BIG '17

ANNUAL REPORT

BACTERIA IMPLEMENTATION GROUP

This annual report for the Implementation Plan for Ninety- Five Total Maximum Daily Loads for Bacteria in the Houston-Galveston Region (I-Plan) is prepared by the Houston-Galveston Area Council's Community and Environmental Planning Department in collaboration with the Bacteria Implementation Group (BIG), a stakeholder group appointed by H-GAC's Board of Directors and charged with the I-Plan's development and oversight.

The preparation of this report was financed in part through grants from the U.S. Environmental Protection Agency and the Texas Commission on Environmental Quality.

More information about the project, including the full I-Plan, can be found at: www.h-gac.com/BIG.

Cover Photo courtesy of Gene Fissler.

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Implementing the BIG I-Plan

The 33-member Bacteria Implementation Group (BIG) consists of government, business, and community leaders working together with other stakeholders from across the region to implement the BIG I-Plan to help reduce bacteria in area waterways.

BIG Members

Rep. Ernest Bailes IV, San Jacinto County (Agriculture)
Michael Bloom, R. G. Miller Engineers, Inc. (Business/Industry)
David Brown, US Geological Survey (Resource Agency/Academia)
Richard Chapin, City of Houston (Large City)
Marilyn Christian, Harris County (Urban County)
Danielle Cioce, Harris County (Urban County)
Hannah Cruce, Texas Forest Service (Agriculture)
Denise Ehrlich, Gulf Coast Authority (Business/Industry)
Catherine Elliott, Harris County Flood Control District (Urban County)
Greg M. Hall Jr., City of Conroe (Small City)
Teague Harris, IDS Engineering Group (Utility District)
Steve Hupp, Bayou Preservation Association (Conservation)
Jason Iken, City of Houston (Large City)
Andrew Isbell, Walker County (Rural County)
Tom Ivy, Environmentally Concerned Citizen (Conservation)
Nate Johnson, Galveston Bay Foundation (Conservation)
Helen Lane, Houston Audubon Society (Conservation)
Mike Lindsey, Montgomery County (Rural County)
Craig Maske, IDS Engineering (Business/Industry)
Cathy McCoy, Harris County Soil and Water Conservation District #442 (Agriculture)
Jack Murphy, City of League City (Small City)
Becky Olive, AECOM (Business/Industry)
Anne Olson, Buffalo Bayou Partnership (Conservation)
Mitchell Page, Schwartz, Paige & Harding, LLP (Utility District)
David Parkhill, San Jacinto River Authority (Business/Industry)
Raymond Pavlovich, Nottingham County MUD (Utility District)
Linda Pechacek, LDP Consultants, Inc. (Public)
Rod Pinheiro, City of Houston (Large City)
Jim Robertson, Cypress Creek Flood Control Coalition (Conservation)
Linda Shead, Texas Coastal Partners (Conservation)
Brian Shmaefsky, Lone Star College, Kingwood (Resource Agency/Academia)
Vacancy, (Rural Small City)
Vacancy, (Business/Industry)

Parenthetical indicates type of organization represented.

BIG Alternates

Zafar Ahmed, City of Houston
Shaun Austin, Gulf Coast Authority
Camila Biaggi, Harris County
Susie Blake, City of League City
Kathlie Bulloch, City of Houston
Ralph Calvino, AECOM
Jerry Caraviotis, Harris County
Matthew Carpenter, IDS Engineering Group
Jon Connolly, Lone Star College, Kingwood
Brian Craig, City of League City
Dale Everitt, San Jacinto County
Bethany Foshee, Houston Audubon Society
Jessalyn Giacona, Buffalo Bayou Partnership
Frank Green, Montgomery County
Denise Hall, Harris County
Jody Hooks, City of League City
Scott Jones, Galveston Bay Foundation
James "Ty" Kelly, Bayou Preservation Association
Carol LaBreche, City of Houston
Michael Lee, US Geological Survey
Jason M. Maldonado, Lockwood, Andrews and Newnam
Patty Matthews, AECOM
Scott Nichols, Montgomery County
Michael Page, Schwartz, Page & Harding, LLP
Rachel Powers, Citizens' Environmental Coalition
Mary L. Purzer, AECOM
Nick J. Russo, Harris County
Scott Saenger, Jones & Carter, Inc.
Linda Shead, Buffalo Bayou Partnership
Hughes Simpson, Texas Forest Service
Richard "Dick" Smith, Cypress Creek Flood Control Coalition
Robert Snoza, Harris County Flood Control District
Michael Thornhill, Si Environmental, LLC
Roberto Vega, Harris County Flood Control District
Jennifer Wheeler, Harris County
Jim Williams, Sierra Club

Be Part of the Solution

The BIG project, the first of its kind in the state, is successful thanks in no small part to your support. We are eager to build on this success and seek the continued commitment of our partners and renewed interest and participation of our stakeholders.

Many of the implementation activities in the I-Plan are voluntary. MS4 Phase I and Phase II operators, local governments, farmers and ranchers, OSSF owners, pet owners, and residents can help reduce the number of bacteria entering waterways.

Learn more by visiting www.h-gac.com/BIG.

Many stakeholders participated in I-Plan implementation activities and development of this Annual Report (see Appendices A and E).

Executive Summary

Half of the Houston-Galveston region's stream and shoreline miles have bacteria levels higher than state standards for contact recreation. High bacterial concentrations may cause gastrointestinal illnesses or skin infections in swimmers or others who come into direct contact with the water.

Since 2008, a group of government, business, and community leaders as members of the Bacteria Implementation Group (BIG) have joined together to develop and implement a plan, the BIG Implementation Plan (I-Plan), to reduce bacteria and improve water quality so that the region's waters support contact recreation where appropriate. The Texas Commission on Environmental Quality (TCEQ) approved the I-Plan (formally known as the Implementation Plan for Seventy-Two Total Maximum Daily Loads for Bacteria in the Houston-Galveston Region) on January 31, 2013. The 2017 Annual Report is designed to track progress made in the BIG Project Area (Figure 1) by the BIG during the period of January 1, 2016 - December 31, 2016.

Hurricane Harvey – At the time of publishing the 2017 Annual Report, Hurricane Harvey impacted the Texas Coast and the counties within the BIG project area. Water quality and other Hurricane Harvey data was incomplete to provide a full rendering of post hurricane impacts. The effects from Harvey will be highlighted in the 2018 Annual Report.

Three BIG Ideas to Consider

A review of available data and current actions taken by BIG stakeholders suggest three key implementation strategies for local communities to consider addressing when committing resources to reduce bacteria:

Reduce or Eliminate Sanitary Sewer Overflows (SSOs) – Develop and implement a routine illicit discharge detection and elimination (IDDE) program and prioritize rehabilitation and replacement of aging and/or undersized infrastructure, including collection systems, lift stations, and wastewater treatment facilities (WWTFs). Coordinating with other partners, develop and implement effective education and outreach with residents concerning the handling of fats, oils, and grease. Example programs include the City of Houston's Corral the Grease, and the Galveston Bay Foundation's Cease the Grease programs.

Address Failing On-Site Sewage Facilities (OSSFs) (commonly referred to as septic systems) – OSSFs are wastewater infrastructure, albeit on a much smaller and localized scale. Like all infrastructure, OSSFs require periodic inspections, routine maintenance, and sometimes eventual replacement to function properly. Residents, cities and counties should participate in OSSF function and maintenance training, encourage real estate OSSF inspections at the time of sale and increase the number of inspections. Local governments, as needed, should seek and make funding available to help incentivize OSSF rehabilitation or replacement and promote connections to centralized waste treatment for areas with chronically failing OSSFs.

Decrease and Disconnect Impervious Surfaces – Consider expanding traditional development methods to include alternative practices that decrease use of and/or disconnect impervious surfaces in redevelopment and new built areas. These practices interrupt and slow rainfall run-off offering bacteria reduction measures the opportunity to work before the run-off reaches the

storm sewer. Low impact development (LID) and green infrastructure along with other practices have been designed to reduce pollutant loads while not adversely impacting flood management. Cities and counties can encourage the use of these practices by removing potential ordinance barriers and offering incentives for their use.

BIG Project Area

The information on this map represents the most current information available to H-GMC and is for general informational purposes only. H-GMC does not implicitly or expressly warrant its accuracy or completeness and neither assumes nor will accept liability for its use.

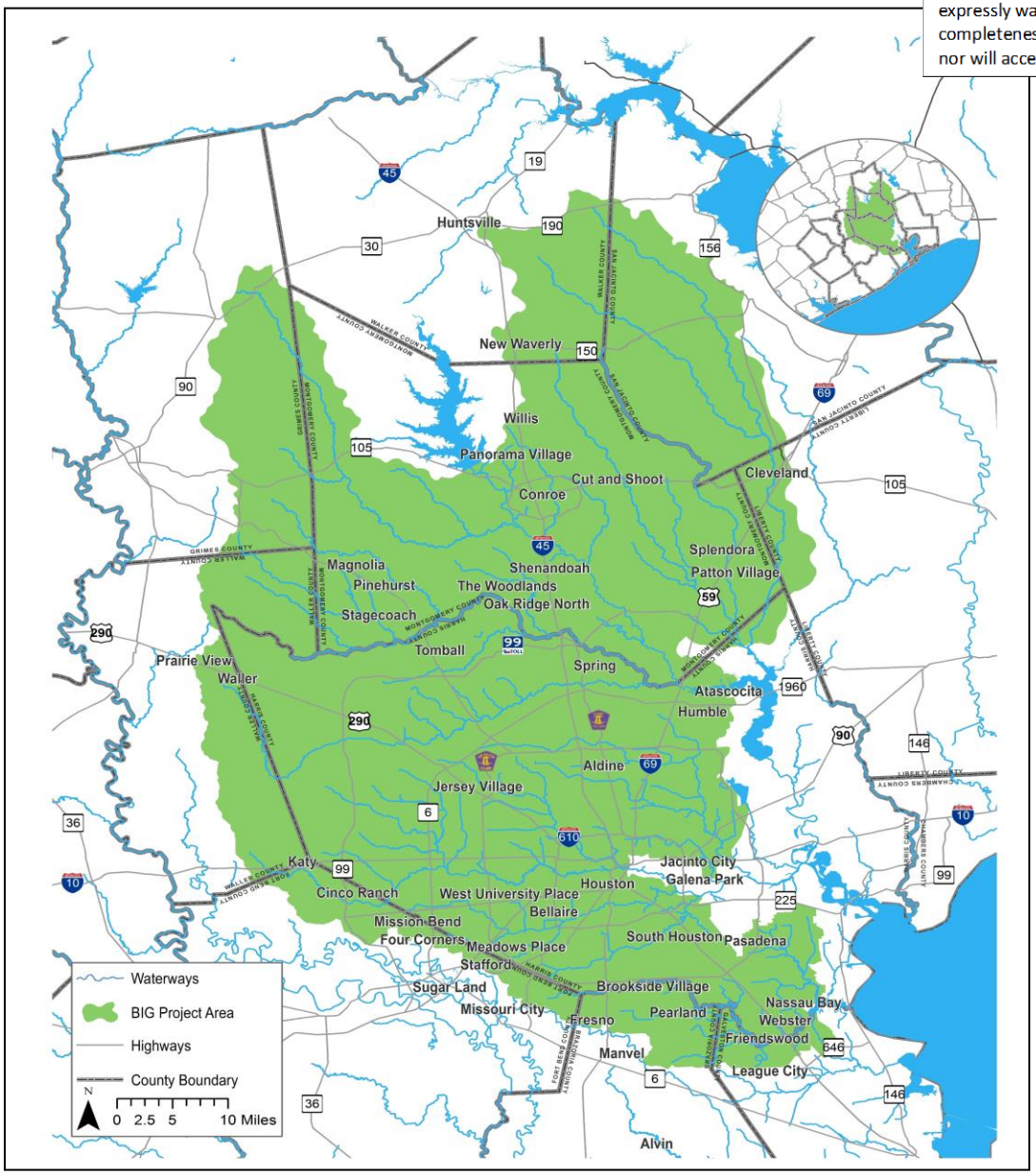


Figure 1. The BIG project area is approximately 3,260 square miles and has a population of nearly five million people. The area encompasses much of the City of Houston and all or part of another 63 cities and 10 counties.

Implementation Strategies

Since different sources contribute to the bacteria issue in the BIG project area, there is no one-size-fits-all solution for the problem. This I-Plan is a common-sense approach for reducing bacteria in our waterways. Municipalities, industries, landowners, and residents can consider a menu of water protection and implementation activities addressed by the following 11 strategies:

1. Wastewater Treatment Facilities
2.Sanitary Sewer Systems
3.On-Site Sewage Facilities
4.Stormwater and Land Development
5.Construction
6.Illicit Discharges and Dumping
7. Agriculture and Animals
8. Residential
9. Monitoring and I-Plan Revision
10. Research
11. Geographic Priority Framework

Making Progress

The good news is the BIG appears to be making a difference. Overall, bacteria levels for waterways in the BIG project area are going down. Since 2005, when stakeholders discussed the problem during the total maximum daily load (TMDL) project, bacteria levels in waterways have decreased from above eight times the state's contact recreation standard to just above four times the standard (Figure 1). There remains a distance to go to accomplish the stated goal of the I-Plan to reduce bacteria concentrations in the region's waters to fully support contact recreation, where appropriate.

Many stakeholders are actively implementing and tracking progress. Partners within the BIG are examining the effectiveness of implementation activities in reducing bacteria, including installing and monitoring structural best management practices; addressing bacteria impairments as part of their MS4 program; committing resources to address aging and failing infrastructure, educating and training local wastewater treatment operators, developers, and water quality service providers; and conducting public education and involvement campaigns. By working together, we can continue to identify what's working and what remains to be implemented.

Since the first annual report was written in 2013, the BIG project area has expanded. The first expansion included the Armand Bayou TMDL project area in 2015. The second expansion happened in 2016 with the inclusion of the East and West Fork of the San Jacinto TMDL Project Area. The original project area was 2,202.7 sq. miles. The expanded area is now 3,259.89 sq. miles, roughly the size of Delaware and Rhode Island, combined. The I-Plan was initially written for 72 TMDLs. With additional TMDLs completed within the BIG project area and with the expanded area, the I-Plan now covers 102 TMDLs.

Figure 1. Bacteria Trend in BIG Area, Original Project Area and Expanded Project Area 2005-2017

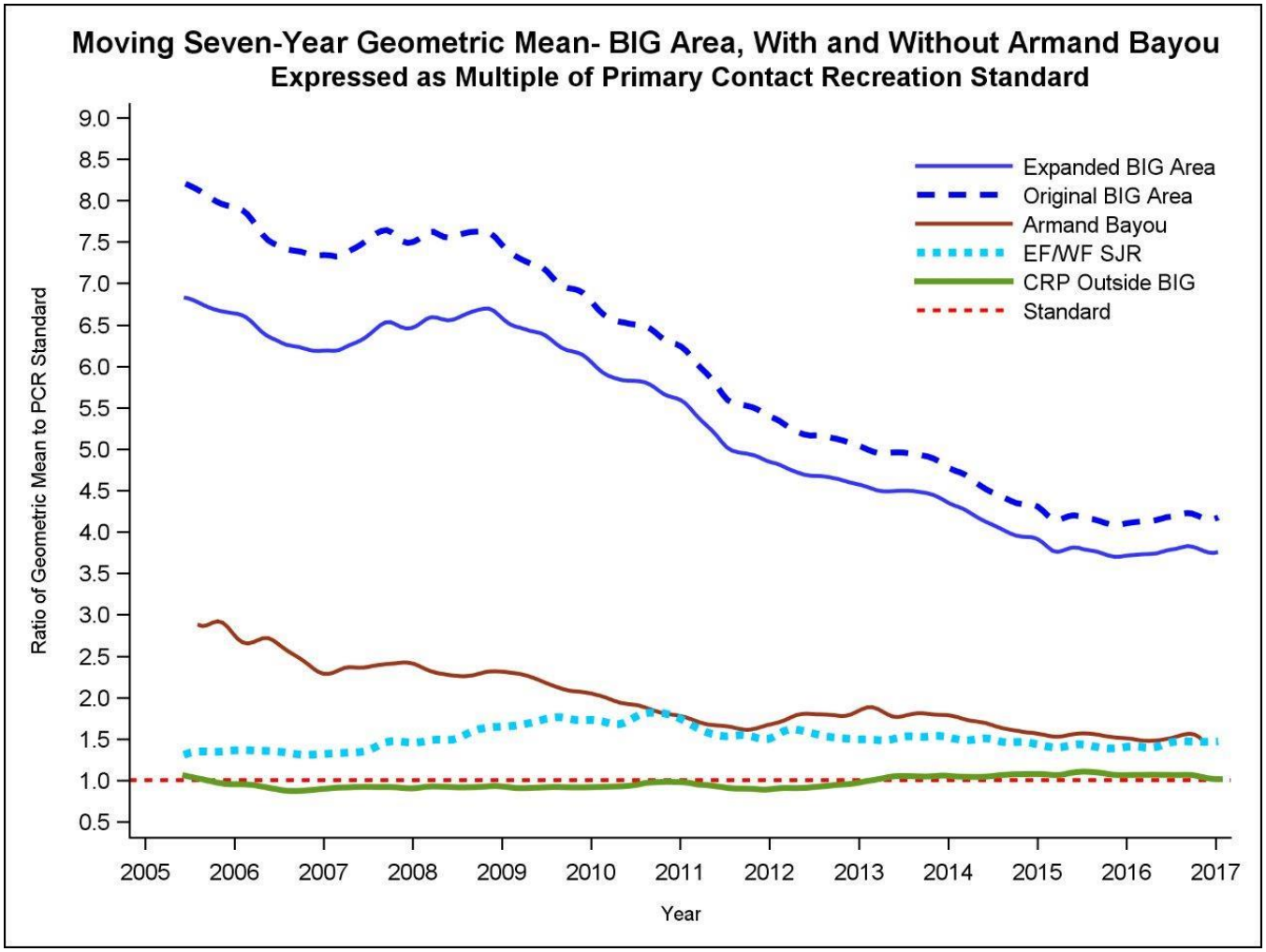


Figure 2. Bacteria trend lines for the BIG, the BIG including Armand Bayou and East and West Fork San Jacinto River (EF/WF SJR), Armand Bayou, EF/WF SJR, Clean Rivers Program (CRP) area outside BIG Project Area, and the state's water quality standard. (Appendix B).

Spotlight on Success

Highlighting successful projects is an important part of the BIG Annual Report. The BIG hopes by focusing on bacteria reduction projects that are having an impact, presenting cost saving opportunities for organizations on tight budgets, increasing knowledge and understanding, improving operation and maintenance, and/or contributing unique and novel approaches will foster a sharing of information and lessons learned, and ultimately result in expanded use across the BIG project area. While several projects follow, please note this list is not exhaustive and does not reflect the entirety of successful projects carried out by the BIG in 2016.

Geographic Expansion

Since the first annual report was written in 2013, the BIG project area has expanded. The first expansion included the Armand Bayou TMDL project area in 2015. The second expansion happened in 2016 with the inclusion of the East and West Fork of the San Jacinto (E&W Fork) TMDL Project Area. TMDL projects were initiated in each of the watershed. Stakeholder groups were convened to discuss developing implementation plans or to consider the option of joining the BIG. Both stakeholder groups decided to join the BIG and begin implementing the BIG I-Plan.

The original project area was 2,202.7 sq. miles. The expanded area is now 3,259.89 sq. miles, roughly the size of Delaware and Rhode Island, combined. The I-Plan was initially written for 72 TMDLs. With additional TMDLs completed within the BIG project area and with the expanded area, the I-Plan now covers 102 TMDLs. With the addition of the E&W Fork project area, the BIG expanded the size of the BIG stakeholder group from 31 to 33 members and the current make up to accommodate a watershed comprised of more rural, agriculture and forest interests.

EAST ALDINE MANAGEMENT DISTRICT

Harris County and East Aldine Management District

Harris County and East Aldine Management District continue to install sewer service in the Aldine region using grant funding. Harris County and East Aldine Management District had made 207 connections to new sanitary sewer systems in 2016 for a total of 646 connections since 2014. 297 OSSFs were abandoned in 2016 for a total of 1,149 abandoned since 2014. Many of the abandoned OSSFs were failing as evidenced by violations (source: Harris County).

Designing for Impact: A Regional Guide to Low Impact Development

In 2016, the Houston-Galveston Area Council (H-GAC) completed the Designing for Impact: A Regional Guide to Low Impact Development (LID). The guide will be used to encourage local governments to consider LID practices in public and private sector development and redevelopment projects. Over the next 20

years, population growth is expected to fuel development and redevelopment in the Houston-Galveston region including estimates of 6 million parking spaces, 680 million square feet of non-residential buildings and 3.5 billion square feet of residential buildings. LID is an alternative stormwater management method to slow or capture stormwater across a project site, decrease impervious surfaces, which affords the opportunity to improve water quality, along with other benefits in the process.

H-GAC hosted a Designing for Impact Design workshop on May 20, 2016 to present the guidebook and discuss how to move LID forward. H-GAC also followed up the workshop with a bus tour to local LID projects on June 16, 2016. H-GAC invited LID project consultants to provide project breakdown on the LID case studies.

Additional outreach included development of an interactive webpage, www.h-gac.com/go/LID, to serve as a regional LID resource. Over fifty LID projects are highlighted. An information form was created that will allow organizations to submit LID projects to continuously update the webpage.

City of Patton Village Central Wastewater Project

The City of Patton Village was incorporated in 1967. Residential properties used conventional septic tanks. Upgraded regulations require aerobic systems and small city lots would only allow for drip systems when the conventional systems needed to be replaced. With a concern for health and sanitation issues, the city sought a centralized sewer system alternative.

The city applied for a United States Department of Agriculture/Rural Development (USDA/RD) grant. As the city has a LMI (Low to moderate income) rate of 62.3% and a poverty rate of 34.9%, the city qualified for a loan/grant component. The grant included house connections and septic tank decommissioning. The total project cost was $10.4 million of which the city is only required to pay back $4 million. The city also received a poverty interest rate on a 40-year loan period.

The grant provided for a 0.250 MGD steel package plant with over 50 percent of capacity available for future growth. The collection system contains five lift stations and services 560 homes. The city is currently working with USDA/RD to finance a new water system to replace a failing system.

Progress Report

Ultimate Success for the BIG will be achieved when the waters assessed by the state are no longer considered impaired, meaning they meet the state water quality contact recreation standard. Achieving that goal requires annually assessing progress to determine what is working and what is not working, looking critically at what each of the BIG partners is doing to further the goals set forth in the I-Plan, sharing information, and coordinating future implementation activities. This Annual Report is meant to be a mechanism for annual assessment, encouraging efforts that appear to be working and redirecting implementation that seems to be falling short. It is also an opportunity to look at the I-Plan to see if expectations are being met or if some activities need further refinement.

Most of the information in this report is based on reports given to H-GAC through the workgroup process by stakeholders already involved in the BIG's planning effort.

The BIG workgroups met in separate meetings between February 2017 and April 2017 to discuss implementation. This report includes activities through December 2016.

This report is divided into 11 sections and appendices. Each section includes a summary of the implementation strategy, a focus for next year, and individual implementation activities in-line with the activities set out in the I-Plan. There are 38 implementation activities described in the I-Plan and laid out in this report. For each activity goals, an assessment, and a summary of implementation efforts conducted throughout the year are presented.

The assessment of each activity includes determining progress made toward achieving the activity's interim goal: Not Started, Initiated, In Progress, or Completed. Additionally, each activity is assessed based on the BIG partner's efforts to advance the activity over the year: Behind Schedule, On Schedule, or Ahead of Schedule.

Overall, 37 activities are listed as In Progress with one remaining as Initiated (Appendix C). Six activities are considered Ahead of Schedule, 28 are On Schedule, and four have been assessed as Behind Schedule. In 2017, the BIG intends to look address those activities that are Behind Schedule and request feedback from the TCEQ on TCEQ implementation of the I-Plan. The BIG will be conducting an extensive Plan review in the 2018 reporting year and will review the activities that are behind schedule to determine if the activities are appropriate and the measures valid.

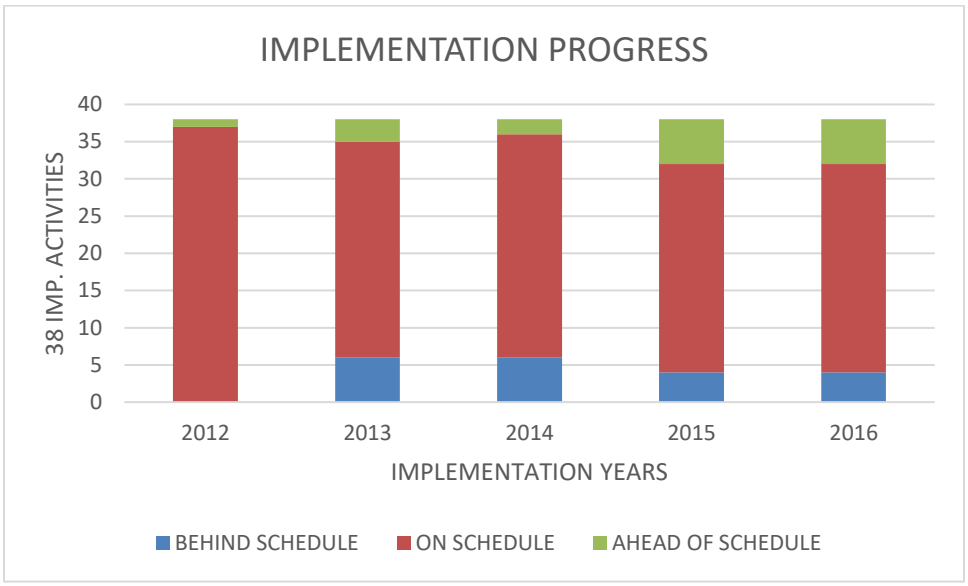
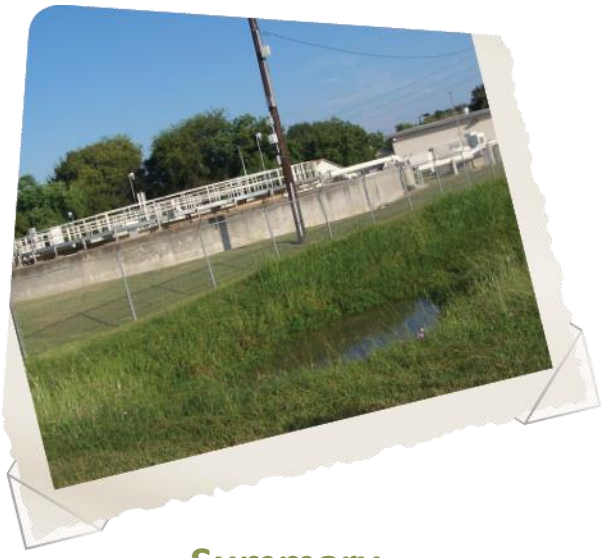


Figure 3 Implementation tracking for all 38 I-Plan Activities.



Wastewater Treatment Facilities

1

Summary

Wastewater Treatment Facility (WWTF) effluent is a potential source for bacteria in the BIG project area. When operated properly and under most conditions, WWTFs meet state permit limits. Texas Pollutant Discharge Elimination System (TPDES) permits have been renewed, bacteriological testing requirements (except in specific circumstances) have been added to the permits to better demonstrate adequate disinfection of effluent prior to being discharged to the receiving stream, since chlorine residual alone was not always reliable as an indicator of adequate disinfection.

Information learned through discharge monitoring can help WWTF operators enhance plant operation and direct resources, when needed, toward maintenance and planned upgrades. Bacteria results taken from DMRs* submitted in 2016 by 532 BIG project area WWTF operators suggests that 97.4 percent of the 4,923-highest single grab/daily maximum bacteria samples reported (Table 1), met the WWTF required bacteria limits for E. coli or enterococci. This is a percentage point increase from the 96.4 percent reported for 2015.

The Wastewater Treatment Facilities and Sanitary Sewer Systems Workgroups met on March 18, 2017. Eleven members reported over the past year the focus of implementation has been directed toward: 1) Track implementation of the revision of Texas Administrative Code Title 30, Chapter 217 and reinstating Chapter 317, 2) Check the progress two TCEQ additional employees to review plan sets and 3) and facility design and upgrades. H-GAC continued to update data on WWTF permit limits, effluent data, compliance, and enforcement.

**H-GMC used data from the TCEQ's DMR database, TCEQ's Central Registry, and EPA's Enforcement and Compliance History Online (ECHO) database for the BIG project area.*

2017 Focus

- H-GAC and BIG stakeholders plan to
  - Evaluate WWTF permits in the Armand Bayou and East and West Fork of San Jacinto watersheds;
  - Recommend WWTF research topics to area universities; and
  - Consult with TCEQ to review TCEQ implementation efforts.

Implementation Strategies

1.1 Impose More Rigorous Bacteria Monitoring Requirements

Interim Measure: Within five years, all of the WWTF permits should have had renewals initiated to include more rigorous monitoring requirements.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– With each WWTF permit renewal, facilities are being required to initiate bacteria monitoring at the state specified frequency. The BIG I-Plan proposed more stringent monitoring frequencies than the state required. However, the TCEQ (source: TCEQ) does not plan to incorporate the BIG proposed monitoring frequencies.

Implementation Effort

- **Increased Monitoring:** The BIG recommended in the I-Plan that the TCEQ apply more stringent monitoring frequencies for WWTFs in the BIG project area. The BIG's Coordination and Policy Work Group reviewed a draft letter that will be presented to the BIG. Once approved, the letter will be sent to the TCEQ. The letter would request renewed or new permits be issued with the BIG I-Plan recommended frequencies.

Table 1: 2016 Bacteria Permit Limit Compliance Taken from DMR Database*

Number of Geomean Results Reported from Permittees with Limits in Permit	4,669
Number of Samples Below Daily Average Limit	4,652
Percentage of Samples Below Daily Geomean Limit	99.6%
Number of Highest Single Grab/Daily Max Samples Reported for WWTF DMR Monitoring Period	4,923
Number of Highest Single Grab/Daily Max for WWTF DMR Monitoring Period Below Limit	4,797
Percentage of Highest Single Grab/Daily Max for WWTF DMR Monitoring Period Below Limit	97.4%

Table 1. Number and percentage of samples taken in 2015 that fell below WWTF bacteria limits for facilities within the BIG project area.

Additional samples are potentially collected by WWTFs during the monitoring period depending on their permits with the state, but only the highest value reported during the monitoring period is used for this analysis.

What is a Geomean?

Bacteria data are often summarized using a geometric mean. H-GAC calculates the mean of the natural logarithms of each bacteria value and then converts the logarithm back into a number by exponentiation.

E. coli and enterococci data can be standardized for comparison by dividing the geometric mean by the water quality standard to produce a relative geometric mean.

What is a Single Grab/Daily Max?

WWTF reporting typically requires a single grab bacteria sample or a daily maximum bacteria sample during the reporting period. A single grab sample is an individual sample collected in less than 15 minutes. A daily maximum sample is the maximum concentration measured on a single day, by the sample type specified in the permit, within a period of one calendar month.

1.2 Impose Stricter Bacteria Limits for WWTF Effluent

Interim Measure: Within five years, all of the WWTF permits should have had renewals initiated to include more stringent limits for bacteria in effluent.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– The majority of WWTFs in the BIG project area have undergone permit renewals that have included the more stringent bacterial limit and performance criteria dealing with the geometric mean and individual maximum results.

Implementation Effort

- **Permit and DMR Findings**. H-GAC analyzed WWTF permits from the TCEQ's Permit Application and Registration Information Systems (PARIS), TCEQ's Central Registry, TCEQ's DMR dataset and EPA's ECHO database and made the following observations:
  - In 2016, there were 655 permitted industrial, municipal, and private WWTFs in the BIG project region (source: EPA's ECHO database).
  - Of the 655, 574 were found to be submitting data of any kind in the DMR database (source: EPA's DMR dataset). Of the 574, 532 facilities reported bacteria data in 2016 (Table 2).
  - 521 WWTFs report *E. coli* as their reportable bacteria and eleven WWTFs (one in Armand Bayou) are using enterococci as their reportable bacteria (Table 2). No bacteria were reported by 42 WWTFs in 2016.
  - Eighty-seven percent (or 451), of the 521 facilities in the BIG project area in 2016 using *E. coli* have the more stringent bacteria limit of 63 MPN/100 mL (Table 2). This is 3 percent lower than what was reported in 2015. This figure can be explained due to the expansion in the number of WWTFs from the joining of the East and West Forks of the San Jacinto River watershed.
  - It should be noted that not all plants using *E. coli* as their reportable bacteria in the BIG project area will be required by the state to have a 63 MPN/100mL limit. As an example, WWTFs in the Clear Creek watershed will have limits of 126 MPN/100mL since the TMDL study demonstrated that limit would allow the waterbody to meet state contact recreation standards.
  - WWTF operators reported 4,669 *E. coli* daily average results in 2016 (Table 1), up from 4,093 results reported in 2015 as the region's bacteria reporting values continue to increase.
- **Future Research.** BIG stakeholders asked H-GAC, as data and funding become available, to conduct further research on the following topics:
  - Age of WWTFs to identify any potential correlations with exceedances (or bacteria levels in general)
  - Correlation to rainfall events
  - Differences between UV and chlorination disinfection

H-GAC currently lacks the funding to conduct additional studies.

Table 2: Total Number of BIG WWTF By Type from 2016 DMR

Permit Type	Permittees Submitting DMRs in 2016 (EPA Data)	Number of Permittees Reporting with E.coli Geomean Limit of 63 MPN/100 mL (EPA DMR)	Number of Permittees Reporting with E. Coli Geomean Limit of 126 MPN/100 mL (EPA DMR)	NumberofPermittees Reporting with Enterococci Geomean Limitof35MPN/100mL (EPA DMR)	No Bacteria Reported in 2016 (EPA DMR)
Industrial	52	9	9	2	32
Domestic	522	442	61	9	10
Total	574	451	70	11	42

Table 2. BIG project area WWTFs reporting DMRs to the TCEQ in 2015. WWTFs are broken out into type of facility, reporting limits per the permit reviewed either through H-GAC's permit database or the TCEQ's Central Registry. WWTFs with 'No Geomean' submitted data to the TCEQ DMR but as of the date data was pulled for the Annual Report, no limit could be determined.

Figure 4. BPA interns conducting a water quality investigation on Cypress Creek.

1.3 Increase Compliance and Enforcement by the TCEQ

Interim Measure: Each year, TCEQ can address low numbers of investigations and renewals by increasing

- *The number of unannounced inspections conducted;*
- *The number of focused sampling investigations;*
- *The percent of plans and specifications reviewed;*
- *The percent of DMRs reviewed;*
- *The number of other investigations conducted; and*
- *The ability of the TCEQ to conduct focused sampling investigations.*

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– H-GAC does not have information from the TCEQ to address this activity's interim measures. BIG stakeholders will continue to work with TCEQ to obtain data to evaluate the interim measure in the future. Local compliance data and DMR data will be used until that time.

Implementation Effort

- **Compliance and Enforcement.** H-GAC analyzed Single Grab/Daily Max reported results from Harris County Pollution Control Services (HCPCS) inspections of WWTFs in Harris County for 2016 with DMR self-reporting data from the same WWTFs inspected by HCPCS in 2016. The following observations were found:
  - HCPCS inspectors reported in 2016, and overall 92.3 percent compliance with the single grab limit, which is up from the 91.5% reported in 2015 but down from the peak of 93.7 percent compliance in 2014.
  - Single grab/daily max bacteria samples for those same WWTFs inspected by HCPCS in Harris County, submitted DMR reports (self-reporting) in 2016 indicated a 97.7% compliance rate. This rate is up over the 97 percent reported in 2015 but down from 98 percent in 2014 (Table 3).
  - The WWTFs' compliance rate appears to fall between 87 percent and 100 percent in 2016 for WWTFs in Harris County's portion of the BIG Project Area using both the HCPCS and WWTF DMR data. This was an improvement over 2015 where the rate fell between 78 percent and 100 percent.
  - Large facilities (>10 million gallons daily [MGD]) and the smallest facilities (>0.1 MGD) appear to have the greatest difficulty with compliance. The large facilities self-reported an 84.8 percent compliance rate. For the smallest facilities, HCPCS found 87.5 percent of inspection samples were compliant with established bacteria permit limits.
  - WWTFs in the less than 0.1 MGD, 1 to 5 MGD, and greater than 10 MGD, continue to exceed the single grab/daily max permit limit 25 percent or more in larger numbers than other sized plants. This was found again in 2016 (Table 4). Since 2011, those three categories accounted for 80 percent of the excursion above the permit limit more than 25% of the time. There were 29, 24 and 13 respectively, for the three WWTF sized categories during 2011-2016 with plants exceeding their permit limits more than 25% of the time compared with 4 (0.1-0.5 MGD), 7 (0.5-1 MGD), and 5 (5-10 MGD) for the remaining sized plants.

- **Percent of Plans and Specifications Reviewed.** The TCEQ hired two additional employees to review plans and specifications. No reports were provided to determine if there was an increase in plans or specifications reviewed.
- **Focused Sampling Investigations.** The TCEQ has not approved focused sampling investigations.
- **Focused Investigation**. The TCEQ reported no focused investigations were carried out in 2016. Focused investigations are targeted investigations rather than multi-day compliance investigations. Using focused investigations, TCEQ can potentially cut down on time investigating each WWTF and increase the number of WWTFs visited per year, increase the time available to spend at WWTFs that are having issues, and

identify plants that would benefit from additional owner/operator education.

Table 3: WWTFs in the BIG Project Area Inspected by Harris County Pollution Control Services

Relative Plant Size / Permitted (MGD)	*Data Source*	*Number of Highest Single Grab/ Daily Max for WWTF DMR Monitoring Period*	*Number of Highest Single Grab/Daily Max for WWTF DMR Monitoring Period Meeting Limit*	*Percentage of Highest Single Grab/ Daily Max for WWTF DMR Monitoring Period Meeting Limit*	*Data Source*	*Number of Random Samples Collected*	*Number of Samples Meeting TCEQ Grab/ Single Sample Limit*	*Percent HCPCS Samples Meeting TCEQ Permit Limit*
< 0.1 MGD	DMR	490	483	98.6%	HCPCS	176	154	87.5%
0.1-0.5 MGD	DMR	873	868	99.4%	HCPCS	100	90	90.0%
0.5-1 MGD	DMR	823	816	99.1%	HCPCS	85	82	96.5%
1-5 MGD	DMR	1179	1141	96.8%	HCPCS	120	116	96.7%
5-10 MGD	DMR	144	134	93.1%	HCPCS	12	12	100.0%
> 10 MGD	DMR	112	95	84.8%	HCPCS	11	11	100.0%
Total	DMR	3621	3537	97.7%	HCPCS	504	465	92.3%

Table 3. Domestic WWTFs in Harris County found within the BIG project area reporting to the DMR database that underwent Harris County Pollution Control Services (HCPCS) inspections and that had permit limits at the time of inspection. The random grab sample collected by HCPCS is compared to single grab/daily max samples, number of samples meeting permit limits, and percentage meeting.

Table 4: Permittees with 25% or More Excursions Above Permit Limit

Plant Size/Permitted Flow	*Daily Geomean*	*Daily Max or Grab*
Variable or Unknown	*	*
< 0.1 MGD	*	4
0.1-0.5 MGD	*	*
0.5-1 MGD	*	*
1-5 MGD	*	6
5-10 MGD	*	*
> 10 MGD	*	2

Table 4. WWTFs in the BIG project area in 2016 are reporting to the DMR database where 25 percent or greater samples taken exceeded the facility's permit limit.

1.4 Improve Design and Operation Criteria for New WWTFs

Interim Measure: Every five years, at least 20% of local governments should consider whether to adopt stricter requirements. Note: The I-Plan indicates the revision process should start in year six of implementation.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– This activity is Ahead of Schedule. While the I-Plan did not anticipate activities for six years, the TCEQ is currently addressing new criteria.

Implementation Effort

- **TCEQ Reviewers.** TCEQ reported two new staff have been added to the region to review plan sets specifications and design. No reports provided as to whether this resulted in greater efficiency.
- **WWTF Design Express Reviews.** Harris County screened 54 WWTF plan sets for compliance with state disinfection standards in 2016. Of those, one was referred to outside consultants for in-depth plan review where modifications had to be made.
- **New State Design Criteria of Domestic WWTFs.** November 4, 2015, TCEQ adopted revisions to Chapter 217 of the Texas Administrative Code(TAC) to update WWTF standards and criteria with current engineering practices and to reflect the current permitting practices. TCEQ also reinserted Chapter 317 to ensure WWTFs established prior to 2008 were included in the TAC, ensuring TCEQ regulatory authority. In 2015, BIG stakeholders continued to track progress of the changes to Chapter 217. The BIG will look for opportunities to determine if revisions result in improved treatment.

1.5 Upgrade Facilities

Interim Measure: WWTFs not meeting effluent limits should upgrade or repair their facilities to comply with individual permits. Over 25 years, WWTFs requiring upgrades in order to meet bacteria limits in their permits will have been upgraded.

Project Status

Not Started	Behind Schedule	– This activity is In Progress and On Schedule due to the availability of data. Additional work is needed to determine whether the upgrades at WWTFs were completed to comply with bacteria effluent standards for individual permits
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Monitoring Upgrades**. A total of 141 projects from counties included in the BIG were submitted as applications to expand, improve, upgrade, rehabilitate, or modify in 2016 (Table 5). Data on facility upgrades was retrieved from the TCEQ website. (www18.tceq.texas.gov/wwps/)

1.6 Consider Regionalization of WWTFs

Interim Measures:

- *Regulators should develop criteria for identifying chronically non-compliant WWTFs.*
- *Regulators should document the number of non-compliant WWTFs identified using said criteria.*
- *Regulators should document the number of chronically non-compliant WWTFs that have considered regionalization.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Regulatory.**
  - The US EPA and TCEQ have developed criteria for chronically non-compliant WWTFs and identified those WWTFs. TCEQ will share documented WWTFs with the BIG to assist with tracking future regionalization.
  - TCEQ reported that during permit application review, permittee is encouraged to consider regionalization when another WWTF is within a three-mile radius and conditions are appropriate (source: Water Quality/Stormwater Seminar on October 12-13, 2016).
- **Regionalization.**
  - BIG stakeholders reported no WWTFs were regionalized in 2016 (source: Harris County Community Services Department).
  - Harris County Pollution Control Services (HCPCS) reported they meet routinely with WWTF representatives to discuss violations, and action plans to achieve compliance, including the possibility of regionalization.

Table 5. Track Approval of Wastewater System Plans and Specifications Applications										
Jan 1, 2013 to Jan 1, 2017										
County	Year	Improvement	Rehabilitation	Expansion	Modification	Upgrade	Reuse/Reclaim	Generator	Lift Station	No. of Projects
Brazoria	2013	1	*	*	*	*	*	1	*	2
	2014	*	*	*	*	*	*	*	*	*
	2015	3	2	1	*	*	*	6	1	13
	2016	1	4	4	*	1	1	*	3	14
Galveston	2013	*	1	*	*	*	*	1	*	2
	2014	1	*	*	*	*	*	1	*	2
	2015	2	4	*	*	*	*	8	1	15
	2016	1	6	*	*	*	*	*	*	7
Harris	2013	12	13	6	2	1	2	1	*	37
	2014	14	13	6	4	2	1	2	*	42
	2015	21	9	9	1	3	*	1	10	54
	2016	13	16	2	*	2	*	1	15	49
Fort Bend	2013	1	*	*	*	*	*	*	*	1
	2014	*	*	1	1	2	1	*	*	5
	2015	18	2	3	*	*	2	*	5	30
	2016	14	4	4	*	*	4	*	16	44
Liberty	2013	*	*	*	*	*	*	*	*	*
	2014	*	*	*	*	*	*	*	*	*
	2015	*	*	*	*	*	*	*	*	*
	2016	1	*	*	*	*	*	*	*	1
Montgomery	2013	1	*	*	*	*	*	*	*	1
	2014	3	5	1	*	1	2	1	*	13
	2015	10	4	1	1	1	1	*	1	19
	2016	9	1	3	1	*	1	1	9	25
San Jacinto	2013	*	*	*	*	*	*	*	*	*
	2014	*	*	*	*	*	*	*	*	*
	2015	*	*	*	*	*	*	*	*	*
	2016	*	*	*	*	*	*	*	1	1
Walker	2013	*	*	*	*	*	*	*	*	*
	2014	*	*	*	*	*	*	*	*	*
	2015	*	*	*	*	*	*	*	*	*
	2016	*	*	*	*	*	*	*	*	*

Table 5. Wastewater system plans and specification applications submitted to the TCEQ per year by county. Application approvals can be reviewed at: http://www18.tceq.texas.gov/wwps/. * While a wastewater system plan or specification type was not found, it does not necessarily suggest that no actions were taken in that county regarding type. It should also be noted that the types are infered based on the wastewater project title description and it is possible that a project is misrepresented here.

1.7 Use Treated Effluent for Facility Irrigation

Interim Measure: Every five years, one WWTF in the project area shall install a new irrigation system that uses treated effluent.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– This activity is On Schedule to meet the five-year target.

Implementation Effort

- **Reuse/Reclaim**. In 2016, six applications for reuse/reclaim water (Table 5) were submitted to the TCEQ from Brazoria County (1), Fort Bend County (4) and Montgomery County (1). Information was extracted from the TCEQ website. (www18.tceq.texas.gov/wwps/).

Sanitary Sewer Systems

2

Summary

Failure of sanitary sewer systems (SSSs), commonly due to blockages from fats, oils and grease (FOG), equipment malfunctions, or operator errors (Figure 5) often results in sanitary sewer overflows (SSOs). SSOs discharge untreated sewage to the surface and sometimes into area waterways. The microbial pathogens and other pollutants present in SSOs can cause or contribute to contamination of drinking water supplies, water quality impairments, beach closures, shellfish bed closures, and other environmental and human health problems. In 2016 there were 1583 reported SSOs in the BIG project area releasing an estimated 3.9 million gallons of untreated waste (Figure 6).

The Sanitary Sewer Systems Workgroup met with the Wastewater Treatment Facilities Workgroup on March 18, 2017. Eleven members reported efforts over the past year focused on increased education, data collection, and source elimination activities that support this implementation activity. H-GAC gathered and analyzed data on SSOs gathered by TCEQ Central Office and the EPA ECHO database.

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Host an annual conference on asset management for SSSs;
  - Work with the TCEQ to improve the SSO reporting system;
  - Survey WWTF operators to gather appropriate contact information, begin tracking utility asset management programs (UAMPs), identify subscriber system contacts, and gather example subscriber system contract language; and
  - Check on the progress of the sponsors for “Cease the Grease” and “Corral the Grease” to determine if there is room for a unified regional message on FOG education.

Implementation Strategies

2.1 Develop Utility Asset Management Programs (UAMP) for Sanitary Sewer Systems

Interim Measures:

- *Within five years, H-GAC, the TCEQ, or another appropriate entity shall offer at least eight educational workshops for owners, operators, and engineers.*
- *After 10 years, all WWTF permits will have UAMPs.*

Project Status

Not Started	Behind Schedule	– This activity is currently On Schedule to meet the five-year target. H-GAC has held three workshops since 2013. The current pace of workshops, including events held by TCEQ should meet the interim measure of eight in five years
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Education.** TCEQ hosted its annual Water Quality/Stormwater Seminar on October 12-13, 2016. The seminar targets water permittees with a focus on permit regulations.
- **TCEQ's Voluntary SSOI.** TCEQ's voluntary Sanitary Sewer Overflow Initiative (SSOI) allows eligible municipalities to direct resources toward corrective actions rather than pay enforcement penalties. Since 2014, there were 32 WWTF operators within the BIG project area listed in the SSOI (source: TCEQ).
- **Infrastructure Funding.**
  - Texas Water Development Board offers State Revolving Funds to assist local communities to rehabilitate and replace existing infrastructure. (https://www.twdb.texas.gov/financial/programs/CWSRF/).
  - EPA's water infrastructure and resiliency finance center website, (http://water.epa.gov/infrastructure/ waterfinancecenter.cfm) serves as a resource to explore innovative finance solutions, including public-private partnerships.
  - The Texas Water Infrastructure Coordination Committee is comprised of state and federal funding agencies, technical assistance providers, and regulatory agencies. The Committee seeks to identify and develop solutions to water and wastewater infrastructure compliance issues and to determine affordable, sustainable, and innovative funding strategies for the protection of public health and efficient use of government resources. (www.twicc.org).

2.2 Address Fats, Oils, and Grease

Interim Measures:

- *Within five years, H-GMC and other local entities will*
  - *Compile and share all existing regulations within the project area;*
  - *Examine each community's regulations and policies;*
  - *Distribute flyers or other collateral material; and*
  - *Develop and promote website.*
- *Within five years, one community shall adopt new regulations.*

Project Status

Not Started	Behind Schedule	– This activity is currently On Schedule to meet the five-year target.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Tracking.** Operators in the BIG project area reported on SSO events and total volume released to the TCEQ (Figure 5 and Figure 6).
  - Texas Senate Bill 912 made changes to SSO reporting which may result in fewer reports. The legislation which became effective September 1, 2015, provides for a volume-based exemption from reporting for certain accidental discharges or spills from WWTFs.
  - There were 1257 reported SSOs releasing almost 3.1 million gallons of untreated waste in 2016, up from previous years except for 2011 (Figure 6).
  - Of the 1257 events reported in 2016, blockages from Fats, Oil, Grease, Roots and other causes remain the greatest number of SSOs at 948 events or 75% (Figure 5).
  - Rainfall and infiltration was attributed to 118 SSO events and at an estimated 1.06 million gallons, caused the largest volume of untreated sewage released in 2016. Lift station failures and combined blockages were the second and third largest release at 665,000 and 587,000 gallons respectively (Figure 5).
  - Reflecting on 1.3 in the previous section, significant rainfall event continued in 2016 which could have contributed to the spikes in SSOs due to I&I could have played a role in WWTF compliance reporting for the small (<0.1 MGD) and the large (>10 MGD) WWTFs.

- **Model FOG Education Programs.** BIG suggested that a regional message be developed based on the following programs:
  - Galveston Bay Foundation (GBF) has received funding to develop Cease the Grease, a FOG program in the BIG region. GBF has been hosting technical stakeholder meetings to coordinate Cease the Grease with local partners. (http://galvbay.org/ceasethegrease/)
  - The City of Houston's Corral the Grease and Grease Busters programs have been in operation for several years. The City participates in a large apartment complex management meeting each year to allow apartment managers to sign up to receive Corral the Grease materials. Apartment complexes referred by the City's stoppage crews as having grease issues in sewer main lines were targeted with educational materials. The City of Houston maintains the Corral the Grease website (www.publicworks.houstontx.gov/pud/corral_grease.html)
  - The BIG and other wastewater professionals have identified non-flushable items, such as sanitary wipes, as an emerging concern for SSOs. The San Jacinto River Authority and Payne Communications & Associates created the Patty Potty campaign to address this topic. (www.pattypotty.com)

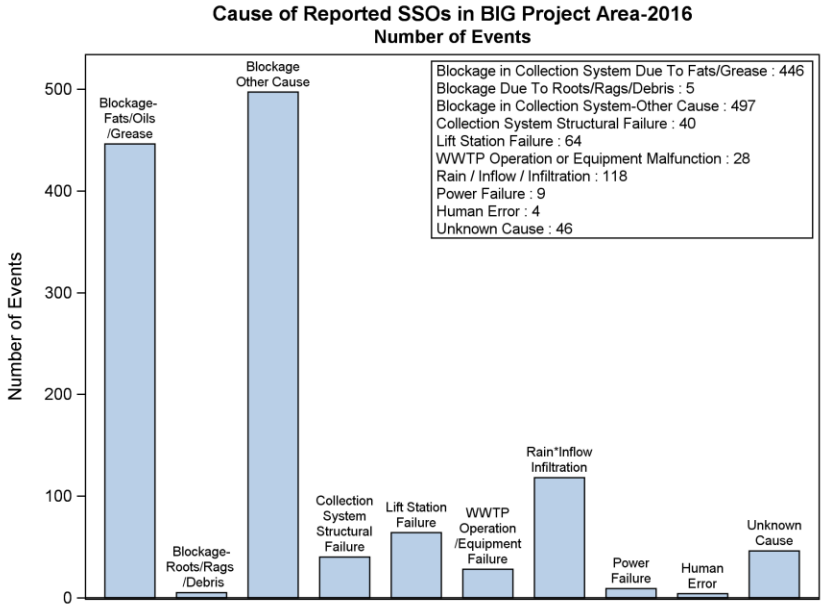


Figure 5 Cause of reported SSOs in BIG project area in 2016.

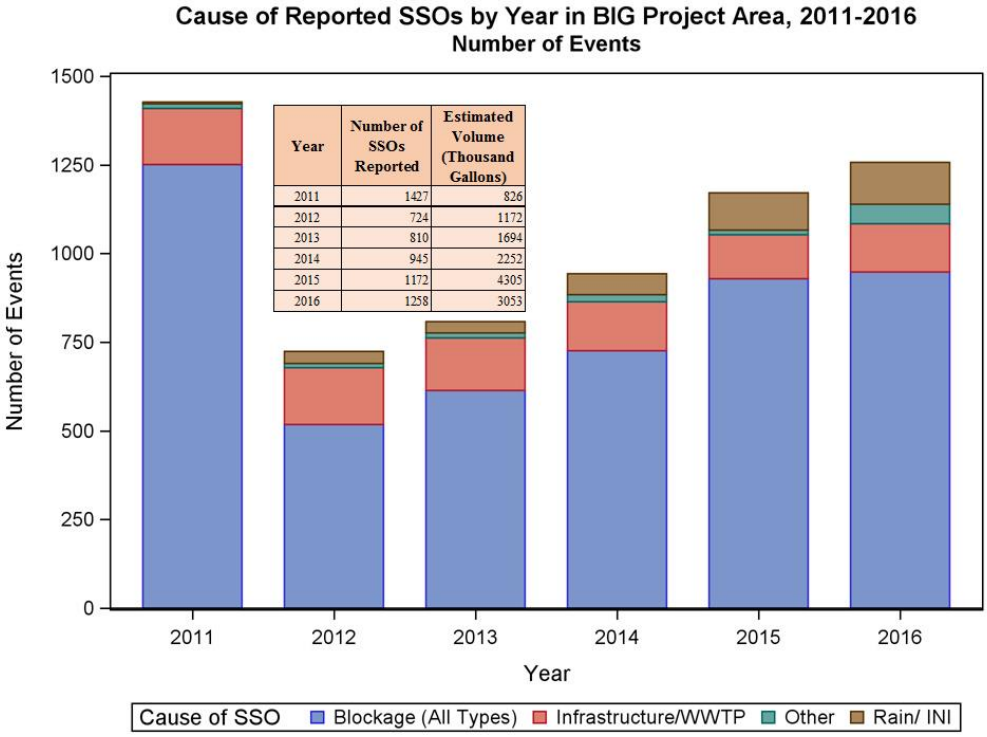


Figure 6 Cause of reported SSOs by year in BIG project area 2011-2016.

2.3 Encourage Appropriate Mechanisms to Maintain Function at Lift Stations

Interim Measure: Every five years, 10% of SSSs shall be compliant with recommendations.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– This activity is Ahead of Schedule to meet the five-year target. EAM completed the National Pollution Discharge Elimination System (NADES) Electronic Reporting Rule

Implementation Effort

- **Emergency Power Requirements.** The TCEQ approved the revision of Title 30, Chapter 217 and reinstated Chapter 317 of the Texas Administrative Code. Of importance to SSSs are Subchapters B and C of Chapter 217, which address emergency power requirements.
- **Tracking.**
  - In 2016, WWTF operators reported 75 SSOs due to malfunctioning lift stations (Figure 5 and Figure 6).
  - SSO events related to power failures were like previous years at 8 in 2016, compared to six and seven events in 2015 and 2014 respectively.
  - Forty-three lift station applications to upgrade, rehabilitate, improve and/or add alternative power were made in 2016 by counties served by the BIG. Information was extracted from the TCEQ's Approval of Wastewater System Plans and Specifications Applications database. (www18.tceq.texas.gov/wwps/)

2.4 Improve Reporting Requirements for SSOs

Interim Measure: Within five years, the U.S. Environmental Protection Agency (EAM) and TCEQ will develop appropriate database structure and technology for collecting and sharing information regarding SSOs.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– This activity is Ahead of Schedule to meet the five-year target.

Implementation Effort

- **Reporting.**
  - On Sept. 24, 2015, the EPA signed the final rule requiring NPDES regulated entities to electronically submit specific permit and compliance monitoring information over filing paper reports. The rule will be rolled out over two phases, with some of the requirement provided below:
    - Phase I – December 21, 2016. All NPDES regulated entities required to submit discharge monitoring reports (DMRs) must do so electronically using NetDMR; and NPDES regulated entities include facilities that discharge wastewater (for example, facilities classified as major or minor dischargers, individually permitted facilities, and facilities covered by general permits).
    - Phase II – December 21, 2020. All NPDES regulated entities will be required to submit notice of

intent (NOI) and notice of termination (NOT) among others; and NPDES regulated entities required to submit MS4 program reports, SSO event reports among other reports will be required to submit electronically.

- Texas Senate Bill 912 provides for a volume-based exemption from reporting for certain accidental discharges or spills from WWTFs and became effective September 1, 2015.

2.5 Strengthen Controls on Subscriber Systems

Interim Measures:

- *By year three, H-GMC will work with attorneys for WWTFs, municipal utility districts, and stakeholders to develop model contract language.*
- *Within five years, H-GMC will develop a list of subscriber systems.*
- *As funds are available, H-GMC will initiate a circuit rider program.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule to meet the three- and five-year targets. Stakeholders are tracking this issue.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Subscriber System Example Contracts.** Three example contracts were gathered and placed on the H-GAC website. (www.h-gac.com/community/water/tmdl/BIG/resources-and-information.aspx)

2.6 Penalties for Violations

Interim Measure: Within five years, the TCEQ will have an appropriate penalty policy in place.

Project Status

Not Started	Behind Schedule	– This activity is On Schedule to meet the five-year target.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Penalty Policy.** The TCEQ is currently working on Enforcement Initiation Criteria revision 15. The draft is currently in review.
- **SSO Investigations.** TCEQ inspectors can conduct focused SSO investigations. TCEQ reported that there were no inspections conducted in 2016.

On-Site Sewage Facilities

3

Summary

Properly functioning and maintained On-Site Sewage Facilities (OSSF) contribute negligible amounts of bacteria to waterways. Therefore, BIG stakeholders have primarily focused on unpermitted, failing, or poorly maintained OSSFs.

H-GAC staff partners with local governments to continually update the OSSF Information System, a GIS-based online mapping tool displaying OSSF data. The OSSF Information System helped identify probable locations of older, unpermitted systems at higher risk of failing. Staff identified 44,914 permitted systems in the BIG project area (Appendix D). There is an estimated 172,537 "grandfathered" systems within the project area.

The On-Site Sewage Facilities Workgroup met with the Illicit Discharges Workgroup on March 23, 2017. Thirteen stakeholders reported continued focus over the past year on education and regulatory action to prevent and remediate failing systems. Efforts are already underway to provide education programs to a variety of audiences. Harris County continues to work with the East Aldine Management District. H-GAC's supplemental environmental project (SEP) received funding to begin to address low-income residences with failing OSSFs.

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Continue to update maps with OSSF location data and establish priority areas;
  - Continue to allow only higher performing systems that are electronically monitored to be installed in unincorporated Harris County within bacteria impaired watersheds; and
  - Continue to seek SEP funds to maintain, repair, and replace failing systems in priority areas.

Implementation Strategies

3.1 Identify and Address Failing Systems

Interim Measures:

- *H-GAC will work with the TCEQ, authorized agents, and other interested parties to create an inventory of OSSFs with a focus on identifying known or suspected failing systems.*
- *Within one year, H-GMC and local authorized agents will create an initial map.*
- *Within two years, H-GMC and local authorized agents will identify target areas.*
- *Every five years, owners will repair or replace 500 failing OSSFs.*
- *Authorized agents will continue to collect and share OSSF data on an ongoing basis.*

Project Status

Not Started	Behind Schedule	– This activity is Ahead of Schedule to meet the five-year target, to repair and replace 500 failing systems. Harris County reports that with East Aldine management District, 1,149 OSSFs have been abandoned since 2014 in Harris County (H-GAC's OSSF Database).
Initiated	On Schedule	
In Progress	**Ahead of Schedule**	
Completed		

Implementation Effort

- **Mapping**. H-GAC staff, with the input from BIG stakeholders, continued to refine and update the OSSF permit database. The mapping system allows the public to view OSSF permit data and access basic analyses. (www.h-gac. com/go/ossf) Highlights of the system include
- Layers showing permitted OSSFs by age, authorized agent, and residential properties with a high chance of having an old or otherwise unpermitted system; and
- Tools, such as maps (Appendix D), to assist in future system repair and replacement prioritization.

- **Data.** Authorized agents continue to provide data to H-GAC. OSSF data is used to refine the mapping system and prioritize areas for education and potential repair and replacement as funding becomes available.
- **Address Failing Systems**.
  - Harris County and East Aldine Management District continue to install sewer service in the Aldine region using grant funding. Harris County and East Aldine Management District had made 207 connections to new sanitary sewer systems in 2016 for a total of 646 connections since 2014. 297 OSSFs were abandoned in 2016 for a total of 1,149 abandoned since 2014. Many of the abandoned OSSFs were failing as evidenced by violations (source: Harris County).
  - H-GAC maintains a Supplemental Environmental Project (SEP) with the TCEQ to address failing OSSF systems. H-GAC received SEP funds in 2016 and began to identifying focus areas.

3.2 Address Inadequate Maintenance of OSSFs

Interim Measures:

- *Each community will examine its regulations and policies.*
- *Existing regulations will be compiled and shared among BIG stakeholders.*
- *Flyers or collateral material will be distributed among BIG stakeholders.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule. Regulations and educational information have been compiled and are available through the H-GAC website.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Wastewater Professional Education.** Harris County hosted its 6th Annual Harris County On-Site Wastewater Seminar on May 3, 2016, which was attended by 134 regional on-site wastewater professionals
- **Real Estate Industry Coordination**. H-GAC developed and maintains a curriculum for real estate inspection professionals to learn how to properly inspect an OSSF during a point-of-sale home inspection. H-GAC is planning to hold workshops in 2017. Three workshops have been offered since 2015 and H-GAC has trained over 100 area home inspectors focusing on conventional, LPD, and aerobic systems. Workshops offer a Texas Real Estate Commission-approved course (6 Continuing Education Credits) on the benefits of visually inspecting OSSFs.
- **Homeowner Education.**
  - H-GAC maintains a website to share educational materials. (www.h-gac.com/go/septic) In addition to providing general information, the site offers content specific to homeowners/homebuyers, local governments, and real estate professionals.

3.3 Legislation and Other Regulatory Actions

Interim Measures:

- *The TCEQ should host biennial meetings to review OSSF regulations.*
- *Local authorized agents will meet annually.*
- *Every five years, one community shall revise or adopt new regulations.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Meetings.** The TCEQ reported Authorized Agent meetings are anticipated to resume in 2016.
- **Education.**
  - May 3, 2016 Harris County hosted the 6th Annual On-Site Wastewater Seminar for water professionals with topics including regulatory requirements.

Stormwater and Land Development

4

Summary

Regional growth and development have reinforced the importance of stormwater management. Bacteria sources, such as waste from pets, wildlife, and even humans, can be washed into storm drains and discharged into local waterways. Stormwater systems are designed to remove stormwater from developments quickly and efficiently. As a result, stormwater in urbanized areas often bypasses natural vegetative barriers. Without these filters, "sheet flow" (stormwater flowing across the landscape) tends to result in more concentrated bacteria loading to waterways.

In general, this strategy area focuses on building upon existing stormwater programs by sharing knowledge and developing incentives to increase voluntary implementation. The Stormwater and Land Development Workgroup met with the Construction Workgroup on March 20, 2017. Fifteen stakeholders reported progress in implementing low impact development (LID); tracking stormwater management projects with an emphasis on effectiveness monitoring; progress on providing education and training opportunities; and continuing to track MS4 Phase II Notices of Intent (NOIs).

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Follow up on information provided by MS4 Phase II permittees and consider content for a second survey.
  - Finish developing a web-based MS4 Phase II Tracking System with stakeholders to facilitate improved tracking;
  - Continue examining local regulations and how they might inhibit LID projects; and
  - Coordinate with local builders/developers and trade organizations to implement the recognition and awards program.

Implementation Strategies

4.1 Continue Existing Programs

Interim Measures:

- *Eighty MS4 programs will be continued.*
- *As many as 200 additional MS4s will be added to TCEQ Region 12 during the new permit cycle; many will be in the BIG project area.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule as existing programs continue and new requirements include addressing impaired waterbodies.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Established Programs**. The City of Houston, Harris County, and Harris County Flood Control District (HCFCD) continue to operate under a Phase I MS4 TPDES permit, calling themselves the Joint Task Force. With the addition of Armand Bayou watershed to the BIG project area, the City of Pasadena, a Phase I community, was added in 2015
- **Continued Program Administration.** The history of approved, pending, expired, denied, and terminated NOIs for small MS4s can be reviewed at the TCEQ's Water Quality General Permits and Registration Search. (www2. tceq.texas.gov/wq_dpa/index.cfm) A review of that registry finds there are 129 permit/registration numbers for MS4 Phase II for the BIG project area: 124 MS4 were found in the BIG original project area, one TxDOT, and four in the Armand Bayou watershed.

4.2 Model Best Practices

Interim Measure: Each year, BIG stakeholders' will hold four to six networking meetings and will highlight five local programs.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– This activity is On Schedule as four meetings were reported in 2016.

Implementation Effort

- **BMP Database.** HCFCD continues to maintain the Regional Best Management Practices (BMP) Database for stakeholders to access and evaluate the effectiveness of structural BMPs. (www.bmpbase.org) The database provides access to BMP effectiveness data set to the International Stormwater BMP Database standards. HCFCD encourages entities to submit qualified BMP effectiveness data from other projects in the region. In cases where projects did not collect desired performance data, HCFCD remains interested in collecting the projects' geographic location and available metadata.
- **LID Resources.**
    - LID Development Manual**:** Harris County (HC) and HCFCD developed a manual to guide the use of LID and Green Infrastructure in development. HC and HCFCD are in process of revising the LID manual.
    - Designing for Impact: A Regional Guide to Low Impact Development: H-GAC completed the guide in 2016. H-GAC developed the guide to encourage the use of LID in the region.
- **LID Tracking.** H-GAC developed a LID tracking and resources website. (www.h-gac.com/community/go/LID) The site currently displays 59 LID projects in the H-GAC region, most of which are in the BIG project area and provides an on-line form for submitting new projects.
- **Education.**
    - TCEQ hosted its annual Water Quality/Stormwater Seminar on October 12-13, 2016. The seminar targets water permittees with a focus on permit regulations.
    - H-GAC, through its CWI, conducted four workshops supporting BMPs: Stormwater Management Approaches from the Region's MS4 Programs (April 13, 2016), Designing for Impact: LID Lessons Learned (May 20, 2016), Back to Basics on Water Quality (September 6, 2016), and Improving Water Quality Through Watershed Planning (October 4, 2016).
    - LID Mobile Workshop: H-GAC hosted on June 16, 2017 with support from local developers and consultants, a LID Mobile Workshop to ferry local stakeholders to LID projects highlighted in the Designing for Impact: A Regional Guide to Low Impact Development.
    - Managing our Stormwater from Gutter to Gator – was a new education program produced by Texas A&M AgriLife Extension in 2016. Two workshops were held in the fall of 2016.Target audiences included resource professionals, local governments and industry professionals.

4.3 Encourage Expansion of Stormwater Management Programs

Interim Measures: Within the next five years:

- *All permit holders shall expand or focus their existing programs.*
- *Thirty previously unpermitted entities shall develop new programs.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule to meet the five-year target. New TPDES permit requirements will encourage MS4 Phase II operators to address impaired waterbodies with appropriate management measures.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **New General Permit Eligibility**. A review of the TCEQ's General Permit Registry for MS4 Phase II, revealed eight permits are new to the MS4 Phase II program within the BIG project area. (www2.tceq.texas.gov/wq_dpa/ index.cfm)
- **New MS4 Permit Requirements.** Under the current TPDES General Permit, MS4 Phase II entities are expected to address the pollutant of concern when their stormwater discharges to impaired waterbodies. The BIG will attempt to track measures implemented to address bacteria impairments.
- **MS4 Assistance.** H-GAC developed a proposal to work with local governments to review ordinance and remove barriers. In 2016, H-GAC received approval for project funding from GBEP and will start work with the City of Pearland in 2017.
- **Implementation.**
  - The City of Houston offers rebates to purchase rain barrels, http://www.rainbarrelprogram.org/Houston
  - The City of Houston maintains a Green Building Resource Center, http://www.greenhoustontx.gov/greenbuilding.html.

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

Interim Measures:

- *Within five years, BIG stakeholders should develop a recognition program and subsequently recognize communities and participants.*
- *Each year, two communities will analyze regulations and programs to accommodate participation in existing programs.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule to meet the five-year target. Additional work must be made to identify communities which have analyzed regulations and other hurdles to meet the requirements of existing recognition programs.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Recognition Program.** H-GAC initiated development of a water quality improvement recognition program through the Natural Resource Advisory Committee with plans to select the first awardees for the 2017 calendar year.
- **Regulations.** H-GAC was awarded a grant in 2016 to work with the City of Pearland to review current regulations and look for opportunities to update them to encourage the use of stormwater BMPs.

4.5 Provide a Circuit Rider Program

Interim Measure: Each year, H-GAC will contact 50 stakeholders and provide five in-depth community consultations.

Project Status

Not Started	**Behind Schedule**	– This activity is Behind Schedule to meet the yearly target of providing five in-depth community consultations.
Initiated	On Schedule	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Consultations:** H-GAC was awarded a grant in 2016 to work with the City of Pearland to review current regulations and look for opportunities to update them to encourage the use of stormwater BMPs. In 2017 H-GAC will work with the City of Pearland.
- **Education.** Communities throughout the BIG region hosted workshops geared toward MS4 Education.
  - MS4 Education. H-GAC, through its CWI, conducted four workshops supporting BMPs: Stormwater Management Approaches from the Region's MS4 Programs (April 13, 2016), Designing for Impact: LID Lessons Learned (May 20, 2016), Back to Basics on Water Quality (September 6, 2016), and Improving Water Quality Through Watershed Planning (October 4, 2016).
  - Additional Education benefiting MS4s.
    - Texas Riparian & Stream Ecosystem Workshop (February 25, 2015)
    - In 2016, Galveston Bay Foundation working with municipalities, held 6 Rain Barrel Workshops to educate homeowners on the water quality and conservation benefits of collecting rain water.

4.6 Petition the TCEQ to Facilitate Reimbursement of Bacteria Reduction Measures

Interim Measure: Within three years, BIG stakeholders should receive letters of commitment or similar support from the TCEQ.

Project Status

Not Started	Behind Schedule	*– This activity is On Schedule to address the need for reimbursement; however, the TCEQ did not provide letters of commitment. Activity needs to be tracked to ensure the reimbursement process is working.*
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **TCEQ Reimbursement.** TCEQ reported during the International Low Impact Development Conference (January 19-21, 2015) in Houston, they did not feel there is a need for additional rule-making to address developer reimbursement for installed water quality practices. The TCEQ stated current rules are sufficient to allow reimbursement and they are prepared to work with developers to assist in the reimbursement process.

Construction

5

Summary

Rapid population growth and increasing densification of the BIG project area have led to more widespread and intense development activity that can contribute to bacterial loading. Although construction sites for typical building and transportation projects are not significant sources of bacteria, runoff from poorly maintained construction sites can contribute to the region's bacteria loadings. This runoff also conveys sediments, nutrients, fertilizers, and other contaminants downstream.

The Construction Workgroup met together with the Stormwater and Land Development Workgroup on March 20, 2017. Fifteen BIG stakeholders reported on their ability to conduct compliance and enforcement at construction sites and offer beneficial construction site education. The group recommended that H-GAC add questions seeking the number of operators conducting compliance and enforcement inspections in the next survey of MS4 Phase II permittees.

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Solicit information and participation via survey from MS4 Phase II permittees;
  - Quantify and document inspections and enforcements in annual reports or survey results;
  - Provide educational materials and opportunities for contractors; and
  - Work with professional organizations.

Implementation Strategies

5.1 Increase Compliance with and Enforcement of Stormwater Management Permits

Interim Measures:

- *In year one, MS4 operators should evaluate needs or requirements for staffing an appropriate construction inspection program.*
- *In year two, BIG stakeholders should develop and begin offering educational material and training.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule as construction education and training is being offered and improving compliance.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Compliance and Enforcement.**
  - The City of Houston and Harris County reported they continue to meet inspection requirements found in their MS4 permits. The City of Houston conducts multiple inspections of all NOIs and Construction Site Notices (CSN) for projects of an acre or more and some sites less than an acre.
- **Training and Education.**
  - H-GAC, through its CWI, conducted one workshop supporting construction BMPs: Stormwater Management Approaches from the Region's MS4 Programs (April 13, 2016).
  - Both Harris County and the City of Houston reported that informal on-site compliance education at construction sites is increasing compliance.

Illicit Discharges and Dumping

6

Summary

Illicit discharge detection efforts have found illegal connections, discharges, and dumping activities resulting in illegal bacterial loads entering in the project area's storm sewer and watershed. BIG stakeholders have widely cited septic waste haulers as a source of contamination when transport waste from OSSFs and grease and grit traps are not properly disposed. While regulations dictate proper methods for disposing of waste at treatment facilities and recording information on manifests, evidence indicates illicit discharges and illegal dumping occurs. Because these discharges can happen in so many locations, there are no flow-adjusted estimates for waste hauler contributions to bacteria levels in area waterways.

In response to these concerns, the BIG recommends that stakeholders focus on three activities: 1) detect and eliminate illicit discharges specific to bacteria; 2) improve local government mechanisms to regulate and enforce illicit discharges; and, 3) monitor and control waste hauler activities through regulations and fleet tracking programs.

The Illicit Discharges and Dumping Workgroup met jointly with the OSSF Workgroup on March 23, 2017. Thirteen stakeholders discussed the challenges facing waste hauler tracking and ensuring waste makes it to a proper disposal site. Attendees suggested continuing efforts to document illegal dumping, identifying locations to install motion sensing cameras, developing a CWI workshop on illegal dumping and use of cameras, and revising the MS4 survey to include questions regarding tracking of honey trucks

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Identify a local government to implement a pilot tracking program;
  - Host a CWI workshop on illegal dumping and use of tracking cameras; and
  - Conduct a survey of MS4 Phase II operators, including questions covering illicit discharge detection activities and tracking of honey trucks.

Implementation Strategies

6.1 Detect and Eliminate Illicit Discharges

Interim Measures:

- *Within 10 years, MS4 operators will complete initial surveys and maps.*
- *Each year, MS4 operators will identify the number of illicit discharges found and resolved each year.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule to meet the 10-year target. Current TPDES MS4 permits require permittees complete surveys and develop maps. Additional effort is needed to routinely capture the number of illicit discharges identified and resolved by MS4 Phase II operators each year.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Compliance and Enforcement.**
  - The Joint Task Force (Harris County, City of Houston, and HCFCD) continue illicit discharge detection and elimination (IDDE) programs to identify and track illicit discharges. Maintaining strong IDDE programs is likely one reason for the declining bacteria seen in the BIG project region (Appendix B).
  - H-GAC supports the Environmental Enforcement Assistance and Education website that maintains resources to assist enforcement officials to better enforce existing environmental laws, including illegal dumping - http://www.h-gac.com/community/environmental-enforcement/default.aspx.
- **IDDE Investigations.**
  - Bayou Preservation Association continued, with the assistance of the City of Houston, to conduct a source identification and elimination project. BPA presented to BIG stakeholders on August 1, 2017. For more details, see Section 11. Geographic Priority Framework.
  - In 2016, H-GAC with a grant from the Galveston Bay Estuary Program, continued an IDDE project in the BIG Project Area using the Top Ten Most Wanted/Top Ten Least Wanted Lists.
- **IDDE Reporting.**
  - CleanBayous.org maintains an illegal dumping notification system used to notify participating small MS4s for correction.
  - HCFCD maintains a Citizen's Service Hotline and verifies reports of illicit discharges to HCFCD facilities and coordinates elimination with enforcement agencies in appropriate jurisdictions.
  - Galveston Bay Action Network is an online resource for reporting fish kills, spills, SSOs, and other incidents (www.galvbay.org/gban).

Figure 76. BPA interns conducting a water quality investigation of P138 in Halls Bayou.

6.2 Improve Regulation and Enforcement of Illicit Discharges

Interim Measures:

- *Within five years, BIG stakeholders will compile and share all existing regulations in the project area.*
- *Within five years, all communities shall examine their regulations, and one shall adopt new or revised regulations.*

Project Status

Not Started	Behind Schedule	– *This activity is On Schedule to meet the five-year target.*
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Compile MS4 Regulations.**
  - H-GAC, along with the BIG, will continue to compile a list of ordinances and add them to ordinances currently available on the BIG website. (www.h-gac.com/community/water/tmdl/big/workgroups/illicit-discharges-and-dumping-workgroup.aspx)
  - Harris County and the City of Houston reported that their regulations are publicly available on their respective websites and at Clean Water Clear Choice. (www.cleanwaterways.org/downloads/)

6.3 Monitor and Control Waste Hauler Activities

Interim Measure: ***Within five years, one waste hauler fleet tracking pilot program shall be started by local stakeholders.***

Project Status

Not Started	**Behind Schedule**	– *This activity is Behind Schedule to meet the five-year target. BIG partners have yet to identify a local program interested in starting a pilot program.*
Initiated	On Schedule	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Education.**
  - H-GAC host the Environmental Enforcement Roundtable which meets regularly to discuss ways to enhance enforcement activities.
  - Workshop – H-GAC hosted "Strategies to Stop Illegal Disposal," on 12/1/2016.
- **Tracking**.
  - The City of Houston reported that it maintains a successful waste hauler tracking program and reviews waste hauler receipts during inspections at WWTFs.
  - Illegal Dumping Surveillance Camera Sharing Program. H-GAC, with administering agencies, Fort Bend, Galveston, and Walker counties, maintains a camera resource sharing program for local governments. Cameras are only used for illegal dumping enforcement. (www.h-gac.com/community/environmental-enforcement/ illegal-dumping-surveillance-camera-sharing-program.aspx)

Animals and Agriculture

7

Summary

Animals and agricultural practices contribute to increased bacteria levels in sediment runoff to waterbodies. Cattle and poultry are the most common agriculture animals of concern in the BIG project area. However, clusters of other animals—such as horses, swine, sheep, and goats— also may contribute to water quality impairments throughout the area. Of interest to BIG stakeholders are feral hogs, considered a state and national problem, estimated to cause $52 million in crop loss in the state each year. Feral hogs damage property due to their rooting and wallowing. They also defecate, often directly into waterways, contributing large amounts of bacteria and nutrients into the environment.

Most agricultural management programs are either voluntary or apply only to confined animal feeding operations (CAFOs) designated by the EPA. These operations are not present in the BIG project area. On April 18, 2017, six members of the Animals and Agriculture Workgroup met and recommended continuing agriculture related outreach and education events, supporting use of individual water quality management plans and following up with the Natural Resource Conservation Service (NRCS) and San Jacinto River Authority on nutrient management programs.

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Continue to encourage agriculture producer involvement in existing Texas State Soil and Water Conservation Board (TSSWCB), Texas AgriLife Extension, and Texas Water Resources Institute (TWRI) programs;
  - Continue to provide technical support and education opportunities;
  - Gather latest information on nutrient management programs; and
  - Continue to track results of Harris County's feral hog management project.

Implementation Strategies

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

Interim Measure: Each year, participation by farmers and ranchers in financial and technical assistance programs should increase by 5%.

Project Status

Not Started	Behind Schedule	– *This activity is On Schedule to meet the annual target.*
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Implementation.**
  - AgriLife Extension Agents reported that there most effective program outreach is one-on-one efforts with land owners.
  - TSSWCB reported there were no new water quality management programs in the BIG project area.
  - NRCS and TSSWCB continued to report owners have placed 8,816 acres under federal funding and technical assistance agriculture programs (Conservation Technical Assistance, Environmental Quality Incentives Program, and Wildlife Habitat Incentive Program) to implement agricultural BMPs.

- **Education and Resources.**
  - The Texas Water Resources Institute (TWRI), as part of its Lone Star Healthy Streams (LSHS) Program, hosts a website to educate Texas farmers, ranchers, and landowners about proper grazing, feral hog management, and riparian area protection to reduce the levels of bacterial contamination in streams and rivers.
  - Best Management Practices: http://lshs.tamu.edu/bmps/
    - Publications and Presentations: http://lshs.tamu.edu/publications/

7.2 Promote the Management of Feral Hog Populations

Interim Measure: During the next five years, AgriLife Extension will host two feral hog management workshops per year for landowners, local governments, and other interested people.

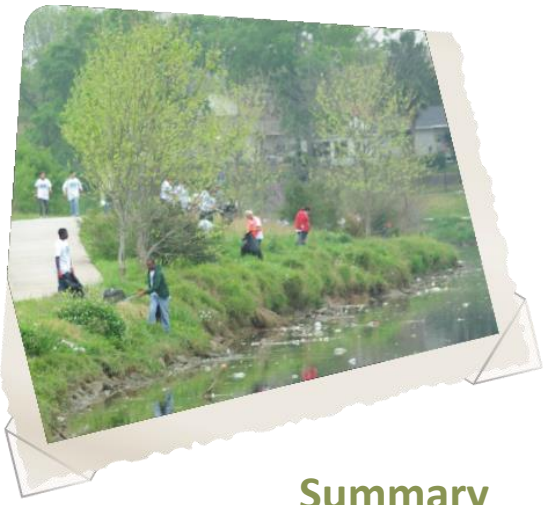
Project Status

Not Started	Behind Schedule	– *This activity is Ahead of Schedule to meet the five-year target.*
Initiated	On Schedule	
In Progress	**Ahead of Schedule**	
Completed		

Implementation Effort

- **Implementation**
  - In 2016, Harris County Precinct 3 continued feral hog trapping activities in Addicks and Barker reservoirs as part of a $630,000 Coastal Impact Assistance Program grant received in 2013. Baseline water quality monitoring began in September 2014 and was completed in April 2015. Since trapping operations under the grant began in June 2014, 373 feral hogs were removed from the reservoirs. More than 21,276 pounds of hog meat have been donated to the Houston Food Bank for distribution. The grant period ended on December 31, 2016. (Source: Harris County)
- **Education and Resources.**
  - AgriLife Extension Agents reported that there most effective program outreach is one-on-one efforts with land owners.
  - AgriLife Extension Online: (Biology, Damages, Management and Control, Videos and Webinars) http://articles. extension.org/feral_hogs

Figure 8. Vegetative buffer strip agriculture BMP.



Residential

8

Summary

Communities can improve water quality by changing overall attitudes and individual behavior — one homeowner at a time. Enforcement, or the threat of enforcement, may be effective with stakeholders regulated by permits, but it has less impact on individuals. Changing attitudes and behaviors of individuals presents an opportunity for long-term water quality improvement and support for existing permitted programs, like MS4 Phase II. This strategy's focus is empowering residents and communities through volunteer activities and educational outreach.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Develop objectives and evaluation measures to better assess results of education efforts;
  - Continue identifying regional opportunities to address pet waste and FOG concerns utilizing education and/or regulatory action; and
  - Encourage MS4 Phase II operators to focus on bacteria reduction public education and outreach.

Figure 9. Fats, Oils and Grease education during Trash Bash© at White Oak Bayou site in Jersey Village.

Implementation Strategies

8.1 Expand Homeowner Education Efforts throughout the BIG Project Area

Interim Measures:

- *Local governments and appropriate agencies should begin or continue homeowner education programs. Each year, participation should increase by 2%.*
- *Every five years, H-GAC and BIG stakeholders will conduct at least one pilot study to evaluate the results of education efforts.*

Project Status

Not Started	Behind Schedule	– This activity is On Schedule to meet yearly education targets. Local MS4 Phase II operators are focusing more on education efforts. Additional work is needed to evaluate and derive environmental results from education as part of a pilot study.
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

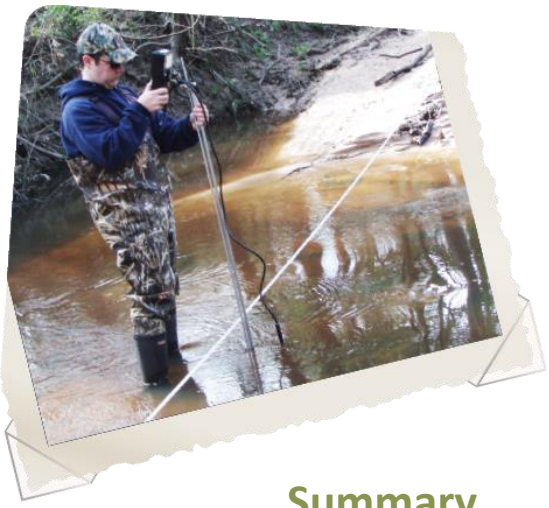
- **Education.** Local organizations and communities continued to offer many homeowner education programs that help reduce bacteria loading in the BIG project area. In addition to the listed programs, events, and website repositories, other formal and informal resources are available to increase awareness and understanding.

- **MS4 Programs.**
  - City of Houston Rain Water Harvesting Initiative provided a rebate to its citizens http://www.rainbarrelprogram.org/Houston.
  - MS4 Phase II entities report participating in CleanBayous.org or CleanWaterways.org to support residential and public, commercial and industrial, construction, business, and municipal employee outreach and education goals.

- **Online Tools and Resources.** Online educational resources include free support tools and downloadable materials to support the missions of local MS4 programs:
  - Cease the Grease - http://galvbay.org/ceasethegrease/
  - Corral the Grease - https://www.publicworks.houstontx.gov/pud/corral_grease.html
  - Back the Bay – www.backthebay.org
  - Pet Waste - www.h-gac.com/community/pet-waste/default.aspx
  - Clean Water Clear Choice - www.cleanwaterways.org
  - Patty Potty – www.pattypotty.com
  - Low Impact Development - www.h-gac.com/community/low-impact-development/default.aspx
  - Galveston Bay Action Network Environmental Reporting Tool - www.galvbay.org/gban
  - OSSF Mapping Tool - http://arcgis02.h-gac.com/ossf/
  - Regional BMB Database - https://www.hcfcd.org/interactive-mapping-tools/bmpbase-regional-bmp-database/
  - Water Resources Information Map (WRIM) - www.h-gac.com/go/wrim
  - Texas Watershed Steward Program - http://agrilifeextension.tamu.edu/solutions/texas-watershed-steward/

- **Outreach and Involvement.**
    - The 2015 Rivers, Lakes, Bays N' Bayous Trash Bash® took place at nine sites in the BIG project areas, with 2,790 volunteers, 54 tons of trash collected, 66 tires recycled and 71 stream miles cleaned. Outreach displays and/or activities were available during the event and included themes like picking up pet waste, FOG programs, LID, water conservation, and watershed education.
    - Galveston Bay Foundation's Bay Day. The day-long celebration is held every May at Kemah Boardwalk. The event offers environmental and natural resource education through educational booths manned by state, local and non-profit organizations.
    - H-GAC's ongoing "Pet Waste Pollutes" campaign aims to reduce pet waste that drains into waterways and causes bacterial pollution. Pet waste bag dispensers were distributed at the 2015 Trash Bash®. This type of programming is supplemented by educational outreach efforts such as new online resources pertaining to other programs and model ordinances. (www.petwastepollutes.org) The campaign is also useful for reporting data. For instance, the City of Houston demonstrated a progressive increase in pet waste-related citations and convictions over the past seven years.
        - H-GAC staff hosted an educational booth at the Sam Houston Area Council Boy Scout Fair, a two-day event for area scouts and their families with roughly 35,000 individuals in attendance.

- **Training and Reporting.**
    - The CWI website houses all past CWI workshops and announcements for upcoming workshops that help local governments, landowners, and citizens develop effective strategies to reduce pollution in our waterways. (www.h-gac. com/CWI). 2016 workshops included: Emerging Technology in Wastewater Treatment (February 16, 2016), Stormwater Management Approaches from the Region's MS4 Programs (April 13, 2016), Designing for Impact: LID Lessons Learned (May 20, 2016), Back to Basics on Water Quality (September 6, 2016), and Improving Water Quality Through Watershed Planning (October 4, 2016).
    - Texas Watershed Steward Program was offered on February 17, 2016 in Galveston County. Program is a free educational workshop designed to help watershed residents improve and protect their water resources. For more information, http://tws.tamu.edu/.
    - In 2016, Galveston Bay Foundation held 6 Rain Barrel Workshops to educate homeowners on the water quality and conservation benefits of collecting rain water. Homeowners purchase barrels at a reduced price during the workshops.
    - Texas Stream Team (TST) hosts volunteer water quality monitoring training in the region. In 2016, H-GAC staff offered TST event in Pearland. 10 volunteers attended.
    - Managing our Stormwater from Gutter to Gator – Is a new stormwater education program focused on green infrastructure. Texas A&M AgriLife Extension targeted two workshops in 2016 toward resource professionals, local governments and industry professionals.



Monitoring and I-Plan Revision

9

Summary

To assess I-Plan progress, the BIG is required to monitor ambient water quality data and the progress of all implementation activities. Using these data, the BIG produces this annual report. This keeps BIG stakeholders apprised of progress and helps to determine if the I-Plan or any of its individual elements require revisions to their implementation strategies or schedules. The monitoring data will be an important indicator of whether I-Plan guidance results in the desired reduction of bacteria loading. A more in-depth evaluation will occur every five years, as resources are available and with stakeholder participation.

The review will address answers to the following questions:

- Do ambient water quality monitoring data indicate that bacteria levels are changing?
  - If so, are the bacteria levels increasing or decreasing?
- Are implementation activities and controls being undertaken as described in the I-Plan?
- Which activities have been implemented and which have not?
- Do non-ambient water quality monitoring data indicate implementation activities are reducing bacteria loads?

Ambient vs. Non-Ambient

Ambient monitoring routinely collects data without selecting for special conditions.

Non-ambient monitoring targets data collection for a specific often non-routine purpose and considers special conditions such as time, precipitation events, and location.

The Monitoring and Plan Revision Workgroup met jointly with the Research Workgroup on April 3, 2017, with eight members in attendance. Under modifications to the I-Plan (Activity 9.4), the BIG approved a modification to the I-Plan which lead to the East and West Fork of the San Jacinto watershed to fully joining the BIG project area. BIG stakeholders reported continued collection of non-ambient sampling tied to BMPs. H-GAC continued to develop the BIG Regional Implementation Plan tracking database and several organizations completed BMPs in 2016.

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Continue ambient water quality monitoring and analysis;
  - Strengthen implementation tracking and coordination of non-ambient efforts through completion and analysis of data; and
  - Continue to develop a BIG Regional Implementation Plan Database.

Implementation Strategies

9.1 Continue to Utilize Ambient Water Quality Monitoring and Data Analysis

Interim Measure: Each year, H-GMC and BIG stakeholders will monitor ambient water quality to help determine if waterbodies are meeting state standards for bacteria.

Project Status

Not Started	Behind Schedule	– *This activity is On Schedule to meet the annual target.*
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Texas Stream Team (TST).** In 2016, there are nineteen volunteer TST monitors actively monitoring sites in the BIG Project Area. Four additional monitors are scheduled to complete their Phase III training in 2017. They will be monitoring the East and West Fork of the San Jacinto River.
- **H-GAC's CRP.** H-GAC's Clean Rivers Program (CRP) continues to be the primary vehicle for water quality monitoring and data analysis in the project area (see Appendix F). Data is used to develop geometric means for each segment in the BIG Project Area (see Appendix G):
    - The 2017 Basin Highlights Report How's the Water? Is an interactive web-based report on water quality impairments and trends based on data collected by eight organizations at 208 sites ((includes 11 in the Armand Bayou and 24 in the East and West Fork San Jacinto River (E&W Fork) watershed)) within the BIG project area (Table 7). http://arcgis02.h-gac.com/BHR2017/index.html
    - There is a total of 125 watershed segments in the BIG project area. Those segments are broken down into 179 assessment units (AUs). One hundred and fourteen (114) of the AUs are considered impaired and another 3 AUs listed as a concern due to bacteria concentrations above the state's water quality standards. In 2016, it was observed that 38 AUs are improving, 7 AUs appear to be getting worse, 84 exhibit no change, and 50 were not assessed (Figure 9).
    - CRP gathered observations of contact recreation while gathering ambient water quality data. Of the 173 stations monitored by CRP partners in 2016 in the BIG project area, CPR monitors recorded at evidence of contact recreation at 21 stations. CRP monitors noted direct observations of 54 individuals engaged in a contact recreation activity while onsite (Table 8).

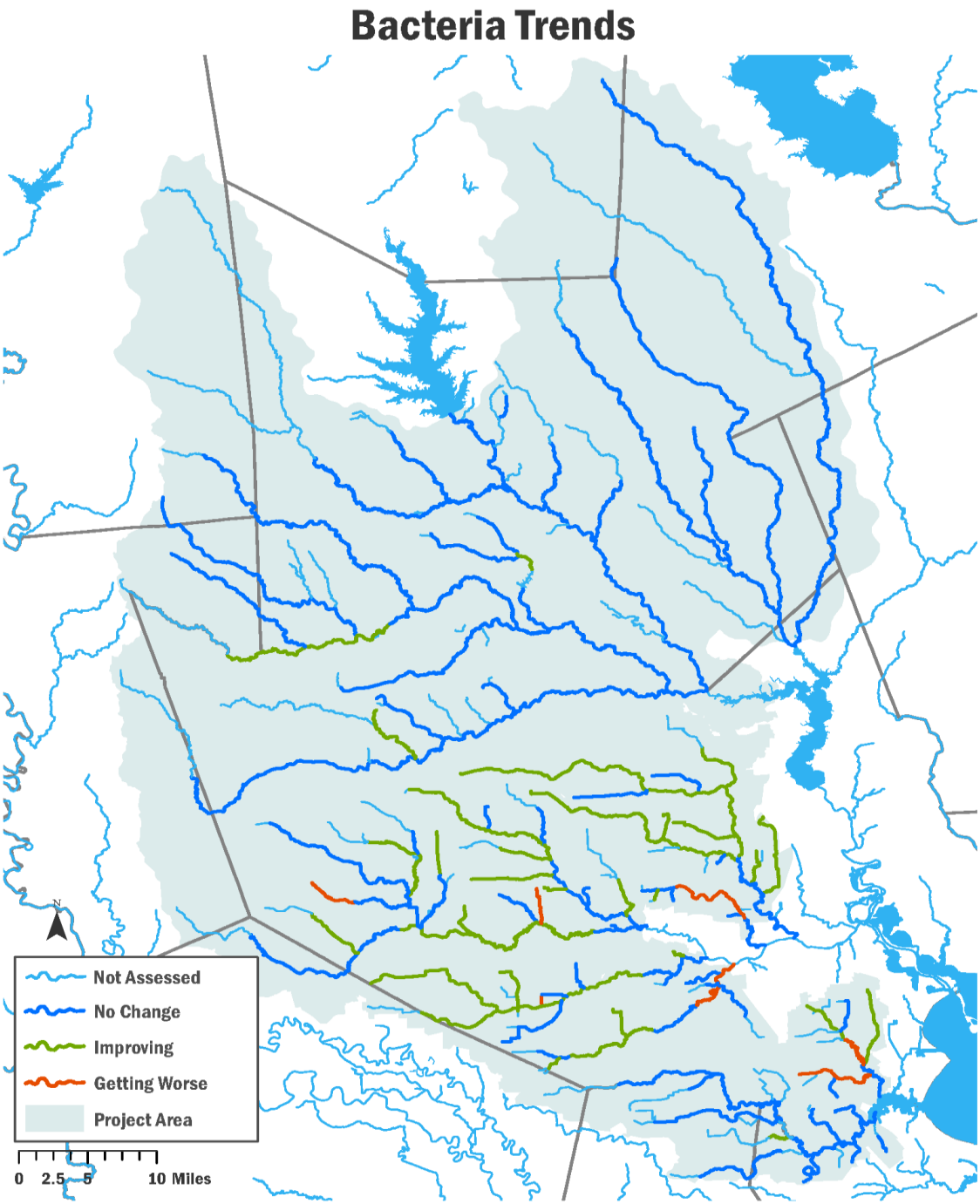


Figure 10 Improving, degrading, no change or not assessed watershed segments (and AUs) in the BIG project area. Much of the improvement is found in the BIG's original project area.

Table 7. CRP Monitoring in the BIG Project Area

Organizations	*Number of Stations in Initial BIG Project Area*	*Number of Stations in Armand Bayou*	*Number of Stations E&W Fork*	*Total Number of Stations*
TCEQ	14	4	2	20
Environmental Institute of Houston	10	0	0	10
Harris County Pollution Control	1	1	0	2
Houston Health and Human Services	119	6	0	125
Houston Water Quality Control	7	0	6	13
San Jacinto River Authority	9	0	0	9
Houston-Galveston Area Council	13	0	6	19
Texas Research Institute for Environmental Studies	0	0	10	10
Total	173	11	24	208

Table 7. CRP monitoring partners and the number of monitoring stations in the initial BIG Project Area and stations in the Armand Bayou area.

Table 8. CRP Stations with Contact Recreation Observed or Inferred 2012-2015

Year	*Evidence of Contact Recreation Observed or Inferred*	*Individuals Observed Involved in Contact Recreation*
2012	16	16
2013	25	79
2014	18	27
2015	22	38
2016	21	54

Table 8. During routine ambient monitoring, CRP partners record observed or inferred evidence of contact recreation. IF evidence of contact recreation, either observed, i.e. a person swimming, or inferred, i.e. a rope swing, then the monitor recorded contact recreation occurring at the site. If people were observed, CRP monitors document the number of individuals recreating at the time.

9.2 Conduct and Coordinate Non-Ambient Water Quality Monitoring

Interim Measures: H-GAC and BIG stakeholders will conduct non-ambient water quality monitoring activities including

- *Developing a regional Quality Assurance Project Plan (QMAA); and*
- *Developing a regional non-ambient monitoring database.*

Project Status

Not Started Behind Schedule – This activity is On Schedule.
Initiated **On Schedule**
In Progress Ahead of Schedule
Completed

Implementation Effort

- **Non-Ambient Water Quality Monitoring QAPP.** There are currently two non-ambient water quality monitoring QAPPs that have been approved by the TCEQ:
  - BPA project. The City of Houston is working on improvements to Almeda Road in the Medical Center area as part of Urban Street Rebuilds that will include LID. BPA completed the QAPP and began collecting preconstruction water quality sampling for the project. BPA will follow up with a post construction sampling once the LID features are installed.
  - H-GAC Top 5/Least 5 Project. H-GAC completed the non-ambient monitoring QAPP and started to collect bacteria samples in hopes of detecting illicit discharges from BIG waterbodies identified on the Top Ten prioritized lists.

- **Regional BMP Database.** The HCFCD developed a regional BMP database modeled on the International Stormwater BMP Database. Currently, the database includes monitoring information for stormwater BMP projects developed by the HCFCD, as well as other BMP projects in the region. (www.bmpbase.org/LandingPage.aspx)

- **Monitoring Data Implementation.**
  - The City of League City and the Texas Coastal Watershed Program (TCWP) completed the Gharardi Watersmart Park which contains monitored BMPs. The monitoring portion was completed in 2015 and TCWP reported project results in 2016.
  - BPA completed a QAPP and conducted preconstruction water quality sampling in 2016 prior to installation of a LID project on Almeda Rd., part of the Urban Street Rebuilds project.
  - BPA continued to conduct non-ambient monitoring to track down sources of bacteria in the BIG project area. For more details, see section 11. Geographic Priority Framework.
  - Harris County Birnamwood Drive LID monitoring project continues to collect water quality and quantity data. The county intends to prepare a final report in 2017.
  - Harris County collected water quality data as part of the feral hog removal project in Addicks and Barker reservoirs. Data collection and analysis was completed in 2015. The county reported on project results in 2016.
  - Environmental Institute of Houston (EIH) at the University of Houston – Clear Lake retrofitted a detention basin in the Armand Bayou Watershed with a stormwater wetland to improve run-off in 2012. Wetland monitoring for water quality and habitat quality parameters was completed in August 2014. EIH has begun to share the results with resource agencies and interested parties, for more information contact EIH. (www.eih.uhcl.edu)

Figure 11. The City of Houston Urban Street Rebuild on Almeda Road automated sampler for the BPA LID BMP preconstruction monitoring project.

9.3 Create and Maintain a Regional Implementation Activity Database

Interim Measure: Each year, BIG stakeholders will provide a report on the activities they implemented during the year. H-GMC will compile and share this information in a database.

Project Status

Not Started	Behind Schedule	– *This activity is On Schedule and has met the annual target.*
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Regional Implementation Activity Database.** H-GAC continued to develop the implementation database that includes a web application in 2015. The implementation database will include provisions for local reporting efforts and provide annual tracking forms to collect information. (http://h-gac.maps.arcgis.com/apps/MapSeries/index.htm l?appid=a75ba4bb46ca40658066c5755a8dba6e)

9.4 Assess Monitoring Results and Modify I-Plan

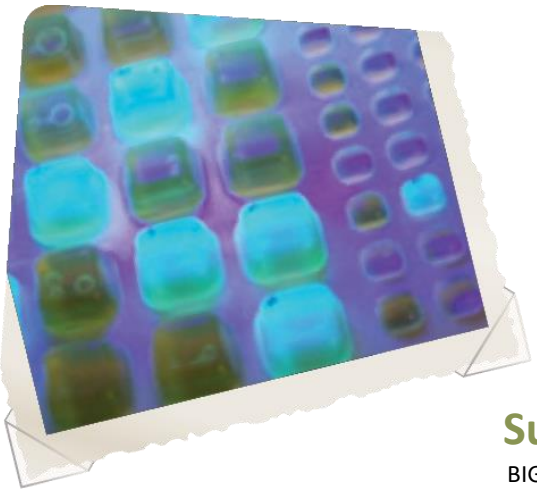
Interim Measure: Each year, H-GAC will assess monitoring in annual reports to identify whether progress is being made and communicate the results to the BIG. The BIG will determine if changes or updates to the I-Plan are needed.

Project Status

Not Started	Behind Schedule	– *This activity is On Schedule and has met the annual target.*
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **BIG Bacteria Trend Line.** The BIG project area bacteria trend line continues to show improvements (see Appendix B). However, it seems that progress has slowed in the past year. H-GAC will continue to review available data to determine trends in bacteria levels.
- **Non-Ambient Water Quality Monitoring.** Data has not been provided to H-GAC at this time to understand the impact of specific implementation activities that have been undertaken in the BIG project area. However, there are projects underway that will be able to provide data and analysis:
  - The HCFCD BMP database
  - Harris County Birnamwood Drive LID monitoring project
  - The City of League City and TCWP Gharardi Watersmart park
  - The BPA LID project on Almeda Rd.
  - H-GAC Top 5/Least 5
- **Modifications to the I-Plan.** Workgroups reviewed the I-Plan to determine if any modifications might be needed.
  - On October 25, 2016, the BIG approved Addendum #3 to the I-Plan which added seven new assessment units within the BIG project area where TMDLs were completed and approved by TCEQ, for segments in the East and West Fork of the San Jacinto watershed. With this modification, there are 102 impaired assessment units in the BIG project area.



Research

10

Summary

BIG stakeholders support new research initiatives that could result in useful findings and recommendations for reducing bacteria. TMDL studies provide a general overview of the extent and source of the presence of bacteria. However, these studies are not sufficient to determine the most cost- effective courses of action to achieve water quality standards for contact recreation. The BIG has identified three top research priorities: 1) effectiveness of stormwater management activities, 2) bacteria persistence and regrowth, and 3) appropriate indicators to identify health risks presented by contact recreation in impaired waters.

These topics are pertinent to the entire project area. However, research is often driven by the availability of resources. While some research is being conducted within the region, BIG's active participation and advocacy at the state and national levels will help ensure regional priorities are addressed. Local participation will also help to ensure findings and recommendations produced elsewhere are transferable to the project area.

On April 3, 2017, the Research Workgroup met jointly with the Monitoring and Plan Revision Workgroup. Eight stakeholders reviewed data related to ambient and non-ambient water quality. They discussed the status of bacteria studies and potential future research.

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Continue existing research and evaluate available data sources; and
  - Secure funding for additional projects, including.
    - analysis of E. coli species colonizing soil,
    - bacteria seasonal variation study,
    - determining location of a representative sample at a WWTF, and
    - appropriateness of a single grab maximum vs. a geometric mean in evaluating compliance.

Implementation Strategies

10.1 Evaluate the Effectiveness of Stormwater Implementation Activities

Interim Measure: BIG stakeholders will monitor current and future stormwater project effectiveness.

Project Status

Not Started	Behind Schedule	– *This activity is On Schedule.*
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **BMP Monitoring.**
  - HCFCD actively monitors several stormwater sites within the region and developed a Regional BMP Database where stakeholders can access and evaluate effectiveness data. (www.bmpbase.org)
  - City of League City, in cooperation with TCWP, installed a BMP park. Monitoring of the BMPs was completed in 2015.
  - Harris County Birnamwood Drive LID monitoring project continues to collect water quality and quantity data. Harris County is preparing a report for release in 2017.
  - BPA completed in 2015 a QAPP and is starting preconstruction water quality sampling prior to installation of a LID project on Almeda Road, part of the Urban Street Rebuilds project.
  - H-GAC developed a LID web resource page. (www.h-gac.com/community/low-impact-development/resources. aspx)

10.2 Further Evaluate Bacteria Persistence and Regrowth

Interim Measure: BIG stakeholders will conduct special studies to better understand the extent of human contributions to bacterial loading. Data from these studies should be included in monitoring databases...

Project Status

Not Started	Behind Schedule	– *This activity is On Schedule.*
Initiated	**On Schedule**	
In Progress	Ahead of Schedule	
Completed		

Implementation Effort

- **Special Studies.**
  - The City of Houston, Harris County, and HCFCD continue to implement the Unified Ambient Water Quality Monitoring Program to quantify diurnal bacteria fluctuations in area waterways)
  - Texas Water Resources Institute received an award in 2016 from the GBEP to start a BST project in 2017.

10.3 Determine Appropriate Indicators

Interim Measure: H-GAC and BIG stakeholders should help determine the need for alternative, supplemental, or multiple bacteria indicators to refine the I-Plan.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– Overall t*is activity is On Schedule.*

Implementation Effort

- **Tracking Indicator Research.** BIG tracks ongoing and future research to identify potential indicator bacteria, as funding is made available:
  - EPA completed a review of Coliphages as potential replacement to current fecal indicator bacteria. EPA plans to continue study in 2016.
    - EPA. "Review of Coliphages as Possible Indicators of Fecal Contamination for Ambient Water Quality", April 17, 2015. EPA Office of Water – Office of Science and Technology Health and Ecological Criteria Division. Document 820-R-15-098.

10.4 Additional Research Topics

Interim Measure: H-GAC and BIG stakeholders should conduct additional research on WWTFs, health risks, recreational use, land use modeling, unimpaired waterways, nutrients, and other constituents as funds are available.

Project Status

Not Started
Initiated
In Progress
Completed

Behind Schedule
On Schedule
Ahead of Schedule

– Activities are *On Schedule.*

Implementation Effort

- **Research Abstracts.**
  - WWTF:
    - Kuo, Jeff and Chi-Chung Tang, "Disinfection of Wastewater Effluent: Comparison of Alternative Technologies." Water Environment Research Foundation. Stock No. 04HHE4. WWW.WERF.Org.
    - Roseman, Jeffrey H., "Innovative Methods in Wastewater Disinfection,"Aqua Ion Plus. Dec. 2004.
    - Erdal, Ufuk G., Innovative/Emerging Wastewater Disinfection Technologies," CH2MHill. Presentation. uerdal@ch2m.com.
    - Ames, Iowa. Wastewater Disinfection Study for the City of Ames, Iowa. Stanley Consultants, Inc. Dec. 2009.
    - Bell, Katherine Y. and Allegra da Silva, "Innovations in Wastewater Disinfection Technology," CDM Smith. 830 Crescent Centre Dr., Suite 400, Franklin, TN 37067.

        - Leng, June, “Wastewater Reuse Treatment Technologies,” HDR, Inc.. Presentation. June 2007. jleng@hdrinc.com.
        - State of California. Treatment Technology Report for Recycled Water. January 2007.
    - OSSF:
        - Leverenz, Harold, et. al., “Evaluation of Disinfection Units for Onsite Wastewater Treatment Systems,” Center for Environmental and Water Resources Engineering, University of California, Davis, CA. Report No. 2006-1. January 2006.
        - Fedler, Clifford B., et. al.”Review of Potential Onsite Wastewater Disinfection Technologies,” Texas Onsite Wastewater Treatment Research Council. Project No. 582-11-11054. TCEQ. Texas Tech University, Lubbock, TX. December 2012.
    - Stormwater:
        - Clary, Jane, et.al. “Can Stormwater BMPs Remove Bacteria?” International Stormwater BMP Database. May 2007.
        - Clary, Jane, et. al. ”Pathogens in Urban Stormwater Systems,” Urban Water Resources Council. August 2014.
        - Jeong, Jaehak, and Roger Glick, ”Application of the SWAT Hydrologic Model for Urban Stormwater Mangement,” Presentation. City of Austin and Texas A&M Univiersity/TX AgriLife. UT Arlington, June 5, 2015.
    - Agriculture:
        - Wagner, Kevin, “Improving Water Quality of Grazing Lands,” Presentation. Texas Water Resources Institute, Texas Agricultural Experiment Station, Texas A&M University System.
        - Collins, Rob, et. al., “Best Management Practices to Mitigate Fecal Contamination by Livestock of New Zealand Waters,” New Zealand Journal of Agriculture. 2007.

- **Future Research Topics.** BIG members recommended research, should additional funding become available, including
    - fate and transport of streambed and streambank sediments and associated bacteria and nutrients with the stream water column;
    - wet sieve analysis;
    - sample dilution;
    - use of filters smaller than 0.45 µm.; and
    - testing sludge blankets from wastewater treatment facilities.

Geographic Priority Framework

1

Summary

For the BIG project area to achieve state standards for contact recreation, a wide range of community stakeholders must be responsible for implementing the I-Plan. While some initiatives span the entire project area, others focus on targeted watersheds.

As regional organizations and local jurisdictions work to establish their priorities, they should consider five main categories of concern: 1) bacteria level, 2) accessibility of waterbody, 3) use level, 4) implementation opportunities, and 5) future land use changes. To assist with prioritization, H-GAC continues to publish the Top Ten "Most Wanted"/" Most Likely to Succeed" lists (Top 10 lists) based on either the 10 assessment units with the highest observed concentrations or the 10 assessment units with concentrations just above the contact recreation standard.

2017 Focus

- H-GAC and BIG stakeholders aim to
  - Host meetings in regional watersheds to encourage local stakeholder feedback and participation;
  - Continue to use the Top 10 streams lists to prioritize implementation; and
  - Use the Top 5/Least 5 Project, to begin addressing the Top 10 lists using funding provided by GBEP.

Implementation Strategies

11.1 Consider Recommended Criteria When Selecting Geographic Locations for Projects

Interim Measure: ***Communities should consider bacteria, accessibility, opportunities, use, and future use when selecting locations for projects.***

Project Status

Not Started	Behind Schedule	– *This activity is Ahead of Schedule. Priority criteria have been developed and are in use. Activity requires tracking to ensure stakeholders continue to prioritize implementation.*
Initiated	On Schedule	
In Progress	**Ahead of Schedule**	
Completed		

Implementation Effort

- **BIG's Geographic Prioritization.** H-GAC cross compared the 2015 and 2016 Top 10 "Most Wanted "streams and Top 10 "Most Likely to Succeed" streams (see Appendices H and I):
  - Two assessment units (AUs) improved between 2015 and 2016 but still remain on the list: 1013C_01 and 1016D_01,
  - Two AUs remained unchanged: 1007F_01 and 1007U_01,
  - Four AUs degraded slightly between 2015 and 2016: 1017_04, 1007I_01, 1007T_01 and 1017E_01,
  - Two AUs degraded and are new to the 2016 list: 1004A_01 and 1013A_01, and
  - Two AUs improved and dropped off the list: 1007R_01 and 1014A_01.
- **Top 10 "Most Likely to Succeed" List**. (Appendix I)
  - Three AUs improved between 2015 and 2016 and remained on the list: 1113_02, 1008C_02 and 1113C_001,
  - Three AUs did not change status: 1113A_01, 1102A_02 and 1010_02,
  - One AU degraded slightly between 2015 and 2016: 1008E_01,
  - Three AUs are new to the list: 1008A_01, 1016A_02and 1011_02, and
  - Three AUs dropped from the list: 1008I_02, 1007A_01 and 1016B_01.
- **Top Five/Least Five Project.** Continuing in 2016, H-GAC and BIG partners have been using the Top Ten Lists to investigate five AUs from each list, screening for bacteria, seeking to identify potential sources and reporting those sources to local jurisdictions. All monitoring is being collected under a TCEQ approved QAPP. Any sources that were reported as corrected will receive follow up monitoring to verify improved conditions.
- **Top 10 "Most Wanted" Streams List.** Bayou Preservation Association and the City of Houston are working together to tackle the "Most Wanted" list. BPA conducts reconnaissance and additional wet and dry weather monitoring to track down bacteria source locations. When likely targets are identified, the information is passed on to the City of Houston or other local authorities to address.

Appendices

Appendix A

Acknowledgments

Texas Commission on Environmental Quality

Chris Loft

Linda Broach

Bryan Eastham

Marty Kelly

Kimbalyn Laird

Earlene Lambeth

Jason Leifester

Henry "Chip" Morris

Nwachukwu Sam Okonkwo

Texas State Soil and Water Conservation Board

Brian Koch

Houston-Galveston Area Council

Jeff Taebel

Todd Running

Steven Johnston

Stephanie Beckford

Justin Bower

Virgie Hall

Bill Hoffman

Kathy Janhsen

Sandra McKnight

Will Merrell

Andrea Tantillo

Jean Wright

Animals and Agriculture Workgroup

Zafar Ahmed, City of Houston

Ernest Bailes, Citizen

Danielle Cioce, Harris County

Winston Denton, Texas Parks and Wildlife

Tom Ivy, Public

Brian Koch, Texas State Soil and Water Conservation Board

Helen Lane, Houston Audubon

Brandt Mannchen, Houston Sierra Club

Steven Mitchell, Texas Parks and Wildlife Department

Mary Purzer, AECOM

Mark Tyson, Texas A&M Extension Service

Kyle Wright, National Resource Conservation Service

Stormwater and Land Development and Construction Workgroups

Zafar Ahmed, City of Houston

Richard Chapin, City of Houston

Lawrence Childress, City of Houston

Danielle Cioce, Harris County

John Concienne, Caroll and Blackman, Inc.

Justin Cox, Storm Water Solutions

Adrian Gengo, Caroll and Blackman, Inc.

Teague Harris, IDS Engineering Group

Bruce Heiberg, Bayou Preservation Association

Steve Hupp, Bayou Preservation Association

Tom Ivy, Public

Craig Maske, Alan Plummer and Associates

Rick Masters, Caroll and Blackman, Inc.

Alisa Max, Harris County

John Moss, Eco Services

Mary Purzer, AECOM

Johan Petterson, Dannenbaum

Jim Robertson, Cypress Creek Flood Control Coalition

Robert Snoza, Harris County Flood Control District

Brittany Tones, Terracon

Coordination and Policy and Plan Revision Workgroups

Zafar Ahmed, City of Houston

Ralph Calvino, AECOM

Richard Chapin, City of Houston

Danielle Cioce, Harris County

Catherine Elliott, Harris County Flood Control District

Denise Ehrlich, Gulf Coast Authority

Phillip Goodwin, City of Houston

Andrew Henderson, Public

Steve Hupp, Bayou Preservation Association

Tom Ivy, Public

Helen Lane, Houston Audubon Society

Carol Lamont, Harris County

Jason Maldonado, Lockwood, Andrews and Newnam

Alisa Max, Harris County

David Parkhill, San Jacinto River Authority

Linda Pechacek, LDP Consultants

Jim Robertson, Cypress Creek Flood Control Coalition

Linda Shead, Texas Coastal Partners

Robert Snoza, Harris County Flood Control District

Research, Monitoring, and Watershed Outreach Workgroups

Michael Bloom, R.G. Miller Engineers, Inc.

Richard Chapin, City of Houston

Danielle Cioce, Harris County

Steve Hupp, Bayou Preservation Association

Tom Ivy, Public

Karen Kottke, AECOM

Carol LaBreche, City of Houston

Alisa Max, Harris County

Robert Snoza, Harris County Flood Control District

On-Site Sewage Facility Workgroup

Alfonso Acosta, Austin County

Zafar Ahmed, City of Houston

Raymond Beckford, Harris County

Louis Bergman, Liberty County

John Blount, Harris County

Richard Chapin, City of Houston

Danielle Cioce, Harris County

Roy Elzondo, Montgomery County

Ryan Gerlich, Texas Agrilife Extension

Frank Green, Montgomery County

Wesley Adam Grier, Harris County

Andrew Isbell, Walker County

Larry Johnson, Harris County

Jeremiah Kilgore, Harris County

Robert Knight, Walker County

Alisa Max, Harris County

Rayfield May Sr., Harris County

Jack Northey, Texas Commission on Environmental Quality

Winford Roberts, Waller County

James Walls, Harris County

Tyrone West, Harris County

Wastewater Treatment Facility Workgroup

Zafar Ahmed, City of Houston

Susie Blake, City of League City

Richard Chapin, City of Houston

Danielle Cioce, Harris County

Denise Ehrlich, Gulf Coast Authority

Frank Green, Montgomery County

Denise Hall, Harris County

Jonathan Holley, Harris County Flood Control District

Steve Hupp, Bayou Preservation Association

Tom Ivy, Public

Carol LaBreche, City of Houston

Alisa Max, Harris County

Scott Nichols, Montgomery County

Ray Pavlovich, Nottingham Country MUD

Mary Purzer, AECOM

Sanitary Sewer Systems Workgroup

Charlene Bohanon, Galveston Bay Foundation

Richard Chapin, City of Houston

Marilyn Christian, Harris County

Daniel Christodoss, URS Corporation

Ralph Cox, Klotz and Associates

Roy Elizondo, Montgomery County

Denise Ehrlich, Gulf Coast Authority

Bill Goloby, City of Houston

Floyd Green, Harris County MUD #26

Teague Harris, IDS Engineering

Tom Ivy, Public

Carol LaBreche, City of Houston

Karen Kottke, AECOM

Jason Maldonado, Lockwood, Andrews and Newnam

Michael Mooney, Woodlands Joint Power Agency

Raghavender Nednur, City of Houston

Ogadimma Oneybuchi, City of Houston

Mary Purzer, AECOM**Gary Syzek,** Harris County MUD #86

Tim Vu, City of Houston

Patrick Walters, City of West University Place

Illicit Discharges Workgroup

Ted Aplace, HPARD

Charlene Bohanon, Galveston Bay Foundation

Richard Chapin, City of Houston

Danielle Cioce, Harris County

Frank Green, Montgomery County

Jesse Espinoza, City of Webster

Denise Hall, Harris County

Anita Hunt, Hunt & Hunt Engineering Corp.

Tom Ivy, Public

Katie McCann, Galveston Bay Foundation

Rasheedah Mujtabay, City of Houston

Mary Purzer, AECOM

Robert Snoza, Harris County Flood Control District

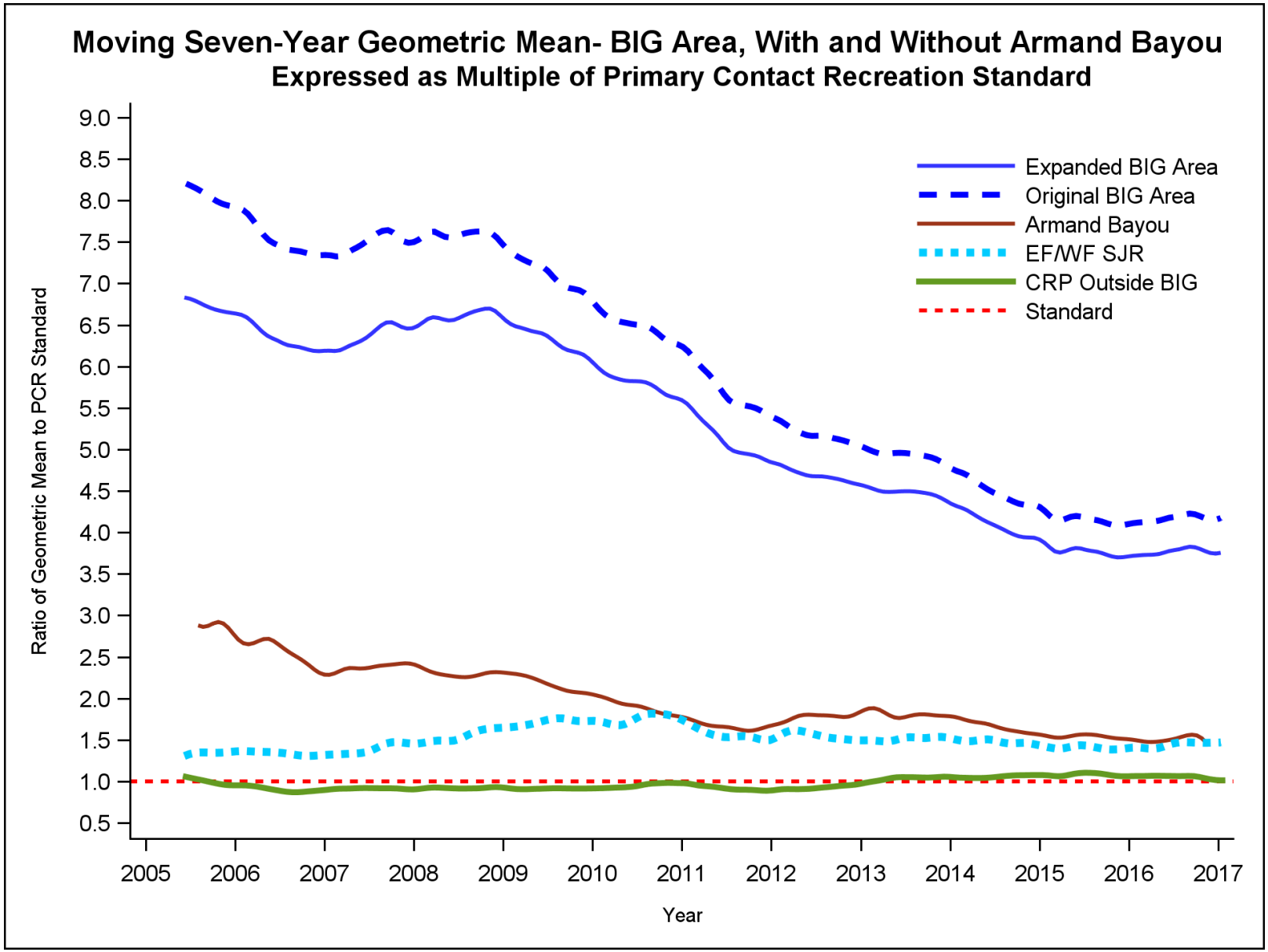
Appendix B

Bacteria Trends

The following chart illustrates how the rolling seven-year geometric mean for bacteria levels has changed over time (2005-2017). It is based on ambient water quality data collecting indicator bacteria samples (E. coli and Enterococci) from all Clean Rivers Program (CRP) monitoring stations within the BIG project area through the calendar year 2016. Included are bacteria trend lines for the BIG (dashed fuchsia line), the BIG (dashed purple line) including Armand Bayou and East and West Fork of the San Jacinto River (EF/WF SJR), Armand Bayou (solid fuchsia line), EF/WF SJR (solid purple line), and CRP area outside of the BIG project area.

The lines were generated using a ratio of the geometric mean of the rolling seven years with that of the state's contact recreation standard, either E. coli or Enterococci (126 MPN/100mL or 35 MPN/100mL). Red dash line represents the standard and the orange solid trend line is the bacteria geometric mean ratio for all areas outside of the BIG project area sampled by the CRP. The state standard is shown here as a straight dash line at 1, which is the ratio of the standard to itself.

While the overall bacteria trend in the BIG project area continues to decline, it appears to be leveling out with the area's relative geometric mean at just above four times the state's water quality standard for bacteria.



Appendix B Figure 1. Seven-year Bacteria Trend in BIG Areas, With and Without Armand Bayou

Appendix C

Tracking Progress

Appendix C Table 1. Tracking implementation Progress for Thirty-Eight I-Plan Activities

Section	Activity	Progress	Status
1.1	WWTF: Rigorous Bacteria Monitoring	Initiated	Behind Schedule
1.2	WWTF: Strict Bacteria Limits	In Progress	Ahead of Schedule
1.3	WWTF: Increased Compliance and Enforcement by TCEQ	In Progress	Behind Schedule
1.4	WWTF: Improved Design and Operation Criteria	In Progress	Ahead of Schedule
1.5	WWTF: Upgrade Facilities	In Progress	On Schedule
1.6	WWTF: Consider Regionalization	In Progress	On Schedule
1.7	WWTF: Treated Effluent	In Progress	On Schedule
2.1	SSS: Utility Asset Management	In Progress	On Schedule*
2.2	SSS: Fats, Oils, and Grease	In Progress	Ahead of Schedule
2.3	SSS: Maintain Function at Lift Station	In Progress	On Schedule
2.4	SSS: Improve Reporting Requirements	In Progress	Ahead of Schedule*
2.5	SSS: Strengthen Controls on Subscriber Systems	In Progress*	On Schedule*
2.6	SSS: Penalties for Violations	In Progress	On Schedule
3.1	OSSF: Identify and Address Failing Systems	In Progress	Ahead of Schedule*
3.2	OSSF: Address Inadequate Maintenance	In Progress	On Schedule
3.3	OSSF: Legislation and Other Regulatory Actions	In Progress	On Schedule
4.1	Stormwater: Continue Existing Programs	In Progress	On Schedule
4.2	Stormwater: Model Best Practices	In Progress	On Schedule*
4.3	Stormwater: Encourage Expansion of Stormwater Programs	In Progress	On Schedule
4.4	Stormwater: Promote Recognition Programs	In Progress	On Schedule
4.5	Stormwater: Provide a Circuit Rider Program	In Progress	Behind Schedule
4.6	Stormwater: Reimbursement of Bacteria Measures	In Progress	On Schedule
5.1	Construction: Increase Compliance and Enforcement	In Progress	On Schedule
6.1	Illicit Discharge and Dumping: Detect and Eliminate	In Progress	On Schedule
6.2	Illicit Discharge and Dumping: Improve Regulations and Enforcement	In Progress	On Schedule
6.3	Illicit Discharge and Dumping: Monitor and Control Waste Hauler Activities	In Progress	Behind Schedule**
7.1	Animals and Agriculture: Promote Increased Participation	In Progress	On Schedule
7.2	Animals and Agriculture: Promote Management of Feral Hog Populations	In Progress	On Schedule
8.1	Residential: Expand Homeowner Education Efforts	In Progress	On Schedule

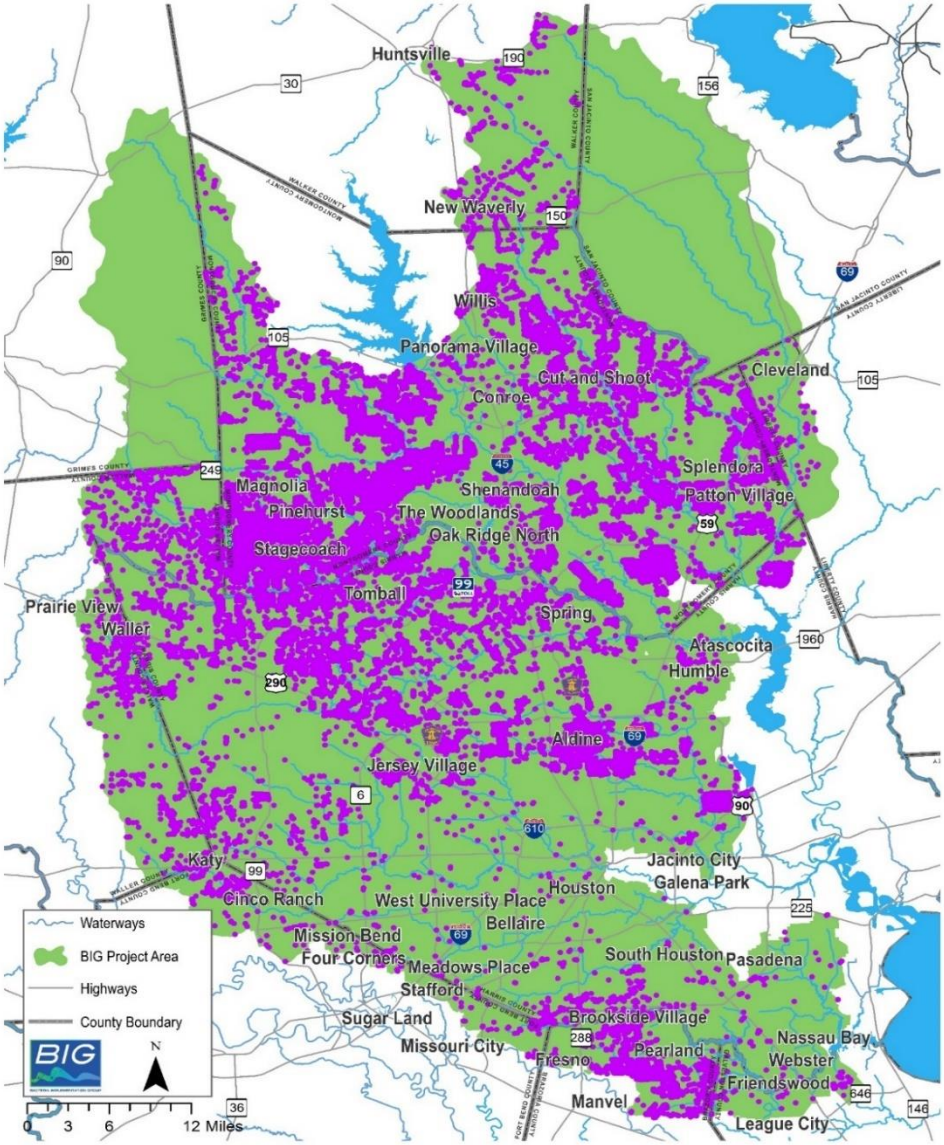
Appendix C Table 1. Tracking implementation Progress for Thirty-Eight I-Plan Activities

Section	Activity	Progress	Status
9.1	Monitoring and I-Plan Revision: Ambient Water Quality Monitoring	In Progress	On Schedule
9.2	Monitoring and I-Plan Revision: Non-Ambient Water Quality Monitoring	In Progress	On Schedule
9.3	Monitoring and I-Plan Revision: Implementation Database	In Progress	On Schedule
9.4	Monitoring and I-Plan Revision: Assess Monitoring Results and Modify I-Plan	In Progress	On Schedule
10.1	Research: Effectiveness of Stormwater Activities	In Progress	On Schedule
10.2	Research: Evaluate Bacteria Persistence and Regrowth	In Progress	On Schedule
10.3	Research: Determine Appropriate Indicators	In Progress	On Schedule
10.4	Research: Additional Research Topics	In Progress	On Schedule
11.1	Geographic: Consider Priority Criteria in Project Location	In Progress	**Ahead of Schedule***

*Appendix C Table 1. Tracking implementation progress. Bolded text denotes a change from the previous year. *Activity's Progress or Status graded higher over the previous year's assessment. **Progress or Status of Activity was downgraded over the previous year's assessment.*

Appendix D

OSSF Information System



Appendix E

"Wall of Fame"

Authorized agents for on-site sewage facilities (OSSFs) and operators of municipal separate storm sewer systems (MS4s) Phase II were asked via e-mail and/or phone to provide data and information for this annual report. The "Wall of Fame" acknowledges participating stakeholders for their contributions. Additional stakeholders, including wastewater treatment facility permit holders, will be asked to provide data and information in the coming year.

On-Site Sewage Facilities

RELIABLY SUBMITTED DATA AND SUBMITTED A COMPLETE PERMIT DATA SET

- City of Manvel
- Brazoria County*
- Fort Bend County
- Galveston County
- Harris County
- Liberty County
- San Jacinto River Authority
- Waller County
- Walker County
- Texas Commission on Environmental Quality

** Also submitted some violation data*
***Note:** Austin, Chambers, Colorado, Matagorda and Wharton counties, while outside of the BIG project area, have provided information in support of the OSSF mapping program initiated by the BIG.*

Municipal Separate Storm Sewer Systems

RESPONDED TO MS4 PHASE II QUESTIONNAIRE

- City of Missouri City
- City of Meadows Place
- Montgomery County MUD No. 94
- Brazoria Drainage District No. 4
- Fort Bend County MUD No. 57
- Cinco Sourthwest MUD No. 1
- City of Pearland
- City of League City
- City of West University Place
- City of Katy
- City of Deer Park
- Harris-Fort Bend Counties No. 1
- Grand Lakes MUD No. 4
- Grand Lakes MUD No. 1
- Southwest Harris County MUD No. 1
- City of Hunters Creek Village
- Fort Bend County MUD No. 122
- Fort Bend County MUD No. 123
- Fort Bend County MUD No. 57
- Fort Bend County MUD No. 34
- Fort Bend County MUD No. 35
- Fort Bend County MUD No. 130
- City of Stafford
- Montgomery County MUD No. 84
- Montgomery County MUD No. 15

SHARED MS4 PHASE II DATA FOR DATABASE TRACKING

- City of Friendswood
- City of League City
- City of Nassau Bay
- City of Pearland

SHARED MS4 PHASE II SWMP AND NOI DOCUMENTS

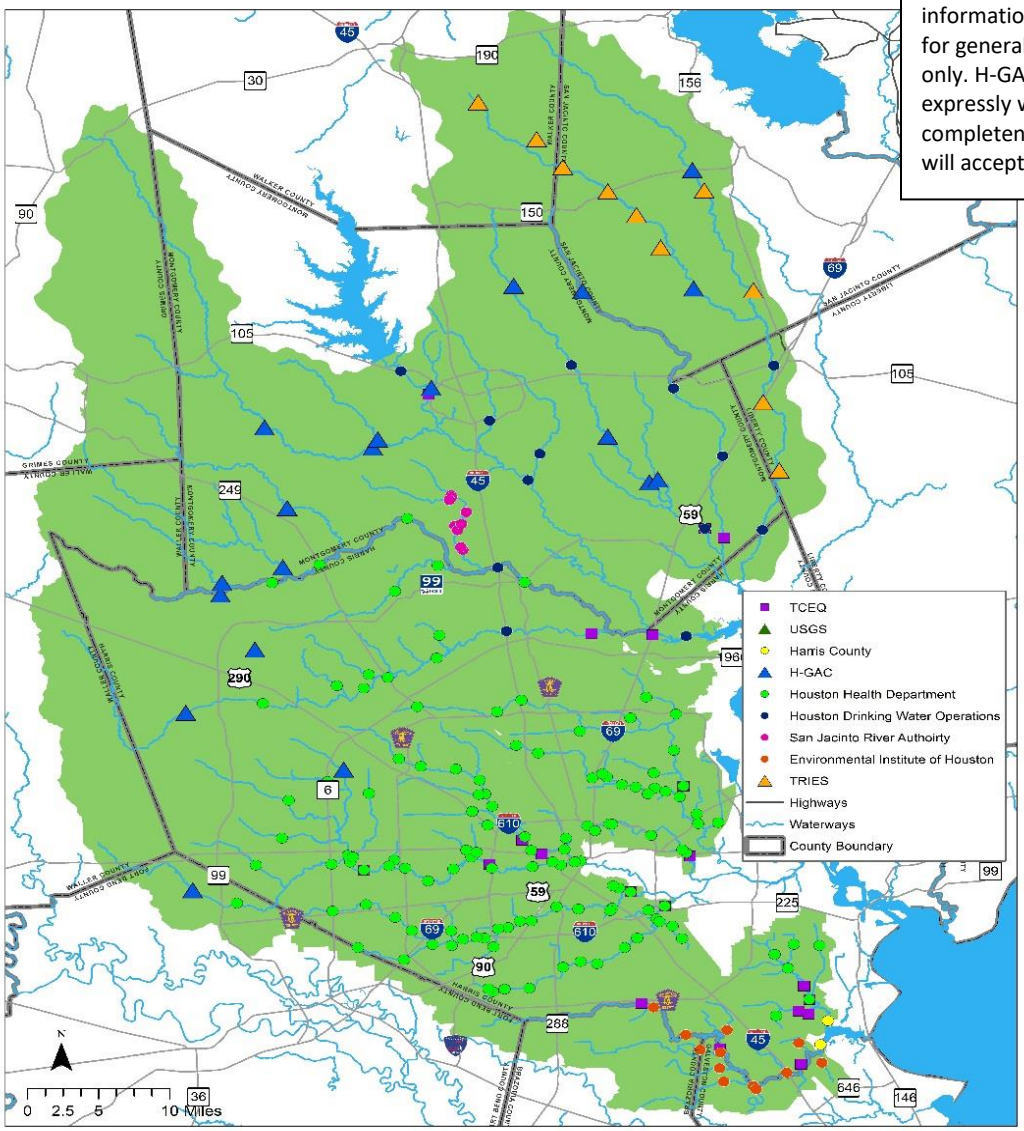
- Brazoria Drainage District No. 4
- Cinco Southwest MUD No. 1
- City of League City
- Grand Lakes MUD No. 1
- Grand Lakes MUD No. 4
- Harris-Fort Bend Counties MUD No. 1
- City of Hunters Creek Village
- City of Missouri City
- Montgomery County MUD No. 94
- City of Nassau Bay
- City of Pearland
- Southwest Harris County MUD No. 1
- City of West University Place
- Harris-Fort Bend County MUD No. 1
- Fort Bend County MUD No. 122
- Fort Bend County MUD No. 123
- Fort Bend County MUD No. 57
- Fort Bend County MUD No. 34
- Fort Bend County MUD No. 35
- City of Stafford
- Montgomery County MUD No. 8

Appendix F

CRP Monitoring Sites in the BIG Region

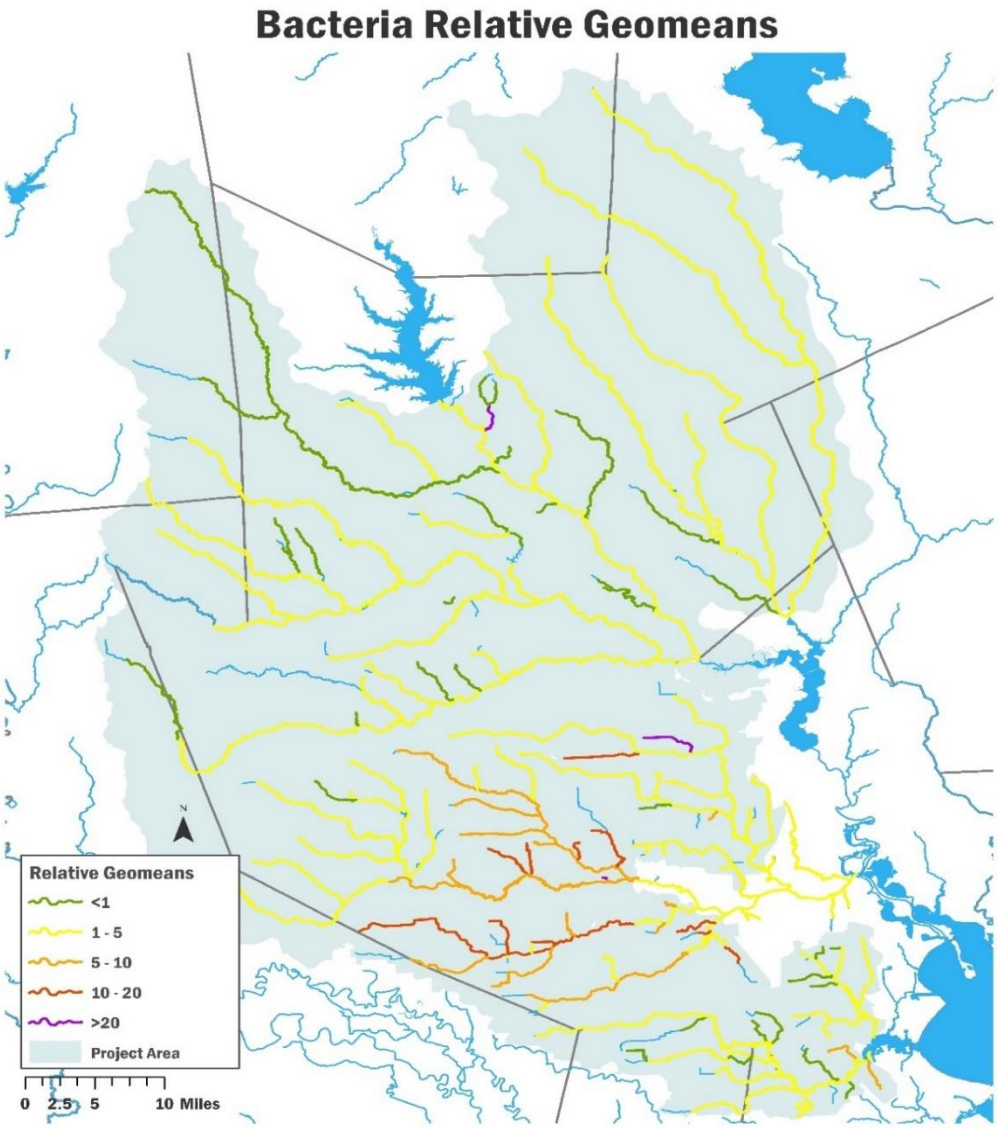
BIG Project Area Monitoring Stations

The information on this map represents the most current information available to H-GAC and is for general informational purposes only. H-GAC does not implicitly or expressly warrant its accuracy or completeness and neither assumes nor will accept liability for its use.



Appendix G

Bacteria Geomeans Within the BIG AREA

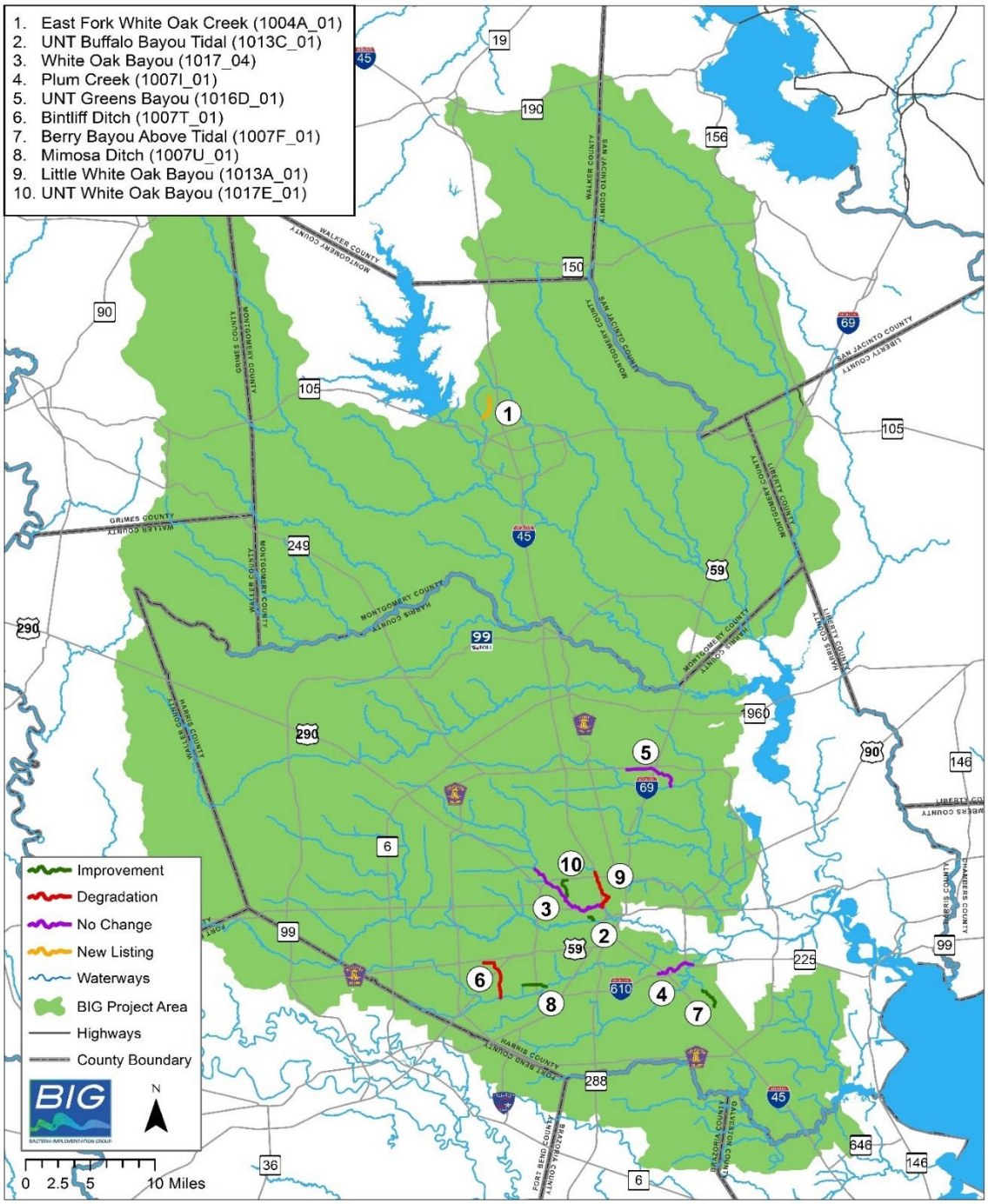


Appendix H

Top 10 "Most Wanted" Streams

Rank	Assessment Unit (AU)	Parameter	Standard (MPN/100mL)	Geometric Mean (MPN/100mL)	Relative Geometric Mean (MPN/100mL)	AU Status	AU Description	Watershed
1	1004A_01	*E. Coli*	126	4849.705408	38.4897255	Degraded New Listing	East Fork White Oak Creek	West Fork San Jacinto River
2	1013C_01	*E. Coli*	126	3189.731197	25.315327	Improved	Unnamed Tributary, located approximately 1.8 miles upstream of the Buffalo Bayou/White Oak Bayou confluence between IH-10 and Memorial Drive west of IH-45 in Harris County	Buffalo Bayou
3	1017_04	*E. Coli*	126	3018.672355	23.9577171	Degraded	White Oak Bayou, Brickhouse Gully confluence to a point immediately upstream of the confluence of Little	White Oak Bayou
4	1007I_01	*E. Coli*	126	2883.592799	22.8856571	Degraded	Plum Creek, from the Sims Bayou confluence to Telephone Road in Harris County	Sims Bayou
5	1016D_01	*E. Coli*	126	2676.869582	21.2449967	Improved	Unnamed Tributary, from the confluence with Greens Bayou, west of El Dorado Country Club to Lee Road, west of US Hwy 59 in Harris County	Greens Bayou
6	1007T_01	*E. Coli*	126	2381.01858	18.8969729	Degraded	Bintliff Ditch, From the Brays Bayou confluence to 0.57 km (0.35 mi) upstream of the Fondren Road bridge crossing	Brays Bayou
7	1007F_01	*E. Coli*	126	2324.74922	18.4503906	No Change	Berry Bayou, from a point 2.4 km (1.5 mi) upstream of the Sims Bayou confluence to SH 3	Sims Bayou
8	1007U_01	*E. Coli*	126	2094.724904	16.6248008	No Change	Mimosa Ditch, from the Brays Bayou confluence upstream 2.9 km (1.8 mi) to the Chimney Rock bridge crossing	Brays Bayou
9	1013A_01	*E. Coli*	126	1979.653411	15.711535	Degraded New Listing	Little White Oak Bayou, from the White Oak Bayou confluence to Yale Street in Harris County	White Oak Bayou
10	1017E_01	*E. Coli*	126	1885.832972	14.9669283	Degraded	Little White Oak Bayou, from the confluence with White Oak, near W 11th Street, to just upstream of W 26th Street, south of Loop 610 W in Harris County	White Oak Bayou

TEN STREAMS "MOST WANTED"



Appendix I

Top 10 "Most Likely to Succeed" Streams

Rank	Assessment Unit (AU)	Parameter	Standard (MPN/100mL)	Geometric Mean (MPN/100mL)	Relative Geometric Mean (MPN/100mL)	AU Status	AU Description	Watershed
1	1113_02	Enterococci	35	36.66984472	1.047709849	Improved	Armand Bayou, from the Horsepen Bayou confluence to the Big Island Slough confluence	Armand Bayou
2	1008C_02	*E. Coli*	126	135.3399192	1.074126343	Improved	Lower Panther Branch, from Saw Dust Road to the Lake Woodlands Dam	Spring Creek
3	1008A_01	*E. Coli*	126	138.7979838	1.1015713	New Listing	Mill Creek, from the normal pool elevation of Neidigk Lake upstream to the Hurricane Creek and Kickapoo Creek	Spring Creek
4	1113A_01	*E. Coli*	126	141.2550749	1.121072023	Degraded	Armand Bayou, from the upper segment boundary of Armand Bayou Tidal (point 0.8 km (0.5 miles) downstream of Genoa-Red Bluff Road) upstream to Beltway 8	Armand Bayou
5	1016A_02	*E. Coli*	126	142.0701499	1.127540872	New Listing	Garners Bayou, from the confluence with Williams Gully upstream to 1.5 km north of Atascocita Road	Greens Bayou
6	1113C_01	*E. Coli*	126	146.4102367	1.161986006	Improved	Unnamed Tributary, from the Horsepen Bayou confluence to Reseda Drive	Armand Bayou
7	1102A_02	*E. Coli*	126	150.9536712	1.19804501	No change	Cowart Creek, confluence with Clear Creek to Sunset Drive	Clear Creek
8	1010_02	*E. Coli*	126	152.9865842	1.21417924	Improved	Caney Creek, from FM 1097 to SH 105	Caney Creek
9	1008E_01	*E. Coli*	126	153.259504	1.21634527	Degraded	From Upper Panther Branch confluence to south of FM 1488	Spring Creek
10	1011_02	*E. Coli*	126	156.2865019	1.240369063	New Listing	Peach Creek, US Hwy 59 to confluence with Caney Creek	Peach Creek

TEN STREAMS "MOST LIKELY TO SUCCEED"