemented in a reasonable time frame, provided that funding can be obtained and all parties cooperate to share financial responsibility.

Two state statutes allow for establishment of a regional authority in less than a year. A new regional system must meet the immediate capacity needs of each of the facilities it replaces, and reserve future capacity for population growth and for moving residences from OSSFs to regional collection and treatment.

Financial Considerations

Funding presents a major challenge to realizing the goal of regionalizing wastewater management. The estimated cost for this project is $50,000,000. Some matching funds could be provided by the entities involved in the consortium. However, these entities have limited ability to assume new debt.

Stakeholders have already begun to seek funding to construct a regional wastewater treatment plan in eastern Orange County, and have formed a consortium called the Orange Interlocal Deepwater Horizon Restoration Group, an ad hoc group formed to pursue possible funding through Deepwater Horizon restoration grants. The consortium includes the cities of Bridge City, Orange, Pinehurst, Vidor, along with the SRA-TX, the Port of Orange, Orange County WCID #2, and the OWSC.

Financial analysis supports the feasibility of implementing a regional system when compared with continued investment in existing plants. The operations and maintenance savings of a regional system can help to offset the costs of higher capital investment to construct a regional system. Over a 30-year period, the cost of maintaining a regional system is about $100,000 per year more than

maintaining existing WWTFs. However, the cost analysis did not account for the costs of capital improvements that will be required to upgrade the existing facilities or the cost of abandoning existing plants.

Responsible Parties and Funding

§ Stakeholder Advisory Group

The Stakeholder Advisory Group will pursue funding from the State Revolving Fund administered by the Texas Water Development Board. They will also investigate federal grant resources, such as the BP oil spill settlement. Because the governmental organizations in the watershed are limited in their ability to repay large (or several) loans, grants will be needed in addition to loans to make completion of these actions feasible.

Measurable Milestones

§ Grants and/or loans applied for.

§ Grants and/or loans secured.

§ Number of WWTF outfalls relocated to the Sabine River.

Table 11. Summary of Management Measure 6: Plan for the regionalization of wastewater treatment

Causes and Sources: Nonpoint sources of sewage (OSSFs)

Potential Load Reduction: dependent on number of WWTF's relocated and number of OSSF's connected.

Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Parties
Funding will be needed for relocation of discharge outfalls and to regionalize wastewater collection and treatment.		§ **Year 1**: Investigate funding options § **Years 2-3**: Pursue funding opportunities § **Years 4-5**: If funding secured, relocate outfalls or build new facility	§ Funding opportunities identified and pursued § Construction of new facility or relocation of outfalls	§ List of options identified § Number of grants and/or loans applied for § Number of grants and/or loans secured § Number of outfalls relocated or progress of new facility	The Stakeholder Advisory Group will monitor progress of this measure at their annual meetings	Stakeholder Advisory Group

Control Actions for Point Sources

Control Action 1.0: WWTFs

Reduce pollution from WWTFs by issuing, revising, and enforcing discharge permits; and by reducing or eliminating sanitary sewer overflows.

Action 1.1: Issue or renew municipal and industrial permits consistent with the TMDLs

Wastewater discharges are authorized and regulated under the Texas Pollutant Discharge Elimination System (TPDES). WWTF permits are generally issued for five-year periods. As permits come due for renewal or amendment, the TCEQ will review and adjust them as needed to comply with the TMDLs for the watershed. Any new facilities will also be regulated according to the same requirements.

Allowable concentrations of bacteria in WWTF effluent throughout Texas are consistent with the bacteria criteria established to protect the contact recreation use. *E. coli* concentrations are regulated for discharges to fresh water, and *Enterococci* for discharges into salt waters.

Discharges of cBOD and NH_3N will be limited by permit to concentrations consistent with the TMDLs established to raise instream levels of dissolved oxygen.

Action 1.2: Enforce permit compliance

All WWTFs in the watershed will monitor their discharges according to the provisions of their permits and report them on Discharge Monitoring Reports (DMRs) as required. Self-reported discharge monitoring is designed to ensure that a facility's effluent complies with its permit limits. If monitoring at a facility indicates concentrations approaching or exceeding permit limits, then said facility will make necessary operational changes to comply with its permit.

The TCEQ is responsible for routine enforcement of permit compliance with individual permits. Each regulated discharger in the watershed is responsible for complying with the conditions of its permit.

Sanitary Sewer Overflows

Regulated WWTFs must report any sanitary sewer overflows (SSOs) to the TCEQ. Such overflows are violations of permits and are subject to fines under some conditions. Regulated facilities in the watershed will continue to monitor and report any SSOs and will take appropriate action to remedy the causes of these overflows.

Texas Water Code Section 7.067 allows the TCEQ discretion to approve a SEP that would assist local governments to come into compliance with environmental

laws or to remediate the harm caused by SSOs. The stakeholders will pursue opportunities to implement SEPs that will reduce loading from WWTFs in addition to maintaining, repairing, and/or upgrading WWTFs to comply with permit limits.

Action 1.3 Reduce or Eliminate System Overflows

Update facilities as needed to accommodate rising population and convert OSSF users to wastewater collection and treatment systems.

Responsible Parties and Funding

- Regulated dischargers
- TCEQ (Office of Water; Office of Compliance and Enforcement)

Measurable Milestones

- Number of permits issued or renewed with revised permit limits.
- All WWTFs are monitoring and reporting within permit limits.

Table 12. Summary of Control Measure 1: Reduce pollution from WWTFs by issuing, revising, and enforcing discharge permits; and by reducing or eliminating sanitary sewer overflows

Causes and Sources: point source from WWTFs

Potential Load Reduction: 164,250 lbs/year

Technical and Financial Assistance Needed	Education Component	Schedule of Implementation	Interim, Measurable Milestones	Indicators of Progress	Monitoring Component	Responsible Parties
Funding will be needed for facility upgrades and relocation of discharge outfalls		§ 5-year cycle for new or renewed permits § Annual WWTF inspections	§ Issue new and renewed permits in accordance with TMDL limits § Conduct routine inspections and complaint investigations § Self-reported data show *E. coli* discharges within permit limits	§ Number of permits issued or renewed with revised limits § Number of inspections and complaint investigations § WWTFs are self-monitoring and within permit limits	Continue CRP monitoring as funding is available	Regulated dischargers, TCEQ Region 10, TCEQ Water Quality Division

Sustainability

The TCEQ and stakeholders in TMDL implementation projects periodically assess the results of the planned activities and other sources of information to evaluate the efficiency of the implementation 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 stakeholders with the assistance of TCEQ may, as resources are available, document the results of these evaluations and the rationale for maintaining or revising elements of the implementation plan, and may present them as summarized in the following section.

The stakeholders and TCEQ may, as resources are available, track the progress of the implementation plan 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 will be monitored under the current Texas Clean Rivers Program biennial contract between the TCEQ and SRA-TX. The SRA-TX currently monitors one site in Adams Bayou and one site in Cow Bayou:

- Site 10441 – Adams Bayou at FM 1006 in Orange, Texas;
- Site 10449 – Cow Bayou 10m Downstream of FM1442/Round Bunch Rd East of Bridge City, Texas.

With additional funding, and as available resources permit, the monitoring program may be expanded to include other parts of the watersheds.

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 plan are included in Appendix C.

The responsible parties identified in this implementation plan will track progress toward the milestones identified in this plan. The Stakeholder Advisory Group

will meet annually to review and evaluate progress on the various measures as reported by the responsible parties.

Communication Strategy

Communication is necessary to ensure stakeholders understand the implementation plan and its progress in restoring water quality conditions. The stakeholders, with the assistance of the TCEQ, will disseminate the information derived from tracking planned activities to interested parties, including watershed residents, state leadership, government and non-governmental organizations, and individuals. Regionally, the progress of this implementation plan will be reported in the annual Basin Highlights or Basin Summary Reports prepared by the SRA-TX under provisions of the Texas Clean Rivers Program.

In accordance with Clean Water Act Section 319, the state must annually report to USEPA on its success in achieving the short and long-term goals of the Texas Nonpoint Source Management Program, including progress in implementing TMDLs for waterways with significant, related nonpoint sources. The TCEQ and TSSWCB jointly publish *Managing Nonpoint Source Water Pollution in Texas: Annual Report*, which highlights the state's efforts during each fiscal year to collect data, assess water quality, implement projects that reduce or prevent nonpoint source (NPS) pollution, and educate and involve the public to improve the quality of water resources. Information derived from tracking and review activities of this implementation plan may be reported in the NPS annual report by the organization that receives the NPS grant.

The TCEQ may assist in hosting annual meetings for stakeholders to evaluate their progress. Stakeholders will meet annually for up to the next five years to evaluate implementation efforts. At the completion of the fourth year of scheduled planned activities, stakeholders will assemble and evaluate the results of their implementation efforts and consider adapting this implementation plan or amending it to add a second phase of implementation.

Appendix A.
Load Reductions and TMDLs

The load reductions for restoring the contact recreation use are based on the geometric mean criterion for *E. coli*, which in all cases were greater than those required to meet the single sample criterion. To improve dissolved oxygen levels and restore the aquatic life use, TMDLs were developed for cBOD and NH_3N.

Table A-1. Summary of Maximum Allowable Loads

Segment	Total cBOD (lbs/day)	Total NH_3N (lbs/day)	Total *E. coli* (billion cfu/day)
Adams Bayou Above Tidal	67	9.8	81
Gum Gully	18	2.3	20
Hudson Gully	6.3	1.8	35
Adams Bayou Tidal*	64.9	17.7	59
Cow Bayou Above Tidal	513	53	NA
Cole Creek	156	22	430
Terry Gully	NA	NA	1,100
Coon Bayou	85	14	51
Cow Bayou Tidal*	833	93	1,900

NA: not applicable

*Note that loads to tributaries are not included in the loads of the main tidal segment; i.e., they are not double-counted, although they also could be considered as loads to the downstream segment.

Table A-2. TMDLs for cBOD and NH_3N

TMDL (lbs/day) = WLA (lbs/day) + LA (lbs/day)

Segment	cBOD TMDLs	NH_3N TMDLs
Adams Bayou Above Tidal	67 = 0 + 67	9.8 = 0 + 9.8
Gum Gully	18 = 0 + 18	2.3 = 0 + 2.3
Hudson Gully	6.3 = 0 + 6.3	1.8 = 0 + 1.8
Adams Bayou Tidal**	63 = 29 + 34	17 = 14 + 3
Cow Bayou Above Tidal	*	*
Cole Creek	156 = 0 + 156	22 = 0 + 22
Terry Gully	231 = 0 + 231	36 = 0 + 36
Coon Bayou	85 = 2 + 83	14 = 0.22 + 13.78
Cow Bayou Tidal**	358 = 130 + 228	47 = 7 + 40

*Due to data and model constraints, an accurate TMDL could not be calculated.

**Note that loads to tributaries are not included in the loads of the main tidal segment; that is, they are not double-counted although they also could be considered as loads to the downstream segment.

Table A-3. *E. coli* TMDLs

TMDL (billion colonies/day) = WLA (colonies/day) + LA (colonies/day)*

Segment	*E. coli* TMDLs
Adams Bayou Above Tidal	81 = 0 + 81
Gum Gully	20 = 0 + 20
Hudson Gully	35= 0 + 35
Adams Bayou Tidal**	59 = 10 + 49
Cole Creek	430 = 0 + 430
Terry Gully	1100 = 0 + 1100
Coon Bayou	51 = 10 + 41
Cow Bayou Tidal**	1900 = 18 + 1882

*All values are expressed in billions colonies/day

**Note that loads to tributaries are not included in the loads of the main tidal segment, i.e. they are not double-counted, although they also could be considered as loads to the downstream segment

†Due to data and model constraints, an accurate total maximum daily load could not be calculated for Cow Bayou Above Tidal.

Appendix B.
Load Reduction Estimates

Required load reductions to meet the TMDL range from 15 to 83 percent, depending on the specific assessment unit. The potential load reduction for some measures cannot be quantified until certain planned activities are completed. The specific load reduction estimates for Measures 2 and 3 are explained in this appendix.

Measure 2: Load Reduction Estimate

Implementing WQMPs and other agricultural best practices in priority areas.

Potential load reductions will depend specifically on the particular BMP implemented by each individual landowner and the number of livestock in each landowner's operation. BMPs that can be employed in the Adams Bayou and Cow Bayou watersheds, which have been documented to measurably reduce the amount of fecal bacteria loading from cattle, include filter strips, prescribed grazing, stream crossings, watering facilities, and exclusionary fencing. Prescribed grazing, watering facilities and stream crossings are the three most likely practices to be implemented.

As of April 2012, 28 WQMPs had been developed and implemented in the Adams Bayou and Cow Bayou watersheds. These plans cover a total of 7,153 acres and include the following specific practices and the acreages on which they are used.

- § prescribed grazing: 3,141 acres
- § nutrient management: 3,528 acres
- § crop residue management: 645 acres
- § forage harvest management: 1,743 acres
- § wildlife land: 1,505 acres
- § conservation crop rotation: 645 acres
- § rangeland: 846 acres

Some of these BMPs have been the subject of research and estimated bacteria reduction efficiencies have been established for them through these studies. Table B-1 lists the individual practice, the range of associated bacteria removal efficiency, and the midpoint of the efficiency range as described in the research literature. While research on these BMPs was not conducted in the Adams Bayou and Cow Bayou watersheds, nor in Texas in most cases, these studies do illustrate the abilities of these practices to reduce bacteria contributions from livestock. Without watershed-specific BMP efficiency evaluations, using the midpoint of the effectiveness ranges should be a safe assumption for predicting potential load reductions; however, using the lowest effectiveness rate will probably give a more dependable prediction of load reductions.

One challenge in getting landowners to use these programs will be pressure from urban development and land use changes. As the population of the watershed

continues to grow, increasing demands will persist for land use changes in areas that are currently rural. Many of the rural areas on the fringes of the urbanized areas are being fragmented into smaller land parcels; these smaller parcels are likely to be taken out of agricultural production or have reduced production. Shifting land use and the scale of those changes often make it difficult for landowners to afford BMP implementation. As a result, load reductions realized from implementation could be minimal.

Table B-1. Livestock BMP Fecal Coliform Removal Efficiencies

Management Practice	Effectiveness: Low Rate	Effectiveness: High Rate	Effectiveness: Mid-point
Filter Strips [1]	30%	100%	65%
Prescribed Grazing [2]	42%	66%	54%
Stream Crossing [3]	44%	52%	48%
Watering Facility [4]	51%	94%	72.5%
Exclusionary Fencing [5]	30%	94%	62%

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

[2] Tate et al. 2004, USEPA 2010

[3] Inamdar et al. 2002, Meals 2001

[4] Byers et al. 2005, Hagedorn et al. 1999, Sheffield et al. 1997, Wagner 2011

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

To calculate potential load reductions for each of these five BMPs, a generic equation was developed based upon the number of animal units, average fecal production rates of beef cattle, the average *E. coli* content of beef cattle manure, and the selected BMP effectiveness rate (Table B-1). A generic equation based on animal units can serve as a starting point for estimating load reductions that could be realized. However, BMP implementation is strictly voluntary, so no firm number of implemented BMPs can be predicted. Also, the number of animals in an operation cannot be determined prior to development of WQMPs.

Generic Potential Load Reduction Equation

$$= Number\ of\ AUs * \frac{37{,}195\frac{g}{day}}{AU} * 7.97x10^5 * BMP\ Effectivness\ Rate$$

Where:

- AU = animal unit defined as 1,000 pounds of animal weight (i.e. a 1,400-lb cow = 1.4 AU)
- 37,195 $\frac{g}{day}\frac{g}{day}$ = the average fecal production rate of beef cattle (Metcalf & Eddy, 1991 and Wagner and Moench, 2009).
- 7.97 x 10^5 = the average *E. coli* production per gram of fecal matter by beef cattle (Karthikeyan, 2011 and unpublished data from pastured cattle in the Cedar Creek watershed, Brazos County, Texas).
- BMP Effectiveness rate = midpoint of BMP efficiencies (Table B-1).

Measure 3: Load Reduction Estimate

OSSF identification, inspection, repair or replacement, and maintenance

Addressing pollutant loading from failing OSSFs in the Adams Bayou and Cow Bayou watersheds has been identified as a primary need to restore instream water quality. The equations presented below provide estimated load reductions that can be expected from identifying and repairing or replacing failing OSSFs in the watershed and by addressing operational malfunctions of aerobic OSSFs.

Conventional OSSFs

Identifying these failing septic systems and working with their owners to correct the problems is assumed to be achievable.

Potential *E. coli* Reductions per OSSF Repaired or Replaced

$$\frac{E.\ coli}{100\ mL} * \frac{70\frac{gallons}{person}}{day} * 3785.4\frac{mL}{gallon} * 2.5\frac{persons}{household} = 6.62x10^{10}\frac{cfu}{day}$$

Where:

$10^5 \frac{\text{cfu}}{\text{100mL}}$ = $10^5 \frac{\text{cfu}}{\text{100mL}}$ = *E. coli* concentration rate in failing OSSF effluent

(Modeled in Parsons, 2006 a & b; number derived by applying a 10x attenuation factor to numbers reported by Metcalf & Eddy, 1991; Canter & Knox, 1985; Cogger & Carlile, 1984)

$3785.4\frac{\text{ml}}{\text{gallon}}$ = $3785.4\frac{\text{ml}}{\text{gallon}}$ = number of milliliters in a gallon

70 gallons per person per day

(Estimated discharge in OSSFs, Horsley & Witten, 1996)

2.5 persons per household

(TCEQ, 2007)

Potential BOD Reductions per OSSF Repaired or Replaced

$$170\ \frac{mg}{L} * \frac{70\frac{gallons}{person}}{day} * 3.7854\frac{L}{gallon} * 2.5\frac{persons}{household} = 1.12x10^5\frac{mg}{day}$$

Where:

$170\frac{\text{mg}}{\text{L}}$ =BOD concentration rate in failing OSSF effluent

(Parsons, 2006 a & b)

$3.7854\frac{\text{L}}{\text{gallon}} = 3.7854\frac{\text{L}}{\text{gallon}}$ = number of liters in a gallon

70 gallons per person per day

(Estimated discharge in OSSFs, Horsley & Witten, 1996)

2.5 persons per household

(TCEQ, 2007)

Potential TSS Reductions per OSSF Repaired or Replaced

$$70\ \frac{mg}{L} * \frac{70\frac{gallons}{person}}{day} * 3.7854\frac{L}{gallon} * 2.5\frac{persons}{household} = 4.64x10^4\frac{mg}{day}$$

Where:

$70\frac{\text{mg}}{\text{L}}$ = TSS concentration rate in failing OSSF effluent

(Modeled in Parsons, 2006 a & b)

$3.7854\frac{\text{L}}{\text{gallon}} = 3.7854\frac{\text{L}}{\text{gallon}}$ = number of liters in a gallon

70 gallons per person per day

(Estimated discharge in OSSFs, Horsley & Witten, 1996)

2.5 persons per household

(TCEQ, 2007)

Potential Ammonia Nitrogen Reductions per OSSF Repaired or Replaced

$$35\frac{mg}{L} * \frac{70\frac{gallons}{person}}{day} * 3.7854\frac{L}{gallon} * 2.5\frac{persons}{household} = 2.32x10^4\frac{mg}{day}$$

Where:

$35\frac{\text{mg}}{\text{L}}$ = Ammonia nitrogen concentration rate in failing OSSF effluent

(Parsons, 2006 a & b)

$3.7854 \frac{\text{L}}{\text{gallon}} = 3.7854 \frac{\text{L}}{\text{gallon}}$ = number of liters in a gallon

70 gallons per person per day is

(Estimated discharge in OSSFs, Horsley & Witten, 1996)

2.5 persons per household

(TCEQ, 2007)

Potential Phosphate Phosphorus Reductions

$$15 \frac{mg}{L} * \frac{70 \frac{gallons}{person}}{day} * 3.7854 \frac{L}{gallon} * 2.5 \frac{persons}{household} = 9.94x10^3 \frac{mg}{day}$$

Where:

$15 \frac{\text{mg}}{\text{L}}$ = Phosphate phosphorus concentration rate in failing OSSF effluent

(Parsons, 2006 a & b)

$3.7854 \frac{\text{L}}{\text{gallon}} = 3.7854 \frac{\text{L}}{\text{gallon}}$ = number of liters in a gallon

70 gallons per person per day

(Estimated discharge in OSSFs, Horsley & Witten, 1996)

2.5 persons per household

(TCEQ, 2007)

Appendix C.
Schedules of Implementation Activities and Milestones

Table C-1. Stormwater Management — Implementation Schedule and Tasks

Plan Year	Responsible Parties	Implementation Measure	Indicators of Progress
1			
	Cities, Orangefield Water Supply Corp, WCID #2	§ Continue inspections of wastewater collection systems for I&I issues	§ Number of inspections completed
	Cities, Orangefield Water Supply Corp, WCID #2	§ Complete repairs and replacements to address issues discovered in I&I inspections, as necessary and as funding allows	§ Number of repairs/replacements made
	Cities	§ Continue and work to expand delivery of educational materials to targeted audiences across the watershed	§ Number of educational materials delivered § Number of education and outreach events
	Cities	§ Contact curriculum development coordinators for local schools and discuss need for environmental stewardship based education and identify materials appropriate for delivery	§ Number of curriculum coordinators contacted § Number of curriculum appropriate materials identified
	Cities, Orangefield Water Supply Corp, WCID #2	§ Contact local industry to discuss funding needs for support of environmental stewardship programming that could be funded through SEP funds	§ Number of local industries contacted § Funding needs/opportunities discussed with industry § Number of commitments received from local industry to direct SEP funds to watershed management based implementation strategies
2 – 5			
	Cities, Orangefield Water Supply Corp, WCID #2	§ Continue inspections of wastewater collection systems for I&I issues	§ Number of inspections completed
	Cities, Orangefield Water Supply Corp, WCID #2	§ Complete repairs and replacements to address issues discovered in I&I inspections, as necessary and as funding allows	§ Number of repairs/replacements made
	Cities	§ Continue and work to expand delivery of educational materials to targeted audiences across the watershed	§ Number of educational materials delivered § Number of educational events participated in
	Cities	§ Contact curriculum development coordinators for local schools and discuss need for environmental stewardship based education and identify materials appropriate for delivery	§ Number of curriculum coordinators contacted § Number of curriculum appropriate materials identified

Table C-2. Develop and Implement WQMPs — Implementation Schedule and Tasks

Plan Year	Responsible Parties	Implementation Measure	Indicators of Progress
1			
	Local agencies	§ Promote the availability of technical and financial assistance for the development and implementation of WQMPs	§ All parties are working cooperatively and prioritizing areas for developing conservation plans
	AgriLife Extension, NRCS, TSSWCB and SWCDs	§ Continue delivery of education and outreach programming through existing programs	§ Number of programs delivered. § Number of people impacted through programming
	NRCS, TSSWCB, SWCDs	§ Catalogue BMP implementation in the watershed to date	§ Number and type of BMPs implemented § Number of acres impacted by BMPs
	Landowners, NRCS, TSSWCB, SWCDs	§ Develop and implement WQMPs throughout the watershed	§ Number of WQMPs developed § Number of BMPs implemented § Number of acres impacted by implemented BMPs
	TSSWCB	§ Conduct status reviews on existing WQMPs as appropriate and revise as needed	§ Number of WQMPs reviewed
2 – 5			
	AgriLife Extension, NRCS, TSSWCB and SWCDs	§ Continue delivery of education and outreach programming through existing programs	§ Number of programs delivered. § Number of people impacted through programming
	Landowners, NRCS, TSSWCB, SWCDs	§ Develop and implement WQMPs throughout the watershed	§ Number of WQMPs developed. § Number of BMPs implemented. § Number of acres impacted by implemented BMPs
5			
	Local agencies	§ Evaluate progress and reassess implementation strategy	§ Number of WQMPs developed § Number of BMPs implemented

Table C-3. Manage OSSFs — Implementation Schedule and Tasks

Plan Year	Responsible Parties	Implementation Measure	Indicators of Progress
1			
	OCHD	§ Prioritize and map focus areas for OSSF inspections § Use information from GLO coastal zone project as appropriate	§ GIS info coordinated between organizations to develop a comprehensive inspection needs assessment for the watershed
	OCHD, SRA-TX, AgriLife Extension	§ Deliver education and outreach on the need to properly operate and maintain OSSFs	§ Number of educational events/materials provided
	OCHD, TCEQ Region 10	§ Continue to enforce existing rules and ordinances regarding OSSF installation, maintenance, and operation	§ Number of enforcement actions taken
2 – 5			
	OCHD, TCEQ Region 10, Contractors as appropriate	§ Inspect OSSFs in priority areas as funding allows and identify systems needing repairs or replacement	§ Number of OSSF inspections performed
	OCHD, TCEQ Region 10, OSSF owners	§ Work with OSSF owners to bring systems needing repair or replacement into compliance as funds allow	§ Number of OSSF repairs/replacements completed
	OCHD, SRA-TX, AgriLife Extension	§ Deliver education and outreach to OSSF owners on the need to properly operate and maintain OSSFs	§ Number of educational events/materials provided
	OCHD, TCEQ Region 10	§ Continue to enforce existing rules and ordinances regarding OSSF installation, maintenance, and operation	§ Number of enforcement actions taken

Table C-4. Forestry BMP Promotion — Implementation Schedule and Tasks

Plan Year	Responsible Parties	Implementation Measure	Indicators of Progress
1 – 5			
	TFS	§ Continue to deliver education and outreach to landowners, loggers, logging contractors and others promoting appropriate BMP adoption and implementation	§ Number of education and outreach programs delivered § Number of landowners, loggers, logging contractors and other impacted by programs
	TFS	§ Document voluntary participation in BMP adoption through periodic surveys	§ Number of landowners and forest managers participating in voluntary BMP adoption
	Landowners and Forest Manager	§ Voluntarily implement, operate, and maintain appropriate BMPs on forested lands they manage	§ Number and type of BMPs implemented in the watershed

Table C-5. Ordinance Development — Implementation Schedule and Tasks

Plan Year	Responsible Parties	Implementation Measure	Indicators of Progress
1			
	Cities and Orange County	§ Meet to discuss the feasibility of developing a uniform stormwater management ordinance framework	§ Number of coordination discussions held
	Cities and Orange County	§ Deliver education and outreach to local officials on the need for ordinance development and benefits of coordinated stormwater management	§ Number of educational events/materials provided § Number of people impacted by education and outreach efforts
	Cities and Orange County	§ If found to be feasible, proceed with drafting coordinated ordinance framework as appropriate	§ Consistent ordinance framework developed
2 – 5			
	Cities and Orange County	§ If found to be appropriate and following completion of a coordinated stormwater management ordinance framework, begin drafting organization specific ordinance language as appropriate	§ Number of draft ordinance language documents in development
	Cities and Orange County	§ Continue to deliver education and outreach to local officials on the need for ordinance development and benefits of coordinated stormwater management	§ Number of educational events/materials provided § Number of people impacted by education and outreach efforts
	Cities and Orange County	§ If ordinance language developed, recommend to local officials for adoption and later implementation	§ Number of stormwater management ordinances adopted

Table C-6. Plan for Regional Wastewater Facility — Implementation Schedule and Tasks

Plan Years	Responsible Parties	Implementation Measure	Indicators of Progress
1			
	Stakeholder Advisory Group	§ Investigate funding options.	§ List of options identified.
2-3			
	Stakeholder Advisory Group	§ Pursue funding opportunities.	§ Amount of funding secured.
4-5			
	Stakeholder Advisory Group	§ Pursue funding opportunities.	§ Amount of funding secured.
		§ If funding secured, relocate outfalls or build new facility.	§ Number of outfalls relocated or construction of new facility.

Table C-7. Issue and Enforce Permits— Implementation Schedule and Tasks

Plan Years	Responsible Parties	Implementation Measure	Indicators of Progress
1 – 5			
	TCEQ Headquarters	§ Issue new and renewed permits in accordance with TMDL limits.	§ Number of permits issued or renewed with revised limits
	TCEQ Region 10	§ Conduct routine inspections and complaint investigations	§ Number of inspections and complaint investigations
	Permitted dischargers	§ Self-reported data show *E. coli* discharges within permitted limits	§ WWTFs are self-monitoring and within permit limits

Appendix D.
Documents of Support

RESOLUTION

SUPPORTING THE IMPLEMENTATION PLAN PROPOSED BY THE ORANGE COUNTY TMDL STAKEHOLDER ADVISORY GROUP

WHEREAS, water quality impairments in Adams Bayou and Cow Bayou and their tributaries have been identified; and

WHEREAS, the Orange County TMDL Stakeholder Advisory Group includes representative of city and county governments, resource agencies, business and agriculture interests, conservation and professional organizations, watershed groups, and the public; and

WHEREAS, the Implementation Plan is a stakeholder-led, consensus process, that presents a voluntary common-sense approach to achieve pollutant reductions in our waterways.

NOW, THEREFORE, BE IT RESOLVED that the Orange County Commissioners' Court does hereby support the Implementation Plan proposed by the Orange County Stakeholder Advisory Group and do hereby encourage stakeholders to voluntarily participate in the activities described in the plan.

PASSED AND APPROVED at the Special Court Session dully called meeting of the Orange County Commissioners' Court on this 2nd day of June, 2014.

CARL K. THIBODEAUX
County Judge

DAVID L. DUBOSE
Commissioner, Precinct One

OWEN W. BURTON
Commissioner, Precinct Two

JOHN W. BANKEN
Commissioner, Precinct Three

JODY E. CRUMP
Commissioner, Precinct Four

ATTEST:

By: Brandy Robertson, Chief Deputy
KAREN JO VANCE
County Clerk

Firestone Polymers, LLC
5713 FM 1006
Orange, TX 77630

June 25, 2014

Orange County TMDL Stakeholders
C/O Sabine River Authority
P.O. Box 579
Orange, TX 77631

Re: *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries*

Dear Stakeholders:

Firestone Polymers, LLC – Orange Plant supports the *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries* (I-Plan), which was developed by the Orange County TMDL Stakeholder Advisory Group (SAG).

The I-Plan, developed through a stakeholder-led, consensus process, presents a voluntary common-sense approach to achieve pollutant reductions identified in the Orange County TMDL (OCTMDL) report and outlines the schedule for implementation of these activities.

An important and vital provision within the I-Plan provides for review and revision. This will allow the plan to be updated to account for improved information about the sources and types of pollutants and the effectiveness of activities intended to reduce them.

We wish to thank the OCTMDL stakeholders for including our organization as a member in the OCTMDL SAG. Firestone Polymers looks forward to its' continued involvement in this process.

Sincerely,

Gene Lavengco
Executive Director Manufacturing

Cc: Brent Iceman, Director CSR22 / Training
Karl Heimbach, Operations Manager - Orange
Moira Layman, Environmental Superintendent

Orange County Drainage District
8081 Old Hwy 90, Orange, TX 77630
(409) 745-3225 (409)745-3004 fax

June 10, 2014

Orange County TMDL Stakeholders
C/O Sabine River Authority
P.O. Box 579
Orange, TX 77631

Re: *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries*

Dear Stakeholders:

The Orange County Drainage District supports the *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries* (I-Plan), which was developed by the Orange County TMDL Stakeholder Advisory Group (SAG).

The I-Plan, developed through a stakeholder-led, consensus process, presents a voluntary common-sense approach to achieve pollutant reductions identified in the Orange County TMDL (OCTMDL) report and outlines the schedule for implementation activities.

An important and vital provision within the I-Plan provides for review and revision. This will allow the plan to be updated to account for improved information about the sources and types of pollutants and the effectiveness of activities intended to reduce them.

We wish to thank the OCTMDL stakeholders for including our organization as a member in the OCTMDL SAG. The Orange County Drainage District looks forward to our continued involvement in this process.

Sincerely,

Mark Stephenson
General Manager
Orange County Drainage District

RESOLUTION NO. 2014-13(R)

A RESOLUTION SUPPORTING THE IMPLEMENTATION PLAN PROPOSED BY THE ORANGE COUNTY TMDL STAKEHOLDER ADVISORY GROUP

WHEREAS, water quality impairments in Adams Bayou and Cow Bayou and their tributaries have been identified; and

WHEREAS, the Orange County TMDL Stakeholder Advisory Group includes representatives of city and county governments, resource agencies, business and agriculture interests, conservation and professional organizations, watershed groups, and the public; and

WHEREAS, the Implementation Plan is a stakeholder-led, consensus process, that presents a voluntary common-sense approach to achieve pollutant reductions in our waterways.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF BRIDGE CITY TEXAS that the CITY COUNCIL OF BRIDGE CITY does hereby support the Implementation Plan proposed by the Orange County Stakeholder Advisory Group and do hereby encourage stakeholders to voluntarily participate in the activities described in the plan.

PASSED at the regular meeting of the City Council for the City of Bridge City, Texas on this the 17th day of June 2014.

CITY OF BRIDGE CITY, TEXAS

KIRK ROCCAFORTE, Mayor

ATTEST:

SHERRY TISDALE, City Secretary

PAUL M. FUKUDA, City Attorney

June 10, 2014

Orange County TMDL Stakeholders
C/O Sabine River Authority
P.O. Box 579
Orange, TX 77631

Re: *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries*

Dear Stakeholders:

The Orange City Council supports the *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries* (I-Plan), which was developed by the Orange County TMDL Stakeholder Advisory Group (SAG).

The I-Plan, developed through a stakeholder-led, consensus process, presents a voluntary common-sense approach to achieve pollutant reductions identified in the Orange County TMDL (OCTMDL) report and outlines the schedule for implementation activities.

An important and vital provision within the I-Plan provides for review and revision. This will allow the plan to be updated to account for improved information about the sources and types of pollutants and the effectiveness of activities intended to reduce them.

We wish to thank the OCTMDL stakeholders for including our organization as a member in the OCTMDL SAG. Orange City Council looks forward to our continued involvement in this process.

Sincerely,

Jimmy Sims
Mayor

803 W Green Avenue P. O. Box 520 Orange, Texas 77631-0520 (409) 886-3611

2014-34

RESOLUTION

SUPPORTING THE IMPLEMENTATION PLAN PROPOSED BY THE ORANGE COUNTY TMDL STAKEHOLDER ADVISORY GROUP.

WHEREAS, water quality impairments in Adams Bayou and Cow Bayou and their tributaries have been identified; and

WHEREAS, the Orange County TMDL Stakeholder Advisory Group includes representatives of city and county governments, resource agencies, business and agriculture interests, conservation and professional organizations, watershed groups, and the public; and

WHEREAS, the Implementation Plan is a stakeholder-led, consensus process, that presents a voluntary common-sense approach to achieve pollutant reductions in our waterways.

NOW, THEREFORE, BE IT RESOLVED that the Orange City Council does hereby support the Implementation Plan proposed by the Orange County Stakeholder Advisory Group and does hereby encourage stakeholders to voluntarily participate in the activities described in the plan.

PASSED AND APPROVED at a regular, duly called meeting of the Orange City Council on this 10th day of June 2014.

Jimmy Sims
Mayor

ATTEST:

Rhonda Haskins, City Secretary

APPROVED:

City Attorney

RESOLUTION

SUPPORTING THE IMPLEMENTATION PLAN PROPOSED BY THE ORANGE COUNTY TMDL STAKEHOLDER ADVISORY GROUP

WHEREAS, water quality impairments in Adams Bayou and Cow Bayou and their tributaries have been identified; and

WHEREAS, the Orange County TMDL Stakeholder Advisory Group includes representatives of city and county governments, resource agencies, business and agriculture interests, conservation and professional organizations, watershed groups, and the public; and

WHEREAS, the Implementation Plan is a stakeholder-led, consensus process, that presents a voluntary common-sense approach to achieve pollutant reductions in our waterways.

NOW, THEREFORE, BE IT RESOLVED that the Lower Sabine-Neches SWCD #446 do/does hereby support the Implementation Plan proposed by the Orange County Stakeholder Advisory Group and do hereby encourage stakeholders to voluntarily participate in the activities described in the plan.

PASSED AND APPROVED at a regular, duly called meeting of the Lower Sabine-Neches SWCD #446 on this 3rd day of June 2014.

APPROVED:

Barbara Winfrie

ATTEST:

_____

date

5/30/14

Orange County TMDL Stakeholders
C/O Sabine River Authority
P.O. Box 579
Orange, TX 77631

Re: *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries*

Dear Stakeholders:

The Water Necessities & Rural Water Co. supports the *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries* (I-Plan), which was developed by the Orange County TMDL Stakeholder Advisory Group (SAG).

The I-Plan, developed through a stakeholder-led, consensus process, presents a voluntary common-sense approach to achieve pollutant reductions identified in the Orange County TMDL (OCTMDL) report and outlines the schedule for implementation activities.

An important and vital provision within the I-Plan provides for review and revision. This will allow the plan to be updated to account for improved information about the sources and types of pollutants and the effectiveness of activities intended to reduce them.

We wish to thank the OCTMDL stakeholders for including our organization as a member in the OCTMDL SAG. WNS & RWC looks forward to our continued involvement in this process.

Sincerely,

Kelly Brewer / operator

CARL K. THIBODEAUX, R. Ph.
COUNTY JUDGE
ORANGE COUNTY ADMINISTRATION BUILDING
123 SOUTH 6TH STREET
ORANGE, TEXAS 77630

JEANNINE DENMAN
Administrative Assistant

PHONE: (409) 882-7070
FAX: (409) 882-7079

June 2, 2014

Orange County TMDL Stakeholders
C/O Sabine Rive Authority
P.O. Box 579
Orange, Texas 77631

Re: ***Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries***

Dear Stakeholders:

The Orange County Commissioners' Court supports the *Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria, Dissolved Oxygen, and pH in Adams Bayou, Cow Bayou, and Their Tributaries* (I-Plan), which was developed by the Orange County TMDL Stakeholder Advisory Group (SAG).

The I-Plan, developed through a stakeholder-led, consensus process, presents a voluntary common-sense approach to achieve pollutant reductions identified in the Orange County TMDL (OCTMDL) report and outlines the schedule for implementation activities.

An important and vital provision within the I-Plan provides fro review and revision. This will allow the plan to be updated to account for improved information about the sources and types of pollutants and the effectiveness of activities intended to reduce them.

We wish to thank the OCTMDL stakeholders for including our organization as a member in the OCTMDL SAG. Orange County looks forward to out continued involvement in this process.

Sincerely,

Carl K. Thibodeaux
Orange County Judge

References

American Veterinary Medical Association U.S. Pet Ownership Calculator. (2007). <www.avma.org/KB/Resources/Statistics/Pages/Market-research-statistics---U.S.-pet-ownership-2007.aspx>.

Brenner, F.J., J.J. Mondok, R.J. McDonald, Jr. (1996). "Watershed Restoration through Changing Agricultural Practices." *Proceedings of the AWRA Annual Symposium Watershed Restoration Management: Physical, Chemical and Biological Considerations.* American Water Resources Association, Herndon, VA. TPS-96-1, pp. 397-404.

Byers, H.L., Cabrera, M.L., Matthews, M.K., Franklin, D.H., Andrae, J.G., Radcliffe, D.E., McCann, M.A., Kuykendall, H.A., Hoveland, C.S., Calvert II, V.H. (2005). Phosphorus, Sediment, and Escherichia coli Loads in Unfenced Streams of the Georgia Piedmont, USA. *Journal of Environmental Quality*. 34. 2293-2300.

Canter, L.W. and R.C. Knox (1985). *Septic tank system effects on ground water quality*. Lewis Publishers. Chelsea, Maryland.

Casteel, M.J., Bartow, G., Taylor, S.R., Sweetland, P. (2005). Removal of bacterial indicators of fecal contamination in urban stormwater using a natural riparian buffer. *International Conference on Urban Drainage.*

Cogger, C.G. and B.L. Carlile (1984). Field performance of conventional and alternative septic systems in wet soils. *Journal of Environmental Quality*. 13:137-142.

Cook, Mary Nicole (1998). Impact of Animal Waste Best Management Practices on the Bacteriological Quality of Surface Water. *Biological Systems Engineering*. Master of Science. 154.

Coyne, M.S., Gilfillen, R.A., Rhodes, R.W., Blevins, R.L. (1995). Soil and fecal coliform trapping by grass filter strips during simulated rain. *Journal of Soil and Water Conservation*. 50. 405-408.

Fajardo, J.J., Bauder, J.W., Cash, S.D. (2001). Managing nitrate and bacteria in runoff from livestock confinement areas with vegetative filter strips. *Journal of Soil and Water Conservation*. 56. 185-191.

Goel, P.K., Rudra, R.P., Gharabaghi, B., Das, S., Gupta, N. (2004). Pollutants Removal by Vegetative Filter Strips Planted with Different Grasses. *ASAE/CSAE Annual International Meeting*. 042177. 1-15.

Hagedorn, C., Robinson, S.L., Filtz, J.R., Grubbs, S.M., Angier, T.A., Reneau Jr., R.B. (1999). Determining Sources of Fecal Pollution in a Rural Virginia Watershed with Antibiotic Resistance Patterns in Fecal Streptococci. *Applied and Environmental Microbiology*. 65. 5522-5531.

HDR Report (2003). Water Quality Study of the Arkansas River, Phase 2 Report.

Horsley and Witten, Inc. (1996). *Identification and Evaluation of Nutrient and Bacterial Loadings to Maquoit Bay, New Brunswick and Freeport, Maine.* Final Report.

Inamdar, S.P., Mostaghimi, S., Cook, M.N., Brannan, K.M., McClellen, P.W. (2002). A Long-term, Watershed-Scale, Evaluation of the Impacts of Animal Waste BMPs on

Indicator Bacteria Concentrations. *Journal of the American Water Resources Association*. 38. 15.

Karthikeyan, R. (2011). Personal Communication on "Fate and Transport of Bacteria in Rural Texas Streams." TSSWCB Project 07-06.

Schaumburg and Polk (2009). Regional Wastewater Study for Eastern Orange County, Texas.

TWDB (2006). Population Projections Data. <www.twdb.state.tx.us/waterplanning/data/projections/2007/popproj.asp>. Accessed January 14, 2010.

USEPA (2001). Protocol for Developing Pathogen TMDLs. <www.epa.gov/owow/tmdl/pathogen_all.pdf>.

USEPA (2003). Nonpoint Source Program and Grants Guidelines for States and Territories. <www.epa.gov/fedrgstr/EPA-WATER/2003/October/Day-23/w26755.htm>.

USEPA (2010). Implementing Agricultural Best Management Practices Improves Water Quality. *Nonpoint Source Program Success Story*.

Wagner, K. and Moench, E. 2009. Education Program for Improved Water Quality in Copano Bay: Task Two Report. TWRI TR-347.

Wagner, K. 2011. Evaluation of Methods to Assess and Reduce Bacterial Contamination of Surface Water from Grazing Lands. Ph.D. Dissertation. Texas A&M University, College Station, TX.

Young, R.A., Huntrods, T., Anderson, W. (1980). Effectiveness of Vegetated Buffer Strips in Controlling Pollution from Feedlot Runoff. *Journal of Environmental Quality*. 9. 483-487.