Approved by the Commission: January 30, 2013

Approved by the Bacteria Implementation Group: October 16, 2012

ABRIDGED VERSION

Implementation Plan for Seventy-Two Total Maximum Daily Loads for Bacteria in the Houston-Galveston Region

Segments

Buffalo and White Oak Bayous: 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E

Clear Creek: 1101, 1101B, 1101D, 1102, 1102A, 1102B, 1102C, 1102D, and 1102E

Greens Bayou: 1016, 1016A, 1016B, 1016C, and 1016D

Eastern Houston: 1006F, 1006H, 1007F, 1007G, 1007H, 1007I, 1007K, 1007M, 1007O, and 1007R

Halls Bayou: 1006D, 1006I, and 1006J

Brays Bayou: 1007B, 1007C, 1007E, and 1007L

Sims Bayou: 1007D and 1007N

Watersheds Upstream of Lake Houston: 1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011.

Distributed by the
Total Maximum Daily Load Team
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TMDL implementation plans are also available on the TCEQ Web site at:
<www.tceq.texas.gov/implementation/water/tmdl/>

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This plan is prepared by
the Houston-Galveston Area Council
Community and Environmental Planning Department
in collaboration with the
Bacteria Implementation Group,
a stakeholder group appointed by the H-GAC Board of Directors and charged with the Implementation Plan's development.

Abridged Version

Implementation Plan

For Total Maximum Daily Loads for Bacteria in the Houston-Galveston Region

BIG
BACTERIA IMPLEMENTATION GROUP

Bacteria Implementation Group

October 2012

Select pages from front matter are not included in this abridged version.

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Table of Acronyms and Abbreviations

BIG	Bacteria Implementation Group
BLEST	Bacteria Load Estimator Spreadsheet Tool
BMP	best management practice
CGP	Construction General Permit
CMOM	Capacity, Management, Operation, and Maintenance for Sanitary Sewer Systems
DMR	discharge monitoring report
EPA	U.S. Environmental Protection Agency
E. coli	*Escherichia coli*
EQIP	Environmental Quality Incentives Program
ETJ	extra-territorial jurisdiction
Farm Bill	Farm Security and Rural Investment Act of 2002
FM	farm to market road
FOG	fats, oils, and grease
H-GAC	Houston-Galveston Area Council
HSPF	Hydrologic Simulation Program Fortran
I-Plan	implementation plan
IA	implementation activity
IS	implementation strategy
LA	load allocation
LID	Levee Improvement District
LDC	load duration curve
MGD	million gallons per day
mL	milliliter
MOS	margin of safety
MPN	most probable number
MS4	Municipal Separate Storm Sewer System
MUD	municipal utility district
NEIWPCC	New England Interstate Water Pollution Control Commission
NELAC	National Environmental Laboratory Accreditation Conference
NRCS	USDA Natural Resource Conservation Service
OSSF	on-site sewage facility
QAPP	Quality Assurance Project Plan
SSO	sanitary sewer overflow
SSOI	Sanitary Sewer Overflow Initiative of TCEQ
SWCD	soil and water conservation district
TAC	Texas Administrative Code

TCEQ	Texas Commission on Environmental Quality
TMDL	total maximum daily load
TOWTRC	Texas Onsite Wastewater Treatment Research Council
TPDES	Texas Pollutant Discharge Elimination System
TSSWCB	Texas State Soil and Water Conservation Board
TWDMS	Texas Wildlife Damage Management Service
UA	Census-designated urbanized area
UAMP	utility asset management program
USDA	United States Department of Agriculture
WEAT	Water Environment Association of Texas
WLA	waste load allocation
WPP	watershed protection plan
WQMP	Water Quality Management Plan
WWTF	wastewater treatment facility

Acknowledgements

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Texas Commission on Environmental Quality

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Mr. Ron Stein, TMDL Program Manager
Ms. Earlene Lambeth
Mr. Jason Leifester
Mr. Henry "Chip" Morris
Mr. Ward Ling, now with Texas AgriLife Extension Service
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Ms. Erin Livingston, Environmental Planner

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Select pages from front matter are not included in this abridged version.

Executive Summary

The most common water quality impairment in the Houston-Galveston region is the presence of bacteria. When a water body is designated as impaired, the Clean Water Act[1] requires that a Total Maximum Daily Load (TMDL) be developed for each segment of the body of water. A TMDL "is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards."[2] Once a TMDL is completed, an Implementation Plan (I-Plan) must be developed, which recommends best management practices designed to reduce the pollutant and restore the waterway to its designated use.

The Texas Commission on Environmental Quality (TCEQ) notified the Environmental Protection Agency (EPA) as early as 1996 that some of its streams were impaired for contact recreation due to high levels of bacteria. Section 303(d) of the Clean Water Act requires the TCEQ to adopt TMDLs for all of the affected segments. The ultimate goal of this I-Plan is the reduction of bacteria concentrations in the 60 bacteria-impaired segments included in this I-Plan for which TMDLs have been adopted by the TCEQ.

The TCEQ adopted 18 TMDLs for bacteria in Buffalo and Whiteoak bayous and their tributaries on April 8, 2009. Nine TMDLs for bacteria in Clear Creek and its tributaries were adopted September 10, 2008. Eight TMDLs in the Greens Bayou Watershed were adopted on June 2, 2010. TMDLs for 18 segments in Brays, Sims, Halls, and eastern Houston bayous were adopted on September 15, 2010. TMDLs for watersheds upstream of Lake Houston were adopted on April 6, 2011.

Based on the TMDL reports, the following reductions are needed to meet respective criteria defined in the state water quality standards:

- Bacteria loading reductions of 25 percent to 91 percent for Clear Creek TMDLs,[3]
- Bacteria loading reductions of 59 percent to 99 percent for Buffalo and Whiteoak bayous TMDLs,[4]
- Bacteria loading reductions of 46 percent to 99 percent for Houston Metropolitan TMDLs,[5] and
- Bacteria loading reductions of 41 percent to 87 percent for Lake Houston TMDLs.[6]

[1] See Clean Water Act § 303(d), 33 U.S.C. § 1313 (2006 & Supp. 2009)

[2] (U.S. Environmental Protection Agency 2010a)

[3] (TCEQ 2008b)

[4] (TCEQ 2009a)

[5] (TCEQ 2010a,b,c,d,j)

[6] (James Miertschin & Associates, Inc. 2009)

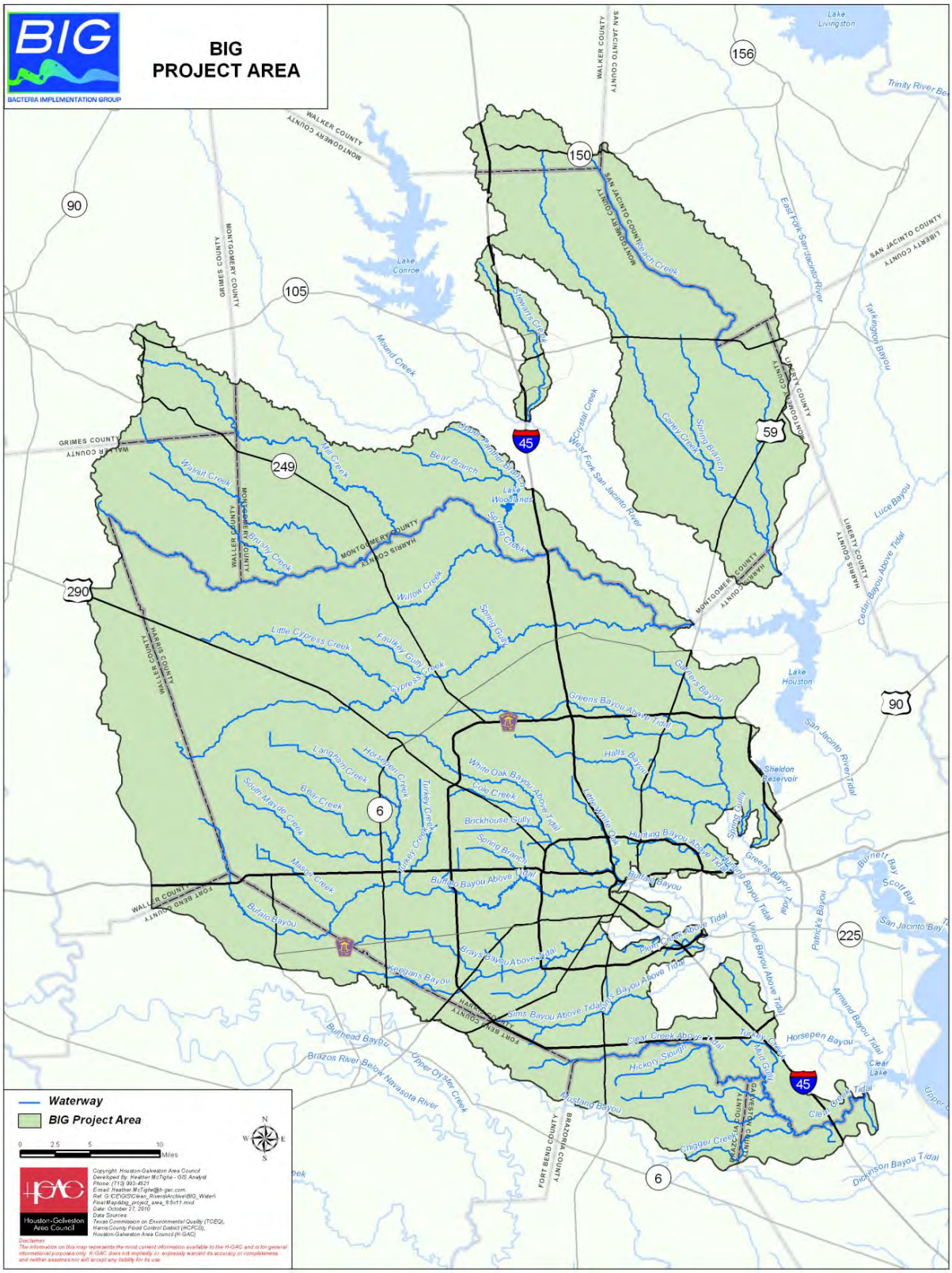
To address the high levels of bacteria in the project area and to develop the I-Plan, the TCEQ asked that H-GAC form a stakeholder group. The Bacteria Implementation Group, or BIG, includes representatives of city and county governments, resource agencies, business and agriculture interests, conservation and professional organizations, watershed groups, and the public. The recommendations in this I-Plan represent the work of the BIG and many additional stakeholders who actively participated in the process.

This I-Plan provides:

- The steps the TCEQ and its stakeholders will take to achieve the pollutant reductions identified in the TMDL reports,
- The schedule for implementation activities,
- A description of the legal authority under which the participating agencies may require implementation of the implementation activities,
- A tracking and monitoring plan to determine the effectiveness of the implementation activities,
- Measureable outcomes for assessing progress, and
- Communication strategies that will be used.

This document applies to waterways and their watersheds as shown in **Error! Reference source not found.**. Additionally, any segments in the BIG project area that have TMDLs adopted by the TCEQ while implementation is underway may be incorporated into this I-Plan.

Figure 1. BIG Project Area



Many of the implementation activities in this I-Plan are directed towards reducing bacteria loading from possible point and non-point sources that the TCEQ identified during development of the TMDLs. The activities are intended to achieve the reductions identified in the TMDL reports that are necessary to comply with established water quality standards. The sources of bacteria include wastewater treatment facilities, sanitary sewer systems, on-site sewage facilities, stormwater runoff, illicit discharges, agriculture, livestock, wildlife, pets, sediment resuspension, and bacterial regrowth.

Many of the strategies in this I-Plan are new to this region, and limited data is available on their effectiveness and cost-effectiveness locally. Stakeholders developed the implementation strategies based on their best professional judgments through a series of workgroup meetings. The BIG recommends an iterative management approach so that data from early implementation efforts can be used to refine strategies throughout the life of the I-Plan. H-GAC staff will track the implementation of activities and monitor water quality data to assess effectiveness of the various efforts.

Recommendations in this I-Plan are presented in sections describing the various sources of bacterial pollution identified through stakeholder and TMDL processes. These include a description of activities, identification of the parties responsible for implementing the activities, a schedule for implementation, the goals associated with the activities, and a process for tracking, evaluating, and reporting progress. A process of implementation, monitoring, analyses, adaptation, and review is also outlined so the I-Plan is regularly updated. The I-Plan provides a pragmatic and scientifically based approach to meet water quality goals within a reasonable timeframe. The primary focus of the implementation activities in each section can be found in Table 1.

Table 1: Summary of Recommended Implementation Strategies

I-Plan Section	Activity Category	Focus of Implementation Activities
Implementation Strategy 1.0	Wastewater Treatment Facilities	Increase monitoring requirements, impose stricter bacteria limits, require updates to facilities not able to comply with limits, and increase enforcement.
Implementation Strategy 2.0	Sanitary Sewer Systems	Require all systems to develop and implement a utility asset management program and to protect against power outages at lift stations.
Implementation Strategy 3.0	On-site Sewage Facilities	Address failing systems and inadequate maintenance.
Implementation Strategy 4.0	Stormwater and Land Development	Expand stormwater management programs, develop a recognition program, and petition the TCEQ to facilitate reimbursement of bacteria reduction measures.
Implementation Strategy 5.0	Construction	Improve compliance and enforcement of existing stormwater management permits.
Implementation Strategy 6.0	Illicit Discharges and Dumping	Increase efforts to address direct and dry-weather discharges, and better control waste hauler activities.
Implementation Strategy 7.0	Agriculture and Animal	Expand existing cost-share programs and the management of feral hog populations.
Implementation Strategy 8.0	Residential	Expand public education efforts.
Implementation Strategy 9.0	Monitoring and I-Plan Revision	Maintain databases of ambient and non-ambient water quality monitoring data and implementation activities, review I-Plan progress, and update I-Plan.
Implementation Strategy 10.0	Research	Examine effectiveness of stormwater activities, bacteria persistence and regrowth, and appropriate indicators for use in water quality monitoring.
Implementation Strategy 11.0	Geographic Priority Framework	Consider recommended criteria when selecting geographic locations for projects.

Introduction

The Clean Water Act requires that states establish standards that describe the ways that water bodies are used.[7] The standard associated with the contact recreation use is designed to ensure that water is safe for swimming, waterskiing, wading by children, or other activities that involve direct contact with the water.[8] Most water bodies in Texas and in the Houston-Galveston region must meet the standard for contact recreation. The TCEQ determines whether water quality in a water body designated for contact recreation meets the contact recreation standard by measuring the levels of indicator bacteria—either *Escherichia coli (E. coli)* or *Enterococcus,* depending on waterway characteristics. High concentrations of indicator bacteria[9] have been associated with an increased risk of becoming ill from recreational activities.

In the Houston-Galveston region, bacteria are the most common pollutant of concern. The 60 bacteria-impaired segments covered by the I-Plan represent 80 percent of assessed streams. It is this high level of bacteria impairment that is the focus of this document.

When a waterway is designated as impaired, a TMDL must be developed. A TMDL "is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards."[10] Once a TMDL is completed, an I-Plan must be developed. An I-Plan recommends implementation activities designed to reduce the pollutant of concern and restore the waterway to its designated use.

This I-Plan is the result of work by the BIG, a stakeholder group convened by the TCEQ. The BIG is composed of 31 members representing city and county governments, resource agencies, business and agriculture interests, conservation organizations, watershed groups, and the public. For more than two years, the BIG, along with dozens of workgroup members and hundreds of additional individuals, developed the recommendations in this I-Plan.

[7] See Clean Water Act § 303, 33 U.S.C. § 1313 (2006 & Supp. 2009)

[8] (TCEQ 2002)

[9] Because of the complexity of terms used to describe pathogens and their indicators, the terms bacteria, indicator bacteria, and bacteria indicator may be used to include both *E. coli* and *Enterococcus.*

[10] (U.S. Environmental Protection Agency 2010b)

Problem Definition

Impairments for the contact recreation use of the 60 segments are identified in the 1996, 2002, and 2006 *Texas Water Quality Inventory and 303(d) Lists.*[11] (Also see Table 2.) The TCEQ initiated four TMDL projects to identify possible sources of bacteria and appropriate reductions necessary to comply with water quality standards. The area encompassed by the watersheds for these four projects form the project area for this I-Plan, shown in Table 2.

Table 2: Segments Categorized by Year of First Listing for Bacteria Impairment

Year placed on the *Texas Water Quality Inventory and 303(d) List*[12]	Segment ID
1996	1008, 1009, 1013, 1014, 1016, 1017, 1101, 1102
1998	None
2002	1006D, 1006F, 1006H, 1006I, 1006J, 1007B, 1007C, 1007D, 1007E, 1007F, 1007G, 1007H, 1007I, 1007K, 1007L, 1007M, 1007N, 1007O, 1007R, 1013A, 1013C, 1014H, 1014K, 1014M, 1014N, 1014O, 1016A, 1016B, 1016C, 1016D, 1017A, 1017B, 1017D, 1017E, 1101B, 1102A, 1102B
2006	1004E, 1008H, 1009C, 1009D, 1009E, 1010, 1011, 1014A, 1014B, 1014E, 1014L, 1101D, 1102C, 1102D, 1102E

The numeric criteria defined in the standards for support of the primary contact recreation use are as follows:

- The geometric mean of *E. coli* in freshwater should not exceed 126 organisms per 100 milliliters (mL).
- Single samples of *E. coli* in freshwater should not exceed 399 organisms per 100 mL more than 25 percent of the time.[13]
- The geometric mean of enterococci in saltwater should not exceed 35 organisms per 100 mL.
- Single samples of enterococci in saltwater should not exceed 104 organisms per 100 mL.

[11] (TCEQ 2010i)

[12] (TCEQ 2008a)

[13] (TCEQ 2010g)

Although these numbers represent the standards for primary contact recreation adopted by the TCEQ on June 30, 2010,[14] other standards may have been in place prior to that date that led to a stream being identified as impaired for bacteria.[15]

This document applies to the 60 segments that are impaired for bacteria and for which TMDLs have been adopted by the TCEQ, their tributaries, and associated watersheds. The map in Figure 2describes the project area to which the I-Plan applies. Additional maps and statistics are available throughout the I-Plan, and also in Appendix I.

Project Area Description

The TCEQ developed TDMLs for the segments mentioned in the preceding text. The 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.

The TCEQ grouped several impaired segments together based on geography to create four TMDL projects. TMDL projects allow for evaluation and analysis of related water bodies to be considered together, both by scientists and by stakeholders. Stakeholders indicated that they would like to develop an I-Plan that was common to four TMDL project areas. The TMDL project areas often share political jurisdictions and communities.

Because many of the waterways within, near, or adjacent to the BIG Project Area are either listed or expected to be listed on the 303(d) list for bacteria impairments, this I-Plan includes provisions which allow for the addition of segments and watersheds in the event that new TMDLs are adopted by the TCEQ in the future.

[14] See 30 Tex. Admin. Code § 307.4 (2010) (General Standards) (State of Texas 2010)

[15] The TCEQ provides guidance pertaining to the collection and assessment of samples in its document "Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)" (TCEQ 2010i). Furthermore, ambient water quality samples in the BIG project area are collected under a Quality Assurance Project Plan developed by H-GAC in conjunction with TCEQ (Houston-Galveston Area Council 2010b).

BIG Project Area

The BIG Project Area is roughly 2,204 square miles and has a population of about four million people.[16] The area encompasses much of the City of Houston and part or all of another 55 cities and 10 counties. It stretches from Galveston Bay and the Clear Creek watershed in the south to Walker County in the north and to the cities of Waller and Katy in the west. Appendix B lists all monitored stream segments in the BIG area, along with information about whether the waterway is impaired or tidally influenced.

The following are the TMDL projects addressed by this document. The projects and their status are outlined in

Table 3.

Clear Creek TMDL Project Area

The nine impaired segments of Clear Creek, consisting of two main segments and seven tributaries, are located in Houston and to its southeast. The Clear Creek watershed is approximately 180 square miles in area with approximately 40 percent within Brazoria County, 35 percent within Harris County, 20 percent within Galveston County, and 5 percent within Fort Bend County. The eastern and central portions of the watershed are primarily urban and residential, with some commercial and industrial uses. The western and southern parts of the watershed include rural and agricultural land uses, which continue to transition over time from cultivated and woody land to developed land.

Buffalo and Whiteoak Bayous TMDL Project Area

The 18 impaired segments of Buffalo and Whiteoak bayous, consisting of three main segments and 15 tributaries, are located within and to the west of Houston. The approximately 492 square miles are in Harris, Fort Bend, and Waller counties, with the majority being within Harris County. Buffalo Bayou flows from outlying, less-developed areas, joining Whiteoak Bayou Above Tidal in the highly urbanized central part of the Houston business district. A unique feature of the Buffalo Bayou watershed is that two flood control reservoirs are located in its upstream end. The U. S. Army Corps of Engineers operates the reservoirs to minimize flooding downstream.

Houston Metropolitan TMDL Project Area

The 24 impaired segments of Houston Metropolitan watersheds are located primarily within Harris County, Texas, with only a small portion of Brays and Sims Bayou watersheds reaching into Fort Bend County. The approximately 416 square miles of land are generally highly developed with a mix of residential, commercial, and industrial uses, although some undeveloped areas still exist.

[16] H-GAC 2010 estimates

Watersheds Upstream of Lake Houston TMDL Project Area

The nine impaired segments of the Lake Houston project are located within the San Jacinto River Basin in East Texas. The project area encompasses approximately 1,100 square miles of land, primarily in Harris and Montgomery counties, but also in portions of Grimes, Liberty, San Jacinto, Walker, and Waller counties. The southern portion of the watershed includes portions of the City of Houston and its northern suburbs. The Woodlands and the City of Conroe join Houston as the largest communities located within the project area. The northern portions are relatively rural and include parts of the Sam Houston National Forest.[17]

[17] The original TMDL project for the Lake Houston Watershed included an additional five impaired segments and a total of about 2,362 square miles. Several segments were removed from the study area in 2010, mainly in the East and West Forks of the San Jacinto River Basin. TMDLs may be initiated in the future for these segments.

Figure 2: BIG Project Area

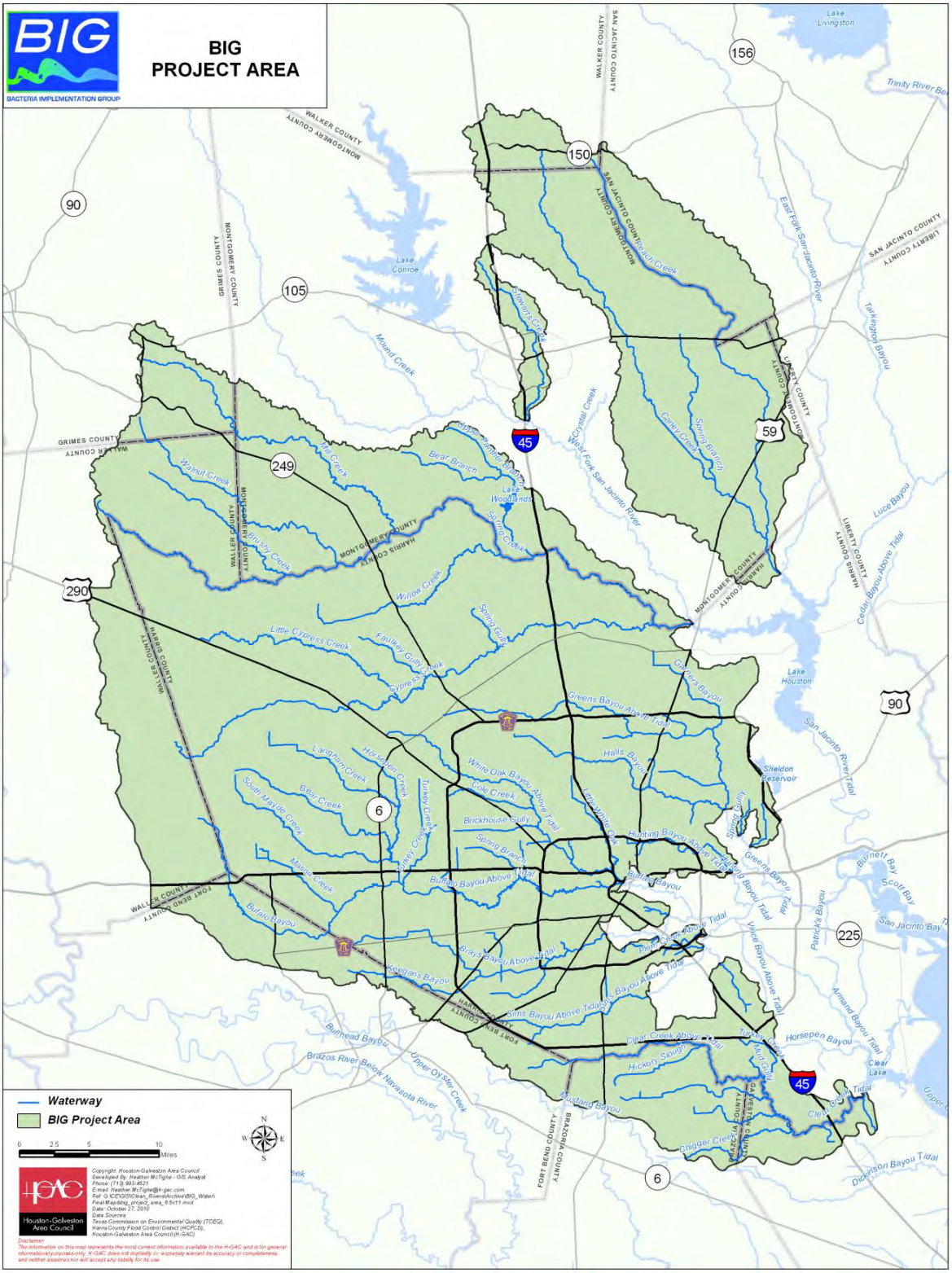


Table 3: TMDL Adoption and Approval Dates

TMDL	Segments in the TMDL	TCEQ adoption date	EPA approval date
Eighteen Total Maximum Daily Loads for Bacteria in Buffalo and Whiteoak Bayous and Tributaries[18]	1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E	April 8, 2009	June 11, 2009
Nine Total Maximum Daily Loads for Bacteria in Clear Creek and Tributaries[19]	1101, 1101B, 1101D, 1102, 1102A, 1102B, 1102C, 1102D, and 1102E	September 10, 2008	March 6, 2009
Eight Total Maximum Daily Loads for Indicator Bacteria in Greens Bayou Above Tidal and Tributaries[20]	1016, 1016A, 1016B, 1016C, and 1016D	June 2, 2010	August 12, 2010
Five Total Maximum Daily Loads for Indicator Bacteria in Brays Bayou and Tributaries[21]	1007B, 1007C, 1007E, and 1007L	September 15, 2010	September 27, 2010
Four Total Maximum Daily Loads for Indicator Bacteria in Sims Bayou and Tributaries[22]	1007D and 1007N	September 15, 2010	September 27, 2010
Total Maximum Daily Loads for Indicator Bacteria in Three Segments of Halls Bayou and Tributaries[23]	1006D, 1006I, and 1006J	September 15, 2010	September 27, 2010

[18] (TCEQ 2009a)

[19] (TCEQ 2008b)

[20] (TCEQ 2010a)

[21] (TCEQ 2010b)

[22] (TCEQ 2010d)

[23] (TCEQ 2010c)

TMDL	Segments in the TMDL	TCEQ adoption date	EPA approval date
Thirteen Total Maximum Daily Loads for Indicator Bacteria in the Eastern Houston Bayous and Tributaries[24]	1006F, 1006H, 1007F, 1007G, 1007H, 1007I, 1007K, 1007M, 1007O, and 1007R	September 15, 2010	September 27, 2010
Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston[25]	1002*, 1003*, 1004*, 1004D*, 1004E, 1008, *1008B, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011	April 6, 2011	Not approved (as of April 15, 2011)

* In original TMDL project, but subsequently removed

Potential Sources of Bacteria

Pollutants may come from both point and nonpoint sources. They include:

- Non-compliant WWTF discharges,
- Industrial and construction site discharges,
- Municipal separate storm sewer systems,
- Unpermitted storm sewer systems,
- Sanitary sewer overflows,
- Leaking wastewater infrastructure,
- Dry weather discharges/illicit discharges into and from storm sewers,
- Sediment re-suspension,
- Bacteria regrowth,
- Failing on-site sewage facilities,
- Agricultural activities and domesticated animals,
- Wildlife, and
- Pets.

Methods for Estimating Bacteria Loads

In the development of the Houston-Galveston area bacteria TMDLs, the TCEQ and its consultants used a variety of methods to analyze indicator bacteria loads, in-stream water quality, and load reductions. Relating bacteria loading to in-stream bacteria levels is difficult because of the dynamics of bacteria

[24] (TCEQ 2010j)

[25] (James Miertschin & Associates, Inc. 2009)

populations. Bacteria populations can be affected by factors such as sunlight, water temperature, nutrients, and sediment.

The specific models for each project area were chosen based on available information about how various models work and characteristics of the water bodies. For the Clear Creek TMDL, load duration curve (LDC) analyses were used for the seven freshwater segments and a tidal prism method was used for the two tidal segments. Three methods of analysis were used to analyze bacteria loads for the Buffalo and Whiteoak bayous TMDLs: LDC analyses, a mass balance analysis using Bacteria Load Estimator Spreadsheet Tool (BLEST), and a Hydrologic Simulation Program Fortran (HSPF) analysis for simulation of watershed hydrology and water quality. LDC analyses were used for waterways in the Houston Metropolitan and Lake Houston project areas.

In LDCs, a line displays the maximum allowable load over the complete range of flow conditions based on the calculation of flow multiplied by the criterion. Using LDCs, a TMDL can be expressed as a continuous function of flow, equal to the line, or as a discrete value derived from a specific flow condition. LDCs do not simulate the fate of contaminants; rather, they calculate allowable loading for a given flow and they show the distribution of bacteria exceedances during different flow levels.

A time-varying tidal prism modeling approach with a moderate level of spatial resolution allows for the calculation of bacteria loadings in tidal waterways. The tidal prism is the volume of water between low and high tide levels or between the high tide elevation and the bottom of the tidal waterway. The model incorporates the three mechanisms through which bacteria loadings enter the impaired systems: runoff, direct point source discharges, and tidally influenced loadings.

BLEST is designed to calculate or estimate the indicator bacteria loads and load reductions for each segment needed to attain the water quality standard for the segment. It estimates load reductions for a fixed time interval and a given segment and does not incorporate the temporal variations associated with pathogen loads. However, it does allow an evaluation of loads by subwatershed.

The HSPF model is a continuous simulation model for watershed hydrology and water quality. The model can account for both point source and nonpoint source loadings in the watershed. It includes simulation of the receiving stream that receives mass loadings from the watershed.

TMDL Equation

The standard TMDL equation is TMDL = WLA + LA + MOS, where TMDL is Total Maximum Daily Load, WLA is Waste Load Allocation, LA is Load Allocation, and MOS is Margin of Safety, a factor to account for uncertainty and future growth. The equation is used to allocate loads among different sources of a pollutant.[26]

[26] (U.S. Environmental Protection Agency 2008)

Waste load allocations were determined for point sources in each TMDL. These point sources include effluent discharges from permitted wastewater facilities, permitted stormwater runoff, and other point sources. Load allocations for nonpoint sources generally include background loads, upstream loads, any stormwater runoff not subject to permit, on-site sewage facility loads, and other nonpoint sources such as animal deposition and leaking wastewater infrastructure. Allocated loads for all TMDLs covered by this document can be found in Appendix C.

Implementation Plan Overview

In order to keep Texas' commitment to restore and maintain water quality in impaired rivers, lakes, bayous, and bays, the TCEQ recognizes that it must establish implementation plans for each TMDL. This I-Plan is designed to guide activities that will reduce bacteria in the 60 impaired segments in the adopted TMDLs and their watersheds. The ultimate goal of the I-Plan is to restore contact recreation use, where appropriate, by reducing concentrations of bacteria to levels that meet the criteria established in the water quality standards for contact recreation.

This I-Plan is a flexible tool that governmental and nongovernmental organizations will use to guide their program management. The participating organizations may accomplish the activities described in this I-Plan through voluntary or regulatory measures as appropriate. Progress will be evaluated on a regular basis with updates and changes being made to the I-Plan as needed.

This I-Plan contains the following components:

- A description of implementation activities and management measures that will be implemented to achieve the water quality targets;
- A schedule for implementing activities;
- A description of the legal authority under which the participating agencies may require certain implementation activities;
- A follow-up tracking and monitoring plan to determine the effectiveness of the implementation activities and management measures undertaken;
- Identification of measureable outcomes and other considerations the TCEQ will use to determine whether the I-Plan has been properly executed and water quality standards are being achieved, or whether this plan needs to be modified; and
- Identification of communication strategies the TCEQ will use to disseminate information to stakeholders and other interested parties.

This I-Plan includes all of the nine key elements for watershed-based plans as prescribed in the *Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories*

in FY 2003[27] (compiled in Appendix K). Projects developed to implement nonpoint source elements of this I-Plan that meet the conditions of the U.S. Environmental Protection Agency's Section 319(h) incremental grant program may be eligible to receive this funding.[28] I-Plans differ from Watershed Protection Plans (WPPs) in two key ways. First, I-Plans typically address only one pollutant in a water body or water bodies while WPPs address all sources and causes of watershed impairments and threats. Second, I-Plans are usually regulatory and state driven while WPPs are usually voluntary and locally driven.

The BIG proposes an adaptive management approach to implementation. The EPA describes adaptive implementation as a tool used to improve implementation strategies. Adaptive implementation may be appropriate when there is uncertainty regarding loading, necessary load reductions, and the effectiveness of implementation activities, as is the case for this I-Plan. Adaptive implementation allows for the implementation of practicable controls while additional data collection and analysis are conducted. Monitoring addresses the uncertainty in the efficacy of implementation actions and can provide assurance that implementation measures are succeeding in attaining water quality standards, as well as inform the ongoing TMDL implementation strategy.[29] The cost-effectiveness of the recommendations in this I-plan will need to be tested early during implementation so the overall strategy can be adapted to emphasize those measures which are working best. The advantage of this approach is that it will avoid major up-front expenditures for untested strategies, but it will also require a sustained investment in monitoring and follow-up communication.

Primary bacteria sources of concern include wastewater treatment facilities, sanitary sewer systems, on-site sewage facilities, and stormwater; however, loadings from the various sources cannot be quantified at this time. Top implementation activities for these sources include more stringent bacteria monitoring requirements and bacteria limits for wastewater treatment facilities, requirements for all sanitary sewer systems to develop and implement an operations and maintenance program, the creation of a geographic inventory of on-site sewage facilities, and the geographic expansion of stormwater management programs. Each activity is more fully described in each section of this plan.

[27] (U.S. Environmental Protection Agency 2002)

[28] See the Clean Water Act § 319(h), 33 U.S.C. 1329 (2006 & Supp. 2009)

[29] (U.S. Environmental Protection Agency, Best-Wong, B. 2006)

Implementation Strategy 1.0: Wastewater Treatment Facilities

Although bacteria are found in fecal waste of all warm-blooded animals, it is the intent of the BIG to focus resources on bacteria from human sources.

In Texas, the level of bacteria loading from wastewater treatment facilities (WWTFs) is largely unknown because, until recently, their permits have not required them to test for bacteria, with the exception of facilities utilizing an ultraviolet disinfection system. However, non-compliant WWTFs were designated in the Clear Creek TMDL as one of the most probable sources of bacteria in the region's waterways.[30] Results from limited monitoring of bacteria in the BIG region suggests that while levels of indicator bacteria in effluent from individual WWTFs is typically low, at any given time approximately 5 percent to 10 percent of the facilities can be found to be exceeding the single-sample criterion for *E. coli.*[31]

As of October 1, 2010, the BIG region has 536 domestic WWTFs and 50 industrial WWTFs, most of which are permitted for less than 0.5 million gallons per day, or MGD. (See Table 4 and Figure 3.) When not dominated by stormwater, flow in many of the region's waterways is dominated by wastewater effluent. Possible sources of bacteria from WWTFs include insufficiently treated effluent and unauthorized/accidental discharge, including sludge.

Table 4: Domestic and Industrial WWTFs[32]

Permitted Flow (MGD)	Number of Domestic WWTFs (% of Domestic Facilities)	Number of Industrial WWTFs (% of Industrial Facilities)
0 to less than 0.1	228 (43%)	43 (86%)
0.1 to less than 0.5	127 (24%)	4 (8%)
0.5 to less than 1	98 (18%)	1 (2%)
1 to less than 5	76 (14%)	2 (4%)
5 to less than 10	5 (1%)	0 (0%)
10 or greater	2 (0%)	0 (0%)

[30] (TCEQ 2008b)

[31] (TCEQ 2009a)

[32] These numbers were extracted from a database, maintained by H-GAC, of permitted WWTF in the thirteen-county region.

Implementation Activity 1.1: Impose More Rigorous Bacteria Monitoring Requirements

Until recently, WWTFs in Texas were not required to monitor for bacteria, with the exception of facilities using an ultraviolet disinfection system. However, the TCEQ recently came to an agreement with the EPA and adopted a new rule requiring that all domestic wastewater draft permits, for which Notice of Application and Preliminary Decision is published on or after January 1, 2010, be updated to include monitoring requirements for bacteria at a specified frequency (See Table 5).[33] It will take five years or more for renewals to be initiated for all domestic wastewater permits.

In order to move toward compliance with contact recreation standards in the region's waterways, it is imperative to have more information about WWTFs' operations. As such, the BIG recommends that the frequency of monitoring be increased over what is currently required by the TCEQ.

According to current regulations, 228 domestic WWTFs in the BIG project area are required to monitor bacteria quarterly and 127 domestic WWTFs are required to monitor monthly. Under the recommendations of this I-Plan, domestic WWTFs in the BIG project area would be required to monitor bacteria on frequencies similar to those for other parameters of their Texas Pollutant Discharge Elimination System (TPDES) permits, up to five times per week. If a domestic permit does not specify a sampling frequency for bacteria, the permittee should follow the frequencies set forth in Table 6. As of August 2010, the cost to run a bacteria sample is approximately $50.

Larger flows have more frequent sampling requirements than small flows, as reflected in the current requirements in Texas for domestic WWTFs. Current requirements are shown in Table 5. Table 6 shows proposed increases in sampling frequency for smaller flows to increase the operational database. Over time, the increased data will help operators understand the effects of variables such as rainfall and infiltration. In addition, the data could help improve load reduction because operators will have more information to use to adjust and control facilities to reduce bacteria levels. The additional data may also protect compliant WWTFs from more stringent regulations that could be imposed if receiving stream quality fails to improve. Frequencies shown in Table 6 could be increased, depending on WWTF performance, other site sampling frequencies, and the impairment of the receiving stream.

[33] See 34 Tex. Reg. 3495 (2009), *adopted* 34 Tex. Reg. 8332 (2009) (codified as an amendment to 30 Tex. Admin. Code § 319.9(b))

Figure 3: Map of Wastewater Treatment Facility Outfalls

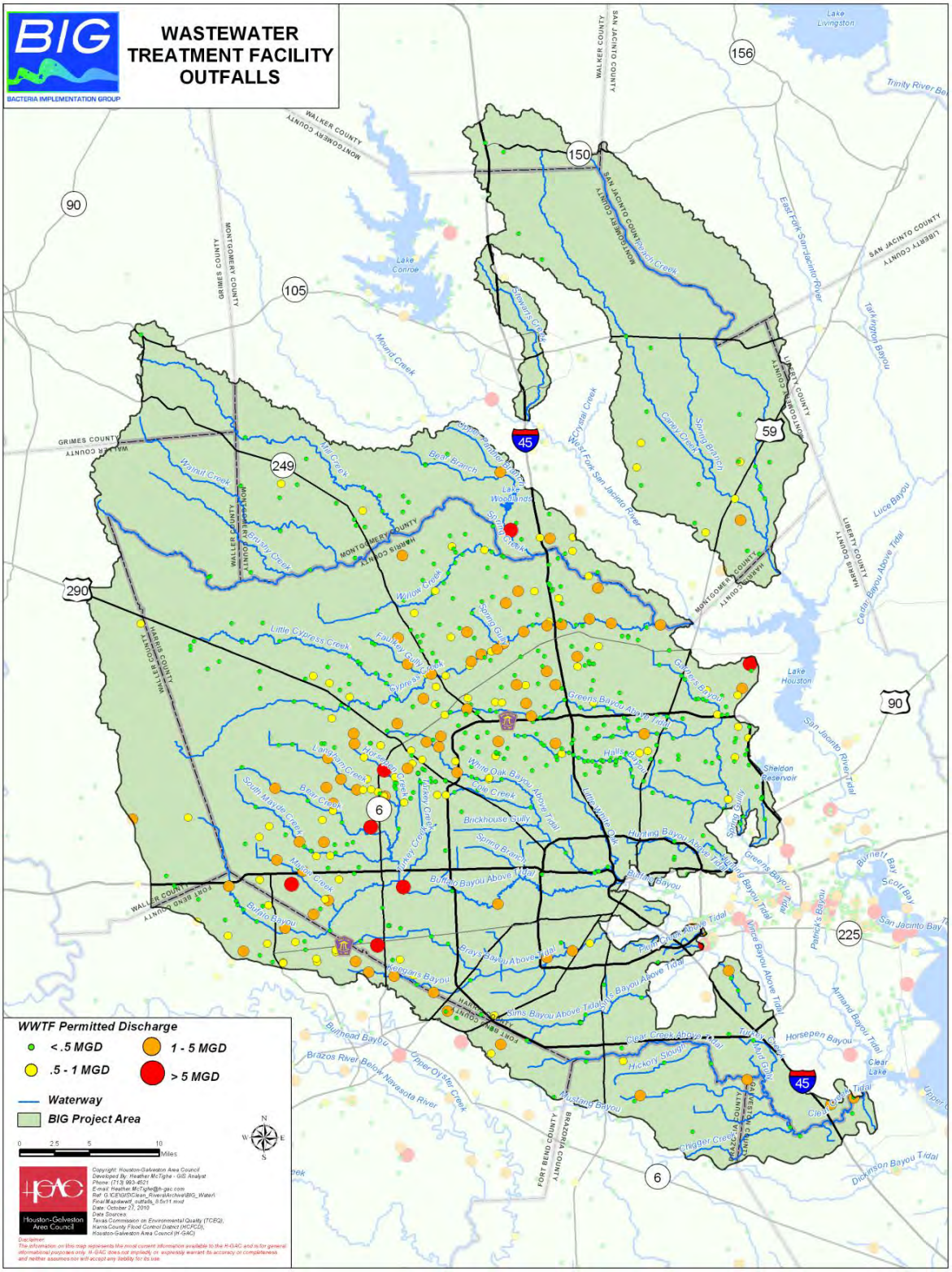


Table 5: *Current* requirements in Texas for domestic WWTFs[34]

Permitted Flow (MGD)	Chlorine systems	Ultraviolet systems	Natural systems
0 to less than 0.1	1/quarter	5/week	1/month
0.1 to less than 0.5	1/month	5/week	2/month
0.5 to less than 1	2/month	Daily	1/week
1 to less than 5	1/week	Daily	3/week
5 to less than 10	3/week	Daily	5/week
10 or greater	5/week	Daily	Daily

Table 6: *Proposed* requirements for domestic WWTFs in the BIG Project Area

Permitted Flow (MGD)	Chlorine systems	Ultraviolet systems	Natural systems
0 to less than 0.1	**1/week***	5/week	**3/week***
0.1 to less than 0.5	**1/week***	5/week	**3/week***
0.5 to less than 1	**3/week***	Daily	**3/week***
1 to less than 5	**3/week***	Daily	3/week
5 to less than 10	**5/week***	Daily	5/week
10 or greater	5/week	Daily	Daily

*These *proposed* values differ from existing values.

According to new bacteria monitoring regulations, in 30 Tex. Admin. Code § 319.9(b), a permittee that has at least twelve months of uninterrupted compliance with its bacteria limit may notify the commission of its compliance and request a less frequent measurement schedule. The same allowance and possible consequences for violation of the permit limit could apply in the project area.

TCEQ procedures specify that effluent limits and monitoring requirements for bacteria associated with industrial discharges will be determined on a case-by-case basis.[35] If the TCEQ elects to include bacteria limits or monitoring in a permit for an industrial facility, the BIG recommends that the TCEQ take into consideration the bacteria limits and monitoring guidelines specified by the BIG for domestic WWTF permits. The TCEQ shall also consider the characteristics of both the waste stream and the receiving water body, particularly when the stream is impaired for bacteria.

[34] See 30 Tex. Admin. Code § 319.9 (2011) (Table (b): Frequency of Bacteria Measurement)

[35] (TCEQ 2010g)

Implementation Activity 1.2: Impose Stricter Bacteria Limits for WWTF Effluent

The TCEQ adopted a rule on November 4, 2009, requiring all TPDES domestic wastewater permits be updated to include bacteria limits for all WWTFs.[36] New regulations state that "by adopting bacteria limits, there will be a more direct and possibly more accurate measure of the level of disinfection achieved in domestic effluent discharged to both fresh and salt water."[37] Current regulations have set the monthly geometric mean bacteria effluent limit and the daily maximum bacteria effluent limit at the most stringent contact recreation category level.[38]

However, if waterways are to meet contact recreation standards, effluent limits should be made more stringent for WWTFs discharging into bacteria-impaired watersheds. In fact, the approved Buffalo and Whiteoak bayous TMDL[39] states, "if WWTFs were to discharge at the water quality criterion (126 MPN/100 mL), there would be no capacity to accommodate other loads and existing downstream discharges."[40] Therefore, for domestic facilities releasing effluent into freshwater, the BIG resolves and recommends to the TCEQ that bacteria limits in domestic WWTF permits throughout the BIG project area be set at 63 MPN/100 mL for the geometric mean of the monthly samples[41] of *E. coli* effluent, using any method approved under 40 C.F.R. § 136, and 197 MPN/100 mL for the daily maximum *E. coli* effluent limit. The authority to set these stricter limits was given explicitly in the rule itself,[42] where it states "the commission may impose more stringent requirements in permits than those specified…on a case-by-case basis, where appropriate to maintain desired water quality levels or protect human

[36] See 34 Tex. Reg. 3495 (2009), *adopted* 34 Tex. Reg. 8332 (2009) (codified as an amendment to 30 Tex. Admin. Code § 319.9(b))

[37] (TCEQ 2009c)

[38] See 30 Tex. Admin. Code § 309.3(h)(2) (2011) (Application of Effluent Sets)

[39] (TCEQ 2009a)

[40] The Buffalo and Whiteoak Bayous TMDL and other TMDLs proposed and anticipated in the BIG region specify that *E. coli* limits for WWTF effluent be one half of the water quality criterion, currently 63 MPN/100 mL, in calculations of the WWTF Waste Load Allocation. More stringent limits for Enterococci were not specified by the TMDLs.

[41] After identifying and rejecting outliers, consistent with ASTM E 178-80, "Standard Practice for Dealing With Outlying Observations" (Section 14.02, General Methods and Instrumentation - General Test Methods; Forensic Sciences: Terminology; Conformity Assessment: Statistical Methods).

[42] See 30 Tex. Admin. Code § 309.3 (2011) (Application of Effluent Sets)

health."[43] As allowed for in the Buffalo and Whiteoak bayous TMDL, the BIG resolves that the bacteria limit be set at a geometric mean of 126 MPN/100 mL for the monthly samples at a WWTF's next permit renewal or major amendment and that the new limit be phased in, such that three years after the permit's effective date the effluent limit shall be a geometric mean of 63 MPN/100 mL for the monthly samples.[44] This phased in approach would allow the WWTFs to implement *E. coli* monitoring while each plant plans and implements processes to address *E. coli* discharges.

The TCEQ has developed criteria for actual classified stream segment testing using *E. coli* as the indicator bacteria for freshwater and *Enterococci* for saltwater per Appendix A of 30 Tex. Admin. Code § 307.10 (1).[45] Fecal coliform can still be used as an alternative indicator during the transition to the new indicator bacteria, as specified in 30 Tex. Admin. Code § 307.7(b).[46] For domestic facilities where the TCEQ determines that *Enterococcus*, rather than *E. coli*, is the appropriate indicator bacteria, the BIG resolves that the Enterococcus effluent limit be set at 23 MPN/100 mL for the geometric mean of the monthly samples[47] and 57 MPN/100 mL for the daily maximum, using any method approved under 40 C.F.R. Part 136.

Implementation Activity 1.3: Increase Compliance and Enforcement by the TCEQ

Stakeholders are concerned that there are insufficient quantities of investigations, reviews, and enforcement being performed by the TCEQ. The BIG recommends that the TCEQ conduct unannounced and focused inspections with a goal to have all facilities inspected every two years. There are multiple methods to address the low numbers of investigations and reviews performed. One method would be to increase the number of staff performing investigations, either through hiring additional TCEQ staff or through a contract with local programs. Another method would be to change TCEQ operating procedures.

[43] (State of Texas 2009)

[44] After identifying and rejecting outliers, consistent with ASTM E 178-80, "Standard Practice for Dealing With Outlying Observations" (Section 14.02, General Methods and Instrumentation - General Test Methods; Forensic Sciences: Terminology; Conformity Assessment: Statistical Methods)

[45] See Appendix A of 30 Tex. Admin. Code § 307.10 (1) (2011) (Site-specific Uses and Criteria for Classified Segments)

[46] See 30 Tex. Admin. Code § 307.7(b) (2011) (Appropriate uses and criteria for site-specific standards)

[47] After identifying and rejecting outliers, consistent with ASTM E 178-80, "Standard Practice for Dealing With Outlying Observations" (Section 14.02, General Methods and Instrumentation - General Test Methods; Forensic Sciences: Terminology; Conformity Assessment: Statistical Methods)

1.3.1: Allow unannounced inspections and focused investigations on all facilities, including sampling-only investigations

Currently, unannounced inspections can be performed at WWTFs that have been designated as poor performers or in response to complaints and other similar situations. In the BIG region only one facility has been so designated. Unannounced inspections have been shown to increase compliance.[48] The BIG assumes that unannounced WWTF inspections would yield similar results.

In addition to the restrictions on whether inspections must be announced, there are restrictions on the types of investigations that may be performed. For example, Comprehensive Compliance Inspections are required for inspections of mandatory facilities and can take days to complete. This severely limits the number of inspections that can be performed. The TCEQ should allow for and conduct focused investigations including inspections that just collect samples at all facilities. An investigator could then conduct numerous inspections in a single day. Currently, focused investigations are permitted only at discretionary minor facilities, which, for the most part, have permitted discharge of less than one MGD.

For facilities that are not currently staffed, the BIG recommends that the TCEQ develop a procedure to facilitate these inspections and investigations. For example, the TCEQ could require access within a defined, restricted period of time after providing notice by telephone to a posted number.

1.3.2: Consider increasing TCEQ staff or contract with local programs to increase inspections and reviews

The TCEQ should perform a workload analysis to correlate recent increases in wastewater fees from the regulated community to the allocation of staff for inspections and enforcement. If that analysis concludes that more staff is necessary, the TCEQ should hire additional employees. An alternative to hiring additional TCEQ employees would be for the TCEQ to consider contracting with a local program, as is done by the TCEQ for its air quality and waste management programs. Increasing the TCEQ staff or contracting with local programs would help ensure all plans and specifications are reviewed, a greater number of WWTFs are inspected each year, and Discharge Monitoring Reports are reviewed on a more frequent basis for effluent violations, non-submittal, and other issues.

Implementation Activity 1.4: Improved Design and Operation Criteria for New Plants

Much of the existing design and operation criteria for WWTFs was improved in 2008 when 30 Tex. Admin. Code § 217 (2011) (Design Criteria for Domestic Wastewater Systems) (formerly § 317) was adopted. As a greater understanding of how plant design impacts bacteria outputs from plants is

[48] (Texas Department of State Health Services 2007)

achieved, the BIG recommends local governments reopen discussion of design criteria in the near future and consider whether adopting stricter requirements within their jurisdiction would be appropriate.

Implementation Activity 1.5: Upgrade Facilities

Bacteria monitoring may reveal WWTFs that are not meeting effluent limits. Upgrades or repairs, as appropriate, will be the responsibility of each individual facility in order to comply with individual permits. Some types of facilities may have more trouble than others in meeting bacteria standards. These facilities may need to undertake an intensive redesign. Grants, although generally not great in size, may be available. Possible sources of funding include:

- EPA via the Texas Water Development Board, Clean Water State Revolving Fund Program
- U.S. Department of Commerce, Economic Development Grants for Public Works and Development Facilities
- U.S. Department of Agriculture, Rural Utilities Service Water and Waste Disposal Program
- U.S. Department of Housing and Urban Development, State Community Development Block Grant Program

Implementation Activity 1.6: Consider Regionalization of WWTFs

Notwithstanding TCEQ and local enforcement authority, WWTFs that are chronically or severely out of compliance with the bacteria limits set in their TPDES permit shall be encouraged to address the problems through operational improvements and/or capital improvements. If the facility continues violating bacteria limits set in their TPDES permit, the BIG encourages the TCEQ or any local government with jurisdictional authority to require the WWTF to evaluate facility regionalization and implement as appropriate. If regionalization is not a viable alternative, the facility should be required to be modified to meet higher design and monitoring standards.

Implementation Activity 1.7: Use Treated Effluent for Facility Irrigation

Many domestic WWTFs currently do not use their effluent for purposes of irrigation of facility grounds. Using effluent for facility irrigation will allow the water to trickle through the grass and soil, filtering out additional pollutants. Each domestic WWTF is required to consider the use of treated effluent for facility irrigation purposes and is encouraged to incorporate its use as appropriate prior to the next renewal of its permit.

Implementation Strategy 2.0: Sanitary Sewer Systems

This implementation strategy focuses on the underground infrastructure (pipes), ancillary support processes (lift stations), and the management of the network of infrastructure that is connected to the wastewater treatment facility itself. Activities to be implemented in the wastewater treatment facilities are discussed in the previous section.

Sanitary sewers can fail to function properly due to blockages, line breaks, defects that allow stormwater and groundwater to overload the system, lapses in operation, inadequate design and construction, power failures, and vandalism. The EPA has concluded that sanitary sewer overflows (SSOs) contribute to bacteria loading in almost all impaired streams, but may or may not be a primary source of loading. EPA acknowledges that SSO data is difficult to assess.[49]

In a Report to Congress, the EPA addressed the extent and possible solutions to human health and environmental impacts caused by SSOs.[50] In the Houston region, sanitary sewer systems are separate and not intentionally combined with stormwater sewer systems. SSOs are untreated or partially treated discharges from sanitary sewers. "SSOs can range in volume from one gallon to millions of gallons. The microbial pathogens and other pollutants present in SSOs can cause or contribute to water quality impairments, beach closures, shellfish bed closures, contamination of drinking water supplies, and other environmental and human health problems."[51]

Based on estimates presented in the TMDL reports or draft technical documents, an average of 77 overflows were reported each month, representing a monthly average of over 700,000 gallons. Overflows were reported in all but two watersheds.

In general, implementation actions consist of encouraging improvements to sanitary sewers; reducing the amount of fats, oils, and grease entering the systems; addressing lift station inadequacies; improving reporting of violations; strengthening controls on subscriber systems;[52] maintaining an accurate map of sanitary sewer coverage; and evaluating the penalty structure for SSOs and other sanitary sewer violations.

[49] (U.S. Environmental Protection Agency 2004)

[50] (U.S. Environmental Protection Agency 2004)

[51] (U.S. Environmental Protection Agency 2004)

[52] A subscriber system is a sewer system that conveys flow to a wastewater treatment facility that is owned by a separate entity. The term is not intended to indicate individual private laterals, such as a homeowner's connection to a sewer system.

Implementation Activity 2.1: Develop Utility Asset Management Programs for Sanitary Sewer Systems

A utility asset management program (UAMP) is a common-sense, proactive approach to managing, maintaining, and operating a sanitary sewer system. The EPA's Capacity, Management, Operation, and Maintenance (CMOM) is probably the most well-known UAMP. This section uses CMOM as a guide for this implementation activity but these programs are intended to function independently of the EPA unless the system's owner or operator requests its technical or other assistance.

UAMPs provide a framework for self-evaluation and planning for the function, condition, and performance of a sanitary sewer system. Currently, UAMPs are voluntary in Texas, although the TCEQ or EPA can require them through a consent decree or administrative order. To facilitate the development and implementation of many elements of UAMPs, the TCEQ offers the Sanitary Sewer Overflow Initiative (SSOI), a voluntary program to improve a system's operation. Some operators have voluntarily implemented a program as a means to improve performance and reduce costs. It should be understood that UAMP elements will vary with requirements and circumstances of individual entities. For example, a small, well-run system with fewer than a dozen connections would have a simple program, possibly described in less than two pages. A large or problematic system would have a substantial UAMP, proportional to its size or problems. Therefore, the BIG does not recommend that the TCEQ, the EPA, or other regulators develop or use a 'standard format.'

2.1.1: Require a UAMP Plan as part of Wastewater permits

The BIG requests that all permits for new WWTFs discharging to a stream within the BIG project area include a UAMP plan for any sanitary system owned and operated by the new WWTF . The BIG also requests that, starting five years from the approval of the I-Plan, all permit renewals for WWTFs discharging to a stream within the BIG project area include a UAMP plan for any sanitary system owned and operated by the WWTF. As allowable by law, the UAMP plan should apply to any subscriber systems that contribute to the WWTF.[53]

The intent of the BIG is that all permits for WWTFs with authority over the collection system discharging to a stream within the BIG project area include requirements for UAMP plans. The BIG recognizes that valid constraints may prevent the TCEQ from including such requirements in all plans and that, in such situations, TCEQ may encourage those facilities to voluntarily develop such plans.

H-GAC or other appropriate entities shall, as resources are available, track the inclusion of UAMP plan requirements in WWTF permits and the voluntary development of UAMP plans by permitted facilities

[53] See sample language in "Model NPDES Permit Language for Sanitary Sewer Overflows (draft)" (U.S. Environmental Protection Agency 2007)

not subject to permit requirements for UAMP plans. The BIG shall evaluate the adoption of UAMP plans and whether additional actions should be recommended.

These recommendations are intended to reduce bacteria loading by reducing the possibility of malfunctions such as blockages, line breaks, inflow and infiltration of stormwater and groundwater, lapses in operation, inadequate design and construction, power failures, and vandalism. By reducing the possibility of malfunction, the BIG intends that UAMP plans will reduce the possibility of discharges of untreated or partially treated sewage from a sanitary sewer system, at the same time they improve the services provided to customers.

Operators of existing systems are encouraged to develop a UAMP plan prior to the inclusion of these requirements in a permit. In general, components of the UAMP plan will include clearly stated goals, a description of the organization, the permittee's legal authority, an overflow emergency response plan, measures and activities, design and performance standards, a capacity assurance plan, provisions for self-audits, and a communication plan. Activities specified in the plan might include lift station maintenance, provision of alternative power sources such as generators for lift stations, periodic manhole surveys that include cover levels and wall condition, periodic line cleaning, and condition surveys. More details and resources for plan development are provided in Appendix D.

Operators of sanitary sewer systems are encouraged to seek technical assistance from either the TCEQ or the EPA as appropriate, although the oversight of neither agency is a requirement of the program. Owners and operators are encouraged to consider participating in the TCEQ's voluntary SSOI program as a means to improve system performance and to facilitate development of an appropriate UAMP plan. The TCEQ's Small Business and Local Government Assistance program is also a source of technical assistance.[54] Minimum elements of the UAMP plan would include the provision of updated coverage maps, confirmation of subscriber system registration (see Implementation Activity 2.5), and improved reporting requirements (see Implementation Activity 2.4). As resources are available, H-GAC shall collect and make available copies of UAMP, CMOM, and SSOI plans for reference.

The TCEQ is encouraged to make facilities that do not have a UAMP plan, and facilities that are not implementing their UAMP plan, higher priorities for inspections and enforcement.

2.1.2: Develop a series of webcasts and meetings to provide introductory information about UAMPs

H-GAC, the TCEQ, or another appropriate entity shall offer a series of meetings geared toward local sanitary sewer owners, operators, and engineers, providing introductory information about UAMPs. Meeting topics may include a description of the problems presented by sanitary sewer systems, a

[54] See also "Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems" (U.S. Evironmental Protection Agency 2005)

definition of CMOM, an outline of EPA guidelines, case studies, and a description of benefits such as cost savings, cost avoidances, and pollution reduction. In an effort to make the information accessible to an expanded audience, the meetings will be recorded and made available in a webcast format during the meeting and as an online archive. Potential development partners include the Water Environment Association of Texas, the TCEQ, the Water Environment Research Foundation, the EPA, the Texas Water Utility Association, the Texas Rural Water Association, and the Association of Water Board Directors – Texas. Continuing education credits should be given to operators for participation in training related to UAMP.

Implementation Activity 2.2: Address Fats, Oils, and Grease

Fats, oils, and grease are considered to be the leading cause of blockages in sanitary sewers, and the EPA estimates that blockages account for nearly 50 percent of all SSOs.[55] This implementation activity encourages local governmental entities to require owners of sanitary sewer systems to determine the proper size for grease traps, to inspect them, and to require grease traps be properly cleaned and otherwise maintained. H-GAC, in consultation with stakeholders and as resources allow, shall develop model language to facilitate the adoption of appropriate legal mechanisms.

The TCEQ developed a model ordinance in response to the Texas 78th State Legislature's amendment of the Texas Water Code, and created standards for managing grease stoppages in utilities' sanitary sewer lines.[56] The City of Houston incorporated elements of the model language into its Code of Ordinances in 2007.[57]

Possible topics for public education include efforts targeted at reducing fats, oils, and grease from residences and multi-family dwellings. Available resources include the *Can Your Fats*[58] brochure developed by Harris County and the City of Houston, the City of Houston's *Corral the Grease* program[59] and the TCEQ's *Let's Tackle the Grease in This Kitchen*[60] poster and video.

[55] (U.S. Environmental Protection Agency 2004)

[56] See Tex. Water Code Ann. § 26.0491 (2010) (Model Standards to Prevent Discharge of Untreated Wastewater from Sanitary Sewers). (State of Texas 2004)

[57] See Houston, Tex., Code of Ordinances, Chapter 47, Article 7 (2008). (City of Houston 2008)

[58] (Harris County & City of Houston 2009)

[59] (City of Houston 2007)

[60] (TCEQ 2007)

Implementation Activity 2.3: Encourage Appropriate Mechanisms to Maintain Function at Lift Stations

Occasionally, lift stations may cease to function and may discharge sewage into waterways, as demonstrated during the extensive power outages following Hurricane Ike in 2008. Lift stations may also fail to function during circumstances other than power outages, such as mechanical failure or repair.

Lift station operators are encouraged to undertake appropriate actions to maintain function of lift stations during power outages and other situations. Operators shall develop a comprehensive plan, possibly part of the UAMP plan, to address such situations. Appropriate mechanisms for inclusion in the plan might include installing underground power lines to lift stations, negotiating with power providers to reclassify lift stations as a higher priority for service restoration, installing solar-powered generators, developing partnerships with transportation partners to allow hybrid vehicles to serve as mobile generators, installing quick-connects if the use of mobile generators is necessary, using by-pass pumps, or using a wireless remote system. Conventional generators, whether fueled by natural gas or diesel fuel, might also be appropriate. Owners and operators are strongly encouraged to install quick-connects at lift stations. Quick-connects allow the quick connection of lift stations to alternative power sources such as mobile generators without the need for time-consuming and expensive facility modifications during a post-storm or other failure.

Implementation Activity 2.4: Improve Reporting Requirements for Sanitary Sewer Overflows

Current EPA regulations specify reporting requirements for noncompliance, including SSOs, in 40 C.F.R. §§ 122.41(1) (6) and (7) (2011).

2.4.1: Implement statewide database to record reported SSOs, allowing operators of sanitary sewer systems to enter information directly into State of Texas Environmental Electronic Reporting System

The TCEQ should further develop its system to allow collection, analysis, and dissemination of this information. This action is not intended to increase the data-entry requirements for TCEQ staff; instead, it is intended to streamline reporting and analysis.

2.4.2: Develop ability for communities to use statewide database to record reported SSOs

The existing TCEQ database security features require a broadband Internet connection for access. Until all sanitary sewer operators have access to a broadband Internet connection, database reporting should not be required.

In 2009, using American Recovery and Reinvestment Act funds, the Texas Department of Agriculture began mapping the coverage of broadband Internet access in Texas.[61] Once areas without coverage have been identified, funds may be available to develop coverage in rural areas, including all of the non-urban areas of the BIG region.

Once a statewide database is available and all communities in the BIG project area have the ability to report electronically, operators' permits shall require them to utilize the database to report SSOs.

2.4.3: Require reporting of SSOs to local programs

EPA regulations allow WWTF permits to include requirements that SSOs be reported to local programs, such as those of cities and counties. The statewide database described in the preceding section should be developed to include reporting capabilities that would allow the program to automatically alert local governments about SSOs.

Implementation Activity 2.5: Strengthen Controls on Subscriber Systems

Subscriber systems are those systems that do not operate their own WWTFs or have their own permits, but instead enter into contracts with permitted WWTFs. (The term subscriber system is not intended to include private laterals such as those connecting a private residence to a sanitary sewer system.) While the exact linear footage of subscriber sanitary sewers in the project area is unknown, it is also unknown whether the contracts that WWTFs have with subscriber systems provide adequate controls and responsibility for operation, management, and maintenance of the subscriber system. Contracts could be developed to require appropriate controls.

2.5.1: Identify subscriber systems

Two approaches shall be taken to identify subscriber systems. First, as resources are available, H-GAC shall contact WWTF permittees and ask them to provide information regarding subscriber systems. Second, the BIG can petition the TCEQ for rulemaking to require registration of subscriber systems. As resources are available, H-GAC or another appropriate agency shall distribute information about subscriber systems. If stakeholder concerns regarding subscriber systems remain after five years, the BIG may consider consulting with the TCEQ to address subscriber systems or petitioning the TCEQ to require that subscriber systems have their own wastewater discharge permits.

2.5.2: Develop model contracts

As resources are available, H-GAC shall work with attorneys for WWTFs, municipal utility districts (MUDs), and other stakeholders to develop model contract documents. Contracts might address operation or maintenance requirements, rights to inspect or repair, flow reduction incentives, flow

[61] See Connected Texas website(Connected Texas 2010)

metering, and the ability to pass on fines or other financial burdens resulting from violations of permit requirements and for unauthorized discharges.

2.5.3: Provide a circuit rider program to work with WWTF permittees and subscriber systems to strengthen subscription contracts

As resources are available, H-GAC shall provide a circuit rider program to review and evaluate subscription contracts and implement terms identified in this section. This program would proceed on a voluntary basis by watershed, using the geographic prioritization framework recommended by the BIG and described later in this I-Plan. As part of the program, education on UAMP, metering, and UAMP development assistance could be provided. Appropriate WWTFs, MUDs, and their attorneys and accountants would be expected to participate.

Implementation Activity 2.6: Penalties for Violations

The TCEQ recently revised its Penalty Policy #3 to address concerns raised during its most recent Sunset review. The legislature added Texas Water Code Section 7.067 to allow the TCEQ discretion to approve a Supplemental Environmental Project (SEP) that would assist local governments that are respondents in enforcement actions to come into compliance with environmental laws or to remediate the harm caused by those violations. The Statute requires the TCEQ to review the penalty policy regularly.

Implementation Strategy 3.0: On-site Sewage Facilities

An on-site sewage facility (OSSF, commonly referred to as a septic system) does not send waste through a system of pipes to be treated elsewhere. Instead, it uses a combination of physical and chemical methods to treat the waste at the owner's location.

A study sponsored by the Texas On-Site Wastewater Treatment Research Council indicates that as many as 19 percent are failing in eastern Texas.[62] Estimates based on census data and OSSF permit records suggest the project area has at least 70,000 systems. However, the actual number and distribution of OSSFs in the region is unknown, and inventories of OSSFs are piecemeal.[63] Enforcement is not uniform throughout the region. Furthermore, enforcement efforts often cease if owners of failing OSSFs do not have the resources to repair or replace their systems or to pay fines associated with violations.

Because properly functioning and maintained OSSFs contribute little to no bacteria to waterways, this I-Plan primarily focuses on OSSFs that are unpermitted, failing, or poorly maintained. The following implementation activities are intended to address these systems.

Based on estimates presented in the TMDL reports, OSSFs contribute bacteria loading in the TMDL Project areas as follows:

- Clear Creek project area: Estimate of 91 failing OSSFs[64]
- Buffalo Bayou and Whiteoak Bayou project area: Estimate of 23 failing OSSFs[65]
- Houston Metro project area: Estimate of 1093 failing OSSFs[66]
- Lake Houston project area: Estimate of 860 failing OSSFs[67]

[62] (Reed, Stowe, and Yanke, LLC 2001)

[63] (Reed, Stowe, and Yanke, LLC 2001)

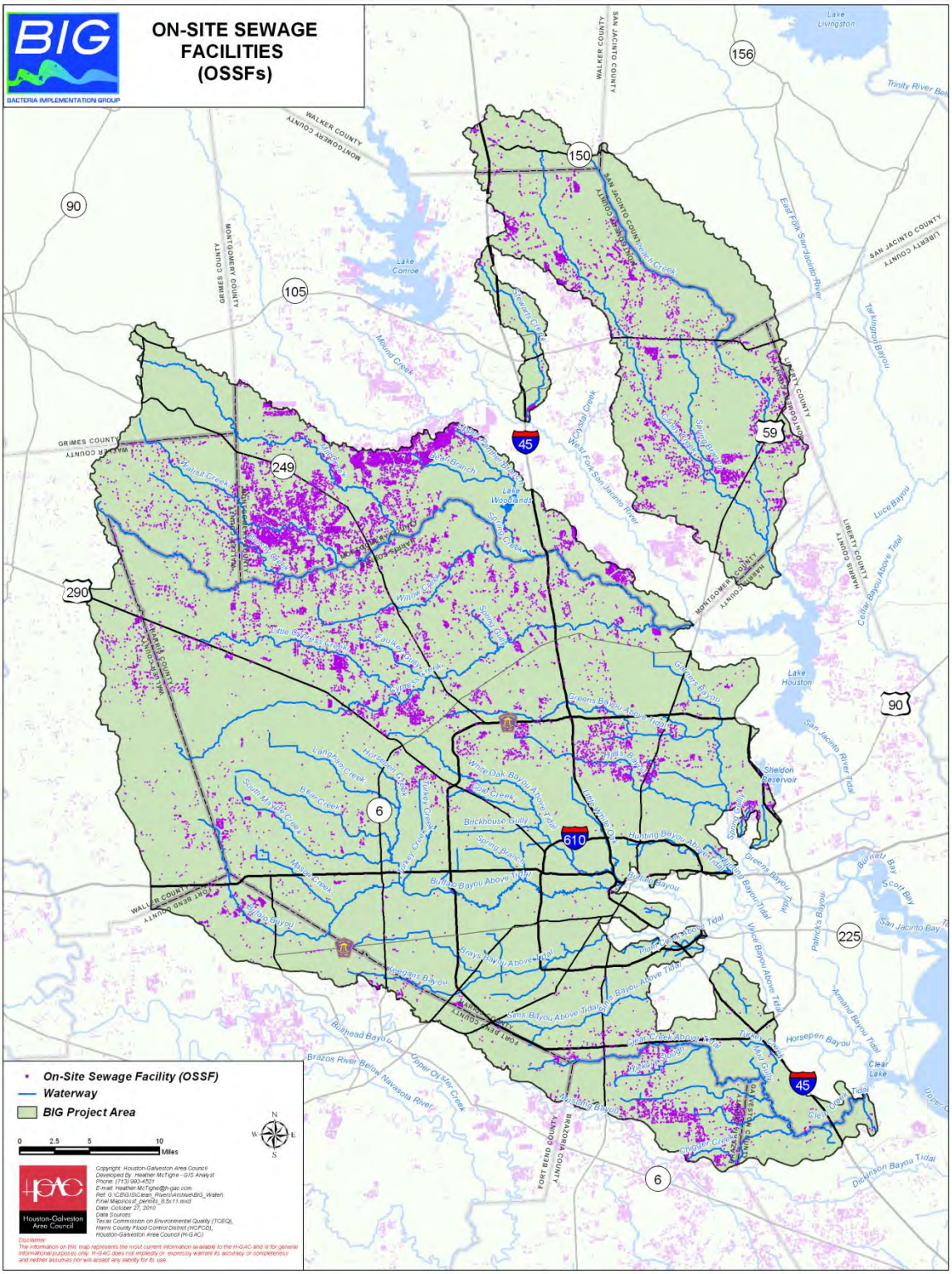
[64] (TCEQ 2008b)

[65] (TCEQ 2009a)

[66] Derived from the five technical documents for the Houston Metro TMDL Projects. (University of Houston & Parsons 2009)

[67] (James Miertschin & Associates, Inc. 2009)

Figure 4: Map of Permitted OSSFs



Implementation Activity 3.1: Identify and Address Failing Systems

H-GAC will work with the TCEQ, authorized agents,[68] and other interested parties to create an inventory and map of OSSFs with particular focus on areas with known or suspected failing systems. The inventory is a crucial component in the development of priorities, budgets, and timelines for repairing or replacing failing OSSFs.

3.1.1: Map permitted and unpermitted OSSFs in the H-GAC and BIG Regions

H-GAC began mapping OSSFs in the region in 2009 and continues to work with the TCEQ and the region's authorized agents to inventory and map permitted OSSFs and reported OSSF violations. As part of the study, H-GAC will identify unpermitted OSSFs by analyzing data from appraisal districts, wastewater treatment plant service areas, census data, and other sources of information. Initial efforts, including data collection and standardization and mapping, were completed in November of 2010.

Ongoing data collection should be continued by H-GAC as resources are available. Authorized agents or the TCEQ shall submit information about OSSF locations as frequently as reporting requirements are specified in 30 Tex. Admin. Code § 285.11(e)(2). Currently, reporting requirements are monthly.

3.1.2: Identify target areas, timelines, and costs

H-GAC, working with stakeholders, will analyze the initial mapping data and prepare a report of recommended target areas, timelines, and budgets. H-GAC will solicit input from authorized agents and other interested parties. When possible, target areas will be identified using the geographical prioritization framework described in Implementation Strategy 11.0. Additional criteria to select target areas will include proximity to an impaired waterway and density of failing systems. The report will be used to facilitate grant applications and identify appropriate resources.

3.1.3: Address target areas and pursue funding

Local governments or other agencies will seek to address failing systems in target areas with appropriate actions which may include enforcement, owner education, repair, replacement, connection to municipal treatment works, and public education. Local governments and H-GAC shall seek to secure funding to address failing OSSFs, particularly in target areas. In addition to local funding, a variety of funding sources may be available.

[68] An authorized agent is defined in the Tex. Health & Safety Code Ann. § 366.002(1) (Definitions) as "a local governmental entity authorized by the commission to implement and enforce rules [related to OSSF regulations in Chapter 366 of the Health and Safety Code]" (TCEQ 2009b)

3.1.4: Reevaluate plan

Annually, as resources allow, H-GAC or other appropriate entity shall convene representatives of the TCEQ, authorized agents, and other stakeholders to review progress, priority areas, funding opportunities, and other elements of the regional plan.

Implementation Activity 3.2: Address Inadequate Maintenance of OSSFs

Authorized agents and other stakeholders are concerned that homeowners do not know enough about maintaining an OSSF to identify problems and solutions in order to prevent failures.

3.2.1: Homeowner education

As resources are available, H-GAC will create or adapt a website to provide homeowner education. An interactive function of this website will encourage OSSF owners to sign up for automatic reminders of required maintenance activities. This interaction not only benefits the homeowner, but it also serves as an information gathering tool for H-GAC regarding ownership, permitting and maintenance of OSSFs. Other possible elements of the website could include an online pumpout and maintenance log for homeowners and a list of licensed maintenance providers. Municipalities, counties, communities, homeowner associations and other interested parties can post a link to the website from their websites, creating a familiar portal for residents.

H-GAC will create or adapt collateral material, such as flyers, advertisements, mailers, and other marketing pieces for distribution at schools, in newspapers and publications, and to real estate agents and property inspectors.

3.2.2: Encourage repair and pumpout logs be kept by homeowners and/or maintenance providers

Authorized agents are encouraged to persuade homeowners and/or maintenance providers to maintain repair and pumpout logs, which may consist of proof of a valid maintenance contract, for their facilities. The logs should describe repair and pumpout data for the previous five years. Authorized agents may choose to require such logs by way of updates to their permit regulations. Homeowners and/or maintenance providers are encouraged to allow potential homebuyers to review the logs upon request. Homeowners and/or maintenance providers are encouraged to provide the logs or a copy of the logs to new homeowners upon transfer of property. Homebuyers will be given flyers or information sheets, possibly by real estate agents or property inspectors, that provide information about what a homebuyer or new owner should look for in the logs.

3.2.3: Coordinate with real estate industry

H-GAC, authorized agents, and other entities shall, as resources are available, provide education opportunities to real estate agents, property inspectors, and consumers about identification and consequences of inadequate maintenance and the failure of OSSFs. The Texas Real Estate Commission requires property inspections at the time of sale, specifies education and certification requirements for licensed real estate salespersons and inspectors, and develops forms for use during sales and inspections. Each of these items can be modified to provide additional resources for homeowners related to their septic systems.

3.2.4: Additional actions

The TCEQ, authorized agents, and other parties are encouraged to develop actions to increase maintenance of OSSFs, including more inspections, incentives for proper maintenance, and requirements that systems must be maintained by a maintenance company or a trained homeowner. The TCEQ is encouraged to suspend or revoke licenses and registrations of poorly performing installers and maintenance providers.[69] As resources are available, H-GAC and other stakeholders shall work to develop continuing education opportunities regarding OSSF regulations and enforcement for district attorneys and justices of the peace to increase prosecution of OSSF violations.

Implementation Activity 3.3: Legislation and Other Regulatory Actions

The BIG recommends consideration of the following changes to Texas legislation, rules, and agency policy.

3.3.1: Model Order, Ordinance, or Resolution

The TCEQ is required to provide a model order, ordinance, and resolution that can be used by authorized agents to meet the minimum requirements of OSSF laws and rules.[70] The TCEQ should maintain a list of more stringent local rules that have been adopted. Authorized agents are encouraged to adopt more stringent local rules as appropriate.

3.3.2: Biennial Review

The TCEQ shall consider providing a biennial forum to consider changes to legislation, rules, policies, and guidance relating to management of OSSFs. As part of this forum, the TCEQ shall discuss and consider appropriate mechanisms for funding OSSF programs.

[69] See 30 Tex. Admin. Code § 285.65 (2011) (Suspension or Revocation of License or Registration)

[70] See 30 Tex. Admin. Code § 285.10

Note: Appendix E provides information about more stringent regulations enacted by authorized agents in the Houston-Galveston region.

Implementation Strategy 4.0: Stormwater and Land Development

The BIG project area has experienced rapid population growth resulting in increased land development, which in turn has led to challenges in maintaining waterways as areas for recreation. These changes may also impact bacteria levels in the waterways.

Bacteria sources, such as wastes from pets, wildlife, and even humans, can be washed into storm drains and then discharged into local waterways. Because stormwater systems are designed to quickly and efficiently remove stormwater from developments, stormwater often bypasses the natural vegetative barriers that filter sheet flow over the land. Thus, bacteria loading may be more concentrated. Infrastructure, such as pipes, inlets, culverts, interceptors, basins, reservoirs, outfalls, and channelized waterways, can also increase direct bacterial loading. The TMDLs for Buffalo and Whiteoak bayous indicate that stormwater from permitted municipal separate storm sewer systems (MS4s) is a significant source of bacteria loading.[71]

Existing requirements of MS4 permits address some important elements of bacteria loading in stormwater, offering an adaptive rather than prescriptive approach to bacteria reduction. Furthermore, many smaller cities and some unincorporated county areas do not currently have stormwater permits, but may become designated as an MS4-permitted community in the future, possibly because of new census data. Some smaller cities and unincorporated areas should be encouraged to voluntarily adopt the six elements of MS4 Phase II permits.[72]

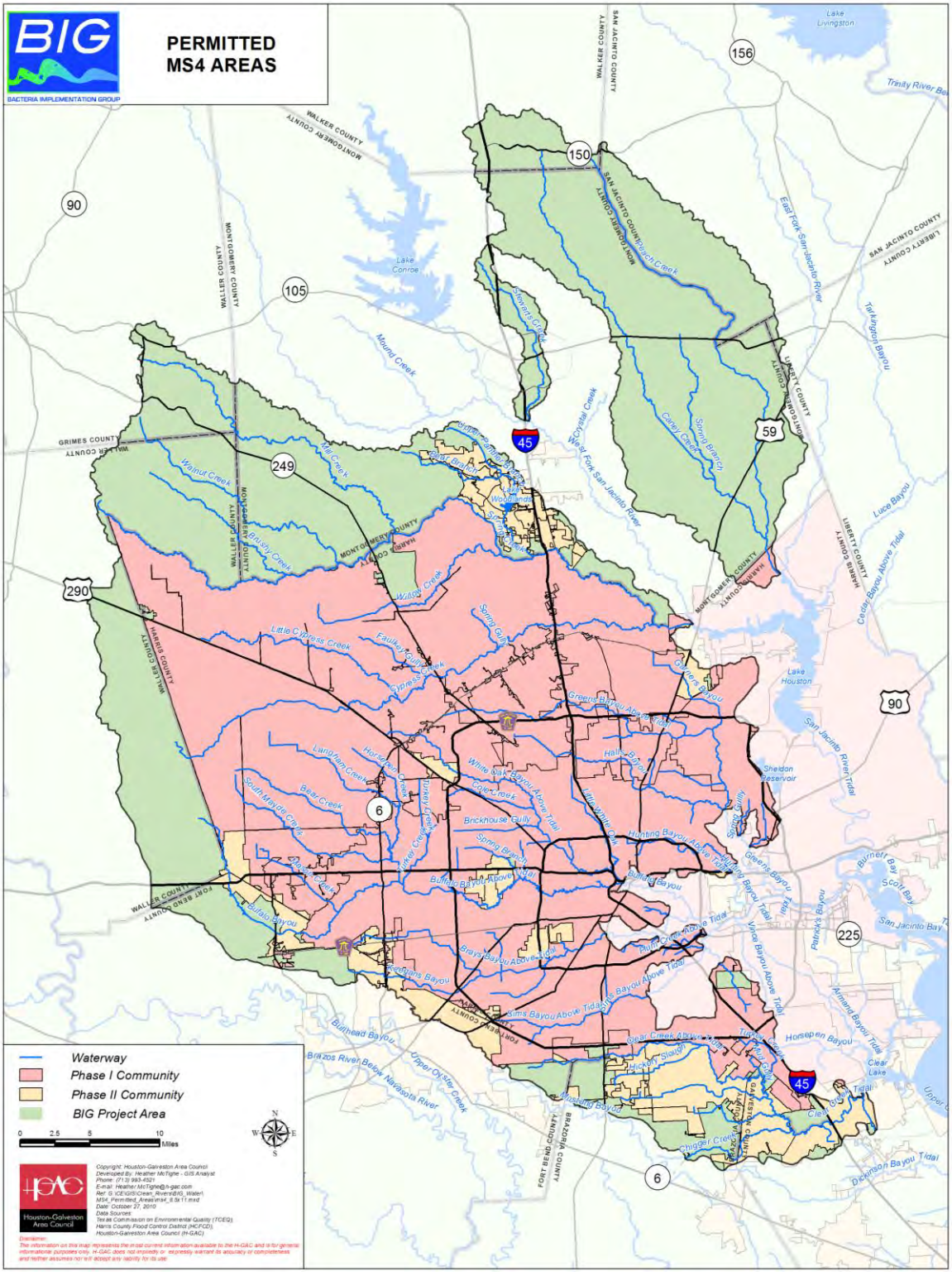
Structural BMPs, such as modifications to stormwater outfalls that may reduce bacteria through aeration, treatment by sunlight, or physical removal of contaminants, have the potential to reduce bacteria loading into waterways. Because there is limited data regarding how well such BMPs might reduce bacteria loading, the BIG has identified the evaluation of the effectiveness of stormwater implementation activities as one of the top research priorities. (See Research Priority 10.1.) Any research, particularly research relevant to the BIG area, should be reported and shared with BIG stakeholders, through Implementation Activities 4.2, 9.2, and 9.4.2, so that stakeholders can devise appropriate strategies for integrating structural stormwater BMPs into their activities.

A map of MS4 areas in the region is shown in Figure 5. Examples of current programs are provided in Appendix F, along with a list of stormwater permits in the region provided in Appendix G.

[71] (TCEQ 2009a, p. 44)

[72] (U.S. Environmental Protection Agency 2000)

Figure 5: Map of Permitted MS4 Areas



Implementation Activity 4.1: Continue Existing Programs

Local governments, especially those with MS4 permits, already employ extensive and innovative stormwater and land development programs, some of which address other bacteria sources identified in this I-Plan. These programs shall be continued as deemed appropriate by the entities that manage them.

For both the library of best practices and the networking meetings, particular attention should be paid to identifying best practices that involve the following:

- How to implement structural BMPs and stormwater controls that address bacteria reduction,
- Opportunities for watershed-based policies and activities,
- Codes, design criteria, and other specifications that address stormwater bacteria loading,
- How to encourage the use of green infrastructure in street design, sidewalk design, and stormwater management programs,
- How to incorporate bacteria reduction elements into flood control features where practicable, and
- How impervious cover affects water quality and bacteria loading, and best practices to address potential negative influences of impervious cover.

Implementation Activity 4.2: Model Best Practices

Existing programs can serve as models for other local governments and land developers in the project area. As resources allow, H-GAC shall provide forums for sharing information about existing programs and for coordinating collaboration.

4.2.1: Create and maintain an online library of best practices

H-GAC or another appropriate entity will create and maintain an online library of stormwater and land development best management practices (BMPs) and stormwater controls specific to bacteria load reduction that have been implemented regionally. Local governments will provide information about their BMPs and stormwater controls, which may include ordinances, policies, and structural BMPs and stormwater controls.

4.2.2: Coordinate networking meetings

As resources allow, H-GAC or another appropriate entity will facilitate a series of meetings relating to stormwater and land development BMPs and stormwater controls. Each meeting will highlight BMPs and stormwater controls implemented by MS4 permittees and focus on either a required element of an MS4 permit or BMPs and stormwater controls that fall outside the scope of the permit. These meetings should lead to discussion of model BMPs, stormwater controls, and other practices, including the identification of practical opportunities for collaboration at a watershed level. These meetings shall also

serve as a forum for collaborative development and maintenance of regionally accepted codes, design criteria, structural BMP information, effectiveness monitoring and information, and guidelines.

Implementation Activity 4.3: Encourage Expansion of Stormwater Management Programs

Existing stormwater management programs shall be improved voluntarily, and the geographic application of stormwater programs shall be expanded voluntarily, unless EPA chooses to expand the definition of the area encompassed by an MS4. If, after five years, voluntary actions are not implemented, stakeholders shall consider mandatory expansion.

4.3.1: Encourage permitted MS4 communities to voluntarily expand and refine elements of their stormwater programs that address bacteria

Local governments are encouraged to focus their existing programs on activities that are specific to bacteria reduction. The BIG encourages the TCEQ to consider bacteria when evaluating and approving MS4 permit renewals within the BIG project area.

4.3.2: Encourage local governments without MS4 permits to voluntarily develop and implement a stormwater management program to address bacteria loading

Stormwater programs similar in structure and content to, or in conjunction with, MS4-permitted programs should be considered. A local government which does not require a stormwater permit should prepare, adopt, implement, and enforce as appropriate a stormwater management plan that meets the general requirements of the TCEQ's small MS4 general permit (TXR040000),[73] as suitable for their community. Elements of such a plan might include activities related to the six minimum control measures identified in a small MS4 general permit.[74]

4.3.3: If voluntary measures are not implemented or bacteria reduction is not being achieved, petition the TCEQ to mandate stormwater program development

The BIG can petition the TCEQ to require activities that are bacteria-specific in MS4 permits or to designate communities that do not already have an MS4 permit. Starting in year four after the adoption of this I-Plan, H-GAC shall, provided sufficient resources are available, evaluate communities to determine whether they have developed or improved a stormwater program to reduce bacteria loading in waterways. Criteria that will be evaluated are formal adoption of the stormwater plan by elected

[73] General Permit TXR040000 for Phase II (Small) MS4s (TCEQ 2007)

[74] For more information, see the EPA's Fact Sheet 2.0: Small MS4 Stormwater Program Overview (U.S. Environmental Protection Agency 2005)

officials of the local government, funding levels for the program, self-reports of stormwater activities, and bacteria levels in local water bodies.

The H-GAC will provide a report to the BIG for evaluation. If local governments have not modified or created a stormwater program by the end of year five after the adoption of the I-Plan, the BIG shall recommend that the TCEQ consider additional permit requirements for those communities.

Implementation Activity 4.4: Promote Recognition Programs for Developments that Voluntarily Incorporate Bacteria Reduction Measures

Several recognition programs already exist or are being developed that address land development and infrastructure. Many of these programs are high-profile, comprehensive programs that could have a positive effect on bacteria loading from these sources. However, the programs are not specific to either bacteria or the BIG region. For this reason, the BIG proposes two complementary elements of action, participating in existing recognition programs and develop a recognition program specific to stormwater for the region.

4.4.1: Encourage voluntary participation in existing recognition programs

Several voluntary programs that address land development and stormwater have been developed or are being developed, including:

- *Leadership for Energy & Environmental Design 2009 for Neighborhood Development Rating System*[75]
- *International Green Construction Code*[76]
- *National Green Building Standard*[77]

Although these programs focus specifically on neither bacteria reduction nor this region, they do contain elements that may help reduce bacteria loading. The BIG encourages local governments, land developers, and stakeholders to promote these programs and similar programs as appropriate. Local governments shall analyze their local regulations and programs in an effort to eliminate hurdles to the attainment of the requirements in these programs.

4.4.2: Develop a recognition program specific to stormwater and land development in the BIG area

As resources are available, H-GAC shall convene a committee and work with existing local groups to develop a voluntary certification or recognition program that will promote stormwater and land

[75] (Congress for the New Urbanism, Natural Resources Defense Council, and the U.S. Green Building Council 2009)

[76] (International Code Council 2010)

[77] (National Association of Home Builders and the International Code Council n.d.)

development practices that are intended to reduce bacteria loading from stormwater and land development. The program may apply to developments, builders, developers, local governments, drainage districts, and others. The committee will consider, among other things:

- Criteria for development and redevelopment,
- Criteria for stormwater infrastructure,
- Integration with existing programs,
- Funding, and
- Scope of the program.

Implementation Activity 4.5: Provide a Circuit Rider Program

As resources are available, H-GAC shall manage a circuit-rider program to provide evaluation and technical assistance to communities implementing stormwater programs. In particular, the circuit rider can provide assistance in identifying and adapting model program elements for specific communities, identifying partnership opportunities, identifying funding mechanisms, and evaluating local regulations that might present obstacles to pursuing recognition programs outlined in this section. The circuit rider program shall also work toward the collaborative development and maintenance of regionally-accepted codes, design criteria, structural BMP information, effectiveness monitoring and information, and guidelines, which may improve consistency in land development and redevelopment practices.

Implementation Activity 4.6: Petition the TCEQ to Facilitate Reimbursement of Bacteria Reduction Measures

The BIG will work with TCEQ staff to interpret existing policies to facilitate MUD reimbursement to developers for stormwater quality features (which may otherwise be considered part of a developer's amenity package and not subject to MUD reimbursement) in their plans for development. As part of this discussion, the parties, including the engineering and development communities, will work to develop criteria which can be used to determine the eligibility of a water-quality feature for reimbursement. If necessary, the BIG shall write a letter to the TCEQ encouraging the adoption of policies.

Implementation Strategy 5.0: Construction

The rapid population growth in the BIG project area has created a demand for new structures and expanded infrastructure. Construction sites for residential, commercial, and linear projects are common throughout the region. Although construction sites are not generally viewed as significant sources of bacteria;[78] they can contribute sediment and nutrients through runoff and erosion. Bacteria may be found at a construction site in products used for fertilization and landscaping and from improper disposal of on-site sanitary wastes.[79] Bacteria may also attach to sediment. Runoff from construction sites may also contain constituents, such as nutrients, solids, fine particles, and other solid material, that could potentially influence instream bacteria levels.

Implementation Activity 5.1: Increase Compliance with and Enforcement of Stormwater Management Permits

If a construction site complies with the TCEQ Construction General Permit (CGP), TXR150000,[80] as well as local stormwater management permits, sediment and bacteria in runoff can be minimized. Problems arise when construction sites do not have adequate erosion and sediment controls. A study conducted by researchers at the University of North Carolina found that greater enforcement of existing regulations, rather than more stringent regulations, is needed to better protect water quality downstream of construction sites.[81] As of February 1, 2010, EPA proposed to add turbidity limits to construction general permits at the time of permit renewals.[82] However, EPA's action is stayed as of this publication. The current CGP expires in 2013.

Construction site regulations are adequate, requiring that sediment be retained on-site to the extent practicable.[83] It is the small number of state or local enforcement staff, faced with an overwhelming number of construction sites at any given time, which accounts for the inadequate enforcement of and, subsequently, limited compliance with the CGP in some areas.

[78] (U.S. Environmental Protection Agency 2005)

[79] (U.S. Environmental Protection Agency 2009a)

[80] (TCEQ 2008d)(TCEQ 2008d)(TCEQ 2008d)(TCEQ 2008d)(TCEQ 2008d)

[81] (U.S. Environmental Protection Agency 2005)

[82] (U.S. Environmental Protection Agency 2009c)

[83] (TCEQ 2008d)

5.1.1: Increase enforcement at construction sites by increasing the percentage of sites inspected

Local governments or other MS4 operators shall evaluate the need for staffing an appropriate construction inspection program. Additional inspectors shall be obtained if needed and as resources are available.

Current TCEQ staffing levels available to conduct stormwater inspections are insufficient. The BIG recommends that the TCEQ consider an increase of staff or resources to increase its inspection capacity primarily where local governments do not have a staff. Additionally, the BIG recommends that the TCEQ consider expanding the regulated areas as described in Implementation Activity 4.3.

5.1.2: Develop and distribute educational material to inform contractors, construction site owners, developers, MS4 operators, and citizens of proper construction site practices

As resources are available, H-GAC will develop and distribute educational material to encourage conformance with requirements by regulated entities. Educational materials will also be used to foster active participation by citizens in improving water quality by reporting construction sites with poor housekeeping and sediment control practices. This public education effort will be combined with the efforts described later in Implementation Activity 8.1, to expand homeowner education efforts throughout the BIG region to take advantage of economies of scale. Educational materials will need to have specific components to address contractors, construction site owners, and MS4 operator education.

The material will discuss why it is important to prevent sediment from leaving construction sites, outline general regulations to which a construction site must adhere, and provide contact information for reporting suspected violations. Increasing citizen knowledge can increase the likelihood of stormwater violations being reported and subsequently may increase the number of construction sites being brought into compliance. Educational materials will be distributed widely and in a variety of ways. including, but not limited to, by trade associations, by local governments (during building permit applications and the plan review process), through mailings and on the internet. Examples of publications that might be used as models are *Storm Water Management Handbook for Construction Activities*[84] developed by the City of Houston, Harris County, and Harris County Flood Control District, and *Don't Get Cited for a Dirty Site*[85] developed by Harris County.

[84] (City of Houston 2006)

[85] (Russo 2008)

5.1.3: Conduct training workshops for contractors, construction site owners, developers, and MS4 operators regarding stormwater management best management practices and encourage them to in turn require training of their crews

Contractors, construction site owners, developers, and MS4 operators are responsible for ensuring compliance. Therefore, it is in their best interest to ensure that construction workers under their supervision are properly trained in the installation and maintenance of erosion and sediment controls. As resources are available, H-GAC will develop training workshops about existing and emerging construction site BMPs and requirements. The workshops will be designed to help operators communicate requirements to employees. A good reference during training is the *Stormwater Management Handbook for Construction Activities*[86] which includes easy-to-understand descriptions and diagrams of erosion controls and describes proper installation and maintenance.

Private construction operations should not be the only target of this activity. Local government departments, municipal districts, and other government entities involved in construction, and their contractors, and subcontractors, also must properly install and maintain erosion and sediment controls and educate their personnel. Training local government inspectors is also essential in the effort to improve compliance. These educational activities should be developed in such a way that they could be incorporated into a voluntary certification program.

[86] (City of Houston 2006)

Implementation Strategy 6.0: Illicit Discharges and Dumping

Illicit discharges and dumping illegally introduce contaminants into waterways. Sources include illicit discharges and connections to storm sewers, as well as direct discharges and dumping to the water body itself. While a wide variety of sources may introduce contaminants to a water body, the following implementation activities specifically address bacterial contamination, both mobile and stationary.

Many of the TMDLs in the BIG region indicate that illicit discharges and dumping account for significant dry-weather bacteria loadings. Outfalls in Buffalo and Whiteoak bayous TMDL have bacterial *E. coli* loads ranging from 7.43 X 10^5 to 2.21 X 10^{11} MPN/day.[87] In Whiteoak Bayou, these discharges represented the largest source of indicator bacteria loading.[88] Similarly, in Clear Creek, estimates indicate that between a quarter and a third of all outfalls have illicit dry-weather discharges, and that more than 20 percent of these had *E. coli* concentrations of over 1000 cfu/mL, more than eight times the in-stream standard.[89]

Stakeholders have expressed concern that mobile waste haulers may contribute bacteria directly to area bayous. Waste from septic systems, grease traps, and grit traps is hauled from its originating point. While regulations dictate this waste be properly transported and recorded on a manifest, anecdotal evidence raises suspicion that this waste may not always be properly disposed in a treatment facility.

Given the transitory nature of these discharges, there are no flow-adjusted estimates for their contributions. They have been a widely cited potential source among the project stakeholders. Sampling data, such as unexplained spikes in bacteria levels with no corresponding permitted outfalls or sources nearby, may help identify illicit discharge sources.

Programs to detect and eliminate these illegal discharges are an integral part of TPDES Phase I and II stormwater permits. As such, the activities discussed in this section may also be considered as part of Implementation Strategy 4.0. While all communities and jurisdictions will participate in implementation efforts, the extent to which these activities are applied may vary by individual need and ability.

Implementation Activity 6.1: Detect and Eliminate Illicit Discharges

Jurisdictions shall devise and implement a program, as they deem practicable, to detect and eliminate illicit discharges that assist them in identifying sources for further enforcement action. This implementation activity is similar to the programs required under stormwater permits, but with a

[87] (TCEQ 2009a)

[88] (TCEQ 2009a)

[89] (TCEQ 2008b)

specific focus on direct, bacteria-laden discharges. Existing illicit discharge programs can be modified to focus on bacteria.

Elements of the detection portion of the program may consist of:

- Conducting field surveys of waterways and associated drainage channels,
- Reviewing existing spatial data (geographic information system, engineering drawings, etc.) with on-site visual inspections of water body channels,
- Producing or revising a storm sewer map of all outfalls and the names and locations of all waters of the state that receive discharges from the outfalls,
- Producing or revising, to the level of detail that meets the specific need of the government entity, an initial record of located discharges for comparison against permitted discharges (stormwater outfalls, permitted industrial outfalls, etc.), and
- Reviewing, verifying, and updating the program and data on a regular basis.

Sampling data, where available, may help predict where unidentified illicit point sources may be located (such as unexplained spikes in bacteria levels with no corresponding permitted outfalls or sources nearby). Publicity and outreach efforts regarding these actions, indicating enforcement is imminent, will help promote self-enforcement by current or potential point source dischargers.

Next, the program will seek to eliminate illicit discharges to the extent allowable under state and local law and as resources allow. Entities will pursue elimination through their established methods. If the existing abilities to eliminate these discharges are deemed insufficient, the local entity shall expand their program as detailed in Implementation Activity 6.2, as appropriate. Several illicit discharge detection programs already exist and may be used as guides by stakeholders for developing or altering their approach.[90]

At least annually, local governments shall provide reports of how many illicit discharges have been found and how many have been eliminated. Provision of this information in a copy of an existing report is sufficient.

Implementation Activity 6.2: Improve Regulation and Enforcement of Illicit Discharges

To the extent allowable under state and local laws, an ordinance or other regulatory mechanism must be utilized to prohibit and eliminate illicit discharges. Each jurisdiction must also establish guidelines for enforcement for removing the source of an illicit discharge.

[90] An example, *A Guidance Manual for Identifying and Eliminating Illicit Connections Municipal Separate Storm Sewer Systems (MS4)*, is available online. (Galveston County Health District 2002)

Stakeholders are concerned current regulations and penalties often fail to act as deterrents, especially given a perceived low level of standardization and enforcement. Jurisdictions shall review and enforce existing regulations, or, as appropriate, develop or improve regulations relating to illicit discharges.

As resources are available, H-GAC shall compile local regulations and make the information available for other communities to emulate as appropriate. H-GAC will also facilitate coordination of standardization, as resources are available, possibly as part of the circuit rider program described in Implementation Strategy 4.0.

Implementation Activity 6.3: Monitor and Control Waste Hauler Activities

Waste haulers routinely transport bacteria-laden materials, including septic, grease trap, and grit trap wastes. When this highly concentrated, untreated waste is discharged into waterways instead of being properly disposed of or treated, it may represent a significant local increase in bacterial loading. Under this implementation activity, bacteria control will occur through the development of monitoring and control programs by individual communities and by a pilot program to monitor waste hauler fleets.

6.3.1: Develop regulations pertaining to waste hauler activities

While many jurisdictions have some degree of regulation regarding waste hauler activities, some programs have had greater success than others. Jurisdictions will, according to their needs and as practicable, create or update a program designed to monitor and control waste hauler activities. This program should integrate inspection and enforcement capacities in order to ensure the ability to provide a strong disincentive for non-compliance. State law[91] allows counties and municipalities to permit and regulate the activities of septic, grease trap, and grit trap waste haulers, up to and including criminal penalties for non-compliance. As resources are available, H-GAC shall compile and make available information about the most effective waste hauler programs.

The City of Pasadena's program, for example, requires all waste haulers have a license or permit, know the nature of their cargo, and maintain a manifest. The program sets forth penalties for violations of these and other requirements, including revocation of permits and monetary fines for each day of non-compliance.[92] Stakeholders may choose to pursue a regional approach to better track haulers who may operate in numerous jurisdictions. A previous regional project, the Environmental Enforcement Database Application (maintained from 2003-2008 as a pilot project by the H-GAC) shared secure

[91] See Tex. Health & Safety Code Ann. § 368 (2011) (Subchapter A - Transporters of Grease Trap, Sand Trap, and Septic Waste)

[92] See City of Pasadena, Tex., Code of Ordinances, ch. 37 (Water, Sewers and Sewage Disposal, Article VIII - Liquid Waste Generators and Transporters)

information for local enforcement agencies regarding waste hauler violations. A similar project may help individual entities identify and curtail violators.

6.3.2: Waste Hauler Fleet Tracking Pilot Program

To promote accountability and compliance among waste haulers, the BIG will consider pursuing a grant to develop a pilot program to install global positioning transponders and/or other apparatus or technology on the vehicles of waste haulers who have violated regulations relating to waste transport and disposal. H-GAC, the TCEQ, local jurisdictions, and waste companies would have access to the transponder feed to determine whether individual haulers are making unscheduled stops that may correlate to illicit discharges. Potential funding sources include EPA Section 319(h) nonpoint source program funding (via the TCEQ or the Texas State Soil and Water Conservation Board), State Revolving Fund monies through the Texas Water Development Board, and private foundations.

Implementation Strategy 7.0: Agriculture and Animal Sources

Bacteria loads from agricultural practices and animals are identified in the TMDLs as nonpoint sources of concern. Areas of concern include the potential for bacteria to attach to sediment in runoff, the potential effect that nutrients will have on bacteria growth rates in water bodies, and livestock's direct deposition of fecal waste in waterways. Existing management programs are traditionally voluntary, unless large populations of animals are involved. The expansion of existing programs could help lower bacteria levels in waterways, particularly in subwatersheds where substantial areas of land are devoted to crop, pasture, and range. (See Figure 6.) According to the technical documents for each of the TMDLs, there are no Concentrated Animal Feeding Operations (CAFOs) in the areas covered by this I-Plan. However, livestock populations have been estimated for the area for the Clear Creek and the Lake Houston TMDLs. Cattle and poultry are most abundant livestock in the region. Estimated populations are described in Table 7.

Table 7: Estimated Livestock Populations

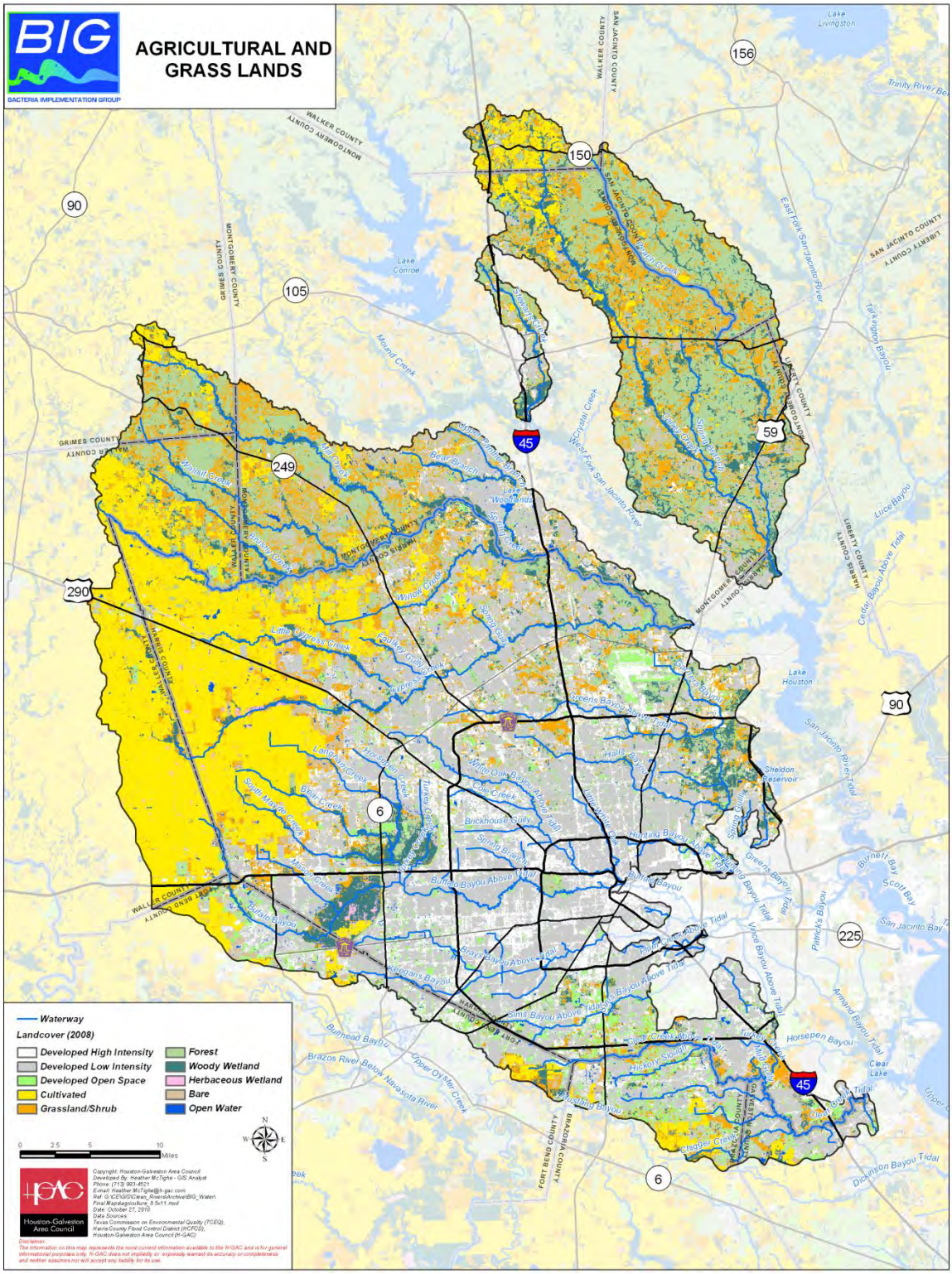
TMDL	Cattle	Poultry
Clear Creek[93]	2,696	2,093
Lake Houston[94]	52,510	50,293

Other animals of concern throughout the region include horses, swine, sheep, and goats, with their densities varying by watershed. For example, horse populations are prevalent in the Cypress Creek and Spring Creek watersheds.

[93] (University of Houston & Parsons 2009b)

[94] (James Miertschin & Associates, Inc. 2009)

Figure 6: Map of Agricultural and Grass Lands



A prominent concern raised by stakeholders pertains to feral hogs. In addition to being a nuisance to landowners because of their rooting and wallowing and occasional predation of small livestock, feral hogs discharge large amounts of bacteria and nutrients into the environment through fecal waste. No precise estimate of the number of feral hogs is available for the BIG project area, yet anecdotal evidence suggest a large hog population in the region. Hogs are known to reproduce quickly, have no natural predators, and spend the majority of their time either in or around water.[95] Hogs are likely a significant source of bacteria for some of the impaired waterways encompassed by this I-Plan.

The four governmental agencies in the following list will be responsible for implementing management measures aimed at reducing nonpoint source loadings from agricultural operations. Their duties and activities related to this I-Plan are described in greater detail in Appendix H.

- **Texas State Soil and Water Conservation Board (TSSWCB**) – The TSSWCB is the lead agency in Texas responsible for planning, implementing, and managing programs and practices for preventing and abating agricultural and silvicultural (forestry) nonpoint source pollution.[96]
- **Natural Resources Conservation Service (NRCS)** – The NRCS provides conservation planning and technical assistance to landowners, groups, and units of government to develop and implement conservation plans that protect, conserve, and enhance their natural resources.
- **Soil and Water Conservation Districts (SWCDs)** – Through decades-old agreements, SWCDs offer agricultural landowners and operators technical assistance through partnerships with the NRCS and the TSSWCB.
- **Texas AgriLife Extension Service** – AgriLife Extension, an agency of the Texas A&M University System, provides quality, relevant outreach and continuing education programs and services to Texans.

Additional agencies may be able to facilitate voluntary actions pertaining to wildlife and property management activities. Agencies include Texas Parks and Wildlife Department, the U.S. Fish and Wildlife Service, wildlife management associations and co-ops, and other entities.[97]

Implementation Activity 7.1: Promote Increased Participation in Existing Programs for Erosion Control, Nutrient Reduction, and Livestock Management

A variety of programs provide farmers and ranchers with the technical and financial assistance necessary to combine agricultural production with environmental control actions. These actions may address

[95] (Taylor n.d.)

[96] See Tex. Agric. Code § 201.026

[97] The Private Landowner Network maintains a comprehensive list of resources available to private landowners at http://www.privatelandownernetwork.org/grantprograms/.

water quality, reduction of soil erosion and sedimentation, livestock waste management, and other issues that are likely to reduce bacteria in regional waterways.

Funding mechanisms identified by stakeholders include:

- Environmental Quality Incentives Program (EQIP), administered by the NRCS;
- Water Quality Management Plan Program (WQMP), a part of the Texas Non-Point Source Management Program administered by the TSSWCB through the SWCDs;
- Conservation Innovation Grants, administered by the NRCS;
- Conservation Security Program (CSP), administered by the NRCS;
- Farm and Ranch Lands Protection Program, administered by the NRCS;
- Grassland Reserve Program, administered by the NRCS;
- Wetlands Reserve Program, administered by the NRCS; and
- Wildlife Habitat Incentives Program, administered by the NRCS.

The funding mechanisms in the preceding list should not be considered an exhaustive list. Additional programs may be added as this I-Plan is updated.

These voluntary programs provide technical and financial assistance. Program participation levels should be increased by increasing familiarity with the program through marketing. Primary methods for disseminating information and increasing participation include:

- Texas AgriLife Extension Service agents' contact with the public;
- Public outreach from local SWCDs;
- Information distribution through local 4-H clubs, rodeos, the Texas Farm Bureau, the Texas and Southwestern Cattle Raisers Association, the Independent Cattleman's Association of Texas, Future Farmers of America, and at Agricultural Field Days; and
- Word of mouth.

Implementation of erosion control, nutrient reduction, and livestock management programs likely will not result in immediate cost savings to the landowner. However, implementation does have other benefits that should be promoted, including increased plant health, increased infiltration, reduced erosion, and increased filtration and trapping of nutrients. Additionally, participation should help landowners avoid violating water quality regulations and the associated fines. If a participating landowner violates water quality regulations while following an approved plan, the regulating agency may give the landowner an opportunity to implement BMPs to come into compliance. Also, when new mandatory implementation practices come into effect, participating landowners are often not forced to update their operations, as they are already in compliance with water quality regulations. Success stories should be highlighted.

The Montgomery County and Harris County SWCDs have informational materials for small landowners regarding environmental best practices for agriculture. These could be updated and made available to landowners in all watersheds. Providing landowners with clear and practical information may increase the likelihood of them implementing agricultural management measures, whether independently or through an existing program.

Targeted program promotion will increase through word-of-mouth campaigns and Extension Agent involvement. Additional promotion methods include emails; notices in newsletters and local newspapers; participation in local festivals, rodeos, and fairs; and development of school programs. Promotion efforts will be conducted by TSSWCB, local SWCDs, NRCS, AgriLife Extension, H-GAC, and other agencies as appropriate with a goal of increasing participation in the programs each year. The BIG will provide this I-Plan to the implementing agencies along with a formal request for their assistance in encouraging program participation in accordance with this Implementation Activity.

Implementation Activity 7.2: Promote the Management of Feral Hog Populations

With continuous effort, feral hogs can be managed. The Texas Wildlife Damage Management Service, a division of the Texas AgriLife Extension Service, is a valuable resource for training, technical assistance, and direct control in wildlife damage management including feral hog populations.[98] Control methods include snaring, live trapping, shooting, hunting with dogs, aerial hunting, exclusion, and habitat management.[99]

The BIG region will take advantage of the services provided by the Texas Wildlife Damage Management Service by arranging two feral hog management workshops for landowners, local governments, and other interested individuals annually for five years. H-GAC will request that workshops be held in strategic locations throughout the BIG region. Workshops will be heavily promoted in the Extension Service newsletter, local newspapers, and radio stations. Management activities, as described, can also be implemented by local governments as appropriate. If interest in workshops remains strong after five years, H-GAC will continue to arrange workshops throughout the area covered by this I-Plan.

[98] (Coping with Feral Hogs 2010)

[99] (Muir and McEwen 2007)

Implementation Strategy 8.0: Residential

Individual residents in the BIG area make only small contributions to waterway pollution. However, the cumulative effect can be significantly detrimental. Similarly, the combined effort of millions of residents participating in activities that reduce bacteria pollution can have a significant positive effect. As the population in the region grows (see Figure 7), the collective actions of individuals will have a greater impact.

Residential contributions to bacteria loading in waterways include bacteria discharging from a residential site either during runoff events or directly, and fats, oils, and grease clogging sanitary sewer lines and resulting in overflows. Decorative ponds, OSSFs, and pet waste can contribute bacteria during runoff events or through direct discharge. Fertilizers, grass clippings, runoff from overwatering, and general lawn care practices may enhance the ability of bacteria to grow and regrow in the environment. Pouring fats, oils, and grease down sink drains can clog sanitary sewer lines, potentially leading to SSOs and direct discharges of bacteria to the bayous.

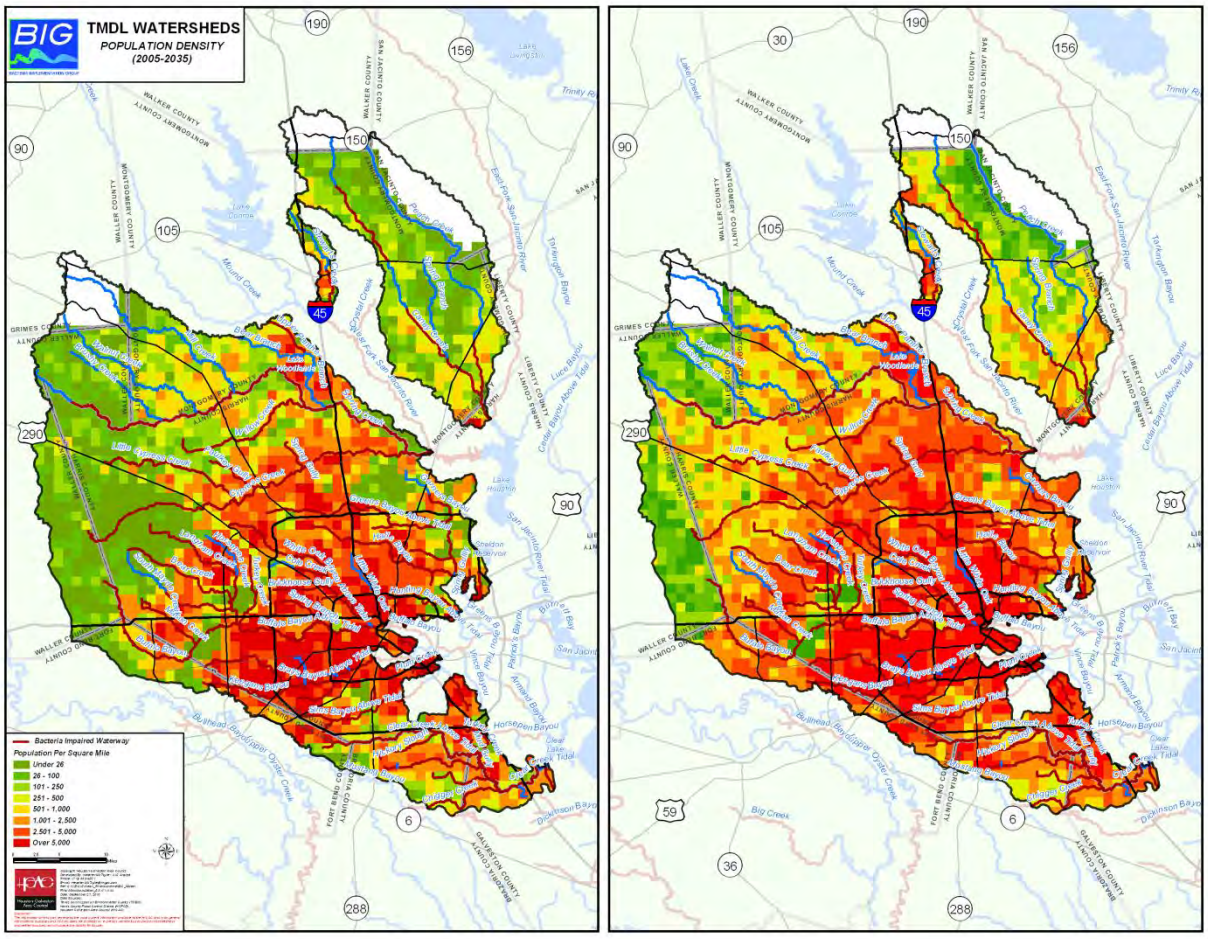
This implementation strategy is aimed at changing public behaviors through education efforts that empower residents to participate in actions that improve water quality. While enforcement, or the threat of enforcement, may be effective against stakeholders regulated by permits, this strategy instead focuses on positive activities that promote public education.

Public education efforts should inform the public about:

- Why waterways are important to the region,
- Why bacteria is an issue, and
- What they can do to reduce bacteria in area waterways.

Many of the activities are easy and inexpensive. Residents can properly dispose of cooking grease, use appropriate lawn care practices, and pick up and properly dispose of pet waste. The simple task of picking up after pets can improve water quality. If individuals can change their behavior, they can help improve water quality.

Figure 7: Map of Projected Changes in Population Density



Implementation Activity 8.1: Expand Homeowner Education Efforts Throughout the BIG Project Area

As resources become available, communities, cities, counties, and other entities shall provide public education that individual residents can use to reduce bacterial loading to area waterways. Topics that should be addressed in a homeowner education program include pet waste disposal, best management practices for yard care, OSSF tips, and proper disposal of fats, oils, and grease.

This implementation activity will take advantage of existing public education programs and materials. Some communities in the region already have educational programs that address bacterial loading and are willing to share materials, including the cities of Houston and Pasadena and Harris County. The *Clean Water, Clear Choice* program[100] is an example of a multi-jurisdictional effort.

[100] (Stormwater Management Joint Task Force n.d.)

Houston is currently developing a stormwater education program where a state-approved, Houston-specific, stormwater education curriculum is being created. Other regional, local governments may access, use, and promote the curriculum and other educational material at no charge.

The Harris County Regional Watershed Education Program[101] allows MS4-permitted communities to buy into their education program at a current rate of 53 cents per resident. Materials available through this program include brochures, presentations, advertisements, and direct mail pieces.

Another resource for communities developing education programs is the Public Participation and Education Subcommittee[102] of the Galveston Bay Estuary Program. This group provides opportunities for idea sharing, learning about resources, and coordinating education and outreach efforts throughout the region.

In addition to local programs, resources are available from outside the region. The EPA's Nonpoint Source Outreach Toolbox[103] is an excellent resource that provides public education materials, for radio, television, or print, as well as case studies on a wide range of topics, including OSSFs, pet waste, gardens and lawns, as well as general stormwater and storm drain awareness. Some materials may require small changes for application in local communities, but many will not.

A community may create its own education program and materials if it prefers. Funding may be available for these projects from the Galveston Bay Estuary Program and Texas' Nonpoint Source Grant Program, among other sources.

8.1.1: Continue or begin a homeowner education program based on existing models

For areas currently under an MS4 permit, public education efforts shall continue to place a high priority on bacteria reduction activities. Communities that don't currently engage in homeowner education efforts will be strongly encouraged to implement a program with guidance from existing programs and materials. A consistent message throughout the area covered by this I-Plan is desirable and might be more effective. H-GAC or another appropriate agency shall convene an annual meeting to identify common messages appropriate for the region and specific to bacteria. This forum will also provide an opportunity to identify funding sources and highlight existing programs. When appropriate, this forum will be held in conjunction with a widely-attended, water-quality event. Messages may include bacteria reduction activities (such as a pet waste campaign), activities that promote responsibility and concern for the cleanliness of our waterways (such as water clean-up events like River, Lakes, Bays 'N Bayous

[101] (Harris County n.d.)

[102] (Galveston Bay Estuary Program n.d.)

[103] (U.S. Environmental Protection Agency n.d.)

Trash Bash[104]), storm drain awareness activities (such as inlet marking), wastewater education (such as reminding residents that sewer lines clogged with grease or other materials will overflow or backup into homes), and activities to reduce illegal dumping (such as the use of strategically placed signage throughout the region). These education efforts should coordinate with education requirements of stormwater management permits.

8.1.2: Conduct pilot studies to evaluate results of education efforts

To measure success of public education efforts, communities shall, as resources are available, conduct studies to determine whether improvements in water quality have resulted from homeowner education efforts. Ambient water quality monitoring regularly conducted throughout the region may not adequately document the effectiveness of a specific education program at reducing bacteria in a water body. Pilot studies, which include water quality monitoring specific to the education efforts in question, should be conducted instead. For example, an appropriate location for a small-scale study could be a neighborhood whose stormwater discharges through a limited number storm sewer outfalls. Opportunities for collaboration between communities on studies may exist and should be explored. Studies should include pre-education monitoring, an education effort, and post-education monitoring. Studies may also document load reductions, public awareness of water quality issues, and behavior change as reported by individual residents. H-GAC water quality staff could provide technical assistance in developing a monitoring strategy for individual pilot studies as appropriate. Any pilot studies should be undertaken in the context of Research Priority 10.1.

[104] (Houston-Galveston Area Council n.d.)

Implementation Strategy 9.0: Monitoring and I-Plan Revision

In order to assess progress toward reducing bacterial loading, the BIG will need to evaluate, on a regular basis, the results of ongoing monitoring. This evaluation will be used to determine any changes that are necessary to this I-Plan.

The I-Plan is to address a period of 25 years. However, given the many unknowns pertaining bacteria sources, the cost-effectiveness of management activities, and the availability of resources for implementation, this time frame is provisional. As such, it will be important to continually track both actions taken and instream bacteria levels to gauge the rate of progress and adapt the strategy accordingly.

Monitoring and annual evaluation will determine if the I-Plan or any of its parts are complete, must address a longer time frame, or require revision. Every five years, as resources are available and with stakeholder participation, a more in-depth evaluation will be completed.

Monitoring of both ambient and non-ambient water quality, as well as the implementation activities in this plan, will form the basis for an annual report to be prepared by H-GAC. Conclusions derived from post-implementation water quality monitoring data will be an important indicator of whether implementation activities are resulting in the desired reduction of bacteria loading. The contents of the report will be reviewed by the BIG to determine strategic changes that are necessary to the I-Plan in order to improve progress.

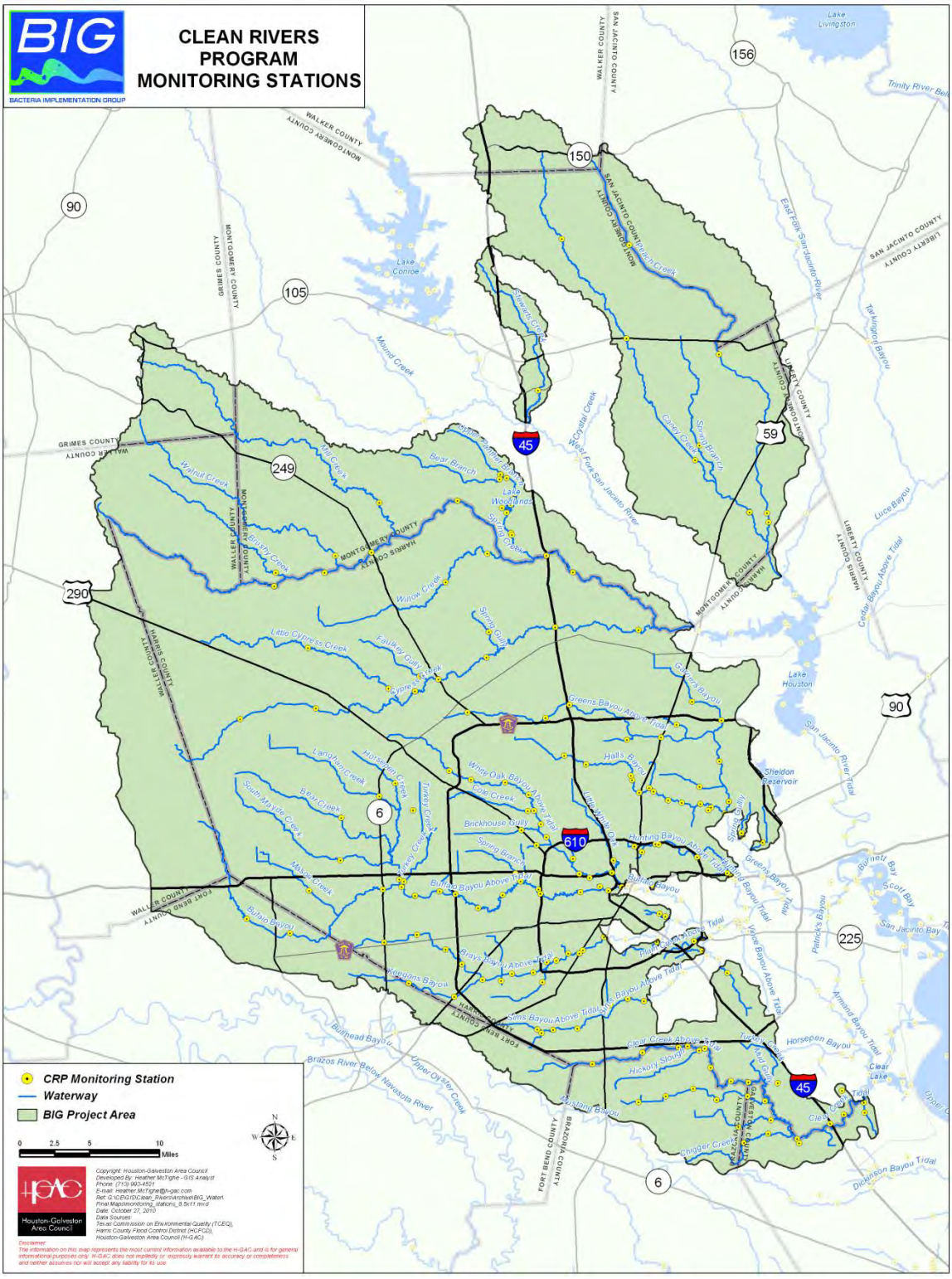
Implementation Activity 9.1: Continue to Utilize Ambient Water Quality Monitoring and Data Analysis

The results of monitoring and evaluating ambient water quality can help determine whether waterways are meeting standards for bacteria. The results will also identify trends of improvement and degradation that need to be addressed. This activity includes two elements: continuing the existing ambient water quality monitoring program and encouraging the use of two indicator organisms in sampling.

9.1.1: Continue to Utilize Clean Rivers Program

Ambient water quality monitoring within the BIG area is primarily the responsibility of the Clean Rivers Program, administered by H-GAC and the TCEQ in conjunction with local partner agencies. This program is ongoing and does not require additional funding for its current efforts. (See Figure 8 for locations of monitoring stations in the BIG project area. More detailed information regarding monitoring data can be found on H-GAC's Water Resources Information Map, or WRIM, which can be found at http://webgis2.h-gac.com/CRPflex/).

Figure 8: Map of Clean Rivers Program Monitoring Stations



The Clean Rivers Program is comprehensive, collecting samples region-wide, and should remain the primary source of data for ambient water quality.[105] This monitoring network includes over 300 sites and provides long-term data accredited by NELAC[106] for the evaluation of ambient conditions in the region's waterways. Monitoring sites are strategically chosen to give the greatest degree of coverage while also attempting to isolate individual waterways or their smaller units to allow for the accumulation of data with direct relevance to local conditions. Monitoring is conducted under a regional Quality Assurance Project Plan (QAPP).[107] Any new ambient monitoring by local partners shall be coordinated with the Clean Rivers Program and shall utilize the regional QAPP.

The Basin Summary Report,[108] produced every five years, evaluates at least seven years of data for each assessment unit and identifies statistically significant change. Along with the general benefit of coordinated regional data, these trend indicators will help guide I-Plan revisions and serve to verify the impact of implementation activities.

The local Clean Rivers Program steering committee meets regularly to discuss ways to improve the ambient water quality monitoring program. Local efforts are coordinated with those statewide to ensure consistency of data and to identify appropriate program improvements, which has already allowed for changes to facilitate this I-Plan. Specifically, monitoring reports now contain standardized information about any recreation that is observed at the sampling site.

9.1.2: Test for Additional Indicators

The presence of *E. coli* or Enterococcus species in water is a commonly employed indicator of the presence of enteric pathogens. Generally, TCEQ guidance and the location of the water sample determine which of the indicators is used. As resources are available, the abundance of both *E. coli* and Enterococcus species should be evaluated at freshwater sampling locations, to ensure a greater ability to correlate impacts of implementation activities on water quality. Additional parameters should be monitored, as deemed necessary and feasible, to target specific activities or sources for which the general correlation between indicators is not precise enough to show impacts. Additional testing may require a new or amended QAPP, and should take into account any existing or ongoing research on correlating current indicator bacteria with pathogens of concern. (See Research Priority 10.3.)

[105] (Houston-Galveston Area Council 2010a)

[106] NELAC, National Environmental Laboratory Accreditation Conference, provides accreditation of environmental labs.

[107] (Houston-Galveston Area Council 2010b)

[108] (Houston-Galveston Area Council 2006)

Implementation Activity 9.2: Conduct and Coordinate Non-Ambient Water Quality Monitoring

While the established ambient monitoring program will form the base of the data, some implementation activities, including monitoring plans for specific implementation activities, may require targeted sampling that may be site or contaminant specific. Because of requirements of the quality assurance plan,[109] this non-ambient program should be separate from the existing ambient program. As such, non-ambient monitoring should be facilitated through four activities.

9.2.1: Create and use a regional non-ambient QAPP

H-GAC will work with the TCEQ to establish a regional QAPP for non-ambient monitoring activities. Applicable sections of existing monitoring efforts, such as Harris County Flood Control District's wet weather monitoring for wet bottom detention basins, should be adopted and incorporated into a regional QAPP, as applicable and practicable.

9.2.2: Create and maintain a regional non-ambient monitoring database

Individual stakeholders will be responsible for implementing activities in their jurisdictions. However, to serve the combined purpose and interests of this I-Plan, the monitoring of non-ambient water quality data will be combined in a regional non-ambient monitoring database. This database could be compatible and coordinated with similar related databases, including the International Stormwater BMP Database[110] and the regional BMP effectiveness database being developed by the Harris County Flood Control District. This database could serve as a clearinghouse for non-ambient or targeted water quality monitoring data from across the region, to ensure availability and coordination of all related efforts. The database will be created in consultation with stakeholders and maintained by H-GAC and will be made available online. The coordinated approach to data acquisition will allow stakeholders, even when working separately, to benefit from their shared experiences. Evaluation of implementation activity effectiveness for one stakeholder can help other stakeholders make more informed decisions concerning the suite of measures they implement to meet the strategies of this I-Plan. Additional data sources that could be incorporated into the database include wet/dry weather monitoring data from MS4 permit holder annual reports, outfall monitoring, and pertinent data (including current and incoming monitoring requirements) from WWTF Discharge Monitoring Reports. This database shall be integrated with the database for tracking implementation activities, described in Implementation Activity 9.3. An ad hoc committee will be invited to participate in the creation of the database. This activity is not intended to create an additional reporting or liability burden for stakeholders.

[109] (Houston-Galveston Area Council 2010b)

[110] (Developed by Wright Water Engineers, Inc. and Geosyntec, Consultants 2010)

9.2.3: Implement targeted monitoring

Targeted monitoring should be implemented in those places where an entity needs to determine the direct impact of an implementation activity or BMP at a site where ambient monitoring will be unable to indicate changes to water quality as a result of the activity. Targeted monitoring may address sampling needs such as:

- Conditions during or differences in loading during dry and wet weather,
- Changes in instream bacteria levels throughout the day,
- Bacteria levels and loading during high-flow and low-flow regimes, and
- Locations specific to implementation activities, such as stormwater BMPs, or potential bacteria sources, such as the evaluation of bacteria levels in water coming from an outfall pipe.

Targeted monitoring of this type is already underway in the BIG area, as conducted by MS4 Phase I entities as part of stormwater permit requirements. These efforts should continue as practicable. Additionally, other entities, regardless of MS4 status, should consider or continue targeted monitoring as needed to evaluate implemented measures. The data collections efforts they undertake should be coordinated as part of the regional QAPP and monitoring database developed for non-ambient water quality in the region.

Implementation Activity 9.3: Create and Maintain a Regional Implementation Activity Database

Implementation tracking provides information that can be used to determine if progress is being made toward meeting the 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 keep the I-Plan on track. The implementation activity database will contain information on implementation activities conducted by the stakeholders. Each stakeholder will be provided a list of the implementation activities designated under this I-Plan. Each year, the individual stakeholders will provide a report on the activities they implement during the year, and any related information regarding the activities. The BIG, through the H-GAC, will provide a reasonable reminder to each stakeholder prior to the due date, compile the individual reports in the database, and publish a summary as part of an annual I-Plan report. As an incentive to report in a timely manner and in addition to a list of implementation activities undertaken, the report will identify communities that either did not report or did not undertake implementation activities.

While there will be additional paperwork requested of stakeholders, the intent is not to increase reporting requirements unduly. Thus, copies of or access to existing reports or records can be submitted as part of the annual report to the BIG.

Implementation Activity 9.4: Assess Monitoring Results and Modify I-Plan

9.4.1: Assess Data

The information contained in the three databases (ambient, non-ambient, and implementation activity) shall be used to assess progress toward meeting the goals of this I-Plan. Annually, H-GAC shall assess information in the reports to identify whether progress is being made. In particular, H-GAC shall evaluate the following:

1. Does ambient water quality monitoring data indicate that bacteria levels are changing? If so, are the bacteria levels improving or degrading?
2. Do non-ambient water quality monitoring data indicate that implementation activities are reducing bacteria loading?
3. Are implementation activities and controls being undertaken as described in this I-Plan? Which activities have been implemented and which have not?

9.4.2: Communicate results

The information identified through the assessment process will form the basis for an annual report. H-GAC shall compile the annual report and shall present this information to stakeholders through various channels, including e-mail, web publication, presentations, and at an annual meeting.

9.4.3: Continue the BIG

The BIG shall continue to be the decision-making body for this I-Plan, as identified in its ground rules.

9.4.4: Update the I-Plan

The BIG shall review the annual report and, as appropriate, update the I-Plan. As it evaluates the I-Plan, the BIG shall consider reported activities and whether identified milestones are being met, changes in bacteria levels in waterways, changes to surface water quality standards or other regulations, and research. While progress shall be evaluated annually, a more rigorous evaluation should be conducted every five years. At the end of five years, the BIG shall identify costs for the implementation activities.

In its document titled, "Clarification Regarding Phased Total Maximum Daily Loads,"[111] the EPA describes adaptive implementation as "an iterative implementation process that makes progress toward achieving water quality goals while using any new data and information to reduce uncertainly and adjust implementation activities." It is under these auspices that the BIG shall approach updates to the I-Plan. H-GAC shall provide support for these efforts.

[111] (U.S. Environmental Protection Agency, Best-Wong, B. 2006)

9.4.5: Expand the geographic scope of the I-Plan as appropriate

As other watersheds in the vicinity of the BIG project area have TMDLs adopted by the TCEQ, stakeholders from those watersheds may petition the BIG to consider incorporating those watersheds into the I-Plan. These requests shall be considered by the BIG as part of its annual review of the I-Plan. Communities and stakeholders within the region are encouraged to participate in I-Plan activities, either informally and voluntarily, or formally upon incorporation by the BIG into the I-Plan. Voluntary action is particularly encouraged in those watersheds with streams that are impaired for bacteria but which do not yet have adopted TMDLs.

Implementation Strategy 10.0: Research

Bacterial contamination of waterways is a concern for the BIG project area, as reflected in the TMDL studies that this I-Plan addresses. The studies provide a general overview of the extent and character of the presence of bacteria, but they are not sufficient to determine the most cost-effective courses of action to achieve contact recreation standards. A dynamic process is required where affected entities continually expand their knowledge of bacteria sources and effects and where various management approaches are tested and refined. This section identifies potential research topics that will be critical to this undertaking.

Recognizing that many of these topics would be area-specific, the BIG was asked to prioritize those which would have the greatest impact on management actions across the area. Three topics emerged. These topics are pertinent to the entire BIG area, are intended to be implemented as resources are available, and may be superseded as necessary for research needs that are specific to individual stakeholders. Research would be conducted using appropriate methodology and quality assurance that have been developed in consultation with the TCEQ and the EPA. In the following text, although the research priorities are presented in a numerical order, this is not a rank order.

The I-Plan's stakeholders identified three priority research topics which address the following:

- Effectiveness of stormwater activities
- Bacteria persistence and regrowth
- Appropriate indicators

Additional topics were identified and, although important, were not identified as top priorities. Many of these topics are related to the three research priorities. As funding is available, these additional research topics should be considered.

A variety of funding sources should be pursued, with a variety of partners. It is unlikely that any one local entity will find it appropriate to conduct this research. Given the large-scale character of the undertakings, entities should look to coordinate efforts with the various academic institutions of the greater Houston area, federal and state agencies like the EPA, Center for Disease Control and Prevention, and Department of State Health Services, water and environmental research groups like Water Environment Research Foundation and Water Environment Association of Texas, and similar potential partners. A shared project, the result of an inter-local agreement or similar instrument, may allow local entities to feasibly investigate these issues. However, the more practical avenue is likely to be the BIG group as a whole advocating for a national or state-level entity to address research priorities.

Research Priority 10.1: Evaluate the Effectiveness of Stormwater Implementation Activities

Additional monitoring of current and future stormwater projects in the planning area will help provide an area-specific set of data on the relative effectiveness of different management practices. This effort would draw from current and proposed activities undertaken by Phase I MS4 permitted entities. The effectiveness studies would include both structural measures and behavioral measures. Structural measures might be based on both traditional drainage engineering, such as specifications for stormwater outfalls, and sustainable infrastructure design methodologies, such as Green Infrastructure and Low Impact Development. Behavioral measures, such as public outreach, public reporting of illicit discharges, and efforts aimed at changing behaviors. The data collected and the results from the comparative evaluations should be made available to all stakeholders through the monitoring databases described in Implementation Strategy 9.0.

Research Priority 10.2: Further Evaluate Bacteria Persistence and Regrowth

To better understand the extent of human contributions to bacterial loading in waterways, the underlying base layer of background or endemic bacteria should be studied in greater detail. Previous studies of water bodies in the region, including evaluations of Buffalo and Whiteoak bayous in Harris County,[112] indicated that naturally occurring bacteria are prevalent and persistent in our slow-moving waterways. While these naturally occurring bacteria are certainly supplemented with bacteria from human activities and other sources, the relationship and relative percentages of each should be studied in greater detail. Additionally, the character and cycle of bacteria in the waterway pertaining to regrowth potential requires further evaluation. More realistic and comprehensive simulations are required to more fully grasp the nature of bacterial behavior in the waterways. Implementing agencies that choose to conduct these studies for specific projects will make their data available for the rest of the stakeholders through the monitoring databases (or through H-GAC as a facilitator). The results could be used to provide more precise predictions of bacterial loading by following the impact of loading over time within the waterway.

Research Priority 10.3: Determine Appropriate Indicators

An indicator species is an organism whose presence is highly correlated to the presence of another organism (or group of organisms). *E. coli* or *Enterococcus* are used as indicator bacteria based on their pervasiveness and correlation between their presence and the presence of a wide range of potential microbial pathogens. However, that general correlation may not be precise enough to justify their exclusive use in monitoring for this I-Plan. While these indicators are generally accepted nationwide,

[112] (Brinkmeyer, Amon and Schwarz 2008) and (NSF International Engineering & Research Services 2007)

they may not reflect the unique balance of microbial pathogens and water quality characteristics of the region's semi-tropical urban bayous and local water bodies. Many studies, including the data used to formulate the 1986 EPA guidance on bacteria limits for recreational waters,[113] were conducted in areas and water bodies greatly different from the BIG area. The potential need for alternate, supplemental, or multiple indicators should be determined to refine the I-Plan's monitoring approach and further assist stakeholders in identifying sources.

The EPA is currently studying the question of appropriate indicators. The results of their inquiry, due in October of 2012,[114] should be incorporated into future revisions of this I-Plan. Additional consideration of the best indicator(s) for the area could help supplement their findings by providing a more specific understanding of local correlations between indicators and pathogens. Stakeholders are encouraged to participate in EPA's discussion of indicators and to encourage the EPA to consider environments similar to those in the Houston region.

Research Priority 10.4: Additional Research Topics

A variety of additional research topics were identified by stakeholders. The following list gives a brief description of broad groups of research topics and some possible research questions. Research addressing these topics should be conducted as resources are available.

- *WWTFs:* Studies should examine the correlation between bacteria levels in effluent and in-stream bacteria levels. Have in-stream bacteria levels changed as a result of the TCEQ's new rules that limit bacteria levels in effluent? Research may also be conducted to identify how other constituents in wastewater effluent may influence in-stream bacteria levels. How are in-stream bacteria levels influenced by sludge discharges, nutrients, and stormwater discharges from WWTFs?
- *Health risks:* The studies should include cumulative review of epidemiological studies, collection of new epidemiological data, and/or microbial risk assessment efforts aimed at determining human health risks from recreational activities in, on, or near bayous in the BIG region. What is the relationship between the levels of pathogens and indicators in different watersheds?
- *Recreational use:* Generally, eight or more illnesses above the background level are considered problematic. Does the rate of illness from contact recreation in impaired waterways in the project area exceed this threshold? What is the level of recreation on the waterways?
- *Land use:* Research could analyze the correlations between land use, turbidity, and in-stream bacteria levels. Some land use types may lead to increased turbidity, and may be associated with increased bacteria levels. Consideration should be given to evaluating the per-capita

[113] (U.S. Environmental Protection Agency 1986)

[114] (U.S. Environmental Protection Agency 2010c)

contribution of bacteria in relative compact mixed use developments versus lower density developments. Historical land use prior to development may also influence in-stream bacteria levels. Is there a correlation between impervious surfaces and in-stream bacteria levels?

- *Modeling:* The document, "Bacteria Total Maximum Daily Load Task Force Final Report,"[115] contains summary information about the selection and application of various water quality models for use in Texas. However, many questions were raised by the authors regarding how well the models work, how they can be improved to be more accurate, and how well they function as predictive models. Research could be done to provide answers to the questions raised in the report. One particular input for which further information could be done is to improve the flow data available for classified stream sections.
- *Unimpaired waterways:* A minority of sampled waterways in the project area are *not* considered impaired for bacteria. Why do these assessment units have relatively low bacteria levels? How could this information be applied to lower bacteria levels in impaired waterways?
- *Nutrients and other constituents:* Waterways in the project area contain constituents such as nutrients, fine particles, sediment, soil, and other solid materials. Studies and research should examine how such constituents influence instream bacteria levels.

[115] (Jones, et al. 2007)

Implementation Strategy 11.0: Geographic Priority Framework

In order to achieve state standards for contact recreation in the BIG region's waterways, all stakeholders will need to be responsible for some aspects of implementation. Some Implementation Activities, such as those described in Implementation Activity 1.1, will be implemented throughout the BIG Project Area. Others, such as Implementation Activity 3.1, will be implemented in targeted areas. It is this second group of IAs, those that are geographically targeted, that need a framework for prioritization. The framework described here provides guidance to communities in setting local implementation priorities.

Implementation Activity 11.1: Consider recommended criteria when selecting geographic locations for projects

As a community prioritizes actions within its watersheds it should consider five main categories of concern: bacteria level, accessibility, use level, implementation opportunities, and future land use changes. Table 8 lists criteria included in these categories. Communities may want to gather input from residents when setting priorities. This can be accomplished through public meetings or surveys. However, an ordered approach needs to be considered as well, such as targeting specific watersheds or suspected sources.

Table 8: Criteria to be considered when selecting geographic priorities

Category	Criteria to Consider
Bacteria Level	• Is the 7-year bacteria geometric mean for the waterway above the water quality criteria for bacteria? If yes, what is the magnitude of the exceedance? • Based on land use surrounding the waterway, is the source of bacteria more likely human or animal? • Is the flow in the waterway primarily effluent from wastewater treatment facilities? • How many impaired stream segments could be affected by the transport of bacteria downstream from the waterway?
Accessibility	• Is there a large population within 0.25 miles of the waterway? [Note: The meaning of the phrase "large population" can differ from community to community.] • Are there public access points (ramps, bridges, trails, developed parks) to the waterway?

Category	Criteria to Consider
Use Level	• Is contact recreation occurring in the waterway? • If the waterway is not currently used for recreation, would the waterway be used for recreation if the bacteria level were low? • Is the waterway part of a drinking water supply? • Are there signs that the waterway is being used for recreation (rope swings, fishing debris, beer cans, or graffiti)? • Is there an existing group that promotes protection and improvement of the waterway as a community asset? • Are the characteristics of the waterway such that individuals could use it for recreation (appropriate flow, depth, natural or man-made banks)?
Implementation Opportunities	• Are there existing groups to partner with for implementation? • Is there political will to lower a particular waterway's bacteria level? • What funds are available? • Can funding be leveraged with funding from upstream or downstream jurisdictions to expand spatial extent of an IA? • What are initial construction or installation costs? • What are estimated long-term maintenance costs? • Is there a waterway that could easily meet the standard? • Can a specific source of bacteria be singled out to better target IAs? • How much land is available to develop stormwater treatment facilities?
Future Land Use Changes	• What development is expected in the watershed? • Is the waterway threatened, but not yet listed as impaired? [Note: H-GAC Clean Rivers Program staff periodically analyzes water quality data to determine trends and can provide this information to interested communities. Additionally, raw data is available for download from the H-GAC website.]

Appendix A: References and Authorities

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Appendix B: Table of Segments and Assessment Units in the Project Area

Table 9: Segments and Assessment Units in the BIG Project Area

Segment ID	Assessment Unit ID	Segment Name	Tidal	TMDL in progress or completed	Included in the original TMDL project area	Year first listed for bacteria impairment
1004E	1004E_01	Stewarts Creek	No	No	Yes	
1004E	1004E_02	Stewarts Creek	No	Yes	Yes	2006
1006D	1006D_01	Halls Bayou	No	Yes	Yes	2002
1006D	1006D_02	Halls Bayou	No	Yes	Yes	2002
1006F	1006F_01	Big Gulch Above Tidal	No	Yes	Yes	2002
1006H	1006H_01	Spring Gully Above Tidal	No	Yes	Yes	2002
1006I	1006I_01	Unnamed Tributary of Halls Bayou	No	Yes	Yes	2002
1006J	1006J_01	Unnamed Tributary of Halls Bayou	No	Yes	Yes	2002
1007A	1007A_01	Canal C-147 Tributary of Sims Bayou Above Tidal	No	No	Yes	2006
1007B	1007B_01	Brays Bayou Above Tidal	No	Yes	Yes	2002
1007B	1007B_02	Brays Bayou Above Tidal	No	Yes	Yes	2002
1007C	1007C_01	Keegans Bayou Above Tidal	No	Yes	Yes	2002
1007D	1007D_01	Sims Bayou Above Tidal	No	Yes	Yes	2002
1007D	1007D_02	Sims Bayou Above Tidal	No	Yes	Yes	2002
1007D	1007D_03	Sims Bayou Above Tidal	No	Yes	Yes	2002
1007E	1007E_01	Willow Waterhole Bayou Above Tidal	No	Yes	Yes	2002
1007F	1007F_01	Berry Bayou Above Tidal	No	Yes	Yes	2002
1007G	1007G_01	Kuhlman Gully Above Tidal	No	Yes	Yes	2002
1007H	1007H_01	Pine Gully Above Tidal	No	Yes	Yes	2002
1007I	1007I_01	Plum Creek Above Tidal	No	Yes	Yes	2002
1007K	1007K_01	Country Club Bayou Above Tidal	No	Yes	Yes	2002

Segment ID	Assessment Unit ID	Segment Name	Tidal	TMDL in progress or completed	Included in the original TMDL project area	Year first listed for bacteria impairment
1007L	1007L_01	Unnamed Non-Tidal Tributary of Brays Bayou	No	Yes	Yes	2002
1007M	1007M_01	Unnamed Non-Tidal Tributary of Hunting Bayou	No	Yes	Yes	2002
1007N	1007N_01	Unnamed Non-Tidal Tributary of Sims Bayou	No	Yes	Yes	2002
1007O	1007O_01	Unnamed Non-Tidal Tributary of Buffalo Bayou	No	Yes	Yes	2002
1007R	1007R_01	Hunting Bayou Above Tidal	No	Yes	Yes	2002
1007R	1007R_02	Hunting Bayou Above Tidal	No	Yes	Yes	2002
1007R	1007R_03	Hunting Bayou Above Tidal	No	Yes	Yes	2002
1007R	1007R_04	Hunting Bayou Above Tidal	No	Yes	Yes	2002
1007S	1007S_01	Poor Farm Ditch	No	No	Yes	
1007T	1007T_01	Bintliff Ditch	No	No	Yes	
1007U	1007U_01	Mimosa Ditch	No	No	Yes	
1007V	1007V_01	Unnamed tributary of Hunting Bayou	No	No	Yes	
1008	1008_01	Spring Creek	No	No	Yes	
1008	1008_02	Spring Creek	No	Yes	Yes	1996
1008	1008_03	Spring Creek	No	Yes	Yes	1996
1008	1008_04	Spring Creek	No	Yes	Yes	1996
1008A	1008A_01	Mill Creek	No	No	Yes	
1008B	1008B_01	Upper Panther Branch	No	Yes	Yes	2006
1008B	1008B_02	Upper Panther Branch	No	No	Yes	
1008C	1008C_01	Lower Panther Branch	No	No	No	
1008E	1008E_01	Bear Branch	No	No	No	

Segment ID	Assessment Unit ID	Segment Name	Tidal	TMDL in progress or completed	Included in the original TMDL project area	Year first listed for bacteria impairment
1008F	1008F_01	Lake Woodlands	No	No	No	
1008H	1008H_01	Willow Creek	No	Yes	Yes	2006
1008I	1008I_01	Walnut Creek	No	No	Yes	
1008J	1008J_01	Brushy Creek	No	No	Yes	
1009	1009_01	Cypress Creek	No	Yes	Yes	1996
1009	1009_02	Cypress Creek	No	Yes	Yes	1996
1009	1009_03	Cypress Creek	No	Yes	Yes	1996
1009	1009_04	Cypress Creek	No	Yes	Yes	1996
1009C	1009C_01	Faulkey Gully	No	No	Yes	2006
1009D	1009D_01	Spring Gully	No	No	Yes	2006
1009E	1009E_01	Little Cypress Creek	No	Yes	Yes	2006
1010	1010_01	Caney Creek	No	No	Yes	
1010	1010_02	Caney Creek	No	Yes	Yes	2006
1010	1010_03	Caney Creek	No	No	Yes	
1010	1010_04	Caney Creek	No	Yes	Yes	2006
1010C	1010C_01	Spring Branch	No	No	Yes	
1011	1011_01	Peach Creek	No	No	Yes	
1011	1011_02	Peach Creek	No	Yes	Yes	2006
1013	1013_01	Buffalo Bayou Tidal	Yes	Yes	Yes	1996
1013A	1013A_01	Little Whiteoak Bayou	No	Yes	Yes	2002
1013A	1013A_02	Little Whiteoak Bayou	No	No	Yes	
1013C	1013C_01	Unnamed Non-Tidal Tributary of Buffalo Bayou Tidal	No	Yes	Yes	2002
1014	1014_01	Buffalo Bayou Above Tidal	No	Yes	Yes	1996
1014A	1014A_01	Bear Creek	No	Yes	Yes	2006
1014B	1014B_01	Buffalo Bayou	No	Yes	Yes	2006
1014C	1014C_01	Horsepen Creek	No	No	Yes	
1014E	1014E_01	Langham Creek	No	Yes	Yes	2006
1014H	1014H_01	South Mayde Creek	No	Yes	Yes	2002
1014H	1014H_02	South Mayde Creek	No	Yes	Yes	2002

Segment ID	Assessment Unit ID	Segment Name	Tidal	TMDL in progress or completed	Included in the original TMDL project area	Year first listed for bacteria impairment
1014H	1014H_03	South Mayde Creek	No	No	Yes	
1014K	1014K_01	Turkey Creek	No	Yes	Yes	2002
1014K	1014K_02	Turkey Creek	No	Yes	Yes	2002
1014L	1014L_01	Mason Creek	No	Yes	Yes	2006
1014M	1014M_01	Neimans Bayou	No	Yes	Yes	2002
1014N	1014N_01	Rummel Creek	No	Yes	Yes	2002
1014O	1014O_01	Spring Branch	No	Yes	Yes	2002
1016	1016_01	Greens Bayou Above Tidal	No	Yes	Yes	1996
1016	1016_02	Greens Bayou Above Tidal	No	Yes	Yes	1996
1016	1016_03	Greens Bayou Above Tidal	No	Yes	Yes	1996
1016A	1016A_01	Garners Bayou	No	No	Yes	
1016A	1016A_02	Garners Bayou	No	Yes	Yes	2002
1016A	1016A_03	Garners Bayou	No	Yes	Yes	2002
1016B	1016B_01	Unnamed Tributary of Greens Bayou	No	Yes	Yes	2002
1016C	1016C_01	Unnamed Tributary of Greens Bayou	No	Yes	Yes	2002
1016D	1016D_01	Unnamed Tributary of Greens Bayou	No	Yes	Yes	2002
1017	1017_01	Whiteoak Bayou Above Tidal	No	Yes	Yes	1996
1017	1017_02	Whiteoak Bayou Above Tidal	No	Yes	Yes	1996
1017	1017_03	Whiteoak Bayou Above Tidal	No	Yes	Yes	1996
1017	1017_04	Whiteoak Bayou Above Tidal	No	Yes	Yes	1996
1017A	1017A_01	Brickhouse Gully/Bayou	No	Yes	Yes	2002
1017B	1017B_01	Cole Creek	No	No	Yes	
1017B	1017B_02	Cole Creek	No	Yes	Yes	2002

Segment ID	Assessment Unit ID	Segment Name	Tidal	TMDL in progress or completed	Included in the original TMDL project area	Year first listed for bacteria impairment
1017D	1017D_01	Unnamed Tributary of Whiteoak Bayou	No	Yes	Yes	2002
1017E	1017E_01	Unnamed Tributary of Whiteoak Bayou	No	Yes	Yes	2002
1101	1101_01	Clear Creek Tidal	Yes	Yes	Yes	1996
1101	1101_02	Clear Creek Tidal	Yes	Yes	Yes	1996
1101	1101_03	Clear Creek Tidal	Yes	Yes	Yes	1996
1101	1101_04	Clear Creek Tidal	Yes	No	Yes	
1101B	1101B_01	Chigger Creek	No	Yes	Yes	2002
1101B	1101B_02	Chigger Creek	No	Yes	Yes	2002
1101D	1101D_01	Robinson Bayou	Yes	Yes	Yes	2006
1101D	1101D_02	Robinson Bayou	Yes	Yes	Yes	2006
1101E	1101E_01	Unnamed tributary of Clear Creek	Yes	No	Yes	
1102	1102_01	Clear Creek Above Tidal	No	Yes	Yes	1996
1102	1102_02	Clear Creek Above Tidal	No	Yes	Yes	1996
1102	1102_03	Clear Creek Above Tidal	No	Yes	Yes	1996
1102	1102_04	Clear Creek Above Tidal	No	Yes	Yes	1996
1102	1102_05	Clear Creek Above Tidal	No	Yes	Yes	1996
1102A	1102A_01	Cowart Creek	No	Yes	Yes	2002
1102A	1102A_02	Cowart Creek	No	Yes	Yes	2002
1102B	1102B_01	Mary's Creek/North Fork Mary's Creek	No	Yes	Yes	2002
1102C	1102C_01	Hickory Slough	No	Yes	Yes	2006
1102D	1102D_01	Turkey Creek	No	Yes	Yes	2006
1102E	1102E_01	Mud Gully	No	Yes	Yes	2006
1102G	1102G_01	Unnamed tributary of Mary's Creek	No	No	Yes	

Appendix C: Allocated Loads for TMDLs

Information included in the following tables was taken directly from TMDL reports and technical documents for the four TMDL Projects covered by this I-Plan.

The units used in the documents vary by project. For example, calculations for the Houston Metro and the Buffalo and Whiteoak TMDLs are provided in billion MPN/day, while the calculations for the Clear Creek and Lake Houston TMDLs are presented as counts per day and CFU per day, respectively, using scientific notation. MPN (Most Probable Number) and CFU (Colony Forming Units) are effectively equivalent. Scientific notation is a standardized format for writing numbers that are extremely large (or small).The following table might be helpful for understanding scientific notation:

Table 10: Examples of Scientific Notation

'Regular' number	In billions	In normalized scientific notation	In E notation of scientific notation
1,000,000,000	1.0	1.0×10^{9}	1.0E+09
1,574,770,000,000	1574.77	1.574×10^{12}	1.574E+12
17,950,000,000	18.0	1.80×10^{10}	1.80E+10
2,390,000,000,000	2390	2.39×10^{12}	2.39E+12
4,490,000,000	4.49	4.49×10^{9}	4.49E+09

Buffalo and Whiteoak Bayous Allocated Loads

Table 11: Summary calculations for Buffalo and Whiteoak bayous assessment units

Assessment Unit	Indicator Bacteria Species	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Stormwater}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Upstream Load (Billion MPN/day)	Future WWTF Capacity (Billion MPN/day)
1013_01	*E. coli*	1574.77	0	267.95	29.77	0	1275.86	1.19
1013A_01	*E. coli*	1379.94	0	234.66	26.07	0	1118.01	1.19
1013C_01	*E. coli*	102.08	0	16.37	1.02	0	82.7	1.19
1014_01	*E. coli*	1841.94	35.93	837.68	93.08	0	856.98	18.28
1014A_01	*E. coli*	195.04	22.81	141.2	15.69	0	0	15.34
1014B_01	*E. coli*	626.91	51.7	482.44	53.6	0	0	39.16
1014E_01	*E. coli*	236.83	4.65	205	22.78	0	0	4.41
1014H_01	*E. coli*	39.18	0	33.12	3.68	0	0	2.38
1014H_02	*E. coli*	175.43	20.78	125.93	13.99	0	0	14.73
1014K_01	*E. coli*	35.06	2.17	27.86	3.1	0	0	1.93
1014K_02	*E. coli*	15.09	0.62	12.58	1.4	0	0	0.5
1014L_01	*E. coli*	69.66	25.68	23.11	2.57	0	0	18.29
1014M_01	*E. coli*	76.75	0	34.79	3.87	0	35.71	2.38
1014N_01	*E. coli*	204.66	62.96	5.56	0.62	0	95.22	40.3
1014O_01	*E. coli*	434.9	0.03	209.26	23.25	0	202.34	0.02
1017_01	*E. coli*	173.57	65.69	58.94	6.55	0	0	42.4
1017_02	*E. coli*	52.06	0.08	46.77	5.2	0	0	0.01
1017_03	*E. coli*	149.47	0	132.38	14.71	0	0	2.38
1017_04	*E. coli*	537.09	0.5	482.69	53.63	0	0	0.27
1017A_01	*E. coli*	175.57	2.37	154.77	17.2	0	0	1.23
1017B_02	*E. coli*	137.95	50.08	52.68	5.85	0	0	29.33
1017D_01	*E. coli*	12.54	0	9.14	1.02	0	0	2.38
1017E_01	*E. coli*	12.54	0	9.14	1.02	0	0	2.38481

Clear Creek Allocated Loads

Table 12: Summary calculations for Clear Creek assessment units

Segment	Indicator Bacteria Species	TMDL (counts/day)	WLA_{WWTF} (counts/day)	WLA_{MS4} (counts/day)	LA (counts/day)	MOS (counts/day)	$TMDL_{Future}$ (counts/day)	$WLA_{WWTF-Future}$ (counts/day)
1101	Enterococci	9370	34.3	8160	709	469	9390	21.1
1101A	Enterococci	81.9	.874	76.9	0	4.09	109	27.4
1101B	*E. coli*	17.4	NA	7.16	9.37	.870	17.5	.0525
1101B	Enterococci	716	NA	680	0	35.8	716	0
1101D	Enterococci	126	NA	78.8	40.6	6.28	180	54.4
1102	*E. coli*	44.4	61.6	NA	0	2.22	132	87.3
1102A	*E. coli*	48.3	.401	23.8	21.7	2.41	48.7	.394
1102A	Enterococci	160	NA	152	0	7.98	160	0
1102B	*E. coli*	163	30.6	112	12.7	8.15	227	64.2
1102C	*E. coli*	19.9	.358	17.8	.737	.997	20.6	.706
1102D	Fecal Coliform	36.6	46.5	NA	0	1.83	71.4	44.8
1102E	Fecal Coliform	145	40.4	80.2	16.8	7.23	179	34.9

Houston Metropolitan Allocated Loads

Brays Bayou Watershed

Table 13: Summary calculations for Brays Bayou assessment units

Assessment Unit	Indicator Bacteria Species	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Stormwater}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Future WWTF Capacity (Billion MPN/day)
1007B_01	*E. coli*	2390	377	1830	9.06	120	56.7
1007B_02	*E. coli*	162	41.2	100	2.05	8.09	10.2
1007C_01	*E. coli*	325	89.6	200	7.01	16.3	12.7
1007E_01	*E. coli*	130	3.07	120	0	6.49	0.373
1007L_01	*E. coli*	10.8	0	10.3	0	0.542	0

Eastern Houston Watersheds

Table 14: Summary calculations for Eastern Houston Watershed assessment units

Assessment Unit	Indicator Bacteria Species	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Stormwater}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Future WWTF Capacity (Billion MPN/day)
1006F_01	*E. coli*	14.9	0.835	7.33	5.53	0.744	0.441
1006H_01	*E. coli*	34.8	0.0477	29	3.96	1.74	0.0282
1007F_01	*E. coli*	162	30.4	115	0	8.12	9.23
1007G_01	*E. coli*	36.3	NA	34.5	0	1.82	0
1007H_01	*E. coli*	10	NA	9.5	0	0.5	0
1007I_01	*E. coli*	27.3	NA	26	0	1.37	0
1007K_01	*E. coli*	38.9	NA	37	0	1.95	0
1007M_01	*E. coli*	32.3	NA	30.7	0	1.62	0
1007O_01	*E. coli*	0.32	NA	0.304	0	0.016	0
1007R_01	*E. coli*	23.3	NA	22.1	0	1.17	0

Assessment Unit	Indicator Bacteria Species	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Stormwater}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Future WWTF Capacity (Billion MPN/day)
1007R_02	*E. coli*	31.1	NA	29.5	0	1.55	0
1007R_03	*E. coli*	192	9.54	146	23.8	9.61	3.36
1007R_04	*E. coli*	273	10	212	34.4	13.7	3.64

Greens Bayou Watershed

Table 15: Summary calculations for Greens Bayou assessment units

Assessment Unit	Indicator Bacteria Species	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Stormwater}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Future WWTF Capacity (Billion MPN/day)
1016_01	*E. coli*	403	70.9	293	0	20.2	19.3
1016_02	*E. coli*	1020	123	789	0	51.2	60.7
1016_03	*E. coli*	1780	219	1050	231	89	190
1016A_02	*E. coli*	197	25.5	138	5.69	9.84	18
1016A_03	*E. coli*	419	64.5	214	31	21	88.9
1016B_01	*E. coli*	15	0	12.4	1.86	0.751	0
1016C_01	*E. coli*	94.1	0.89	88.2	0	4.7	0.32
1016D_01	*E. coli*	79.7	13.3	35.8	6.51	3.99	20.1

Halls Bayou Watershed

Table 16: Summary calculations for Halls Bayou assessment units

Assessment Unit	Indicator Bacteria Species	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Stormwater}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Future WWTF Capacity (Billion MPN/day)
1006D_01	*E. coli*	463	42.7	382	3.4	23.2	12
1006D_02	*E. coli*	280	25.4	233	0	14	6.94
1006I_01	*E. coli*	2.72	0	2.15	0.435	0.136	0
1006J_01	*E. coli*	26.1	0.317	24.4	0	1.31	0.133

Sims Bayou Watershed

Table 17: Summary calculations for Sims Bayou assessment units

Assessment Unit	Indicator Bacteria Species	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Stormwater}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Future WWTF Capacity (Billion MPN/day)
1007D_01	*E. coli*	213	23	174	0	10.6	5.50
1007D_02	*E. coli*	527	90.1	358	10.2	26.3	42
1007D_03	*E. coli*	777	107	569	17.5	38.9	45.3
1007N_01	*E. coli*	25.5	0.238	23.9	0	1.28	0.119

Lake Houston Watershed Allocated Loads

Table 18: Summary calculations for Lake Houston Watershed assessment units

Assessment Unit	Indicator Bacteria Species	TMDL (Billion cfu/day)	MOS (Billion cfu/day)	WLA_{WWTF} (Billion cfu/day)	MS4%	WLA_{MS4} (Billion cfu/day)	$LA_{Stormwater}$ (Billion cfu/day)	$Future_{WWTF}$ (Billion cfu/day)
1004E_02	*E. coli*	44.9	2.24	0	0.00	0	42.6	0
1008_02	*E. coli*	154	7.70	.560	0.12	17.2	128	.578
1008_02	*E. coli*	287	14.4	3.33	0.12	31.4	235	3.25
1008_03	*E. coli*	487	24.4	15.9	0.12	51.0	380	15.6
1008_03	*E. coli*	1420	70.9	78.7	0.12	141	1050	77.0
1008_04	*E. coli*	1510	75.7	103	0.12	146	1090	101
1008H_01	*E. coli*	166	8.28	13.9	0.12	14.9	104	24.4
1009_01	*E. coli*	227	11.3	8.70	0.30	59.9	138	8.64
1009_02	*E. coli*	516	25.8	33.6	0.30	128	296	33.4
1009_02	*E. coli*	615	30.8	59.5	0.30	141	325	59.0
1009_03	*E. coli*	729	36.4	89.0	0.30	156	359	88.3
1009_03	*E. coli*	1340	67.0	142	0.30	299	690	141
1009_04	*E. coli*	1550	77.4	178	0.30	338	779	176
1009C_01	*E. coli*	35.3	1.76	11.8	0.36	4.42	8.00	9.31
1009D_01	*E. coli*	20.5	1.02	3.36	0.33	4.09	8.13	3.89
1009E_01	*E. coli*	91.1	4.56	7.82	0.08	5.16	59.4	14.2
1010_02	*E. coli*	245	12.2	.806	0.06	14.8	216	1.14
1010_04	*E. coli*	495	24.6	11.2	0.06	28.2	413	15.8
1011_02	*E. coli*	419	21.0	6.47	0.00	0	381	10.8
1011_02	*E. coli*	422	21.1	6.47	0.00	0	383	10.8

Appendix D: Utility Asset Management Program Resources and Examples

Utility Asset Management Program Resources

The EPA

The EPA's website for Sanitary Sewer Overflows and Peak Flows provides useful information regarding Utility Asset Management Programs (UAMPs), particularly capacity, management, operation, and maintenance (CMOM) programs:

- EPA's Sanitary Sewer Overflows and Peak Flows website[116]
  http://cfpub1.epa.gov/npdes/home.cfm?program_id=4
- "Model NPDES Permit Language for Sanitary Sewer Overflows"[117]
  http://www.epa.gov/npdes/pubs/sso_model_permit_conditions.pdf
- Report to Congress : Impacts and Control of CSOs and SSOs[118]
  http://cfpub1.epa.gov/npdes/cso/cpolicy_report2004.cfm
- Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM) programs at Sanitary Sewer Collection Systems[119]
  http://www.epa.gov/npdes/pubs/cmom_guide_for_collection_systems.pdf
- Self-Assessment Checklist[120]
  http://www.epa.gov/npdes/pubs/cmomselfreview.pdf

EPA Region 4

EPA Region 4 has been instrumental in the development of EPA's CMOM plan:

- EPA Region 4 Management, Operations, and Maintenance (MOM) Program Web page[121]
  http://www.epa.gov/region4/water/wpeb/momproject/index.html
- EPA Region 4 MOM Checklist[122]
  http://www.neiwpcc.org/neiwpcc_docs/WEBOM&R.AppendixE.pdf

[116] (U.S. Environmental Protection Agency 2010d)

[117] (U.S. Environmental Protection Agency 2007)

[118] (U.S. Environmental Protection Agency 2004)

[119] (U.S. Evironmental Protection Agency 2005)

[120] (U.S. Environmental Protection Agency 2003)

[121] (U.S. Environmental Protection Agency 2009b)

[122] (New England Interstate Water Pollution Control Commission 2003)

EPA Region 6

EPA's Region 6, in association with the TCEQ, the Water Environment Association of Texas, and the City of Austin Water Utility, hosts an annual conference on CMOM. Information is available at http://www.weat.org.

The TCEQ

The TCEQ offers resources for managing and improving sanitary sewer systems:

- Sanitary Sewer Overflow (SSO) Initiative: Information for Prospective Participants[123]
  http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/gi/gi-389.html/at_download/file
- Water Quality Noncompliance notification[124]
  http://www.tceq.state.tx.us/assets/public/compliance/enforcement/forms/00501.pdf
- Additional information is available from the Water Program Liaison, Program Support Section of the Field Operations Division.

New England Interstate Water Pollution Control Commission

New England Interstate Water Pollution Control Commission (NEIWPCC) has assembled excellent resources regarding collection system management:

- NEIWPCC Wastewater and Onsite Systems—Collection Systems website[125]
  http://www.neiwpcc.org/collectionsystems/
- Optimizing Operation, Maintenance, and Rehabilitation of Sanitary Sewer Collection Systems[126]
  http://www.neiwpcc.org/collectionsystems/OMR.asp

Water Environmental Federation's CMOM.net

CMOM.net is a reliable source of information about the EPA's CMOM regulations. It is maintained by members of the Collection Systems Committee of the Water Environment Federation (WEF).

- CMOM.net[127]
  http://www.cmom.net/

[123] (TCEQ 2008c)

[124] (TCEQ 2010k)

[125] (New England Interstate Water Pollution Control Commission 2010)

[126] (New England Interstate Water Pollution Control Commission 2003)

[127] (Collection Systems Committee of the Water Environment Federation (WEF) 2009)

H-GAC Website

H-GAC maintains a Web page containing these and additional references. This page is available at www.h-gac.com/BIG.

Examples

A variety of websites contain case studies and examples:

- EPA's Featured Case Studies, Fact Sheets, and Other Information website[128] http://cfpub1.epa.gov/npdes/sso/featuredinfo.cfm?program_id=4
- NEIWPCC Capacity, Management, Operation, and Maintenance (CMOM) website[129] http://www.neiwpcc.org/collectionsystems/CMOM.asp
- H-GAC's Clean Waters Initiative CMOM workshop http://www.h-gac.com/community/water/cwi/cwi_past_workshops.aspx

[128] (U.S. Environmental Protection Agency 2007)

[129] (New England Interstate Water Pollution Control Commission 2009)

Appendix E: Local OSSF Amendments

Communities that have been designated as authorized agents by the TCEQ may adopt regulations that are more strict than the regulations that the TCEQ applies statewide. Several authorized agents in the 13-county H-GAC region have adopted such regulations, as shown in the following examples.

Austin County[130]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620008

1. Every on-site sewage facility to be constructed, repaired, extended or altered, must obtain a permit prior to construction regardless of the size of the tract of land.
2. Site evaluations may be performed by either:
   A. A Registered Installer II and have successfully completed a site evaluation training course approved by TCEQ. The individual doing site evaluations must be in good standing with their respective licensing program. Or
   B. A Registered Professional Engineer and have successfully completed a site evaluation training course approved by TCEQ. The individual doing site evaluations must be in good standing with their respective licensing program. Or
   C. A Registered Professional Sanitarian and have successfully completed a site evaluation training course approved by TCEQ. The individual doing site evaluations must be in' good standing with their respective licensing program.
3. Site evaluations must be done on Austin County's form.
4. Boring/Back-hoe pit requirement whereby Austin County's Designated Representative is authorized to require any necessary excavation if two different site evaluations have been submitted on the same property and flagged for County Inspector to find.
5. Installation of Systems:
   A. A property owner can only install an: On-Site Sewage Facility that does not require a Professional Sanitarian or Professional Engineer planning materials.
   B. Registered Installer must be present at the Final Inspection.
   C. Property owners only to submit application, fee, and planning material.
   D. All residential lots must be one acre minimum regardless whether served by private water well or community/public water system.
   E. Property owner/homeowner maintenance of any secondary treatment system shall not be allowed unless the property owner/homeowner has proof that he/she has been trained by the manufacturer/installer or is a Registered/Certified Maintenance Provider.

[130] (Austin County 2007)

F. The authorized agent may periodically inspect the on-site disposal system using aerobic treatment, regardless of when the authorized agent conducted the last inspection.

Brazoria County[131]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620020

1. Registration: A person must be licensed or registered by TCEQ, as well as, registered with the Brazoria County Environmental Health Department, before engaging in any OSSF related activity in the area of jurisdiction of this Order, as an installer or maintenance provider. The County Registration application shall be submitted in person, on a standard form with the attached evidence of current license or registration. No fee shall apply to the registration. It is the responsibility of the Registrant to maintain required current registration information. Non-compliance of registration requirements shall result in denial of all permit applications. An installer may not install OSSFs in Brazoria County's area of jurisdiction if their County Registration has been suspended or revoked. Maintenance providers may not enter into any new OSSF contracts in Brazoria County's area of jurisdiction if their County Registration has been suspended or revoked.

   Homeowners are not required to register with the County.

   Installers and maintenance providers who are currently performing OSSF-related activity within Brazoria County's area of jurisdiction will have 90 days from the effective date of this Order to register with Brazoria County Environmental Health Department.

   (A) A person (Registrant), maintaining a County Registration is subject to additional disciplinary action by the County of Brazoria, Texas, if such person is convicted of a Class "C" misdemeanor violation relating to TH&SC 366, TWC Chapter 7, and/03 Chapters 30 to 285.

   (B) Enforcement action against a Registrant shall be initiated and pursued for any and all violations of this Order by the issuance of notice of violation or a notice of enforcement or a Class "C" misdemeanor citation. Upon conviction of a Class "C" misdemeanor citation, the Registrant's penalty for each separate occurring offense is as follows:

      (1) *First Class "C" Misdemeanor Conviction:* Provide to the Brazoria County Environmental Health Department documented proof of violation resolution and a $125.00 fee payment within 72 business hours of the violation resolution. This fee is in addition to any additional fee which is assessed to Registrant from obtaining permits until the fee is paid regardless of appeals of the Class "C" Misdemeanor Conviction. A maintenance provider will be prohibited from entering new contracts until the fee is paid regardless of appeals of the Class "C" Misdemeanor Conviction.

      (2) *Second Class "C" Misdemeanor Conviction:* Provide to the Brazoria County Environmental Health Department documented proof of violation resolution and a $250.00 fee payment within 72 business hours of the violation resolution. This fee is in addition to any additional fee which is assessed to the Registrant from formal judicial prosecution. Failure to pay fee within the allotted period will result in denial

[131] (Brazoria County 2010)

of new permits until fee is paid. Further, the Registrant's County Registration shall be suspended three-months from the conviction. An installer will be prohibited from obtaining permits and installing OSSFs from the date of the conviction regardless of appeals of the Class "C" Misdemeanor Conviction. A maintenance provider will be prohibited from entering new contracts from the date of the conviction regardless of appeals of the Class "C" Misdemeanor Conviction.

(3) *Third Class "C" Misdemeanor Conviction:* Provide to the Brazoria County Environmental Health Department documented proof of violation resolution and a $500.00 fee payment within 72 business hours of the violation resolution. This fee is in addition to any additional fee which is assessed to Registrant from formal judicial prosecution. Failure to pay fee within allotted period will result in denial of new permits until fee paid. Further, the Registrant's County Registration shall be suspended six-months from the date of conviction. An installer will be prohibited from obtaining permits and installing OSSFs from the date of the conviction regardless of appeals will be prohibited from entering new contracts from the date of the conviction regardless of appeals of the Class "C" Misdemeanor Conviction.

(4) *Fourth Class "C" Misdemeanor Conviction:* Provide to the County documented proof of violation resolution and a $750.00 fee payment within 72 business hours of the violation resolution. This fee is in addition to any additional fee which is assessed to Registrant from formal judicial prosecution. Failure to pay fee within allotted period will result in denial of new permits until fee paid. The Registrant's County Registration shall be suspended for twelve-months from the date of conviction. An installer will be prohibited from obtaining permits and installing OSSFs from the date of the conviction regardless of appeals of the Class "C" Misdemeanor Conviction. A maintenance provider will be prohibited from entering new contracts from the date of the conviction regardless of appeals of the Class "C" Misdemeanor Conviction.

Each Class "C" Misdemeanor Conviction will be maintained for a 36-month period in order to determine the level of penalty applied.

All judicial disciplinary documentation of Registrant's violation(s) shall be forwarded to TCEQ Operator Licensing Section.

Failure to comply with provisions of this subchapter will result in immediate revocation of County Registration.

Registrants aggrieved by an action or decision of this provision may appeal such action or decision to the Brazoria County, Commissioners Court within 30 days of notice of disciplinary action. Notice of Appeal must be delivered to the Brazoria County Judge. After Notice of Appeal is properly served, a hearing will be held within 30 days.

2. *Excavations*: Excavations may be partially backfilled to the bottom of the lowest outlet of the tanks with appropriate fill of Class 3 or better. All ends and other critical items shall not be covered until the Designated Representative has determined, as evidenced by the issuance of a Notice of Approval, that the installation, construction, extension or repair complies with these Rules, Standards, or other special conditions specified in the permit.
3. *Sprinklers*: When sprinklers are used as the application method, the sprinkler heads shall be stabilized to ensure the uniform distribution of the treated effluent.

4. Any single family dwelling, commercial or institutional facility, multi-unit residential development or recreational vehicle park occupied any part of the day or night shall be connected to an OSSF or other approved method of wastewater treatment and/or disposal.
5. Before the Permitting Authority issues an authorization to construct/install an OSSF, the owner of an OSSF requiring a maintenance contract must record an affidavit in the Brazoria County Deed Records pursuant to 30 TAC 285.3(b)(3). An example of the affidavit is located in 30 TAC 285.90(2)

   The owner of the OSSF or the owner's agent must provide to the Designated Representative a filed-copy affirming the recording of the above Affidavit in the Deed Records.
6. On-Site Sewage Facilities Maintenance and Management Practices: Maintenance contract requirements for all OSSFs are identified in 30 TAC 285.91(12). Further, maintenance and management practices shall comply with 30 T AC 285.7 and 285.39.

   No homeowner/property owner shall be allowed to perform any maintenance on an on-site sewage disposal system using aerobic treatment unless the homeowner/property owner

   (A) Provides documentation of completing and passing a basic OSSF maintenance course, approved by TCEQ for aerobic treatment units and the property to be maintained is owned by the trained homeowner, or

   (B) Holds a valid wastewater Class D license or higher wastewater treatment license and is certified by the manufacturer for the brand of the OSSF that they own.

   An exception to the prohibition on homeowner/property owner maintenance includes"

   (A) The homeowner/property owners that were approved to conduct maintenance upon completion of training through a licensed installer between September 1, 2005 and August 30, 2007 under the training requirements included in HB 2510[79(R)]; and

   (B) The homeowner/property owner is currently conducting maintenance on their own aerobic treatment system that was in place prior to August 30, 2007.

   This exception will no longer apply if:

   (A) The aerobic treatment system is replaced after August 30, 2007; or

   (B) The homeowner/property owner no longer owns the property on which the aerobic treatment system is installed.
7. The owner of a malfunctioning OSSF shall initiate repair no later than the 10th day after the date which the owner is notified by the Designated Representative.
8. All construction of any type of OSSF shall be by a State licensed and County Registered installer. There shall be no property owner installation unless the property owner is also a State licensed and County Registered Installer.

Chambers County[132]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620040

1. All on-site sewage facilities, whether standard, non-standard or proprietary" must be designed under the seal of a Registered Sanitarian or Registered Licensed Engineer in accordance with the design standards set up in these Rules and the Texas Natural Resource Conservation Commission Rules for OSSF and approved by the local authority of Chambers County Environmental Health Department.
2. All on-site sewage facilities, regardless of acreage will be required to meet all State and County Standards and be permitted by Chambers County.
3. Platted subdivisions of single family dwellings platted or created after June 1 2006 served by a public water supply but utilizing individual on-site sewage facilities must provide for individual lots having surface areas of at least 32,670 sq. Ft. (.75 acres) exclusive of roadways and ditches. Platted subdivisions of single family dwellings platted or created after served by an individual water system and utilizing individual on-site sewage facilities must provide for individual lots having surface areas of at least 43,560 sq. ft. (1.0 acres) exclusive of roadways and ditches.
4. The authorized agent may periodically inspect the on-site sewage disposal system using mechanical devices for a single-family residence regardless of when the authorized agent conducted the last inspection.
5. When a visual and audible alarm is required for an on-site sewage facility connected to a “Food Establishment” and additional visual and audible alarm shall be located or installed inside the facility, located in an area conspicuous to view by employees or management. (For the purpose for this Order) a "Food Establishment" is an operation that stores, prepares, packages, serves, or otherwise provides food for human consumption, such as: a food establishment; retail food store; satellite or catered feeding location; catering operation; if the operation provides food directly to a consumer or to a conveyance used to transport people; market; remote catered operations; conveyance used to transport people; institution; or food bank; and that relinquishes possession of food to a consumer directly, or indirectly through a delivery services such as home delivery of grocery orders or restaurant takeout orders, or delivery service that is provided by common carriers).
6. For systems controlled by a commercial irrigation timer and required to spray between midnight and 5:00 a.m., there shall be at least one and one-third days of storage between the alarm-on level and the pump-on level, and a storage volume of one-third of the daily flow between the alarm-on level and the inlet to the pump tank.

[132] (Chambers County 2008)

Colorado County[133]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620048

1. A soil site evaluation must be conducted by a person who has completed and passed a site evaluation course approved by Texas Natural Resource Conservation Commission.
2. All on-site sewage facilities, regardless of acreage, will be required to meet all State and County Standards and be permitted.
3. All aerobic test papers must include the serial number of the unit.

Fort Bend County[134]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620076

1. All construction of, alteration, extension or repair to, on-site sewage facilities shall be permitted and inspected, regardless of the size of the tract of land.
2. All construction of any type of on-site sewage facility shall be by a Registered Installer. There shall be no property owner/ homeowner installations unless the property owner/ homeowner is also a Registered Installer.
3. All facilities holding a Fort Bend County Food Service Permit and receiving secondary treatment of the effluent shall be checked and maintained monthly by a contracted service provider. A chlorine residual or fecal coliform test shall be made at each site visit where disinfection is required. One BODs and TSS Grab Sample test shall be conducted per year. The minimum acceptable test results shall be those outlined by the applicable State rules. All test results and maintenance reports shall be sent to the permitting authority within 14 days after the test is performed.
4. All pipes shall be installed with the identifying numbers visible for inspection.
5. The backfill material shall be on the site in sufficient quantities to complete the job at the time of the construction inspection.
6. No component of an on-site sewage facility shall be covered until an inspection by the permitting authority has been made. Provided, however, excavations may be partially backfilled with the permission of the permitting authority only. All ends and other critical items shall not be covered until the permitting authority has determined, as evidenced by the issuance of a Notice of Approval, that the installation, construction, extension or repair complies with these Rules, Standards, or other special conditions specified in the permit.
7. When sprinklers are used as the application method, the sprinkler heads shall be stabilized to ensure the uniform distribution of the treated effluent.

[133] (Colorado County 2001)

[134] (Fort Bend County 2005)

8. Any single family dwelling, commercial or institutional facility, multi-unit residential development or recreational vehicle park occupied any part of the day or night shall be connected to an on-site sewage facility or other approved method of wastewater treatment and disposal.
9. When a visual and audible alarm is required for an on-site sewage facility connected to a "Food Establishment," an additional visual and audible alarm shall be located or inside the facility located in an area conspicuous to view from employees or management.

   (For the purpose of this Order, a "Food Establishment" is an operation that stores, prepares, packages, serves, or otherwise provides food for human consumption, such as: a food establishment; retail food store; satellite or catered feeding location; catering operation; if the operation provides food directly to a consumer or to a conveyance used to transport people; market; remote catered operations; conveyance used to transport people; institution; or food bank; and that relinquishes possession of food to a consumer directly, or indirectly through a delivery services such as home delivery of grocery orders or restaurant takeout orders, or delivery service that is provided by common carriers).
10. Low Pressure Dosed drain fields shall be constructed of excavations of at least one foot wide and shall have at least one foot of media depth.
11. The Registered Installer of record shall be present at the final construction inspection.
12. Anyone-site sewage disposal system using aerobic treatment shall have a maintenance contract on that system.
13. All contracted maintenance of an on-site sewage disposal system using aerobic treatment shall be conducted by a certified maintenance provider. There shall be no homeowner/property owner maintenance of an on-site sewage disposal system using aerobic treatment unless the property owner/homeowner is a certified maintenance provider for that aerobic treatment unit.
14. The authorized agent may periodically inspect the on-site sewage disposal system using aerobic treatment for a single-family residence that is maintained directly by the owner of the system regardless of when the authorized agent conducted the last inspection.

Galveston County[135]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620080

1. All on-site sewage facilities regardless of the size of the property on which they are installed must be permitted by the Health District.
2. All construction of any type of on-site sewage facility shall be by a Registered Installer. There shall be no property owner/homeowner installations unless the property owner/homeowner is also a Registered Installer.
3. Any single family dwelling, commercial or institutional facility, multi-unit residential development, recreational vehicle park or any other structure occupied any part of the day or night shall be connected to an on-site sewage facility or other approved method of wastewater treatment and disposal.

[135] (Galveston County Health District 2008)

4. The groundwater evaluation performed in association with any site evaluation for subsurface OSSF systems proposed for installation on Galveston Island or Bolivar Peninsula, must be evaluated for accuracy by a Health District Designated Representative prior to construction authorization being issued. A soil pit, needed for the evaluation, must be prepared by the property owner or owner's agent to the specifications required by the Health District in the area of the proposed disposal field. An evaluation fee, set by the Health District, must be paid prior to Health District staff performing the evaluation.

Harris County[136]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620091

A. An "Affidavit to the Public" will be required on all on-site sewage facilities.

B. The County Engineer will not authorize electrical service be provided to a new development utilizing an on-site sewage facility unless all inspections of the on-site sewage facility have passed.

C. On all new plats for residential subdivisions of two or more lots, easements for the proposed wells shall be established by plat unless an alternative strategy is developed in the feasibility study.

D. Easements described in §285.4(b)(2)(C) shall be filed for record in the Harris County Real Property Records.

E. The following additional submittals are required in addition to §285.4(c) for subdivision plat review:

   1) A sealed property survey.

   2) A topographic map on one-foot (1') contours.

   3) A Federal Emergency Management Agency Flood Plain Map with the site delineated to scale.

   4) A NRCS-USDA soil survey map with the site located to scale.

   5) The plat shall show the locations of soil bore holes.

   6) A comprehensive drainage plan complying with the minimum Harris County Flood Control District Criteria or the Harris County Regulations for Approval and Acceptance of Infrastructure as appropriate.

   7) If planning material shows that subsurface disposal is proposed then Potential replacement areas must be shown located outside the primary disposal area. This is due to poor soil conditions and high ground water tables in Harris County.

F. Discharges of gray water other than washing machines shall be disinfected to the same standard as secondary effluent.

G. All on-site sewage facilities installed along the main body of Lake Houston east of I-45, (the main body being where 100' or more exist between parallel banks at normal pool elevation shall have the following additional standards.

[136] (Harris County 2009)

1) All systems installed within one thousand feet (1000') of the main body of Lake Houston shall have secondary treated effluent.

2) All systems, installed within one thousand feet (1000') of the main body of Lake Houston shall incorporate nutrient reduction Best Management Practices (BMP's) in the treatment or disposal systems.

H. All applications for an on-site sewage facility as well as an Affidavit to the Public shall be executed by the property owner. If the proposed OSSF requires on-going maintenance per §285.91(12) of these Rules, a completed Acknowledgement of Testing must be completed by the owner.

I. All planning material is required to be prepared by a Professional Engineer or Professional Sanitarian authorized to practice in the State of Texas.

J. The installer shall notify Harris County at least 24 hours before the date the OSSF will be ready for inspection.

K. At the completion of an inspection, the installer, owner, or owner's agent will be given a Notice of Inspection. This will serve as notice of any deficiencies found. If none are found it will be so noted and this will serve as an Authorization to Operate.

L. The following additional requirements apply in the submittal of planning materials:

1) All site plans shall be submitted to a standard engineering scale.

2) A flow diagram of the tank battery shall be prepared. An installation detail for subsurface systems shall be provided.

3) Calculations for hydraulic loading rate, wastewater strength and dosing calculations, if applicable, shall be provided.

4) Grease trap sizing, if applicable, shall be done using the EPA method and the Uniform Plumbing Code method. The larger of the two resulting tank sizes shall be used.

5) All existing and proposed development shall be shown.

6) Plugging reports for any wells proposed to be abandoned shall be provided.

7) Copies of letters authorizing encroachments across, along, under or above any easement where an OSSF component is proposed to be placed.

8) Calculations for hydraulic and organic load for both normal and peak flows on all commercial systems shall be provided showing that both organic and hydraulic overloading of the treatment and/or disposal method is prevented.

9) Proprietary systems must be approved by the County Engineer prior to being allowed in Harris County. A technical review of all material will be conducted with relation to high ground water tables and local soil conditions that occur in Harris County. Approval will be granted, additional data will be requested, or the reason for non-approval will be stated. Harris County will only review proprietary products previously approved by the TCEQ.

10) The County Engineer may require additional planning materials if in his opinion they are warranted for the specific instance.

11) Aerobic plants tested under NSF Standard 40 shall be sized for residential units based on an assumed organic load of 150 GPD per bedroom.

M. The following additional maintenance requirements apply:

1) On non-standard treatment systems as prescribed by §285.32(d), the designer is required to provide Harris County with the maintenance requirements of the system at time of plan approval.

2) The allowable time frame for a maintenance company to respond to a complaint from the property owner or electronic notification shall be no longer than 48 hours.

3) All maintenance contracts shall include the permit number, OSSF or wastewater operator license identification, the printed name and signature of the system owner and maintenance company representative or maintenance provider, the starting and ending dates of the contract with the starting date being the date of the authorization to operate, the physical address and phone number of the system location, the physical address, business address, business phone number and emergency phone number of the maintenance company or maintenance provider.

4) The following electronic monitoring protocol is required:

   a) All new OSSF systems requesting a variance and utilizing any pumps or other electrical equipment or commercial systems installed requiring ongoing maintenance by these rules shall be electronically monitored. Other systems may be electronically monitored to reduce the number of required maintenance visits.

   b) The electronic monitoring shall be provided by Harris County's contract provider. The contract provider will contract at the County approved rate for this service in accordance with County procedures.

   c) Electronic monitoring must be continuously maintained.

   d) Systems electronically monitored will not require the submittal of paper maintenance reports or renewal maintenance contracts to the County unless a major component affecting the design of the system is altered, or the contract for maintenance has not been renewed.

5) The maintenance frequency shall follow the schedule below:

   Residential-4 visits a year

   Residential Electronically Monitored – 2 visits a year

   Commercial-12 visits a year unless the system is essentially a residential system.

   Requests for quarterly maintenance visits for commercial systems will be considered on a case-by-case basis.

6) Reports shall be submitted using the County's automated systems. Reports submitted on paper to the County shall include a processing fee to off-set the cost of manually entering the data.

7) Homeowners may maintain their own aerobic unit if they have obtained a Class "D" Wastewater license in addition to any other state requirements. A homeowner conducting their own maintenance shall submit the same reports maintenance providers are required to submit.

8) A permittee who fails to provide the County with a copy of a contract with a valid maintenance company or maintenance provider, and allows the on-site system to miss two or more maintenance report periods shall be required to enroll in the County's electronic maintenance monitoring system.

9) Systems at locations where hard wire phone service does not exist, are exempt from electronic monitoring until such time as the County monitoring system has an approved cellular monitoring system or hard wire phone services become available. Once available the permittee has ninety days to install said system and begin monitoring.

N. Site evaluations shall be submitted on a form provided by Harris County or in a format with all the same information as the Harris County form. The location of the soil borings shall be denoted on the site evaluation or the site plan.

O. A restrictive horizon includes subsoil that has higher clay content than the preceding layer which impedes downward movement of water.

P. For structures with more than one sewer stub-out or other such instances, all sewer lines shall have a common connection prior to entering the main tank battery.

Q. Any outlet device other than a "T", such as an effluent filter, must be listed under ANSI/NSF Standard 46.

R. Only septic and pump tanks that appear on the Harris County list of approved tanks shall be utilized on the systems installed under these rules. The following additional standards apply:

1) Concrete tank manufacturers must demonstrate through the submittal of drawings and specifications that the tanks meet the structural portion of ASTM C1227. Drawings must be sealed by a Professional Engineer and the tanks are subject to inspection and verification for compliance to the standard.

2) Glass fiber reinforced polyester tanks shall meet the applicable provisions of ASTM D4021-81 and applicable provisions of IAPMO/ANSI Z 1000-2007.

3) Polyethylene tanks must meet the applicable provisions of IAPMO/ANSI Z 1000-2007.

4) At a minimum, a Professional Engineer's Certification of product and process is required, as well as a sealed drawing and specifications of the completed product. The County Engineer may randomly inspect the product and compare it to submitted data.

S. All proprietary aerobic plants must meet the requirements of these rules as well as being approved by the TCEQ and NSF. The County engineer will review the report and determine if the unit meets the requirements of NSF Standard 40 and the additional Harris County requirements. Approval by the TCEQ and/or NSF does not ensure approval by the County Engineer. All aerobic treatment units shall use a pretreatment tank of a minimum of 500 gallons if required to have one by the testing protocol and it is not manufactured as part of the plant.

Any testing entity wishing to submit data for approval by Harris County other than NSF shall meet the criteria above as well as the following additional criteria:

1) The testing entity must be ANSI accredited laboratory.

2) The testing entity must have a minimum of five years of verifiable testing experience in certification of aerobic units.

3) The testing entity must maintain an independent third party status. No aerobic manufacturer, supplier or distributer may have any direct or indirect financial interest in the testing entity. A sworn affidavit verifying this fact may be required to be submitted.

T. Owner compliance history may be used as a reason on to deny a permit for an on-site sewage facility.

U. After October 1, 2006 all disinfection devices approved for use in Harris County must be listed by the National Sanitation Foundation as having passed ANSI/NSF Standard 46 for effluent disinfection devices. Any upgrade or alteration of a system equipped with a disinfection device after October 1, 2006 shall have the disinfection device upgraded to one meeting these requirements.

V. The minimum application area of a surface application system may be reduced, if designed according to all the requirements found in the report Evaluation of Surface Application Rates for Texas OSSF Systems prepared by Clifford B. Fedler PhD, P. E.

W. Installers and their apprentices shall maintain copies of approved plans, contracts, manifests, well data, material data, and component specifications required and specified by the approved plans on the job site and make available to the designated representative until all required inspections are completed.

X. Certain systems may be allowed to direct discharge to the roadside ditch or storm sewer, provided they meet all the provisions of TPDES General Permit No. TXG5300000. Each design for said system shall be reviewed by the TCEQ staff as well as Harris County. Additionally all provisions of the Memorandum of Agreement between Harris County and the TCEQ as approved by Commissioners Court on 25 May 2004 shall be followed.

Y. In watersheds where one or more stream segments are listed as impaired for bacteria on the EPA 303(d) list the following additional requirements apply.

1) Electronic monitoring as outlined in amendment M(4) shall be required for all new and replacement on-site sewage facilities.

2) All on-site sewage facilities must use secondary treatment meeting a 30 day average CBOD of 10 mg/L and TSS of 10 mg/L. On NSF Standard 40 units this must be demonstrated by test results. On engineered one of a kind systems, a design parameter of 5 mg/L CBOD and 5 mg/L TSS shall be used.

3) Pump tanks shall be equipped such that when pumping a portion of the effluent is returned below static water level to insure scour of the pump tank bottom.

Z. Any residential system permitted after January 1, 2011 which utilizes flows lower than those listed on Table III: Wastewater Usage Rate of these regulations, and all commercial systems, and permanent holding tanks shall incorporate the County's electronic monitoring protocol for daily wastewater flows and peak flow measuring. This system will report to the County systems that exceed daily or peek permitted flows. Usage of ULF fixtures is not a trigger to require electronic monitoring.

Matagorda County[137]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620137

1. A permit will be required for all On-Site Sewage Facilities, regardless or tile size or the lot or acreage onto which they are installed.
2. All construction of any type of on-site sewage facility shall be by a registered installer. There shall be no property owner/homeowner installation unless the property owner/homeowner is also a registered installer.
3. Testing and reporting of On-Site Sewage Facilities must be performed by an approved maintenance company, regardless of population.

Montgomery County[138]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620145

1. All subsurface on-site sewage systems will be sized using full flow (gallons per day).
2. Timed pump tanks will allow for a two-third day flow in reserve. An override switch may be installed as long as it is positioned above the high water alarm to activate after the reserve has been used up and prior to the pump tank completely filling.
3. Use of "septic" tanks and "pretreatment" tanks:
   Any structure producing fifty gallons per day or more of gray/black water must utilize a septic/pretreatment tank with no more than fifty foot of solid pipe between the structure and the tank.
4. All gravity fed sub-surface disposal fields must be closed loop and have an inspection port at the furthest point of the disposal area from the tank.
5. Lot Sizes:
   Single Family Residence:
   A. One acre with septic system and a public water system. (No water wells.)
   B. One and one-half acre with septic system and private water well.
   C. Special consideration will be taken for a property recorded and/or listed on the Montgomery County Tax Rolls prior to December 16, 1986.
6. All submissions of planning materials must be under the seal of a Registered Sanitarian *and/or* Professional Engineer.
7. All on-site sewage facilities, regardless of acreage, must meet all county and state standards.

[137] (Matagorda County 2006)

[138] (Montgomery County 2007)

8. On-site sewage facilities will not be installed in the flood way. Only aerobic systems will be installed in the floodplain with components of the on-site sewage facility (risers, chlorinator, clean-outs, inspection ports, control panels, compressors) elevated above base flood elevation. Sprinklers shall be back-flow prevention type. All pump tanks are to be strapped with three-eighth to one-half inch ten thousand pound steel cable and connected to four by four by eight foot treated posts with backfill over them. Buoyancy calculations on all pump tanks.
9. All domestic wastewater is to be properly treated prior to disposal; including gray water defined as: showers, bathtubs, hand washing lavatories, sinks.

San Jacinto River Authority[139]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620146

1. All lots utilizing on-site sewage facilities and being served by a public water system must be at least one acre, and all lots not served by a public water system must be at least one and one-half acres in size.
2. All new systems, and existing systems being modified, must be designed and submitted by a registered sanitarian or professional engineer.
3. All on- site sewage facilities, regardless of the size of the property served, must meet all requirements of the Rules and the San Jacinto River Authority and must be permitted by the San Jacinto River Authority.

Walker County[140]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620195

1. To ensure all systems meet T AC 30 Chapter 285 Rules, all on-site sewage facilities and on-site sewage planning, regardless of acreage, must meet all county and state standards.
2. Walker County shall require the maintenance, testing, and reporting for all OSSF's utilizing secondary treatment to be performed by a TCEQ registered maintenance company unless the OSSF serves a single family dwelling that is the primary residence of the property owner, all portions of the disposal area are a minimum of 50 feet from the property line, and:
    A. The property owner is a TCEQ registered maintenance provider for their aerobic treatment nit; or
    B. The property owner was trained by an installer or manufacturer according to the requirements of HB 2510 [79(R)] prior to adoption of HB 2482 [80(R)]; or
    C. The property owner holds a valid Class D or higher wastewater treatment license; or

[139] (San Jacinto River Authority 2004)

[140] (Walker County 2008)

D. The property owner has satisfactorily completed a TCEQ approved Basic Maintenance Provider Course; or

E. The property owner has satisfactorily completed the OSSF - Aerobic/Surface Application System Operation and Maintenance Course offered by the Texas Engineering Extension Service.

3. Maintenance Inspections and Reports:

A. Any homeowner/property owner who is not contracted with a TCEQ registered maintenance company to perform testing, reporting, and maintenance on an OSSF shall still be required to submit all required reports and testing required of a TCEQ registered maintenance company to Walker County along with any required fees or charges (fees required for property owners may be different than those required of registered maintenance companies).

B. Inspections at a minimum must meet all inspection requirements as set by the TAC 30 Chapter 285 and Walker County, Texas.

C. Inspection reports shall address all inspection and testing required by Walker County policies and procedures or the State of Texas, including TAC 30 Chapter 285.

D. In addition to the information required by TAC 30 Chapter 285 all maintenance/inspection reports shall include:

1. the reporting of any unauthorized alterations to the system
2. the condition of the spray area (if applicable)
3. the permit number
4. OSSF or wastewater operator license identification
5. the printed name and signature of the maintenance company representative or home owner/property owner if he or she is submitting the report
6. the physical address of the OSSF location

E. the physical address, business address, business phone number and emergency phone number of the maintenance company
In addition to the information required by TAC 30 Chapter 285 all maintenance/inspection contracts shall include:

1. the permit number
2. OSSF or wastewater operator license identification
3. The printed name and signature of the maintenance company representative and the homeowner/property owner.
4. the physical address of the OSSF location
5. the physical address, business address, business phone number and emergency phone number of the maintenance company

4. Permitting Procedures and Additional Requirements.

   The Walker County Commissioners Court may from time to time adopt local procedural requirements for applications, permitting, and inspection procedures for On-Site Sewage Facilities.

5. On all new plats for residential subdivisions of two or more lots, easements for the proposed wells shall be established by plat unless an alternative strategy is developed in the feasibility study.

6. All On-site Wastewater planning materials are required to be sealed by a Professional Engineer or Professional Sanitarian authorized to practice in the State of Texas.

7. Revocation or Suspension of License to Operate. Neither the revocation of a license nor any other provision of these Regulations shall impede the designated representative or any other governmental entity from taking the proper steps to prevent or curtail pollution, to abate a nuisance, or to protect public health. The designated representative may revoke or suspend a license for any of the following causes:

   A. A change in volume of wastewater being treated by the on-site sewage facility.

   B. Failure of the holder of the license to properly maintain the on-site sewage facility.

   C. Malfunction of the on-site sewage facility.

   D. Evidence that the on-site sewage facility is causing or will cause pollution.

   E. Failure to comply with the terms or conditions of the license or any part of these regulations.

8. Any single family dwelling, commercial or institutional facility, multi-unit residential development or recreational vehicle park occupied any part of the day or night shall be connected to an on-site sewage facility or other approved method of wastewater treatment and/or disposal.

9. When a visual and audible alarm is required for an on-site sewage facility connected to a "Food Establishment," an additional visual and audible alarm shall be located or installed inside the facility, located in an area conspicuous to view by employees or management. (For the purpose of this Order, a "Food Establishment" is an operation that stores, prepares, packages, serves, or otherwise provides food for human consumption, such as: a food establishment; retail food store; satellite or catered feeding location; catering operation; if the operation provides food directly to a consumer or to a conveyance used to transport people; market; remote catered operators; conveyance used to transport people; institution; and that relinquishes possession of food to , consumer directly, or indirectly through a delivery services such as home delivery of restaurant takeout orders, or delivery service that is provided by common carriers.)

10. All "Food Establishments" as defined above which are receiving secondary treatment of the effluent shall be checked and maintained monthly by a contracted registered maintenance company. A chlorine residual or fecal coli form test shall be made at each site visit where disinfection is required. One BODs and TSS Grab Sample test shall be conducted per year. The minimum acceptable test results shall be those outlined by the applicable State rules. All test results and maintenance reports shall be sent to the permitting authority within 14 days after the test is performed. Additional testing and reporting may be required on a case by case basis.

11. The authorized agent may periodically inspect any pem1itted or un-permitted on-site sewage facility; a frequency deemed appropriate by the authorized agent.

12. All OSSF that require a minimum license level of Installer II for professional installation may only be installed by a licensed installer.
13. All OSSF installations for commercial, institutional, or multi-family residential use must be installed by a licensed installer.

Waller County[141]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620196

1. All On-Site sewage facilities, regardless of acreage, will be required to meet all State and County Standards and be permitted.
2. Homeowner maintenance of any secondary treatment system shall not be allowed unless the homeowner has proof that he/she has been trained by the manufacturer/installer or is a maintenance provider that is licensed/certified or has taken a training course approved by Waller County under TCEQ guidelines.
3. Homeowner shall test and report as per 30 TAC 285.91 (4).
4. Permits for "all other types of OSSF's" will be conditioned to require testing monthly per 30 TAC 285.3 (a) (4).
5. On-site sewage facilities will not be installed in the floodway. Only aerobic treatment systems with surface application will be installed in the floodplain.
6. The allowable time frame for a maintenance company/maintenance provider to respond to complaint from the property owner shall be no longer than 48 hours.
7. All disinfection devices approved for use in Waller County must be listed by the National Sanitation Foundation as having passed ANSIINSF standard 46 for effluent disinfection devices.

Wharton County[142]

http://www5.tceq.state.tx.us/oars/index.cfm?fuseaction=Search.download&AUTH_AGENT_AR_NUM=620199

1. To ensure all systems installed meet minimum requirements, the full permitting process must be followed.
2. To ensure all systems are installed according to design and/or plan, a Registered Installer, who is knowledgeable about the requirements of different designs and installations, will be required to install the system. A homeowner will be allowed to work under the supervision of the Registered Installer.

[141] (Waller County 2009)

[142] (Wharton County 2006)

3. To protect the public health, "Food Establishments" will be required to have a maintenance inspection once a month and to have audible and visual alarms inside and outside the establishment.
4. Since backfill is done after the inspector leaves, having backfill material on the site will help ensure the proper type of soil is utilized.
5. To be able to visually inspect the tank for leaks and to ensure that tank flotation will not be a concern.
6. To protect the public health and environment, all residential structures must be connected to an approved on-site sewage facility or other approved method of wastewater treatment and disposal.
7. To protect the public health, surface application systems will be required to spray during the hours persons are less likely to come in contact with effluent.
8. To protect the environment, a Registered/Certified Maintenance Provider will be required. Due to the rural nature of Wharton County, obtaining the necessary parts for repair will prove difficult for most property owners/homeowners doing their own maintenance. There is a lack of incentive for a property owner/homeowner to report malfunctions to the permitting authority. Due to the size of the permitting authority's department that oversees OSSF's, regulating homeowner maintenance would be cumbersome.

Appendix F: Local Examples of Stormwater Programs

The Stormwater Management Joint Task Force

The most notable example of a cooperative effort to address requirements of Municipal Separate Storm Sewer (MS4) permits is the Stormwater Management Joint Task Force (JTF), comprised of the City of Houston, Harris County, Harris County Flood Control District, and the Texas Department of Transportation. These four entities applied for and received a Phase I MS4 permit. Cooperation has provided consistency and efficiency among programs and created cost savings in permit implementation. While the JTF provides an environment of cooperation, each member is responsible for implementing its own program for the areas within the MS4 where the member has jurisdiction over discharges. More information about the JTF can be found at http://www.cleanwaterways.org/.

City of Houston

In addition to participating in the JTF, the City of Houston Stormwater Management Program administers the planning, engineering, and construction of the City's stormwater infrastructure. The program oversees floodplain management for the city, supports the City's participation in the National Flood Insurance Program, and works with the City Comprehensive Drainage Plan. Engineering and geographic data for the Comprehensive Drainage Plan have been incorporated into a web-based format. More information can be found at http://swmp.org/.

Harris County

Like the other members of the JTF, Harris County's programs are diverse and comprehensive. The County monitors rainwater run-off and has a comprehensive illicit discharge elimination & detection program. Inspections are conducted at construction sites, industrial facilities, wastewater treatment plants, and on-site sanitary sewage facilities to ensure they are following laws and regulations that limit significant pollutants to the MS4. The County offers household hazardous waste disposal options to its residents, which lessens illicit dumping and proper disposal of dangerous chemicals. The County also performs research to assist policymakers better understand how to protect our natural assets, and additionally educates the public on things individuals can do to protect our waterways. More information can be found at http://www.hcphes.org/eph/stormwater.htm and http://www.eng.hctx.net/watershed/default.html .

Harris County Flood Control District

As a member of the JTF, the District participates in a variety of stormwater programs with the other co-permittees and manages programs associated with the District's flood damage reduction infrastructure. The District's Storm Water Management Program includes regular assessments of water quality impacts by flood control projects, and requires that new flood control structures be designed and constructed to

provide pollutant removal to the maximum extent practical. The District maintains channels to reduce erosion, remove debris and litter (including floatables), control nuisance species, and sustain flood damage reduction. Monitoring of floatables within flood control facilities is conducted on an annual basis. The District also maintains an ongoing water quality monitoring program within detention basin sites throughout the County to study BMP effectiveness, and within channels to monitor ambient and wet weather flows. In order to track BMP effectiveness, the District is developing a Regional BMP database to store, share, and analyze water quality monitoring data. Additionally, the District works closely with Harris County to support programs for Construction Site Runoff Control, Illicit Discharge Detection and Elimination, and Public Education. More information can be found at http://www.hcfcd.org/.

Texas Department of Transportation

As with other JTF members, the Texas Department of Transportation monitors stormwater run-off and collects stormwater samples for laboratory analysis from specified locations. TxDOT also monitors its outfalls for illicit discharges, and TxDOT has some control over the volume and flow of third party discharges to its MS4. TxDOT also offers training in preventive work practices to its personnel. However, unlike other JTF members, TxDOT does not have direct enforcement authority, so our main tools are education and preventive measures. TxDOT's "Don't Mess With Texas" public education effort is well known and proven. The Adopt a Highway program for public involvement is emulated nationwide and in other countries. Both programs are effective in education and prevention. More information is available at http://dontmesswithtexas.org/ and http://www.dot.state.tx.us/trv/aah/ .

Brazoria County Stormwater Quality Coalition

This Brazoria County Stormwater Quality Coalition is comprised of Brazoria County, the cities of Alvin, Angleton, Clute, Freeport, Lake Jackson and Richwood, Brazoria County Conservation and Reclamation District No. 3, Brazoria Drainage District No. 4, Velasco Drainage District and Angleton Drainage District. The Coalition oversees the countywide program including construction stormwater permits, stormwater management program required of Phase II communities and provision of public education materials as well as relevant web links. More information can be found at http://www.ms4web.com/BCSWQC/.

Pasadena

As a Phase I MS4 community, the City of Pasadena has developed activities to prevent introduction of pollutants into the MS4 and other waters through the City's storm sewers. Pasadena does this through prohibiting illicit discharges and connections to the storm sewer system, providing enforcement of the MS4 NPDES permit, and applying penalties. In addition to implementing MS4 permit actions, Pasadena has developed its *Walk the Water* program to assist citizens in becoming more aware of the waterways and associated habitats within the city. The City's *Adopt a Waterway* program offers individuals,

families, and service organizations the opportunity "to help maintain Pasadena's waterways for coming generations." The City's ordinance specifically lists prohibited discharges, prohibited connections, penalties, and enforcement. More information can be found at http://www.ci.pasadena.tx.us/default.aspx?name=volunteer_pasadena_ongoing.

Fort Bend County

The Fort Bend County Stormwater Management Plan contains a list of Best Management Practices that meet the objectives of the six Minimum Control Measures required for a Phase II MS4 permit. The website contains links to stormwater education opportunities and a section called 'Am I Regulated?' for construction activities. More information can be found at http://www.co.fort-bend.tx.us/stage/getSitePage.asp?sitePage=34449.

North Central Texas Council of Governments

The North Central Texas Council of Governments website is a source of reference materials regarding stormwater management and water quality. It contains a list of Regionally Developed Initiatives for Stormwater Development, including public education-oriented activities like the Stormwater Public Education Task Force, the annual *March is Texas SmartScape Month*, municipal employee training resources, and Illicit Discharge Detection and Elimination. The website also contains a *Menu of Management Plan Options for Small MS4s in North Central Texas*, sample schedules of implementation, and a sample outline for a small city Stormwater Management Program. More information about this program, which integrates stormwater quality with stormwater volume, can be found at http://www.nctcog.org/envir/SEEclean/stormwater/index.asp.

U.S. Environmental Protection Agency Region 6

EPA is responsible for the nationwide stormwater permit program. EPA's Region 6 oversees Texas, Oklahoma, Louisiana, Arkansas, and New Mexico. Region 6 offers an annual MS4 Operator's Conference that recognized for its excellence. The Region 6 NPDES Municipal Stormwater website contains helpful links to a variety of stormwater management issues including financing, best management practices, and resources available to stormwater managers. More information can be found at http://epa.gov/region6/water/npdes/sw/ms4/index.htm.

Appendix G: MS4 Permits in the Thirteen-County Region [143]

Not all permits listed are within the BIG Project Area. Permits within the BIG Project Area are indicated with an asterisk.

Unless otherwise indicated, the permits in the table below are active permits, rather than pending, cancelled, or denied permits.[144]

Table 19: Permitted Phase II MS4s within the Thirteen-County Region

County	Regulated Entity Name	Location	RN Number	ID
Brazoria	Angleton Drainage District MS4	Area within the City of Angleton limits that is located within the Lake Jackson Angleton urbanized area	RN105523484	TXR040137
Brazoria	Brazoria County Conservation And Reclamation District 3 MS4	Area within the Brazoria County Conservation and Reclamation District 3 limits that is located within the Lake Jackson Angleton urbanized area	RN105526552	TXR040148
Brazoria	Brazoria County MS4	Area within the Brazoria County limits that is located within the Lake Jackson Angleton urbanized area	RN105528459	TXR040154
Brazoria	* Brazoria County MUD 16 MS4	Area within Brazoria County MUD 16 that is located within the Houston urbanized area	RN105558043	TXR040222
Brazoria	* Brazoria County MUD 2 MS4	Area within Brazoria County MUD 2 that is located within the Houston urbanized area	RN105557276	TXR040220
Brazoria	* Brazoria County MUD 3 MS4	The area within Brazoria County MUD 3 that is located within the Houston urbanized area	RN105557284	TXR040221
Brazoria	* Brazoria County MUD 4 MS4	The district lies partially within the City of Houston urbanized area and is located in unincorporated Brazoria County	RN105589196	TXR040302
Brazoria	* Brazoria County MUD 6 MS4	Area within Brazoria County MUD 6 that is located within the Houston urbanized area	RN105558092	TXR040223
Brazoria	* Brazoria Drainage District 4 MS4	Area within the City of Pearland limits that is located within the Houston urbanized area	RN105523708	TXR040144
Brazoria	* City of Alvin MS4	Area within the City of Alvin limits that is located within the Lake Jackson Angleton urbanized area	RN105523526	TXR040138
Brazoria	City of Angleton MS4	Area within the City of Angleton limits that is located within the Lake Jackson Angleton urbanized area	RN105523401	TXR040136
Brazoria	City of Clute MS4	Area within the Clute City limits that is located within the Lake Jackson Angleton UA	RN105523575	TXR040139

[143] Not all permits listed are within the BIG Project Area.

[144] (TCEQ 2010h)

County	Regulated Entity Name	Location	RN Number	ID
Brazoria	City of Freeport MS4	Area within the City of Freeport limits that is located within the Lake Jackson Angleton urbanized area	RN105523328	TXR040135
Brazoria	City of Lake Jackson MS4	Area within the City of lake Jackson limits that is located within the Lake Jackson Angleton urbanized area	RN105523617	TXR040140
Brazoria	* City of Pearland MS4	Area within the City of Pearland city limits that is located within the Houston urbanized area also located in Brazoria Fort Bend and Harris counties	RN105552335	TXR040208
Brazoria	City of Richwood MS4	Area within the City of Richwood limits that is located in the Lake Jackson Angleton urbanized area	RN105523625	TXR040141
Brazoria	Velasco Drainage District MS4	Area within the Velasco Drainage District limits that is located within the Lake Jackson Angleton urbanized area	RN105523658	TXR040142
Fort Bend	* Big Oaks MUD MS4	The mMS4 is bounded to the north by FM 1093 the east by FM 1464 the south by said district boundary line and West by said district boundary line	RN105591325	TXR040320
Fort Bend	* Blue Ridge West MUD MS4	The area within Blue Ridge West MUD that is located within the Houston urbanized area	RN105555783	TXR040219
Fort Bend	* Chelford City MUD MS4	Chelford City MUD is within the Harris County urbanized area	RN105589477	TXR040304
Fort Bend	* Cinco MUD 1 MS4	Area is located within Fort Bend County and bounded by Cinco Ranch Blvd and Green Busch Rd	RN105549778	TXR040186
Fort Bend	* Cinco MUD 12 MS4	Area is located within Fort Bend County runs adjacent to Grand Pkwy and bounded by Peek Rd	RN105550123	TXR040194
Fort Bend	* Cinco MUD 2 MS4	Area along border of Fort Bend and Harris County bounded by Peek Rd and Mason Rd and bisected by Westheimer Pkwy	RN105527568	TXR040151
Fort Bend	* Cinco MUD 3 MS4	Area along border of Fort Bend and Harris County bounded by Westheimer Pkwy and Mason Rd and bisected by Cinco Ranch Blvd	RN105549828	TXR040187
Fort Bend	* Cinco MUD 5 MS4	Area along border of Fort Bend and Harris County bounded by Mason Rd Fry Rd and Westheimer Pkwy	RN105549711	TXR040185
Fort Bend	* Cinco MUD 6 MS4	Area along border of Fort Bend and Harris County bounded by Fry Rd and intersected by Westheimer Pkwy	RN105549844	TXR040188
Fort Bend	* Cinco MUD 7 MS4	Area is located within Fort Bend County intersected by Fry Rd Mason Rd and located along the Grand Pkwy	RN105549927	TXR040189
Fort Bend	* Cinco MUD 8 MS4	Area is located within Fort Bend County bounded by FM 1093 and bisected by Mason Rd	RN105527741	TXR040152
Fort Bend	* Cinco MUD 9 MS4	Area along border of Fort Bend and Harris County bounded by Grand Pkwy Peek Rd and Cinco Ranch Blvd	RN105549992	TXR040190

County	Regulated Entity Name	Location	RN Number	ID
Fort Bend	* City of Meadows Place MS4	Area within the City of Meadows Place limits that borders Houston Stafford and Sugar Land	RN105603559	TXR040358
Fort Bend	* City of Missouri City MS4	Area within the urbanized area of the City of Missouri City limits and also located in Harris County	RN105588297	TXR040298
Fort Bend	City of Richmond MS4	Area within the City of Richmond limits that is located within the Houston urbanized area	RN105494199	TXR040088
Fort Bend	City of Rosenberg MS4	Area within the City of Rosenberg limits that is located within the Houston urbanized area	RN105576615	TXR040272
Fort Bend	* City of Stafford MS4	The entire city limits of Stafford that is located within the Houston urbanized area and also located in Harris County	RN105569842	TXR040252
Fort Bend	* City of Sugar Land MS4	Area within the City of Sugar Land city limits that is located within the Houston urbanized area	RN105507925	TXR040111
Fort Bend	* Eldridge Road MUD MS4	Eldridge Road MUD lies entirely within the City of Houston urbanized area	RN105601942 Denied	TXR040354
Fort Bend	First Colony LID 2 MS4	Area within the City of Sugar Land limits that is located within the Sugar Land urbanized area	RN105566129	TXR040242
Fort Bend	First Colony LID MS4	First Colony LID is wholly located within the City of Houston urbanized area	RN105589766	TXR040309
Fort Bend	First Colony MUD 9 MS4	The district lies wholly within the City of Houston urbanized area	RN105586507	TXR040292
Fort Bend	* Fort Bend County Drainage District MS4	Area within Fort Bend County that is located within the Houston urbanized area	RN105706519	TXR040383
Fort Bend	Fort Bend County LID 10	The district lies within the City of Houston urbanized area in Fort Bend County	RN105480750	TXR040033
Fort Bend	Fort Bend County LID 11 MS4	The district lies within the City of Houston urbanized area in Fort Bend County	RN105578645	TXR040281
Fort Bend	Fort Bend County LID 14 MS4	The district lies wholly within the City of Houston urbanized area	RN105591119	TXR040311
Fort Bend	Fort Bend County LID 17 MS4	The district lies wholly within the City of Houston urbanized area	RN105591200	TXR040314
Fort Bend	Fort Bend County LID 2 MS4	The district lies wholly within the City of Houston urbanized area	RN105591069	TXR040310
Fort Bend	Fort Bend County LID 7 MS4	Located 22 miles southwest of Houston and west of Sugar Land area within the Sugar Land ETJ	RN105479125	TXR040021
Fort Bend	* Fort Bend County MS4	Area within the county of Fort Bend County that is located within the Houston urbanized area	RN105481550	TXR040045

County	Regulated Entity Name	Location	RN Number	ID
Fort Bend	Fort Bend County MUD 1	The district lies within the City of Houston urbanized area in Fort Bend County	RN105480735 Cancelled	TXR040032
Fort Bend	Fort Bend County MUD 106 MS4	The district lies within the City of Houston urbanized area in Fort Bend County	RN105580369	TXR040285
Fort Bend	Fort Bend County MUD 108 MS4	The district lies within the City of Houston urbanized area in Fort Bend County	RN105580351	TXR040284
Fort Bend	Fort Bend County MUD 109 MS4	The district lies within the City of Houston urbanized area in Fort Bend County	RN105580302	TXR040283
Fort Bend	Fort Bend County MUD 111 MS4	Located 22 miles SW of Houston and W of Sugar Land area within the Sugar Land ETJ	RN105574610	TXR040267
Fort Bend	Fort Bend County MUD 112 MS4	Area within the City of Sugar Land ETJ located 22 miles Southwest of Houston and West of the City of Sugar Land	RN105591408	TXR040321
Fort Bend	Fort Bend County MUD 115 MS4	The district lies wholly within the City of Houston urbanized area	RN105588271	TXR040297
Fort Bend	Fort Bend County MUD 117 MS4	The district lies within the City of Houston urbanized area in Fort Bend County	RN105580161	TXR040282
Fort Bend	Fort Bend County MUD 118 MS4	The entire Fort Bend County MUD 118 within Fort Bend County in the Houston urbanized area	RN105528392	TXR040153
Fort Bend	* Fort Bend County MUD 119 MS4	Lies wholly within the City of Houston urbanized area	RN105591275	TXR040319
Fort Bend	* Fort Bend County MUD 2 MS4	Area within the City of Houston ETJ in east Fort Bend County	RN105606255	TXR040367
Fort Bend	Fort Bend County MUD 23 MS4	Fort Bend County MUD 23 is partially within the City of Houston urbanized area	RN105591234	TXR040316
Fort Bend	Fort Bend County MUD 25 MS4	The regulated area is located in northeastern Fort Bend County within the Houston Sugar Land Baytown Metropolitan Area	RN105573042	TXR040260
Fort Bend	* Fort Bend County MUD 26 MS4	Area within legal district boundaries of Fort Bend County MUD 26	RN105588222	TXR040295
Fort Bend	* Fort Bend County MUD 30 MS4	Lies wholly within the City of Houston urbanized area	RN105591267	TXR040318
Fort Bend	* Fort Bend County MUD 34 MS4	Entire Fort Bend County MUD 34 boundary entirely within Fort Bend County in the Houston urbanized area	RN105572978	TXR040258
Fort Bend	* Fort Bend County MUD 35 MS4	Entire Fort Bend County MUD 35 boundary entirely within Fort Bend County in the Houston urbanized area	RN105572887	TXR040257
Fort Bend	Fort Bend County MUD 41 MS4	Area within Fort Bend County MUD 41 that is located within the Houston urbanized area	RN105558704	TXR040224

County	Regulated Entity Name	Location	RN Number	ID
Fort Bend	Fort Bend County MUD 42 MS4	The district lies wholly within the City of Houston urbanized area	RN105586598	TXR040293
Fort Bend	Fort Bend County MUD 46 MS4	Within the City of Missouri City located within the Houston metro area	RN105608384	TXR040370
Fort Bend	Fort Bend County MUD 47 MS4	Area within Fort Bend County MUD 47 located in City of Missouri City urban area	RN105586374	TXR040290
Fort Bend	Fort Bend County MUD 48 MS4	Area within Fort Bend County MUD that is located within the Houston urbanized area	RN105586457	TXR040291
Fort Bend	Fort Bend County MUD 49 MS4	Area within the urbanized area of the City of Missouri City limits	RN105604912	TXR040363
Fort Bend	Fort Bend County MUD 67 MS4	Located 22 miles SW of Houston and W of Sugar Land area within the Sugar Land ETJ	RN105574743	TXR040269
Fort Bend	Fort Bend County MUD 68 MS4	Located 22 miles SW of Houston and w of Sugar Land area within the Sugar Land ETJ	RN105573018	TXR040259
Fort Bend	Fort Bend County MUD 69 MS4	Located 22 miles SW of Houston and W of Sugar Land area within the Sugar Land ETJ	RN105574669	TXR040268
Fort Bend	* Grand Lakes MUD 1 MS4	The district lies partially within the urbanized area and ETJ of the City of Houston within Fort Bend County	RN105588529	TXR040300
Fort Bend	* Grand Lakes MUD 2 MS4	The district lies partially within the urbanized area and ETJ of the City of Houston within Fort Bend County	RN105588347	TXR040299
Fort Bend	* Grand Lakes MUD 4 MS4	The district lies partially within the urbanized area and ETJ of the City of Houston within Fort Bend County	RN105588636	TXR040301
Fort Bend	* Grand Lakes WCID MS4	The district lies partially within the urbanized area and ETJ of the City of Houston within Fort Bend County	RN105586820	TXR040294
Fort Bend	* Harris County WCID Fondren Road MS4	Area within the urbanized area of the City of Missouri City limits	RN105608442	TXR040371
Fort Bend	* Harris Fort Bend Counties MUD 1 MS4	The district lies wholly within the City of Houston urbanized area in Fort Bend County	RN105589568	TXR040306
Fort Bend	* Harris Fort Bend Counties MUD 5 MS4	The district lies wholly within the City of Houston urbanized area in Fort Bend County	RN105589527	TXR040305
Fort Bend	* Kingsbridge MUD MS4	Area within the Kingsbridge MUD boundary that is located in Fort Bend County and within the Houston urbanized area and also located in Harris County	RN105611735	TXR040374
Fort Bend	Meadowcreek MUD MS4	Area within legal district boundaries of Meadowcreek MUD	RN105588248	TXR040296
Fort Bend	* Mission Bend MUD 1 MS4	The district lies wholly within the City of Houston urbanized area	RN105589659	TXR040307

County	Regulated Entity Name	Location	RN Number	ID
Fort Bend	* North Mission Glen MUD MS4	Area W of Gaines Rd S of Barbarossa Dr and N of Crooked Arrow Dr also located in Harris County	RN105521827	TXR040126
Fort Bend	Palmer Plantation MUD 1 MS4	Area within the urbanized area of the City of Missouri City	RN105604870	TXR040361
Fort Bend	Palmer Plantation MUD 2 MS4	Area within the urbanized area of the City of Missouri City	RN105604904	TXR040362
Fort Bend	Pecan Grove MUD MS4	Area within Pecan Grove MUD that is located within the Houston urbanized area	RN105559009	TXR040225
Fort Bend	Plantation MUD MS4	Area within plantation MUD that is located within the Houston urbanized area	RN105559090	TXR040226
Fort Bend	Quail Valley Utility District MS4	Area within the legal district boundaries of Quail Valley utility district	RN105604813	TXR040359
Fort Bend	* Renn Road MUD MS4	The district lies wholly within the City of Houston urbanized area in Fort Bend County	RN105589725	TXR040308
Fort Bend	Thunderbird Utility District MS4	Area within legal district boundaries of Thunderbird Utility District	RN105604839	TXR040360
Fort Bend	* West Keegans Bayou Improvement District MS4	Area bounded by Eldridge and Old Richmond Road on the east and west and by Beachnut and O'Brien on the north and south also located in Harris County	RN105506349	TXR040109
Fort Bend	* Willow Fork Drainage District MS4	Area along border of Fort Bend and Harris County bisected by SH 99	RN105550214	TXR040196
Galveston	City of Clear Lake Shores MS4	Area within City of Clear Lake Shores limits that is located approximately 30 miles south east of the central business district of Houston	RN105551337	TXR040204
Galveston	City of Dickinson MS4	Area within the City of Dickinson limits that is located within the Texas City urbanized area	RN105576581	TXR040271
Galveston	* City of Friendswood MS4	Area within the corporate limits of the City of Friendswood that is located within Harris and Galveston counties urbanized areas	RN105562086	TXR040233
Galveston	City of Galveston MS4	Area within Galveston City limits that is located within the Galveston urbanized area	RN105591143	TXR040312
Galveston	City of Hitchcock MS4	Area within the City of Hitchcock limits that is located within the Texas City urbanized area	RN105477434	TXR040013
Galveston	City of Kemah MS4	Area within the city limits of Kemah corporate limits located within the urbanized area of Galveston County	RN105498216	TXR040096
Galveston	City of La Marque MS4	Area within the corporate limits of the City of La Marque	RN105538763	TXR040178

County	Regulated Entity Name	Location	RN Number	ID
Galveston	* City of League City MS4	City of League City located in Northern Galveston County also located in Harris County	RN105569735	TXR040249
Galveston	City of Santa Fe MS4	Area within the City of Santa Fe limits that is located within the Texas City urbanized area	RN105550107	TXR040193
Galveston	City of Texas City MS4	Area within the City of Texas City limits that is located within the Texas City urbanized area	RN105479513	TXR040024
Galveston	Galveston County Consolidated Drainage District MS4	City of Friendswood and League City located within the Houston urbanized area	RN105485353	TXR040067
Galveston	* Galveston County Drainage District 1 MS4	Area within the Galveston County Drainage District 1 boundaries that is located within the Texas City urbanized area	RN105551048	TXR040203
Galveston	Galveston County MS4	An area in the unincorporated county classified as urbanized that surrounds the City of Santa Fe and area identified as unincorporated San Leon and Bacliff both listed in the Texas City urbanized area.	RN105604987	TXR040364
Galveston	Galveston County MUD 12 MS4	Area within the city limits of Bayou Vista within the Texas City urbanized area	RN105477566	TXR040014
Galveston	University of Texas Medical Branch At Galveston MS4	Area within the City of Galveston limits that is located within the Galveston urbanized area	RN105553440	TXR040215
Harris	* City of Bellaire MS4	Area within the City of Bellaire limits that is located within the Houston urbanized area	RN105538623	TXR040173
Harris	* City of Bunker Hill Village MS4	Complete area within the City limits of the City of Bunker Hill Village	RN105559702	TXR040228
Harris	City of Deer Park MS4	Area within the City of Deer Park corporate limits is bordered by City of Pasadena and City of La Porte	RN105484307	TXR040058
Harris	City of Galena Park MS4	Area within the City of Galena Park corporate limits located within the City of Houston urbanized area	RN105497580	TXR040094
Harris	* City of Hedwig Village MS4	Area within the City of Hedwig Village limits that is located within the Houston urbanized area	RN105480545	TXR040027
Harris	* City of Houston, Harris County, Harris County Flood Control District, and Texas Department of Transportation	Phase I Permit	WQ0004685-000	TXS001201
Harris	* City of Humble MS4	Area within the City of Humble limits that is located within the Houston urbanized area	RN105569826	TXR040251
Harris	* City of Hunters Creek Village MS4	Area within the City of Hunters Creek Village limits that is located within the Houston urbanized area	RN105551402	TXR040206
Harris	* City of Jacinto City MS4	Corporate limits within the City of Jacinto City located within the City of Houston urbanized area	RN105497614	TXR040095

County	Regulated Entity Name	Location	RN Number	ID
Harris	* City of Jersey Village MS4	Area within the City of Jersey Village limits that is located within the Houston urbanized area	RN105559116	TXR040227
Harris	* City of Katy MS4 Public Works Department	Area is the City of Katy limits within the Houston urbanized area and portions of Waller and Fort Bend counties	RN105475503	TXR040009
Harris	City of La Porte MS4	Area within the City of La Porte limits that is located within the Houston urbanized area	RN105510440	TXR040117
Harris	* City of Nassau Bay MS4	Area within the City of Nassau Bay that is located within the Houston urbanized area	RN105591226	TXR040315
Harris	*City of Pasadena	Phase I Permit	WQ0004524-000	TXS001701
Harris	* City of Piney Point Village MS4	Area within the City of Piney Point Village that is located within the Houston urbanized area	RN105551386	TXR040205
Harris	City of Seabrook MS4	Area within the City of Seabrook limits that is located within the Houston urbanized area	RN105499289	TXR040098
Harris	* City of Southside Place MS4	Area within the City of Southside Place limits that is included within the Houston UA	RN105484786	TXR040063
Harris	* City of Spring Valley Village MS4	Area within the City of Spring Valley Village that is located within the Houston urbanized area	RN105555650	TXR040218
Harris	City of Taylor Lake Village MS4	Area within the City of Taylor Lake Village that is located within the Houston urbanized area	RN105597496	TXR040345
Harris	* City of Webster MS4	The city is located between Houston and Galveston, 2 miles from NASA	RN105487318	TXR040070
Harris	* City of West University Place MS4	Area located within West University Place city limits within the Houston UA	RN105862668 Pending	TXR040392
Harris	* Clear Lake City Water Authority MS4	Area within the Cities of Pasadena Houston Webster and Taylor Lake Village that is located within the Houston UA	RN105774152	TXR040388
Harris	* Harris County MUD 122 MS4	Area within Harris County MUD 122 that is located within the Houston urbanized area	RN105607188	TXR040369
Harris	Harris County WCID 50 MS4	Area in the City of El Lago with borders of City of Taylor Lake Village and City of Seabrook	RN105915904 Pending	TXR040403
Harris	* National Aeronautics and Space Administration Johnson Space Center MS4	Located in City of Houston between NASA Parkway Saturn Lane and Space Center Boulevard	RN105552723	TXR040214
Harris	Port of Houston Authority	Phase I Permit	WQ0004421-000	TXS001202
Harris	* Southwest Harris County MUD 1 MS4	Southwest Harris County MUD 1 lies in the Houston urbanized area	RN105589428	TXR040303

County	Regulated Entity Name	Location	RN Number	ID
Harris	* Texas Department of Transportation Houston District MS4	Located within the Houston Galveston Angleton Lake Jackson Texas City and The Woodlands urbanized areas and portions of Brazoria Fort Bend and Galveston counties	RN105549869	TXR040191
Harris	* Texas Department of Transportation Houston District MS4	Phase I Permit within the limits of the City of Pasadena	WQ0004520-000	TXS001702
Montgomery	* City of Oak Ridge North MS4	Area within the City of Oak Ridge North limits that is located within The Woodlands urbanized area	RN105576656	TXR040273
Montgomery	* City of Shenandoah MS4	Area within the City of Shenandoah and ETJ boundaries that are located within The Woodlands urbanized area	RN105552582	TXR040210
Montgomery	Kings Manor MUD MS4	Area within Kings Manor MUD that is located within the Houston urbanized area and within Montgomery County	RN105768618	TXR040387
Montgomery	* Montgomery County Drainage District 6 MS4	Area within drainage district 6 within The Woodlands urbanized area	RN105514590	TXR040121
Montgomery	* Montgomery County MS4	Area within the boundaries of the County of Montgomery that is located within The Woodlands urbanized area	RN105600936	TXR040348
Montgomery	Montgomery County MUD 15 MS4	Area within Montgomery County MUD 15 located within the Houston urbanized area	RN105697239	TXR040382
Montgomery	* Montgomery County MUD 19 MS4	Area within the Montgomery County MUD 19 limits that is located within The Woodlands urbanized area	RN105521389	TXR040123
Montgomery	* Rayford Road MUD MS4	Area within the Rayford Road MUD limits that is located within The Woodlands urbanized area	RN105524953	TXR040147
Montgomery	* Southern Montgomery County MUD MS4	Area within the Southern Montgomery County MUD limits that is located within The Woodlands urbanized area	RN105521215	TXR040122
Montgomery	* Spring Creek Utility District MS4	Area within Spring Creek Utility District that is located within The Woodlands urbanized area	RN105553473	TXR040216
Montgomery	* The Woodlands Joint Powers Agency MS4	Area within The Woodlands Joint Powers Agency jurisdiction that is located within The Woodlands urbanized area	RN105572838	TXR040256

Appendix H: Implementing Agencies for Agricultural Measures

The governmental agencies listed below will be responsible for implementing management measures aimed at reducing nonpoint source loadings from agricultural operations. Their duties and activities related to this I-Plan are described in Implementation Strategy 7.0.

Texas State Soil and Water Conservation Board

The Texas State Soil and Water Conservation Board (TSSWCB) is the lead agency in Texas responsible for planning, implementing, and managing programs and practices for preventing and abating agricultural and silvicultural (forestry) nonpoint source pollution (Texas Agriculture Code Section 201.026). In accordance with this responsibility, the TSSWCB administers a certified Water Quality Management Plan (WQMP) Program that provides, through local soil and water conservation districts (SWCDs), for the development, implementation, and monitoring of individual WQMPs for agricultural and silvicultural lands. Each WQMP is developed, maintained, and implemented under rules and criteria adopted by the TSSWCB. A WQMP achieves a level of pollution prevention or abatement consistent with the state's water quality standards.

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

The TSSWCB regularly performs status reviews on WQMPs to ensure that the producer is implementing the measures prescribed in the WQMP. The TSSWCB administers technical and cost-share assistance programs to assist producers in implementing their WQMPs. The TSSWCB utilizes both state appropriations and federal grants to fund the WQMP Program.

Soil and Water Conservation Districts

An SWCD, like a county or school district, is a subdivision of state government. SWCDs are administered by a board of five directors who are elected by their fellow landowners. There are currently 216 individual SWCDs organized in Texas. Through decades old agreements, SWCDs offer agricultural landowners and operators technical assistance through a partnership with the NRCS and the TSSWCB. It is through this conservation partnership that local SWCDs are able to furnish technical assistance to farmers and ranchers in the preparation of a complete soil and water conservation plan to meet each land unit's specific capabilities and needs. The SWCDs that are active in the BIG project area watersheds are shown in Table 20.

Table 20: SWCDs in the BIG Project Area Watersheds

SWCD	Counties within SWCD
Coastal Plains SWCD #317	Fort Bend
Waters-Davis SWCD #318	Brazoria, Galveston
Lower Trinity SWCD #435	Liberty
Polk-San Jacinto SWCD #436	San Jacinto
Navasota SWCD #440	Grimes, Waller
Harris County SWCD #442	Harris
Montgomery County SWCD #452	Montgomery
Walker County SWCD #453	Walker

USDA Natural Resources Conservation Service

The NRCS is a federal agency that works hand-in-hand with Texans to improve and protect their soil, water, and other natural resources. For decades, private landowners have voluntarily worked with NRCS specialists to prevent erosion, improve water quality, and promote sustainable agriculture.

The NRCS provides conservation planning and technical assistance to landowners, groups, and units of government to develop and implement conservation plans that protect, conserve, and enhance their natural resources. When providing assistance, NRCS focuses on the sound use and management of soil, water, air, plant, and animal resources. NRCS helps customers manage their resources in a way that prevents resource degradation, ensures sustainability, allows for productivity, and respects the customers' needs. Conservation planning can make improvements to livestock operations, crop production, soil quality, water quality, pastureland, forestland, and wildlife habitats. The NRCS also integrates ecological and economic considerations in order to address private and public concerns.

The NRCS administers numerous programs authorized by the U.S. Congress in the federal Farm Security and Rural Investment Act of 2002 (Farm Bill) that provide financial assistance for many conservation activities:

- Conservation Innovation Grants
- Conservation Security Program (CSP)
- Environmental Quality Incentives Program (EQIP)
- Farm and Ranch Lands Protection Program
- Grassland Reserve Program
- Wetlands Reserve Program
- Wildlife Habitat Incentives Program

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

Texas AgriLife Extension Service

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 serves every county in Texas: its information is provided by scientists and researchers at Texas A&M and other universities, and is made practical and relevant by Extension educators or agents who work in each county. AgriLife Extension continually assesses and responds to educational needs identified by community residents, advisory committee members, volunteers, stakeholder groups, and representatives of organizations and agencies. Extension education encompasses the broad areas of agriculture and natural resources, community economic development, family and consumer sciences, and youth development programs such as 4-H. Among other goals and priority objectives pursued by AgriLife Extension, the following relate to agriculture and natural resources.

- Consumer, homeowner, agricultural producers, horticultural producers, communities, and irrigation districts understand and adopt best management practices to protect water quality and enhance conservation so water supplies will meet future water needs in Texas that are

essential for expanding agricultural growth, jobs, and the economy in both rural and urban areas.

- Landowners, professional ecosystem managers, community planners, and other interest groups become more knowledgeable, make informed decisions, and adopt best management practices that insure the proper management of rural and urban natural ecosystem resources (rangeland and forestry, etc.) through stewardship education in order to support the biological, sociological, and economic sustainability of those resources.
- AgriLife Extension works to advance the planning and management of natural resource-based recreation opportunities in Texas.
- Through pesticide safety education, licensed and unlicensed pesticide users (including farmers, ranchers, pest control businesses, and the general public) will understand and adopt safer pesticide and non-chemical management methods for managing pests and will be able to continue their pursuit of business enterprises and employment.

AgriLife Extension also administers the Texas Wildlife Damage Management Service (TWDMS), a United States Department of Agriculture (USDA) program. The TWDMS serves as the Texas leader in the science, education, and practice of wildlife management in order to protect agricultural, industrial, and natural resources. Provided in both rural and urban areas, the program's services also guard the public's health, safety, and property from the negative effects of wildlife. The TWDMS provides both technical assistance and direct control services in wildlife damage management, the resolving of conflict between humans and wildlife.

Appendix I: Maps

The following pages show maps related to the BIG project area. The table below indicates where in the document the various maps may be found. Copies of maps shown in the body of the document are included in this appendix.

Figures

Figure 9: BIG Project Area

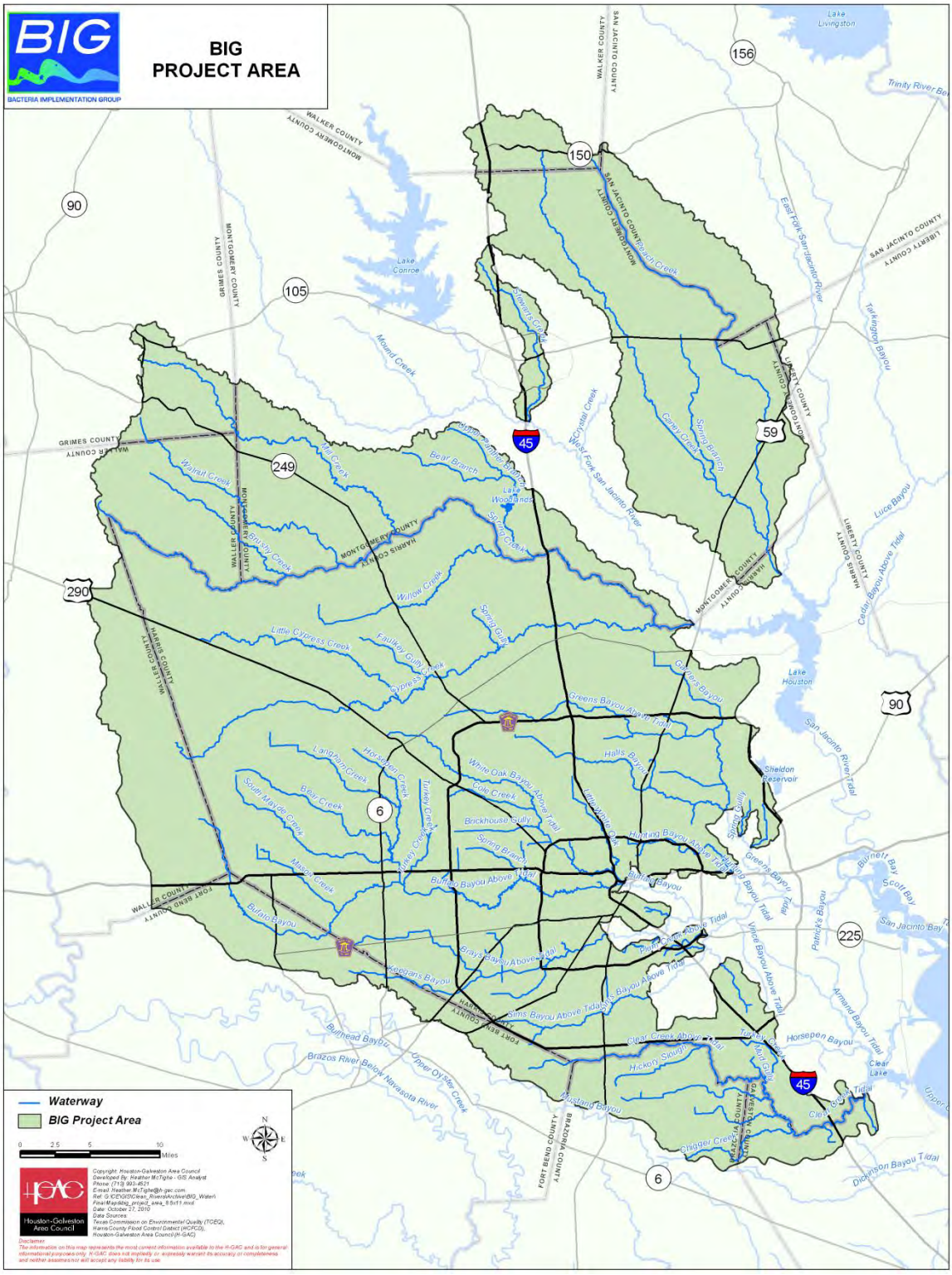


Figure 10: Map of Clean Rivers Program Monitoring Stations

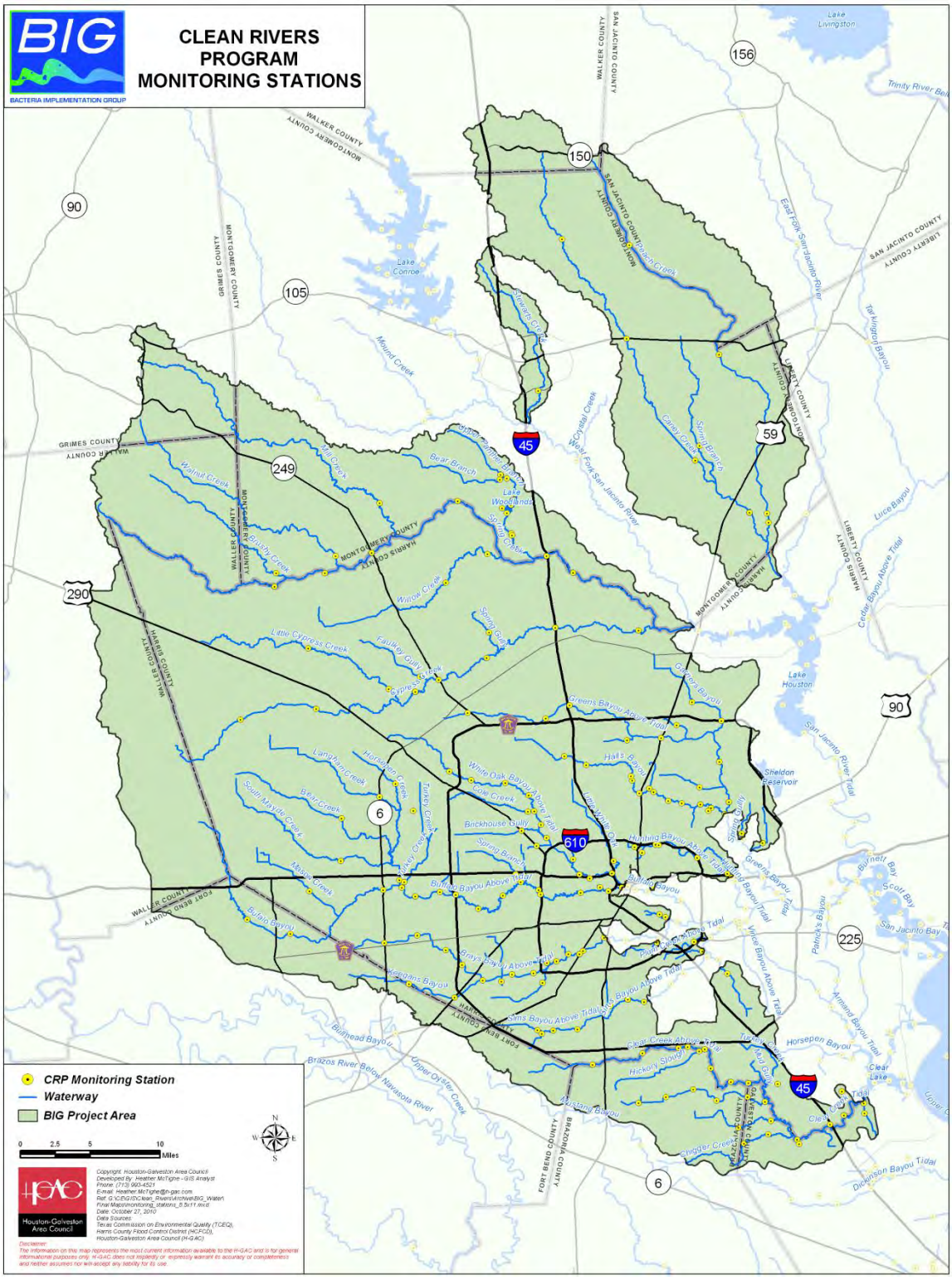


Figure 11: Map of Impaired Assessment Units

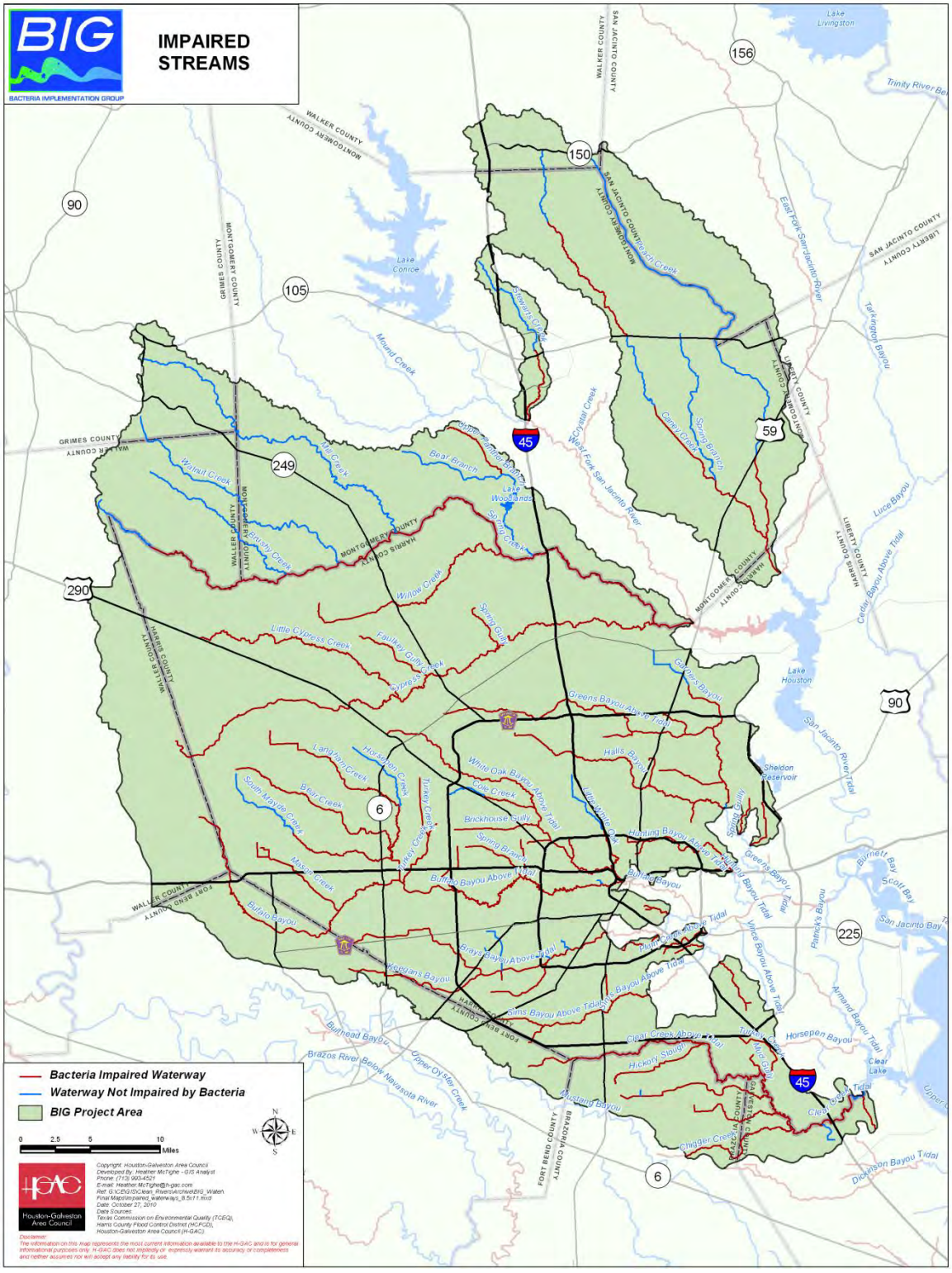


Figure 12: Map of Significant Changes in Bacteria Impaired Waterways

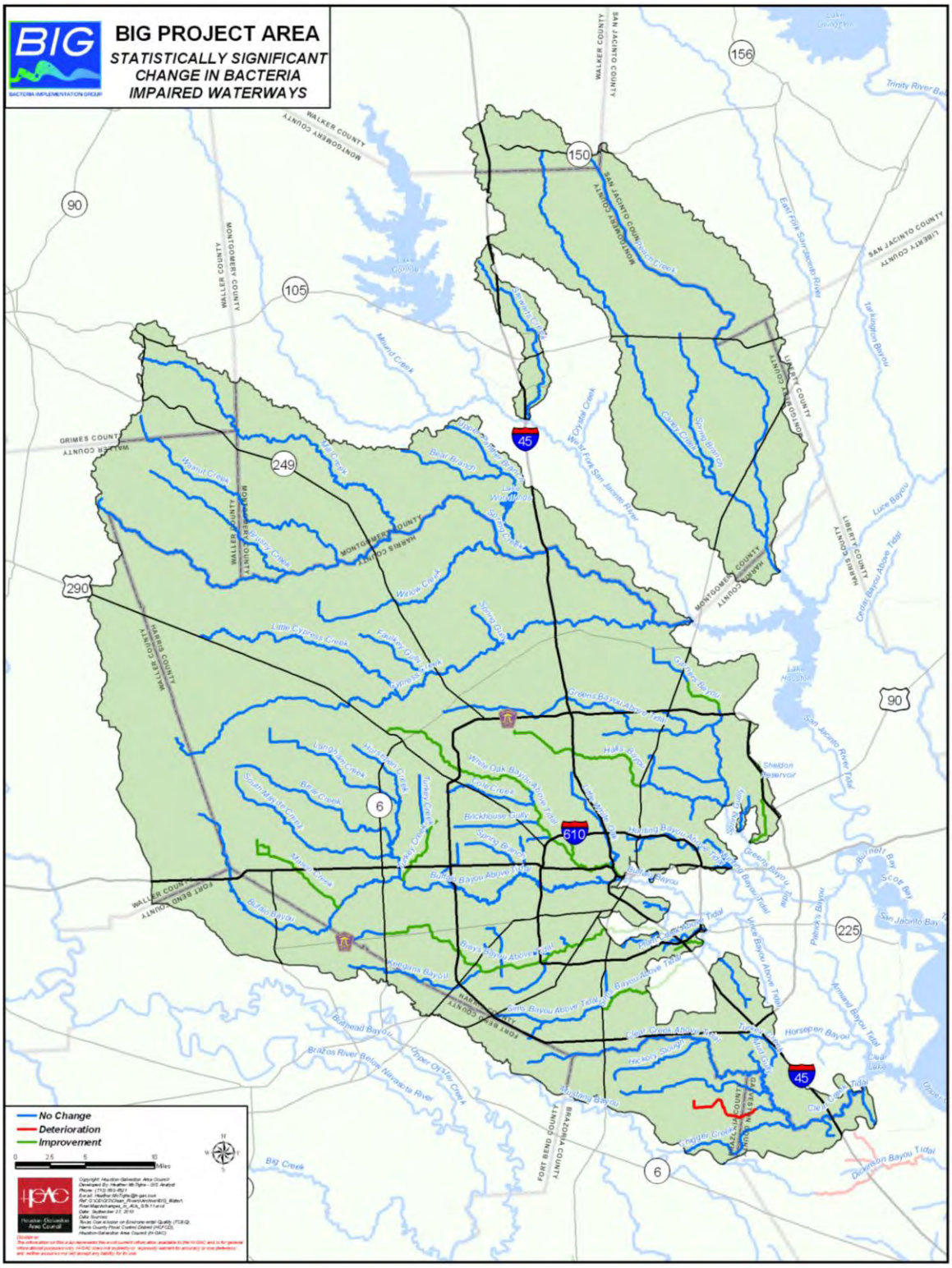


Figure 13: Map of Wastewater Treatment Facility Outfalls

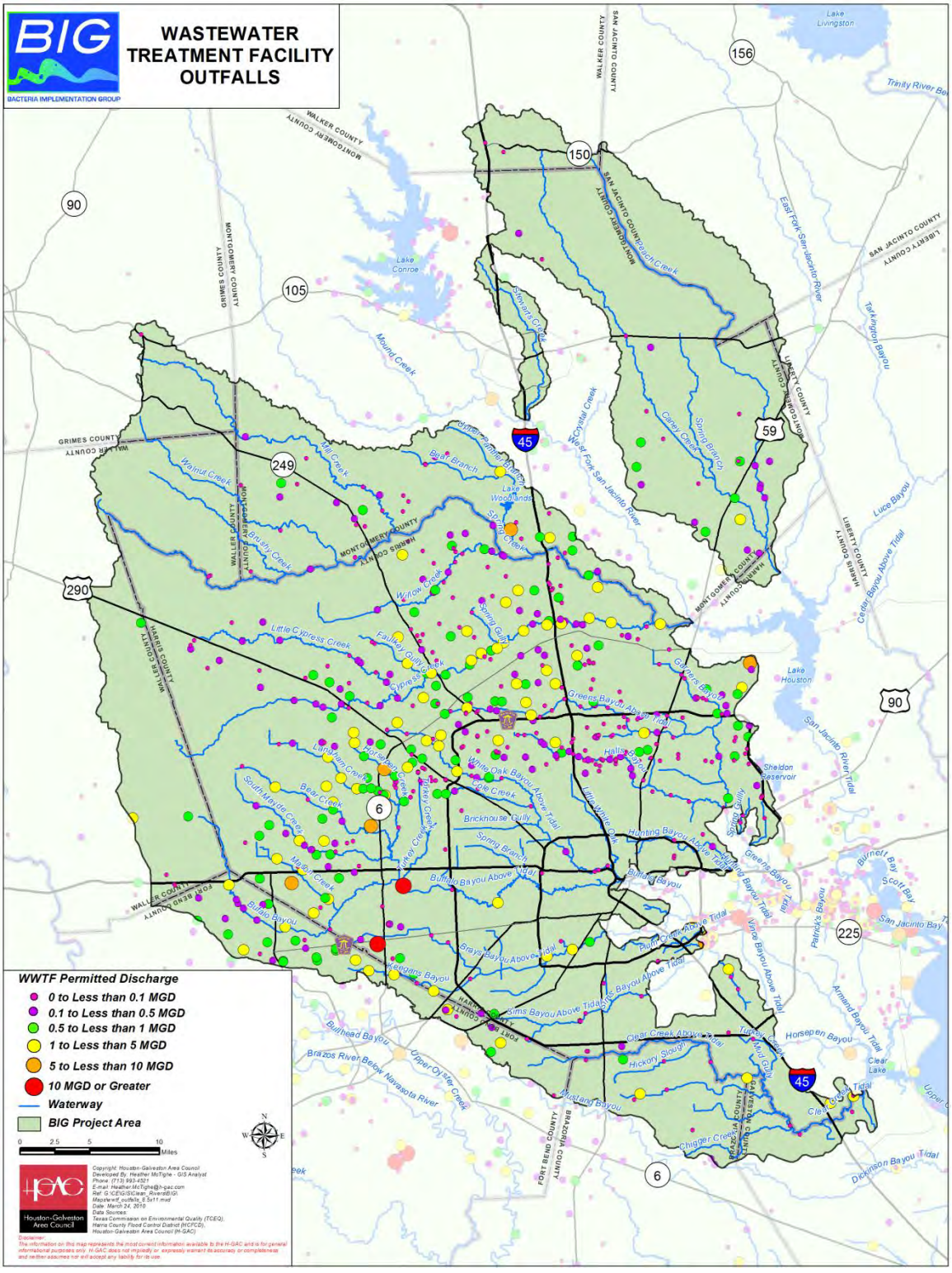


Figure 14: Map of Wastewater Service Area Boundaries

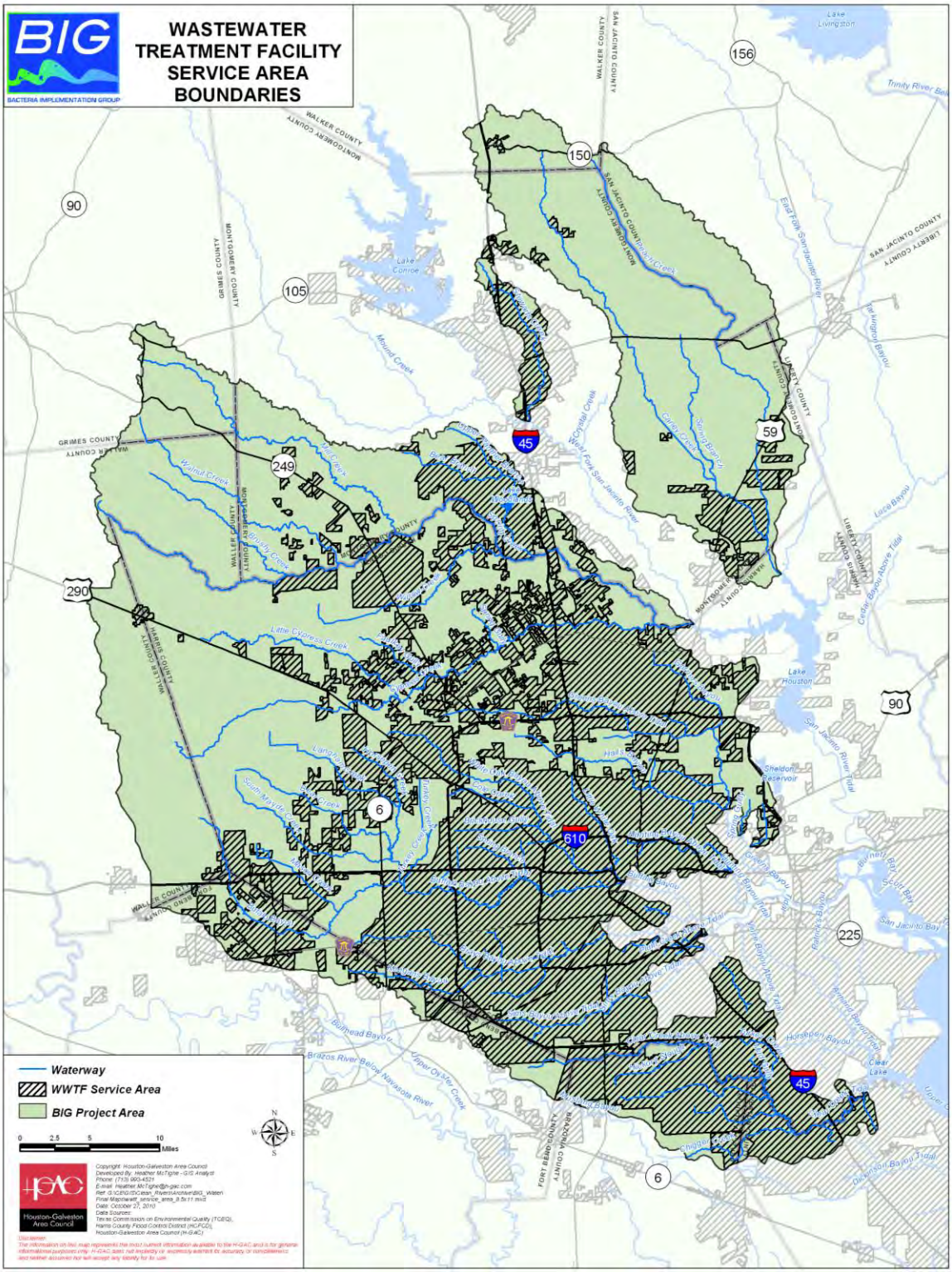


Figure 15: Map of Permitted On-Site Sewage Facilities

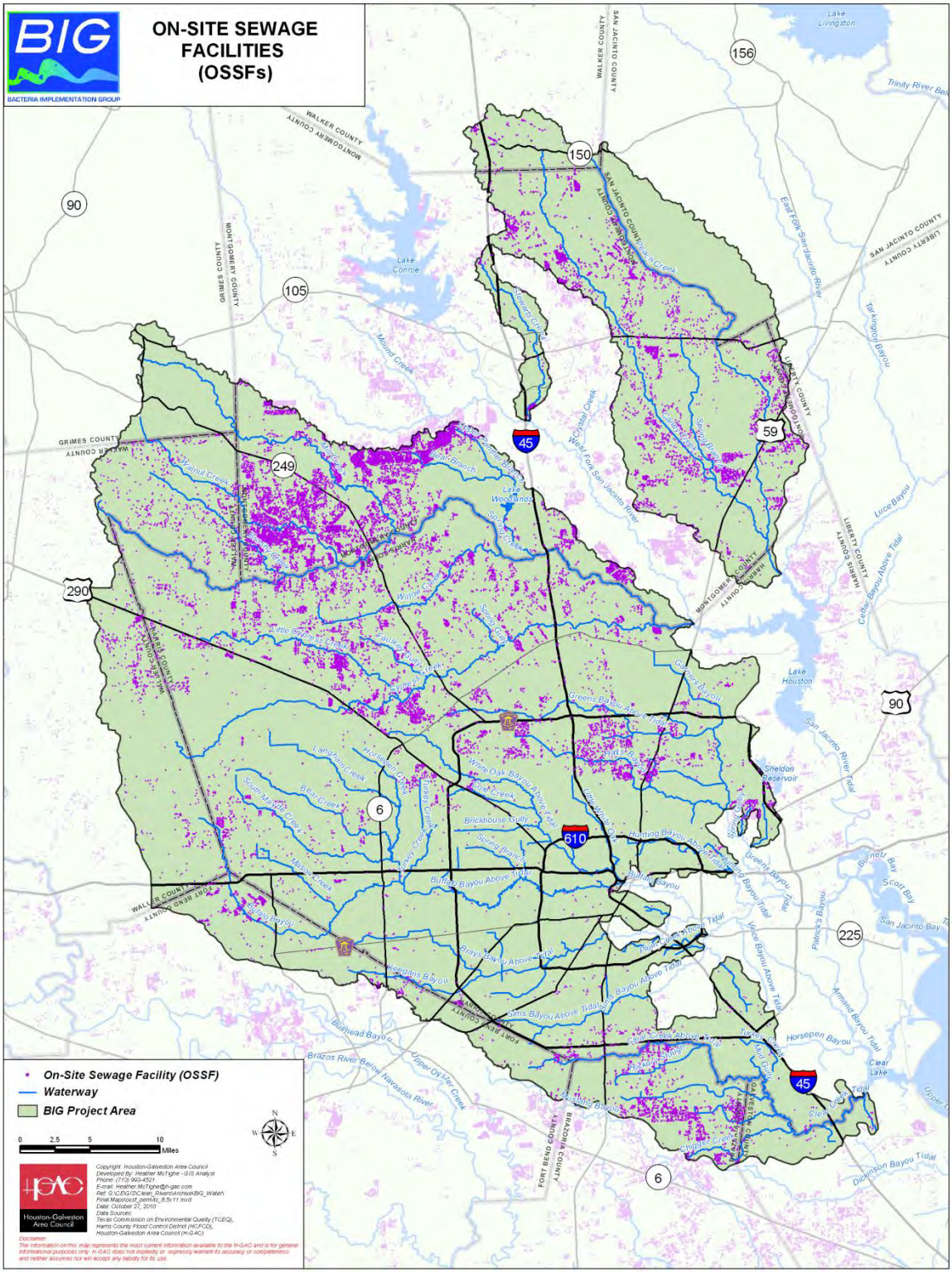


Figure 16: Map of MS4 Areas

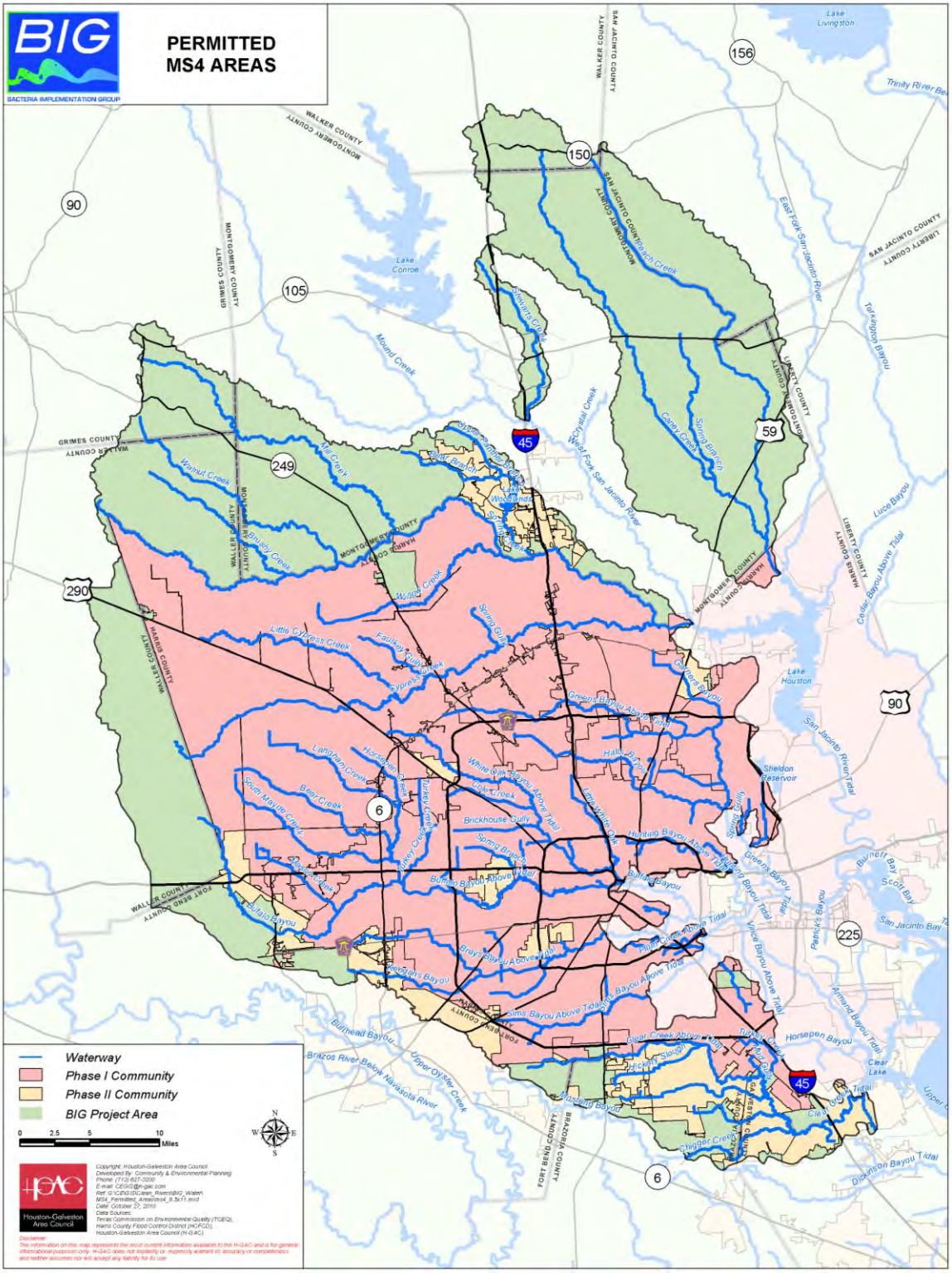


Figure 17: Map of 2005 Population Density

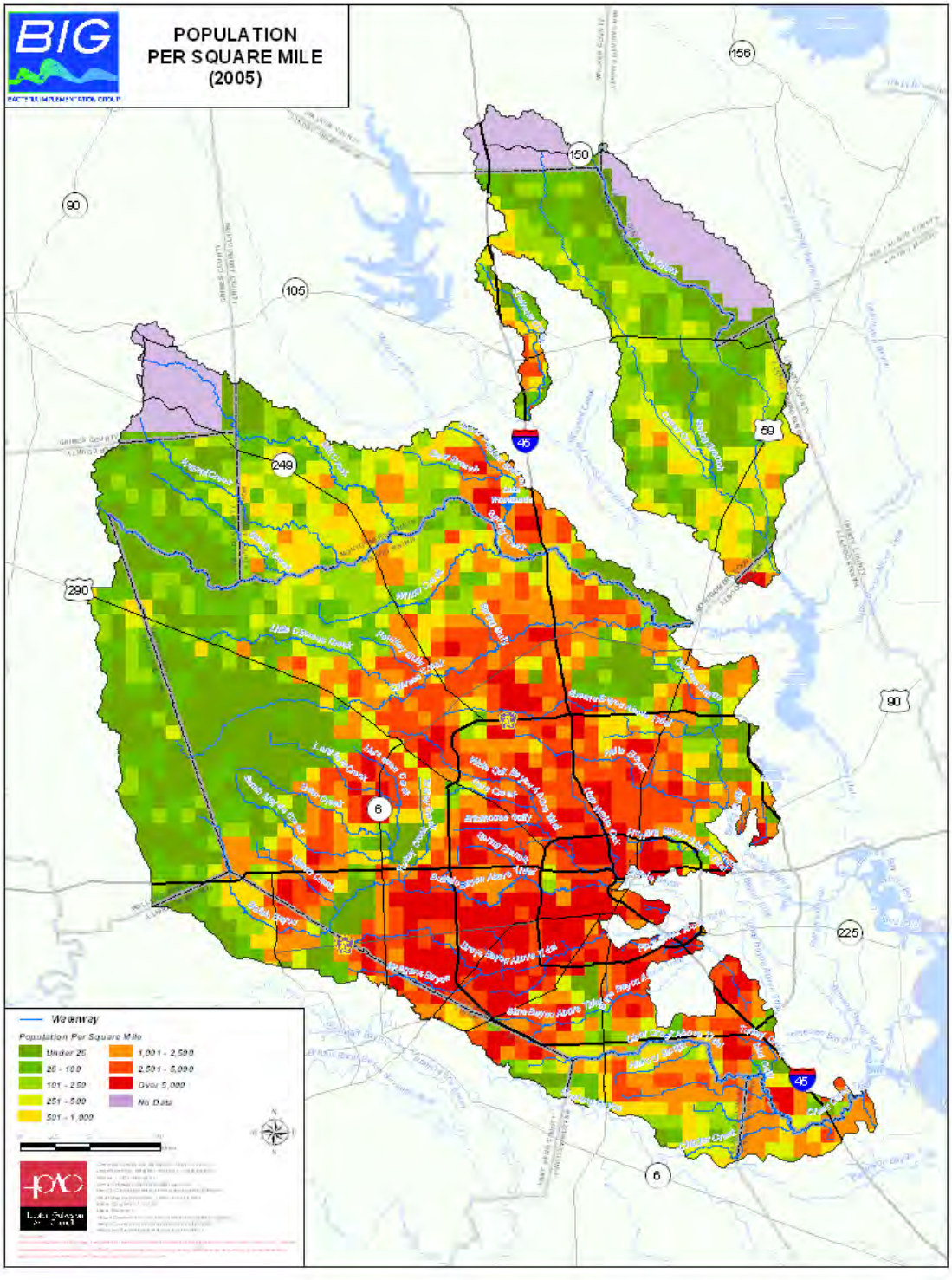


Figure 18: Map of 2035 Population Density Projection

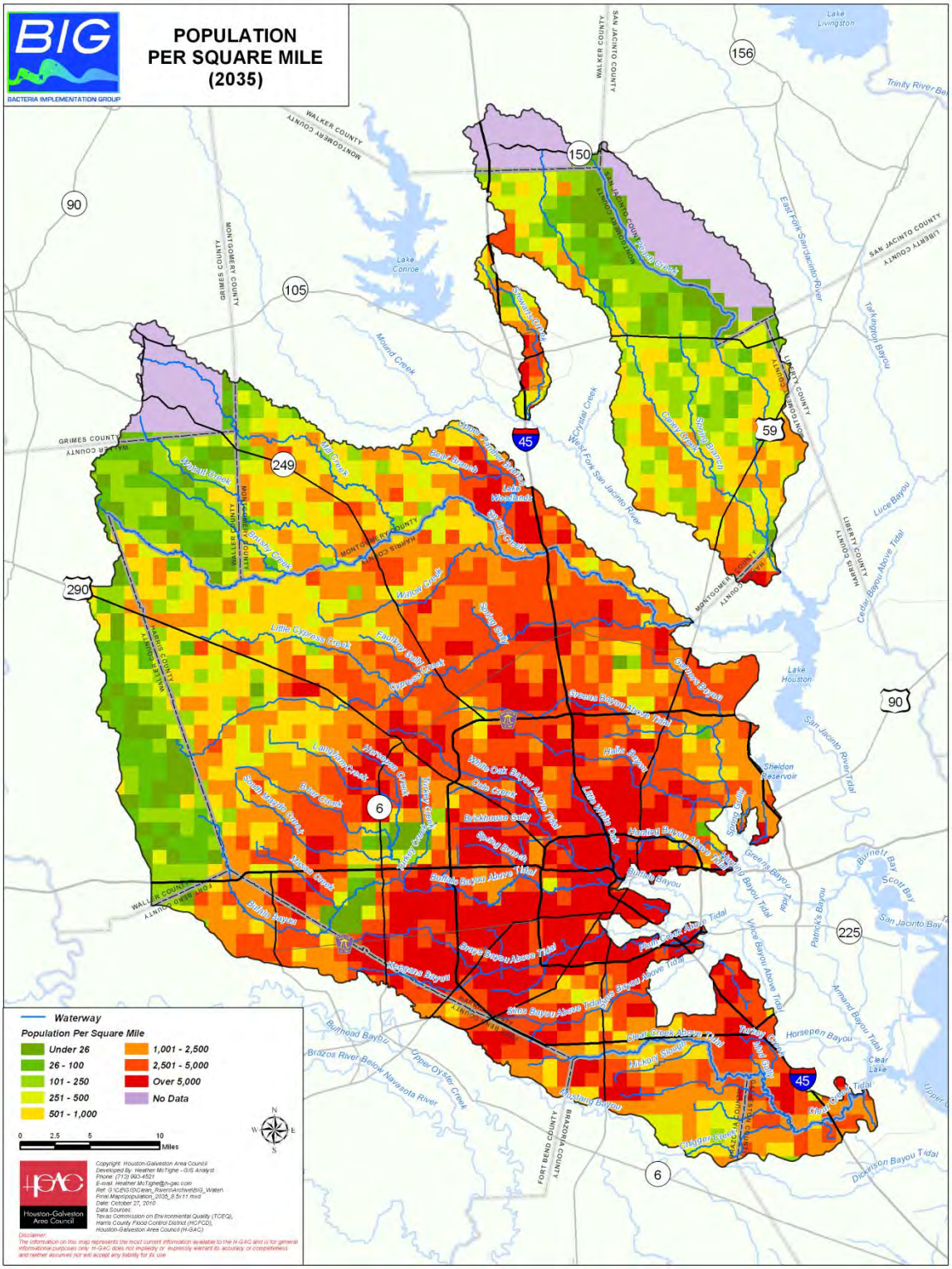


Figure 19: Map of TMDL Watersheds

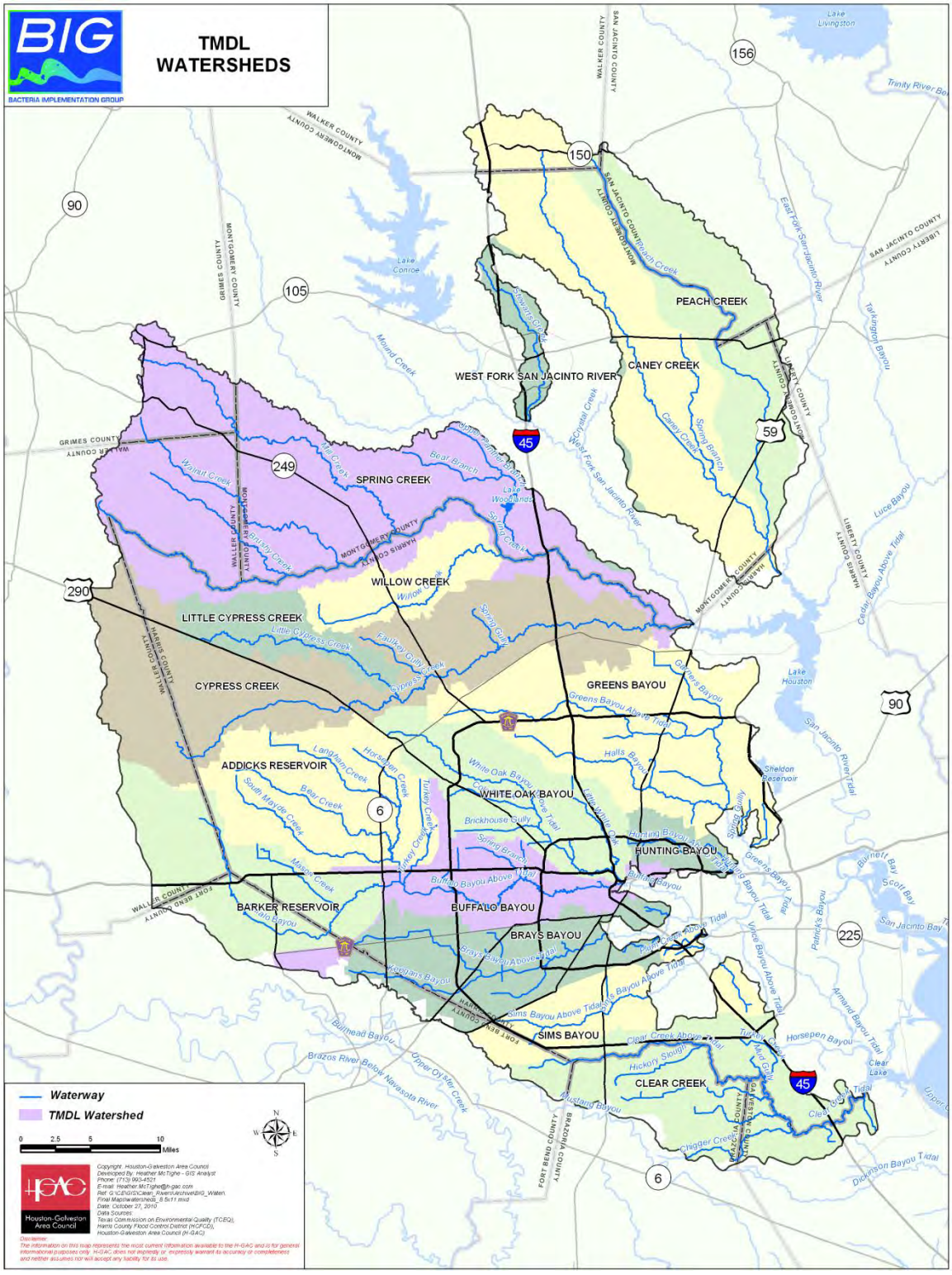


Figure 20: Map of City Boundaries

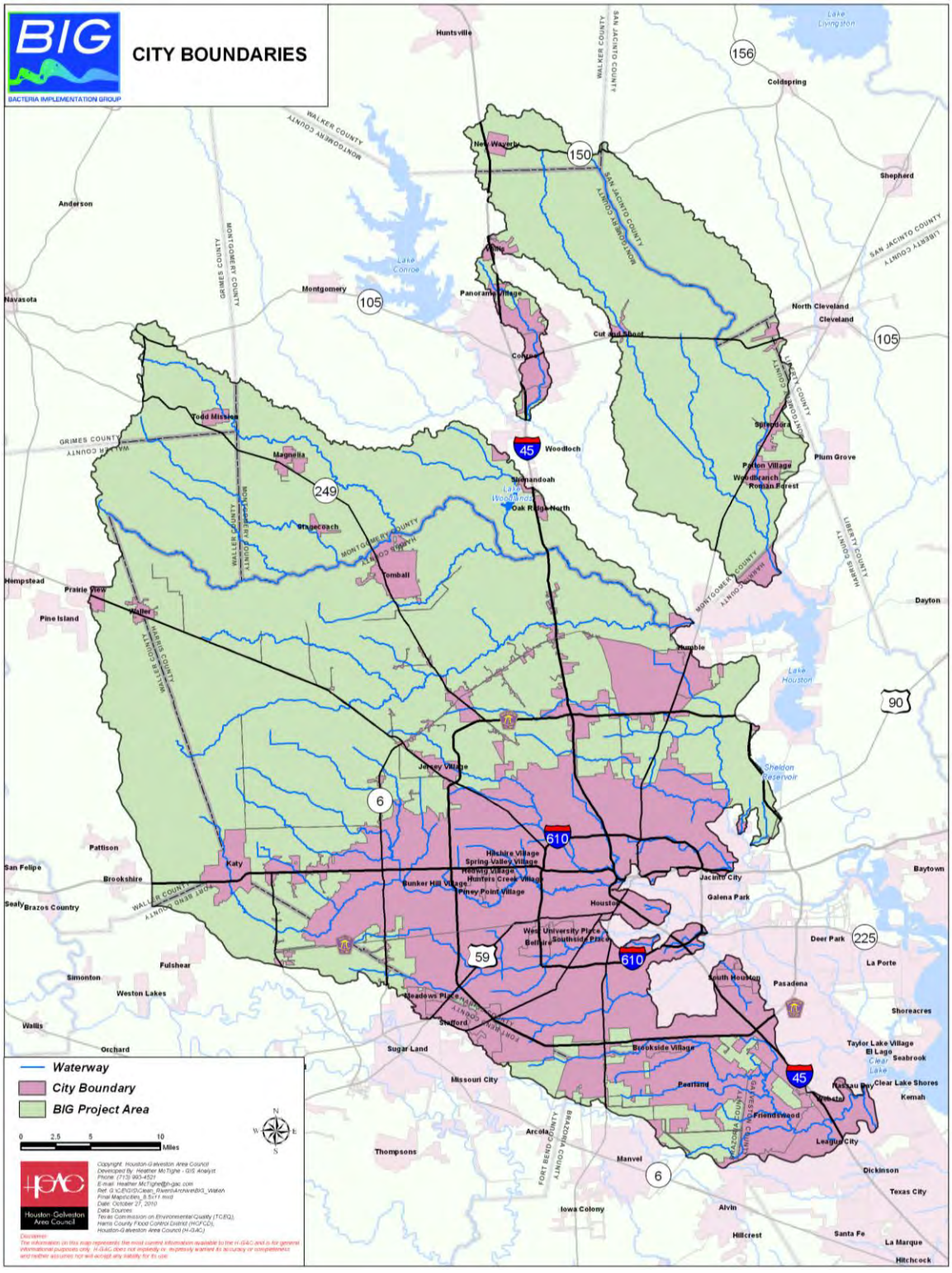
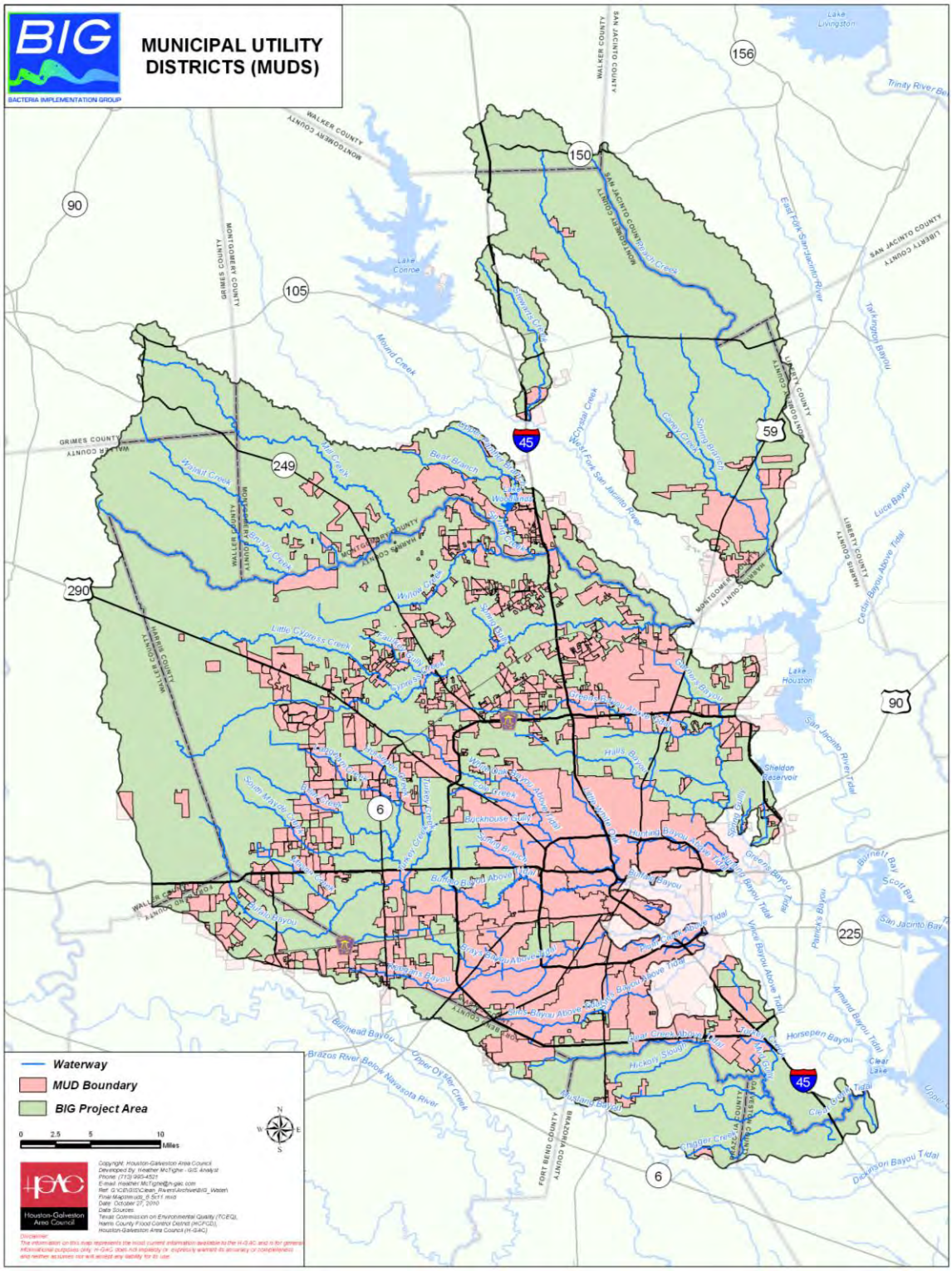


Figure 21: Map of Special Purpose Districts



Appendix J: Load Reduction Value Information

Due to the large number of TMDLs covered by this I-Plan and the imprecise bacteria loading values from various sources, estimated load reductions more specific than those given in the following sections could not be determined. Load reductions for each source will vary from segment to segment based on a variety of factors including, but not limited to, the existing land uses in the watersheds and the current loadings from each source.

These load reduction percentages are not based on results of any direct, peer-reviewed, or technically supported studies performed on pathogens or fecal indicators in waterways in the greater Houston area. Many of the estimated reductions are presumptions based on the broad application of the referenced pollutant studies and behavior predictions, some of which are not specifically water related. Also, as this is only a presumed reduction in fecal load; it is still undetermined how this estimated reduction in fecal load would translate to reduction in fecal indicators or the level of pathogens in the water body. Given the untested nature of this information in our area, these estimated potential load reduction percentages should be considered as broad approximations based on limited information and subject to a large margin of error. More due diligence and validation should be required prior to obligating resources based on them.

Although the load reductions presented in the following sections may be less than the load reductions required by the TMDLs, the BIG intends that greater load reductions may be achieved through the iterative process of implementation. The ultimate goal of this I-Plan is continued progress toward greatly reduced bacteria levels.

Implementation Strategy 1.0: Wastewater Treatment Facilities (IS1)

10 percent-20 percent reduction in load assigned to WWTFs

The estimated load reductions for the seven main activities within IS1 range from zero to 45 percent of the load assigned to WWTF. Based on studies of compliance and enforcement in other fields, the hypothesis is that the strategy with the greatest potential for reducing loads would be improved compliance and enforcement, although concerns exist that resources available are insufficient to attain the full reduction estimate. Over 25 years these seven activities could result in a reduction of up to 20 percent in the load assigned to WWTF.

Implementation Activity 1.1: Impose More Rigorous Bacteria Monitoring Requirements is expected to reduce the waste load allocation assigned to WWTFs by 2-4 percent. The hypothesis is that this action will function in a manner similar to mass communication to

change public behavior, which is typically about 2 percent for public health campaigns.[145] In this instance, the behavior changes are mandated by permits, and so participation is expected to be greater than for campaigns directed at the general public.

Implementation Activity 1.3: Increase Compliance and Enforcement by the TCEQ is expected to reduce the waste load allocation assigned to WWTFs by up to 45 percent. In a study of random unannounced inspections of tobacco retailers over seven years regarding underage sales, compliance increased to approximately 90 percent when compliance began at 33 percent.[146] Targeted inspections at WWTFs may not show such a marked increase in compliance because they go after the repeat offenders and will start to leave out those consistently in compliance. Additionally, WWTF inspections look at numerous regulations as opposed to the one considered in the tobacco studies, which results in a greater opportunity for noncompliance. If only compliance with bacteria limits were considered for when measuring compliance trends would likely behave closer to the tobacco study results than otherwise.

Implementation Activity 1.5: Upgrade Facilities is expected to reduce the waste load allocation assigned to WWTFs by 12 percent. TCEQ data indicates that, at any one time, samples from 5-10 percent of select WWTFs in the BIG area do not meet the single grab sample limit of 197 *E. coli*/100 mL. This estimate of a 12 percent reduction, as a result of the implementation of 1.5, was based on a 6 percent non-compliance rate for WWTFs and the average concentration of *E. coli* samples during sampling of WWTFs between 2001 and 2006 in the Buffalo and Whiteoak bayous watersheds.[147] In actuality, the loading from many plants would not be reduced at all by updates, while for some WWTFs, the load reduction from making updates would be far more substantial than 12 percent. Load reductions will probably not be 12 percent for any individual plant.

Implementation Activity 1.6: Consider Regionalization of WWTFs is estimated to produce no reduction in the waste load allocation assigned to WWTFs except in segments where chronically non-compliant WWTFs are identified and subsequently made compliant or regionalized. In these particular segments the reduction will be estimated after identification of the chronically non-compliant facilities is complete.

[145] (Abroms and Maibach 2008)

[146] (Lally 2000)

[147] (TCEQ 2009a)

Implementation Strategy 2.0: Sanitary Sewer Systems (IS2)

75 percent reduction of calculated load from reported SSOs

The estimated load reduction for the six main activities within IS2 range from zero to 75 percent of the load from reported SSOs. Based on staff estimates, UAMP may substantially reduce the number of SSOs and the causes of those violations. Reported SSOs represent only a portion of the loading from sanitary sewer systems, however it should be possible to address most SSOs.

Implementation Strategy 3.0: On-Site Sewage Facilities (IS3)

75 percent reduction of current load from OSSF

The estimated load reduction from the three main activities within IS3 is a 75 percent reduction of the current load from OSSFs over 25 years. The TMDL projects identify approximately 2,100 failing OSSFs in the BIG region. Replacing or repairing 100 failing systems each year over 25 years is possible. Other measures should compensate for the expected increase in the number of systems that fail within the next 25 years. Of particular note is a Galveston County study that indicated that 20-46 percent of surveyed participants changed their behavior based on educational material.[148]

Implementation Strategy 4.0: Stormwater and Land Development (IS4)

20 percent reduction in loading from stormwater each year, compounded

The estimated annual load reduction from the six main activities within IS4 is 20 percent. Studies indicate that individual activities can range from increasing bacterial loads to a 99 percent reduction. In the absence of better data, analogous studies pertaining to other constituents in large scale development, as documented in *The Practice of Low Impact Development* sponsored by the U.S. Department of Housing and Urban Development, suggest a range of values in various situations, but can be conservatively be averaged to be about 20 percent.[149] Implementation activities related to stormwater are expected to reduce bacteria loading from stormwater and land development by up to 20 percent over the entire implementation process.

[148] (Galveston County Health District 1998)

[149] (NAHB Research Center, Inc. 2003)

Implementation Strategy 5.0: Construction (IS5)

Up to 85 percent reduction in loading from construction sites

Up to an 85 percent annual load reduction is estimated from the main activity within IS5. Effectiveness studies for construction site best management practices have largely focused on removal of sediment from runoff. Subsequently, information regarding the effectiveness of erosion and sediment control measures at removing bacteria from runoff is lacking and sediment removal efficiencies are often used as a surrogate for bacteria removal efficiencies. A Virginia Implementation Plan, *A Total Maximum Daily Load Implementation Plan for Knox Creek and Pawpaw Creek,*[150] indicates bacteria and sediment removal rates of up to 85 percent for erosion and sediment controls. If the rules, guidelines, and best management practices for our region are implemented, best professional judgment suggests that bacteria loads from construction sites will be substantially reduced.

Implementation Strategy 6.0: Illicit Discharges and Dumping (IS6)

5 percent reduction in loading from illicit discharges and dumping each year

The estimated load reduction from the three main activities within IS6 is 5 percent. Best professional judgment suggests that a slight to moderate decrease in loading may be accomplished.

Implementation Strategy 7.0: Agriculture and Animals (IS7)

10 percent reduction in loading from agriculture and animals each year

The estimated load reduction from the two main activities within IS7 is ten percent each year. Studies of animal-population-based estimates show up to a 65 percent reduction in loading per population addressed[151] This, combined with the assumption that a limited number of populations will be addressed each year, suggests only mild load reductions as a result of these activities.

Implementation Strategy 8.0: Residential (IS8)

2 percent reduction of load from residential sources each year

The estimated load reduction from the main activity within IS8 is 2 percent each year. Studies of public health campaigns suggest that advertising and marketing has a limited influence on behavior

[150] (Map Tech, Inc. and New River-Highlands RC & D 2008)

[151] (Wagner, et al. 2008)

modification, although sustained efforts over multiple years can lead to improved results.[152] Best professional judgment suggests a slight decrease in loading may be accomplished.

[152] (Abroms and Maibach 2008)

Appendix K: I-Plan Matrix Comparing Implementation Activities to the Nine Elements of a Watershed Protection Plan [153]

Table 21: Implementation Strategy 1.0: Wastewater Treatment Facilities

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Wastewater Treatment Facility Effluent	Implementation Activity 1.1 (IA 1.1): Impose more rigorous bacteria monitoring requirements	IA 1.1 is expected to reduce the waste load allocation assigned to WWTFs by 2-4%.	Technical: None Financial: Existing local funding. Current cost estimates for a bacteria sample are $50. The largest increase in sampling expenditures would be experienced by the smallest facilities. Expenditures for a WWTF with a permitted flow of less than 0.1 MGD would increase from $200 to $2,600.	Inform WWTF owners and operators that more rigorous monitoring requirements will be included in their permits.	As permits come up for renewal or as new permits are written, TCEQ will include the new requirements for WWTF permits, including any grace period approved by regulatory agencies.	Within five years, all of the permits should have had renewals initiated	The number of permits which include more rigorous bacteria monitoring requirements The level of indicator bacteria in the receiving streams	H-GAC will monitor the number of permits renewed and new permits issued each year in the BIG area and which contain more rigorous monitoring requirements Ambient water quality monitoring, as described in section 9.1	TCEQ: include requirements in permits. Inform WWTF owners of more stringent requirements. WWTF owners and operators: abide by the permit requirements H-GAC: Monitor and report on updated permits, provide annual report to BIG BIG: Evaluate progress
Wastewater Treatment Facility Effluent	Implementation Activity 1.2 (IA 1.2): Impose stricter bacteria limits for WWTF effluent	IA 1.2 is expected to reduce the waste load allocation assigned to WWTFs by up to 2%.	Technical: None Financial: Existing local funding. If changes are needed by the facility to meet standards, additional local funds, loans or grant funds may be required.	Inform WWTF owners and operators that more stringent bacteria limits will be included in their permits.	As permits come up for renewal or major amendments or as new permits are written, TCEQ will include the new requirements WWTF permits.	Within five years, all of the permits should have had renewals initiated	The number of domestic permits which include more stringent bacteria limits	H-GAC will monitor the number of new, amended, and renewed permits issued each year in the BIG area and which contain more stringent bacteria limits	TCEQ: include lower limits in permits. Inform WWTF owners of more stringent requirements. WWTF owners and operators: meet the lower limits H-GAC: Monitor and report on updated permits and compliance, provide annual report to BIG BIG: Evaluate progress

[153] The load reduction percentages presented in these tables are not based on results of any direct, peer-reviewed, or technically supported studies performed on pathogens or fecal indicators in waterways in the Greater Houston area and may not relate well to the level of fecal indicator reductions. More information about how these estimates were generated can be found in Appendix J: Load Reduction Value Information.

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Wastewater Treatment Facility Effluent	Implementation Activity 1.3 (IA 1.3): Increase compliance and enforcement by TCEQ	IA 1.3 is expected to reduce the waste load allocation assigned to WWTFs by up to 45%.	Technical: None Financial: State funding for additional staff or support of a local program to perform additional inspections and reviews.	New TCEQ staff or local programs conducting new activities will need to be trained.	Year One: TCEQ will allow for additional types of investigations at all WWTFs and determine the number of staff needed to perform inspections/investigations at each WWTF every two years. Year Two and on: TCEQ will hire additional staff or contract with local programs to perform inspections and reviews.	An increase each year in: - The number of unannounced inspections conducted each year - The number of focused sampling investigation each year - The percent of plans and specifications reviewed - The percent of DMRs reviewed - The number of other investigations conducted - The ability of TCEQ to conduct focused sampling investigations	The number of unannounced inspections each year The number of focused sampling investigations each year The percent of plans and specifications reviewed each year The percent of DMRs reviewed each year	H-GAC will collect reports from TCEQ including the number and types of inspections conducted, and the number of plans and specifications and DMRs reviewed	TCEQ: conduct a workload analysis to determine the necessary number of staff, allow for focused sampling investigations and unannounced inspections at all WWTFs, consider contracting with a local program to perform additional inspections and reviews H-GAC: collect information concerning the number of inspections and reviews conducted each year, provide annual report to BIG BIG: review the collected information and evaluate progress
Wastewater Treatment Facility Effluent	Implementation Activity 1.4 (IA 1.4): Improved design and operation criteria for new plants	IA 1.4 is expected to reduce the waste load allocation assigned to WWTFs by up to 10-20% over the life of the I-Plan if significant deficiencies are found in existing design and operation criteria.	Technical: Stakeholders, such as representatives of local governments and facility operators and engineers will need to assess the ability of WWTFs to remove bacteria from wastewater and determine appropriate changes to the design and operation criteria for new WWTFs Financial: Existing local funding	None	Year Six: Stakeholders, such as representatives of local governments and facility operators and engineers will begin to reopen the discussion of the design and operation criteria for new plants and consider whether stricter requirements should be adopted	Every five years 20% of local governments will have considered whether to adopt stricter requirements or not	The percent of local governments that have considered whether or not to adopt stricter requirements as reported by local governments	Reports collected from stakeholders.	WWTF owners and operators: Assess the ability of various WWTFs to remove bacteria, make suggestions of needed changes to the design and operation criteria for new plants based on the findings H-GAC: facilitate discussion between stakeholders as appropriate, collect reports BIG: participate in assessments and in making suggestions

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Wastewater Treatment Facility Effluent	Implementation Activity 1.5 (IA 1.5): Upgrade plants	An estimated 12% of the load from WWTFs can be expected from implementation of IA 1.5.	Technical: engineering or other specialized technical help will be necessary Financial: grant funding, loans, and existing local funding as available	Operators will need to be trained in the operations of any new components at the WWTF.	Beginning immediately, as individual WWTFs are found to be inadequate at bacteria removal	Over twenty-five years all facilities requiring upgrades in order to meet bacteria limits in their permit will have been upgraded.	The number of non-compliant WWTFs upgraded.	Reports from TCEQ to determine compliance rates with bacteria limits	WWTF owners and operators: monitoring compliance with bacteria limits and making appropriate upgrades H-GAC: monitor compliance rates, provide annual report to BIG BIG: evaluate progress
Wastewater Treatment Facility Effluent	Implementation Activity 1.6 (IA 1.6): Consider regionalization of WWTFs	It is estimated that no reduction in the waste load allocation assigned to WWTFs will be achieved from implementation of IA 1.6 except in segments where chronically non-compliant WWTFs are identified and subsequently made compliant or regionalized. In these particular segments the reduction will be estimated after identification of the chronically non-compliant facilities is complete.	Technical: engineering, legal, or other specialized technical help may be necessary Financial: grant funding, loans, and existing local funding as available	TCEQ compliance and enforcement staff and local government staff with jurisdictional authority will need to be trained regarding new protocols.	Beginning immediately, TCEQ and local governments with jurisdictional authority will identify WWTFs that are chronically non-compliant for bacteria.Stakeholders will evaluate regionalization, modification, or operational cessation of any WWTFs that are chronically non-compliant for bacteria	Develop a process for targeting WWTFs that are chronically non-compliant for bacteria	The number of WWTFs that are chronically non-compliant for bacteria that have been required to evaluate regionalization The number of WWTFs that are chronically non-compliant for bacteria that have regionalized, modified, or ceased operations	Reports from TCEQ or other local governments regarding the regionalization, modification, or operational cessation of any WWTFs that were chronically non-compliant for bacteria	TCEQ and stakeholders: Develop a process for targeting WWTF that are chronically non-compliant for bacteria; encourage WWTF that are chronically non-compliant for bacteria to regionalize, modify to meet higher design or monitoring standards, or cease operations; report activities H-GAC: collect progress reports, which may be in the form of existing reports, provide annual report to BIG BIG: evaluate progress
Wastewater Treatment Facility Effluent	Implementation Activity 1.7 (IA 1.7): Use treated effluent for plant irrigation	An estimated 1% reduction of the waste load allocation assigned to WWTFs can be expected.	Technical: professional engineers, operators, sanitarians, and licensed irrigators may need to be consulted regarding design, installation, and operation of appropriate systems Financial: grant funding and existing local funding as appropriate	Operators will need to be trained in the operations of any new components at the WWTF.	Beginning immediately as appropriate, WWTF owners or operators will consider the use of treated effluent for plant irrigation	One WWTF shall install and use a new irrigation system, utilizing treated effluent, every five years	The number of WWTFs using treated effluent for plant irrigation	Reports from WWTF owners and/or operators	WWTF owners, operators, and engineers: consider the use of effluent for plant irrigation H-GAC: collect progress reports, provide annual report to BIG BIG: evaluate progress

Table 22: Implementation Strategy 2.0: Sanitary Sewer Systems (SSS)

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Sanitary Sewer System (SSS) failures.	Implementation Activity 2.1 (IA 2.1): Develop Utility Asset Management Programs (UAMPs) for SSS	IAs 2.1 to 2.6, combined, over 25 years, may result in a 50% reduction in calculated bacteria loading from SSSs as identified in the TMDL projects.	Technical- Assistance from EPA, TCEQ, WEAT, and private consultants may be necessary to develop UAMP plans for individual systems. Technical assistance for EPA's CMOM program and TCEQ's SSOI program may be helpful. Financial- existing local funding and grant funding when available	Workshops presented by TCEQ, WEAT, H-GAC, and other entities Existing resources Occasional e-mails between stakeholders	Year One: Begin developing UAMP plans for individual SSS; begin developing workshops Year Two: TCEQ to begin adding UAMP requirements to new WWTF permits Year Six: TCEQ to begin adding UAMP requirements to all WWTF permits being renewed Continuing, as permits are renewed: updates to UAMP plans, implementation of UAMP plans	After five years, eight workshops held After ten years, all WWTF have UAMP plans	Reports provided by stakeholders to the BIG regarding progress	H-GAC will collect reports from SSS owners/ operators and TCEQ.	SSS owners/ operators: develop UAMP plan; report progress to BIG H-GAC: collect and share information on the progress made each year; facilitate workshops BIG: Evaluate progress TCEQ: Add UAMP provisions to TPDES permits for WWTF as described, provide technical assistance
Sanitary Sewer System (SSS) failures.	Implementation Activity 2.2 (IA 2.2): Address fats, oils, and grease	IAs 2.1 to 2.6, combined, over 25 year, may result in a 50% reduction in calculated bacteria loading from SSSs as identified in the TMDL projects.	Technical- regulations, ordinances, and orders of other communities, as collected and shared by H-GAC and/or TCEQ, may serve as models. Legal assistance may be necessary for individual communities EPA, TCEQ, WEAT, and other agencies offer some technical resources. Financial- existing local funding and grant funding as available	Provision of example and model language provided on website Jurisdictions who choose to change or add regulations will need to offer public comment and participation as appropriate. Distribution of website and collateral educational material related to fats, oils, and grease.	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	Compile and share all existing regulations in project area within five years Each community shall examine their regulations and policies within five years One community shall adopt new regulation every five years Flyers or other collateral material distributed Website created and distributed	Information included in annual reports to the BIG Number of new regulations Number of flyers or other collateral material distributed Number of website visits	H-GAC will collect reports from stakeholders	Cities, counties, special purpose districts, and TCEQ: Examine relevant regulations and make changes as appropriate; report progress H-GAC: collect and share information about communities' regulations; collect and share information on the progress made each year BIG: Evaluate progress

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Sanitary Sewer System (SSS) failures.	Implementation Activity 2.3 (IA 2.3): Encourage appropriate mechanisms to maintain function at lift stations	IAs 2.1 to 2.6, combined, over 25 year, may result in a 50% reduction in calculated bacteria loading from SSSs as identified in the TMDL projects.	Technical- Assistance from private consultants, EPA, TCEQ, and other entities may be necessary to develop appropriate mechanisms for individual lift stations Financial- existing local funding and grant funding as available	Educational components for this activity will be conducted as part of IA 2.1	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	10% of SSS shall be compliant with recommendations every five years for 25 years	Information included in annual reports to the BIG Number of systems in compliance with recommendations	H-GAC will collect reports from stakeholders	Cities, counties, special purpose districts, and TCEQ: develop and deploy appropriate mechanisms; report progress to BIG H-GAC: collect and share information on the progress made each year BIG: Evaluate progress
Sanitary Sewer System (SSS) failures.	Implementation Activity 2.4 (IA 2.4): Improve reporting requirements for SSOs	IAs 2.1 to 2.6, combined, over 25 year, may result in a 50% reduction in calculated bacteria loading from SSSs as identified in the TMDL projects.	Technical- EPA and TCEQ will require technical assistance to develop appropriate database and reporting technologies SSS owners/operators may need broadband internet access or equivalent Financial- existing local funding and grant funding as available	TCEQ/EPA shall provide appropriate instructions to SSS operators for using statewide database	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process. Within five years, EPA/TCEQ will have developed appropriate database and technology for collecting and sharing information regarding SSOs Following the deployment of the database, SSS owner/operators shall begin using the database	Deployment of an appropriate database for tracking SSOs SSO reports available in five years from database	Creation of database Number of reports in the database Number of SSS owner/operators reporting SSOs	H-GAC will collect information from TCEQ	EPA/TCEQ: develop and deploy database; report progress to BIG SSS owner/operators: report SSOs as appropriate H-GAC: collect and share information on the progress made each year BIG: Evaluate progress

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Sanitary Sewer System (SSS) failures.	Implementation Activity 2.5 (IA 2.5): Strengthen controls on subscriber systems	IAs 2.1 to 2.6, combined, may result in a 50% reduction in calculated bacteria loading from SSSs as identified in the TMDL projects is expected over 25 years.	Technical- TCEQ will need to be able to develop a registry of subscriber systems SSS owners/operators will need legal and technical assistance to review and improve contracts with subscribers Financial- existing local funding and grant funding as available	Circuit rider program to inform and assist SSO owners/ operators	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process. By year three: Develop model contract language Within three years: As resources are available, H-GAC shall begin offering a circuit rider program; begin contract reviews and modifications Within five years, TCEQ/H-GAC shall have a list of subscriber systems in the project area	List of subscriber systems Model contract language developed 5 contract renewals incorporating model language each year starting in year five	Information included in annual reports to the BIG Creation of subscriber registry Number of subscribers in registry Number of contract renewals incorporating model language each year starting in year five	H-GAC will collect reports from stakeholders	TCEQ: develop and deploy registry; report progress to BIG SSS/WWTF owner/operators: report any improvements to contracts; provide information regarding subscribers H-GAC: collect and share information on the progress made each year; manage circuit rider program BIG: Evaluate progress
Sanitary Sewer System (SSS) failures.	Implementation Activity 2.6 (IA 2.6): Restructure penalties for SSS violations	IAs 2.1 to 2.6, combined, may result in a 50% reduction in calculated bacteria loading from SSSs as identified in the TMDL projects is expected over 25 years.	Technical- Legal assistance may be necessary Financial- existing local funding and grant funding as available	TCEQ shall offer a public participation process as appropriate	Within five years, have appropriate penalty structure revisions in place	Within five years, have appropriate penalty structure revisions in place	Revised penalty structure for SSS violations	H-GAC will collect reports from stakeholders, including TCEQ	TCEQ: revise penalty structure H-GAC: collect and share information on the progress made each year BIG: Evaluate progress

Table 23: Implementation Strategy 3.0: On-site Sewage Facilities

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Nonpoint sources from malfunctioning On-site Sewage Facilities (OSSFs).	Implementation Activity 3.1 (IA 3.1): Identify and address failing systems.	In conjunction with IAs 3.2 and 3.3, a 75% reduction in bacteria loading from failing OSSFs as identified in the TMDL projects is expected over 25 years.	Technical- data and cooperation from Authorized Agents and TCEQ must be provided. Financial- existing local funding and grant funding when available	Annual meeting for Authorized Agents, TCEQ, H-GAC, and other stakeholders. Occasional e-mails between stakeholders. Development of educational material as appropriate.	Year One: Initial map Year Two: Target areas identified Ongoing: Collect data from Authorized Agents and TCEQ, fix/replace failing systems	Map created. Identification of target areas. 500 OSSFs repaired/replaced every five years for 25 years.	Reports provided by stakeholders to the BIG regarding progress. The number of OSSFs repaired or replaced.	H-GAC will collect reports from Authorized Agents and TCEQ.	Authorized Agents and TCEQ: Identify, seek to require replacement and/or repair of failing systems; participate in annual meeting; provide permit, violation, and enforcement data; report progress to BIG. Owners of failing OSSF: Replace or repair OSSFs. H-GAC: create and update map; facilitate annual meeting; collect and share information on the progress made each year BIG: Evaluate progress
Nonpoint sources from malfunctioning On-site Sewage Facilities (OSSFs).	Implementation Activity 3.2 (IA 3.2): Address inadequate maintenance of OSSFs.	In conjunction with IAs 3.1 and 3.3, a 75% reduction in bacteria loading from failing OSSFs as identified in the TMDL projects is expected over 25 years.	Technical- regulations, ordinances, and orders of other Authorized Agents, as collected and shared by HGAC and/or TCEQ, may serve as models. Legal assistance may be necessary. TCEQ, EPA, H-GAC, Texas Real estate Council, and other agencies offer some technical resources. Financial- existing local funding and grant funding as available	Annual meeting for Authorized Agents, TCEQ, H-GAC, and other stakeholders. Occasional e-mails between stakeholders. Provision of example regulations provided on website Jurisdictions who choose to change or add regulations will need to offer public comment and participation as appropriate. Website and collateral educational material.	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	Each community shall examine their regulations and policies within five years Compile and share all existing regulations in project area within five years One community shall revise or adopt new regulations every five years By year five, flyers or other collateral material distributed Number of website visits	Information included in annual reports to the BIG Number of new regulations Number of flyers or other collateral material distributed Number of website visits	H-GAC will collect reports from Authorized Agents and TCEQ.	Authorized Agents and TCEQ: Examine relevant regulations and make changes as appropriate; report progress H-GAC: collect and share information about communities' regulations; collect and share information on the progress made each year BIG: Evaluate progress

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Nonpoint sources from malfunctioning On-site Sewage Facilities (OSSFs).	Implementation Activity 3.3 (IA 3.3): Legislation and other regulatory actions	In conjunction with IAs 3.1 and 3.2, a 75% reduction in bacteria loading from failing OSSFs as identified in the TMDL projects is expected over 25 years.	Technical- regulations, ordinances, and orders of other communities, as collected and shared by HGAC, may serve as models. Legal assistance may be necessary. Financial- existing local funding and grant funding as available	Annual meeting for Authorized Agents, TCEQ, H-GAC, and other stakeholders.Occasional e-mails between stakeholders. Jurisdictions who choose to change or add regulations will need to offer public comment and participation as required by law.TCEQ shall provide samples of more stringent local rules.	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process. Starting in 2013, TCEQ shall consider hosting biennial meetings to review OSSF regulations.	Compile and share all existing regulations in project area within five years Each community shall examine their regulations and policies within five years One community shall revise or adopt new regulations every five years Starting in 2012, TCEQ shall begin hosting biennial meetings to review OSSF regulations Changes to TOWTRC rules updated within five years	Information included in annual reports to the BIG Number of new regulations Updated TOWTRC rules	H-GAC will collect reports from Authorized Agents and TCEQ.	Authorized Agents: Examine and share relevant regulations and make changes as appropriate; report progress H-GAC: collect and share information about communities' regulations; collect and share information on the progress made each year BIG: Evaluate progress TCEQ: Host biennial meeting

Table 24: Implementation Strategy 4.0: Stormwater and Land Development

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Stormwater runoff	Implementation Activity 4.1: Continue Existing Programs	In conjunction, IAs 4.1 through 4.6 are expected to reduce bacteria loading from stormwater and land development by up to 20% over the entire implementation process	Technical- No additional technical assistance is needed to undertake this activity Financial- existing local funding and grant funding as available	Education will be provided as specified in existing programs.	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	80 programs will continue.	Reports, which may be in the form of existing reports, provided by stakeholders to the BIG regarding continuation of the programs The number of programs continued	H-GAC will collect reports, which may be in the form of existing reports, from appropriate entities	Cities, counties, TCEQ, and permitted MS4 communities, and other stakeholders: Continue existing programs, report progress to the BIG H-GAC: collect progress reports, which may be in the form of existing reports, provide annual report to BIG BIG: Evaluate progress
Stormwater runoff	Implementation Activity 4.2: Model Best Practices	In conjunction, IAs 4.1 through 4.6 are expected to reduce bacteria loading from stormwater and land development by up to 20% over the entire implementation process	Technical- technical assistance will be provided by stakeholders through the participation process Financial- existing local funding and grant funding as available	As resources allow, collaborative networking meetings will be offered on an ongoing basis to address the topics of minimum control measures required in MS4 permits and/or related BMPs Website highlighting best practices	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	Four to six networking meetings each year Five local programs highlighted on H-GAC or other appropriate website each year	Number of meetings each year Number of attendees at networking meetings Number of programs highlighted on website Number of visitors to the web library Number of programs modified as a result of meetings or evaluation of model programs	H-GAC will collect reports, which may be in the form of existing reports, from appropriate entities	Cities, counties, TCEQ, and permitted MS4 communities, and other stakeholders: Provide information to the BIG regarding model programs, attend meetings, view website H-GAC: coordinate meetings, develop website, collect progress reports, which may be in the form of existing reports, provide annual report to BIG BIG: Evaluate progress

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Stormwater runoff	Implementation Activity 4.3: Encourage Expansion of Stormwater management Programs	In conjunction, IAs 4.1 through 4.6 are expected to reduce bacteria loading from stormwater and land development by up to 20% over the entire implementation process	Technical- Several storm-water programs already exist and may be used as guides, including EPA and TCEQ programs and programs of MS4 permit holders. Engineering, legal, or other specialized technical help may be necessary in some communities Financial- existing local funding and grant funding as available. New local funding may be necessary	H-GAC, BIG, and other stakeholders shall contact local governments as resources are available Website and networking meetings, as specified in IA 4.2	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process. By year five, all permit holders shall expand or focus their existing stormwater programs as appropriate By year five, 30 previously unpermitted entities shall develop new programs	Number of reported program expansions/modificationsNumber of reported new programs	Reports of modified and new programs	H-GAC will collect reports, which may be in the form of existing reports, from appropriate entities	Cities, counties, TCEQ, and permitted MS4 communities, and other stakeholders: Expand and focus existing programs, develop new programs, report progress to the BIG H-GAC: collect progress reports, which may be in the form of existing reports, provide annual report to BIG BIG: Evaluate progress; as appropriate, recommend expansion of MS4 program to TCEQ
Stormwater runoff	Implementation Activity 4.4: Promote Recognition Programs for Developments that Voluntarily Incorporate Bacteria Reduction Measures	In conjunction, IAs 4.1 through 4.6 are expected to reduce bacteria loading from stormwater and land development by up to 20% over the entire implementation process	Technical- Technical assistance will be needed from stakeholders and experts from existing recognition programs Financial- existing local funding and grant funding as available	-Website -Stakeholder participation process -Education as identified in the development of the recognition program	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	Within five years, develop a recognition program Upon completion of the program development, recognize at least one community/ project each year for five years and an increasing number of communities/ projects thereafter, or as specified as part of the program development process Two communities each year analyze regulations and programs to accommodate participation in existing programs	A new recognition program Number of communities/projects participating in existing programs Number of communities/projects participating in new recognition program The number of local regulations modified to accommodate participation in existing recognition programs	H-GAC will collect reports, which may be in the form of existing reports, from appropriate entities	H-GAC and other stakeholders: Develop and promote new recognition program; accommodate existing programs; provide annual reports Developers and other stakeholders: Participate in recognition programs and development thereof H-GAC: collect progress reports, which may be in the form of existing reports, provide annual report to BIG, facilitate development of recognition program BIG: Evaluate progress

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Stormwater runoff	Implementation Activity 4.5: Provide a Circuit Rider Program	In conjunction, IAs 4.1 through 4.6 are expected to reduce bacteria loading from stormwater and land development by up to 20% over the entire implementation process	Technical- technical assistance will be provided by stakeholders through the participation process Financial- existing local funding and grant funding as available	The circuit-rider program will focus on education	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	Employment of circuit rider Each year, contact 50 stakeholders and provide five in-depth community consultations	As specified by the circuit rider, number of stakeholders contacted and number of in-depth community consultations	H-GAC will collect reports, which may be in the form of existing reports, from appropriate entities	Cities, counties, TCEQ, and permitted MS4 communities, and other stakeholders: Work with circuit rider to improve programs H-GAC: collect progress reports, which may be in the form of existing reports, provide annual report to BIG, oversee circuit-rider program BIG: Evaluate progress
Stormwater runoff	Implementation Activity 4.6: Petition TCEQ to Facilitate Reimbursement of Bacteria Reduction Measures	In conjunction, IAs 4.1 through 4.6 are expected to reduce bacteria loading from stormwater and land development by up to 20% over the entire implementation process	Technical- Engineering, legal, or other specialized technical help may be necessary Financial- existing local funding and grant funding as available	Occasional stakeholder communications	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	Letter of commitment (or similar) from TCEQ within three years	Letter of commitment (or similar) from TCEQ	H-GAC will collect reports, which may be in the form of existing reports, from appropriate entities	Stakeholders: Work with TCEQ to provide guidance TCEQ: interpret existing policies, promulgate guidance H-GAC: collect progress reports, which may be in the form of existing reports, provide annual report to BIG BIG: Evaluate progress

Table 25: Implementation Strategy 5.0: Construction

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Runoff from construction sites	**IA 5.1 -** Increase compliance with and enforcement of stormwater management permits through: Increases in the percentage of sites inspected through increases in inspectors Development and distribution of educational materials Training workshops for contractors, construction site owners, developers, and MS4 operators regarding stormwater management best management practices	The amount of bacteria leaving individual construction sites may be reduced by up to 85% if water quality best management practices are implemented for the first time and to the full extent possible.	Technical- The expertise and assistance of stormwater management professionals will be necessary to develop educational and training materials. Financial- salaries for additional inspectors, both in local communities and at TCEQ, and financial support for educational materials and trainings will be funded through a mixture of state, local, and grant funding.	Education materials explaining proper construction site practices will be developed and distributed to contractors, construction site owners, MS4 operators, developers, and citizens. Training workshops will be held for contractors, construction site owners, developers, and MS4 operators regarding stormwater management best management practices.	Year 1: MS4s must evaluate the need or requirement for staffing an appropriate construction inspection program. If needed, additional inspectors must be hired as resources are available. Year 2: Develop and begin distributing/offering educational materials and trainings.	Evaluations conducted regarding the need or requirement for staffing an appropriate construction inspection program and subsequent increases in staffing levels as needed Development, distribution, and offering of educational materials and trainings	Increases in inspection capacity Number of educational materials distributed and the number of groups receiving educational materials Number of trainings offered and the number of attendees	H-GAC will collect reports from MS4s and data from H-GAC staff records.	MS4s: evaluate the need or requirement for staffing an appropriate construction inspection program and increase staffing levels as needed and as resources are available H-GAC: develop and distribute educational materials, develop and offer trainings, report on the progress made each year BIG: Evaluate progress, make recommendations as appropriate

Table 26: Implementation Strategy 6.0: Illicit Discharges and Dumping

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Illicit Discharges and Dumping	Implementation Activity 6.1 (IA 6.1): Detect and eliminate illicit discharges	In conjunction with IAs 6.2 and 6.3, a 5% reduction in indicator bacteria loading from illicit discharges and dumping is expected over 25 years.	Technical- several illicit discharge detection programs already exist and may be used as guides, including publications by EPA and TCEQ and H-GAC's publication "NPS Guide to Identifying Illicit Connections." Engineering or other specialized technical help may be necessary in some communities Financial- existing local funding and grant funding when available	Collaborative workshops, offered as an implementation activity for stormwater, will address detection and elimination of illicit discharges.	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process. Initial surveys/maps shall be completed within ten years.	Initial surveys shall be completed within ten years.	Information included in annual reports to the BIG Number of illicit discharges resolved each year Number of surveys completed Number of illicit discharges identified each year	H-GAC will collect reports, which may be in the form of existing reports, from jurisdictions such as counties and cities.	MS4 Permit holders and the state: identify and eliminate illicit discharges, map system, report progress Individual violators: eliminate illicit discharges H-GAC: collect and share information on the progress made each year BIG: Evaluate progress
Illicit Discharges and Dumping	Implementation Activity 6.2 (IA 6.2): Improve regulation and enforcement of illicit discharges	In conjunction with IAs 6.1 and 6.3, a 5% reduction in bacteria loading from illicit discharges and dumping is expected over 25 years.	Technical- regulations, ordinances, and orders of other communities, as collected and shared by HGAC, may serve as models. Legal assistance may be necessary. Financial- existing local funding and grant funding as available	Collaborative workshops, offered as an implementation activity for stormwater, will address detection and elimination of illicit discharges. Provision of example regulations provided on website As resources are available, a circuit rider will provide information and assistance Jurisdictions who choose to change or add regulations will need to offer public comment and participation as appropriate.	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	Compile and share all existing regulations in project area within five years Each community shall examine their regulations and policies within five years One community shall adopt new or revised regulations every five years	Information included in annual reports to the BIG Number of new or revised regulations	H-GAC will collect reports, which may be in the form of existing reports, from jurisdictions such as counties and cities.	MS4 Permit holders and the state: Examine relevant regulations and make changes as appropriate; report progress H-GAC: collect and share information about communities' regulations; collect and share information on the progress made each year BIG: Evaluate progress

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Dumping by waste haulers	Implementation 6.3 (IA 6.3): Monitor and control waste hauler activities.	In conjunction with IAs 6.1 and 6.2, a 5% reduction in bacteria loading from illicit discharges and dumping is expected over 25 years.	Technical- regulations, ordinances, and orders of other communities, as collected and shared by H-GAC, may serve as models. Legal assistance may be necessary. H-GAC's solid waste program may be able to provide assistance. Financial- existing local funding and grant funding as available	Collaborative workshops, offered as an implementation activity for stormwater, will address detection and elimination of illicit discharges. Provision of example waste hauler programs provided on website Jurisdictions who choose to change or add regulations will need to offer public comment and participation as appropriate.	As resources are available, implementation of this activity will begin immediately and will continue for the entire implementation process.	Compile and share all existing regulations in project area within five years Each community shall examine their regulations and policies within five years One community shall adopt new or revised regulations every five years One waste hauler fleet tracking pilot program shall be started within five years	Information included in annual reports to the BIG Number of new and revised regulations Number of new programs	H-GAC will collect reports, which may be in the form of existing reports, from jurisdictions such as counties and cities.	MS4 Permit holders and the state: Examine relevant regulations, make changes as appropriate; report progress H-GAC: collect and share information about communities' regulations; collect & share information about progress annually Funding recipient for waste hauler fleet tracking pilot program: manage program, provide reports BIG: Evaluate progress

Table 27: Implementation Strategy 7.0: Agriculture and Animal

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Nonpoint sources from croplands and rangelands	Promote increased participation in existing erosion control, nutrient reduction, and livestock management programs (IA 7.1).	It can be expected that a 65% reduction in bacteria loading can be achieved for each cattle population addressed. In conjunction with IA 7.2, a 10% reduction in bacteria loading from agriculture and animal sources is expected over 25 years.	Technical- assistance will be provided to farmers and ranchers by the Texas State Soil and Water Conservation Board, local Soil and Water Conservation Districts, Texas AgriLife Extension Service, the United States Department of Agriculture's Natural Resources Conservation Service, etc. Financial- The costs depend on the goals for the property, the size of the management area, the existing condition of the property, and the plan that is collaboratively developed with the various resource agencies. The state's cost-share limit for Water Quality Management Plans is $15,000.	Information will be disseminated via word of mouth from participants; Texas AgriLife Extension Service agents' contact with the public; public outreach from local Soil and Water Conservation Districts; and through 4-H clubs, rodeos, agricultural field days, the Texas Farm Bureau, the Texas and Southwestern Cattle Raisers Association, and the Independent Cattleman's Association of Texas.	Implementation of this activity will begin immediately and will continue for the entire implementation process.	5% increase in participation each year.	The number of new or expanded plans or projects	H-GAC will collect reports from agencies such as TSSWCB, local SWCDs, NRCS, and AgriLife Extension.	Farmers and Ranchers: upgrade/develop plans and projects BIG: provide the I-Plan to the implementing agencies along with a formal request for their assistance in encouraging program participation TSSWCB, local SWCDs, NRCS, and AgriLife Extension: work with landowners and provide information and technical assistance H-GAC: collect and share information on the progress made each year
Bacteria deposited in the watersheds by feral hogs	Promote the reduction of feral hog populations (IA 7.2).	In conjunction with IA 7.1, a 10% reduction in bacteria loading from agriculture and animal sources is expected over 25 years.	Technical- existing resources such as feral hog management trainings offered by the Texas Wildlife Damage Management Service and others. Financial- grant funding and existing program funding	Trainings will be offered to large landowners, land managers, local governments, and other interested parties on feral hog management and reduction methods.	Two feral hog management workshops will be offered each year for the first five years of implementation with the potential to continue offering the trainings.	Two workshops each year for five years	The number of trainings offered each year The number of attendees	H-GAC will collect information from agencies regarding the number of trainings held and the total number of attendees at each.	TWDMS: conduct feral hog management training H-GAC: request workshops and collect and share information on the progress made each year

Table 28: Implementation Strategy 8.0: Residential Sources

(a) Causes/ Sources	(b) Implementation Activities and Targeted Critical Areas	(c) Estimated Potential Load Reduction	(d) Technical and Financial Assistance Needed for Each Activity	(e) Education Component for Each Activity	(f) Schedule of Implementation for Each Activity	(g) Interim, Measureable Milestones for Each Activity	(h) Indicators to Measure Progress	(i) Monitoring Component	(j) Responsible Entity
Nonpoint sources from residential property	**IA 8.1 -** Expand homeowner education efforts throughout the BIG project area	Expanded homeowner education efforts are expected to reduce bacteria loading from residential sources by 5%.	Technical- communities will look to existing education programs and materials when developing their own. Financial- funding can be expected to come through a mixture of local and grant funding opportunities.	Homeowner education efforts may include printed materials and other media	Implementation of this activity will begin immediately and will continue for the entire implementation process.	Average 2% annual increase in number of communities participating in new or expanded programs One pilot study in the BIG project area every five years	Progress will be indicated by the number of new or expanded education programs and pilot studies noted in the annual reports	H-GAC staff will collect data from communities through the annual report process. Data collected will include the information distributed or publicized, the method of distribution or publication, the number of individuals or households reached, and the results from pilot studies.	Cities, counties, and special purpose districts: expand bacteria related education efforts and conduct pilot studies to evaluate the results of selected efforts H-GAC: collect and share information on the progress made each year BIG: Evaluate the progress made

Appendix L: Public Involvement and Public Outreach

The development of TMDLs in the Houston region involved many diverse stakeholders. The stakeholders for the TMDL projects expressed support for a common steering committee to oversee the development of an implementation plan for the TMDLs. H-GAC sought stakeholders that represented business, agriculture, conservation, municipalities, cities, counties, and each of the four TMDL projects that were being undertaken in the area.

Stakeholders submitted nearly 50 nominations for the advisory committee. H-GAC's Natural Resources Advisory Committee reviewed the nominations. The H-GAC Board of Directors, which is composed of elected officials throughout the region, approved the stakeholder appointments recommended by H-GAC's Natural Resources Advisory Committee.

The BIG includes representatives of city and county governments, resource agencies, business and agricultural interests, conservation and professional organizations, watershed groups, and the public. The BIG has met 27 times between July of 2008 and March of 2011. The BIG arrived at decisions pertaining to the I-Plan by consensus. These meetings were open to everyone. On average, about 60 people attended in person or on the phone, with new people attending almost every meeting.

In addition, the BIG formed 14 workgroups to address specific topics of concern to the committee. In total, these workgroups met more than 75 times over two years. Participants and interested parties were added to the mailing lists for these workgroups and to the mailing list for the BIG.

After one year, the BIG made a concerted effort to reach out to elected officials and key staff at cities, counties, and special purpose districts. Other stakeholder organizations, including non-profit environmental organizations and professional associations, were included in this effort. Hundreds of letters were sent and hundreds of stakeholders were added to the e-mailing list. In general, two e-mails were sent every month to each of the identified stakeholders.

In addition to letters and e-mails, H-GAC hosted and attended dozens of meetings in order to share information about the activities of the BIG. Meetings included over a dozen TMDL stakeholder meetings throughout the BIG project area and ten informational open houses. Presentations were given and booths were hosted in many forums, including meetings of:

- *Texas Environmental Health Association,*
- *EPA Region 6 MS4 Operators Conference,*
- *Sierra Club,*
- *Bayou Preservation Association,*
- *Quality of Life Coalition,*
- *EPA Region 6 CMOM Conference,*
- *Texas Association of Water Board Directors,*

- *Central Fort Bend Chamber Alliance,*
- *Harris County Flood Control Task Force,*
- *H-GAC's Natural Resources Advisory Committee,*
- *Pasadena Citizens Advisory Council,*
- *Texas Water Conference,*
- *Texas Association of Environmental Professionals, Houston Chapter*
- *Sam Houston District of the Texas Water Utilities Association,*
- *White Oak Bayou Association, and the*
- *Houston Council of Engineering Companies.*

Multiple press releases were sent out to a large number of local media. Media coverage included both local radio and newspaper articles as well as information in local and statewide newsletters and list serves.

A formal public comment period was held from December 2010 through February 15, 2011. Over two hundred comments were submitted in person, by mail and e-mail, web survey, and on the phone. The BIG developed responses to the comments which were then incorporated into the draft. These comments and responses are included in Appendix M. Once the updated draft was approved by the BIG, H-GAC began soliciting formal support from stakeholders including counties, cities, special purpose districts, professional and conservation organizations. The BIG is soliciting formal support for the I-Plan in order to reflect the widespread support displayed by stakeholders. The aforementioned support will be incorporated into the I-Plan as an additional appendix before it is submitted to the TCEQ for consideration. Before submittal to the TCEQ, BIG members will sign a document indicating their approval, arrived at by consensus, of the I-Plan for submittal. This signature page will be included in the I-Plan submitted to the TCEQ.

Opportunities for involvement and participation by stakeholders will not end after the I-Plan is submitted to the TCEQ. TCEQ review, which may take several months, will also include an opportunity to submit comments on the I-Plan. Furthermore, the I-Plan contains provisions for continued stakeholder involvement and oversight, including annual reports to the BIG and stakeholders and revisions to the I-Plan.

Select pages from front matter are not included in this abridged version.

Appendix N: Minority Reports

No minority reports were received.

Appendix O: Formal Support for the I-Plan

The following entities passed resolutions of support for the I-Plan or submitted a letter in support of the plan. Copies of the resolutions and letters follow the list.

Counties

Fort Bend County
Harris County
Montgomery County *

Cities

City of Brookside Village
City of Houston
City of League City
City of Manvel
City of South Houston *
City of West University Place

Special Purpose Districts

Addicks Utility District
Baker Road MUD
Grand Lakes MUD No. 1
Grand Lakes MUD No. 2
Grand Lakes MUD No. 4
Grand Lakes Water Control and Improvement District
Green Trails MUD
Harris County Flood Control District (see joint resolution with Harris County)
Harris County Municipal Utility District No. 26
Harris County Municipal Utility District No. 70
Harris County Municipal Utility District No. 96
Harris County Municipal Utility District No. 183
Harris County Municipal Utility District No. 200
Harris County Municipal Utility District No. 239
Harris County Municipal Utility District No. 281
Harris County Municipal Utility District No. 282
Harris County Municipal Utility District No. 284
Harris County Municipal Utility District No. 304

Harris County Municipal Utility District No. 316
Harris County Municipal Utility District No. 341
Harris County Municipal Utility District No. 345
Harris County Municipal Utility District No. 370
Harris County Municipal Utility District No. 399
Harris County Municipal Utility District No. 400
Harris County Municipal Utility District No. 401
Harris County Municipal Utility District No. 418
Harris County Municipal Utility District No. 419
Harris County Water Control and Improvement District No. 109
Harris County Water Control and Improvement District No. 157
Harris-Fort Bend Counties MUD No. 1
Harris-Fort Bend Counties MUD No. 3
Harris-Fort Bend Counties MUD No. 5
Harris-Montgomery Counties MUD No. 386
Jackrabbit Road PUD
Langham Creek MUD
Montgomery County MUD No. 94
Montgomery County MUD No. 119
Morton Road MUD
Northpointe WCID
Nottingham Country Municipal Utility District
Ricewood MUD
Spring West MUD
Westlake MUD No. 1
The Woodlands Joint Powers Agency, including the following MUDs:

- Montgomery County MUD Nos. 6,7,36,39,40,46,47,60,67, and The Woodlands Metro Center MUD.
- The remaining MUD in The Woodlands JPA is expected to approve a resolution in August.

Other Organizations

Bayou Preservation Association
Brays Bayou Association
Buffalo Bayou Partnership
Cypress Creek Flood Control Coalition
Galveston Bay Council *
Greater Houston Partnership
Greens Bayou Corridor Coalition

Gulf Coast Waste Disposal Authority
Harris County Flood Control District Task Force
Harris County Soil & Water Conservation District #442
Houston Audubon Society*
Houston Council of Engineering Companies
Houston-Galveston Area Council
North Houston Association
Texas Coastal Partners *

* While resolutions of support have been passed by these organizations, H-GAC had not received copies at the time of publication. These, and other documentation of support, will be sent to TCEQ upon receipt and added to the document.

Select pages from front matter are not included in this abridged version.