BIG '18

ANNUAL REPORT

BACTERIA IMPLEMENTATION GROUP

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)

Carol La Breche, City of Houston (Large City)

Andrew Isbell, Walker County (Rural County)

Tom Ivy, Environmentally Concerned Citizen (Conservation)

Sarah Gossett, 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)

Leah Tarrant, (Rural Small City)

Vacancy, (Business/Industry)

Vacancy, Bayou Preservation Association (Conservation)

Parenthetical indicates type of organization represented.

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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, Terracon

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

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

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Patty Matthews, AECOM

Scott Nichols, Montgomery County

Michael Page, Schwartz, Page & Harding, LLP

Rachel Powers, Citizens' Environmental Coalition

Karen Kottke, 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

Mary Ellen Whitworth, Texas Coastal Partners

Jim Williams, Sierra Club

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

Be Part of the Solution

The BIG project, the first of its kind in thestate,issuccessful thanksinnosmall parttoyoursupport.Weare 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. Municipal Separate Storm Sewer Systems (MS4) Phase I and PhaseIIoperators,localgovernments, 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.

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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 2018 Annual Report is designed to track progress made in the BIG Project Area (Figure 1) by the BIG during the period of January 1, 2017 - December 31, 2017.

Hurricane Harvey impacted the Texas Coast and the counties within the BIG project area in 2017. As much as 60 inches of rain fell in Texas, or about 275 trillion tons of water. Most of the Houston region experienced a 1,000-year storm event. Bacteria levels were documented well above the standard following the storm. Monitoring completed by the city of Houston found 75-100% of samples exceeding the standard for several weeks following the hurricane (HARC, 2017). Over 190,000 homes were estimated to be flooded because of Harvey. Harris County Flood Control District reported that most flooding occurred "in areas developed prior to current understanding of flood potential and prior to regulations restricting construction in flood-prone areas" (AWBD, 2018). Sixty-five% of flooded homes were built before 1981 while less than 3% of homes built after 2009 were flooded (AWBD, 2018). Of 1,100 waste water treatment facilities (WWTFs) monitored by TCEQ, only three were destroyed (AWBD, 2018). The City of Houston reported taking one WWTF offline and merging the service with another plant.

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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 WWTFs. Coordinating with other partners, develop and implement effective education and outreach with residents concerning the handling of fats, oils, and grease (FOG). 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 than WWTFs. 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 resident or water professional 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.

The brochure, "BIG Ideas for Cleaner Water 2017: Local Government Strategies for Improving Water Quality," covers these topics in greater detail. The brochure is available at http://www.h-gac.com/community/water/tmdl/BIG/reports.aspx. Appendix C provides common resource links to available funding, outreach and education materials, more detailed reporting and data information to assist in the implementation of these three strategies and other activities of the I-Plan.

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BIG Project Area

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.

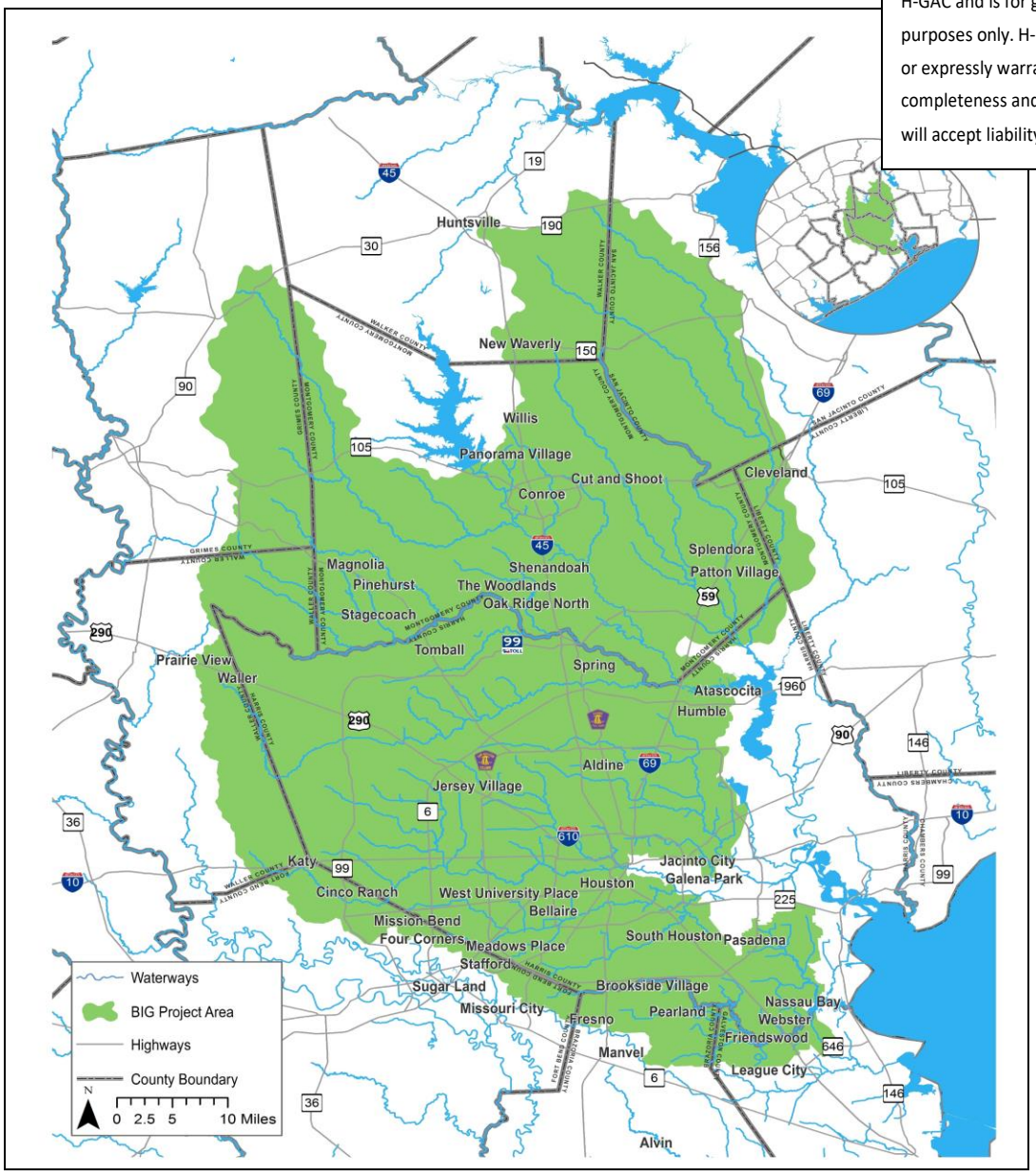

Figure 1. The BIG project area is approximately 3,260 square miles and has a population of nearly five million people. The area encompasses much of the City of Houston and all or part of another 63 cities and 10 counties.

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 the region's 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

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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 2). 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 square miles. The expanded area is now 3,259.89 square 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.

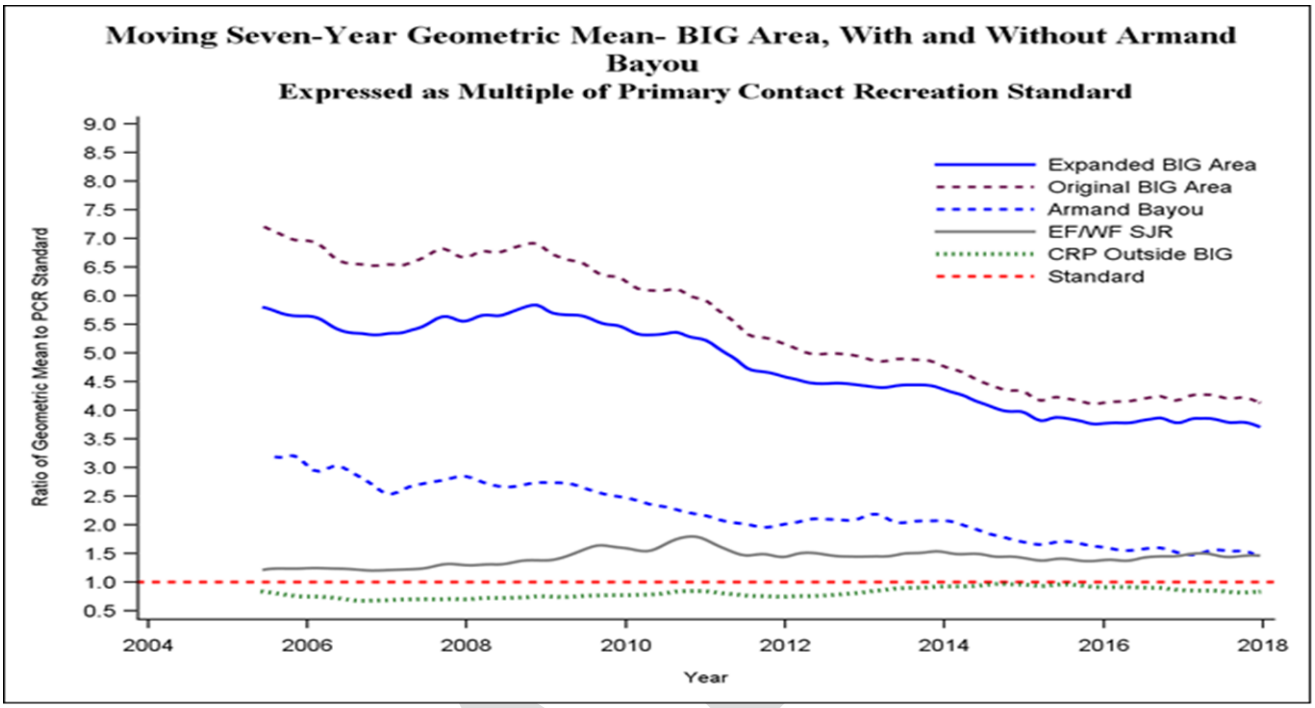

Figure 2. Bacteria trend lines for the BIG Area, Original Project Area and Expanded Project Area 2005-2018. The BIG expanded to include Armand Bayou and East and West Fork San Jacinto River (EF/WF SJR). Trend lines for Armand Bayou, EF/WF SJR, Clean Rivers Program (CRP) area outside BIG Project Area, and the state's water quality standard are also shown. The graph is explained in more detail in 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 2017.

Fats, Oils, Grease (FOG) Sanitary Sewer System Reduction Efforts

The City of Houston and Galveston Bay Foundation have active programs seeking to reduce FOG. The Houston Health Department maintains a comprehensive FOG program under FOG Ordinance Chapter 47 Article XI, that focuses on reducing the impact of pollutants that may interfere with the function of the sanitary and storm sewer system. The department has an active community education and involvement presence and provides necessary enforcement through investigations and follow up remediation. In 2017, 3,017sanitary sewer overflows were investigated by staff. Additionally, staff investigated and found 11,492 violations and issued 923 citations. Staff in 2017 conducted 37 public outreach initiatives.

In 2017, Galveston Bay Foundation promoted the Cease the Grease Program at 18 outreach events, reaching 7,527 people. An additional 7 million people were reached through media promotions. The Galveston Bay Action Network (www.galvbay.org/gban) was used to file 9 sanitary sewer issue reports. The reports are sent on to the appropriate agency for response.

Residential Wastewater Assistance Program for OSSF Repair/Replacement

The Houston-Galveston Area Council (H-GAC) continued to develop its Wastewater Assistance Program which includes a Supplemental Environmental Project (SEP) through TCEQ .and an additional SEP through the Harris County District Attorney's Office. Environmental fines from water quality violations can be directed to both SEPs. H-GAC uses these funds to assist homeowners with failing systems by providing holding tank pump outs, make system repairs, and if necessary, a complete replacement of the entire system. Homeowners must qualify based on income level, must own the home and live in the 13 county H-GAC Service Area. H-GAC began identifying potential owners in 2017. To date H-GAC has completed three system replacements and has another 15 systems inspected, qualified and ready for replacement.

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Top Five / Least Five Illicit Discharge Detection and Elimination Model Program

H-GAC and an advisory group of local agencies and governments carried out the IDDE model program based on the BIG's Top Ten / Least Ten geographic priorities list. The program was designed to serve as a model for local MS4s and other governments without established IDDE programs. The program includes a rapid and low-cost phase, with a simplified bacteria analysis, to quickly detect potential leaks. A second, more rigorous and potentially costlier phase is included which requires the use of a National Environmental Accredited Program laboratory for bacteria analysis, when more certain and defensible data is needed. The program includes a Quality Assurance Project Plan that can serve the basis for a local government should it wish to pursue state of federal funds to initiate a IDDE project. All portions of the project, including project results are available online at http://www.h-gac.com/community/water/tmdl/BIG/reports.aspx.

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 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 March 2018 and May 2018 to discuss implementation. This report includes activities through December 2017.

There are 38 implementation activities described in the I-Plan and laid out in this report. Activity goals, an assessment, and a summary of implementation efforts conducted throughout the year are presented for each.

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, Ahead of Schedule, or Completed and in Tracking. Completed and in Tracking is a new category for the 2018 BIG Annual Report. It signifies that the activity has been completed and the BIG will continue to track. In a future I-Plan update, the activity will be reviewed to determine if a new activity is needed, a change to the assessment measure is required, or if the activity should continue to be tracked.

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Overall, four activities have been completed and 34 are In Progress. The four activities that have been completed and four activities In Progress have been placed into Tracking to evaluate changes over time. Three activities were considered Ahead of Schedule, 26 On Schedule, with only one being considered Behind Schedule (Figure 3). 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.

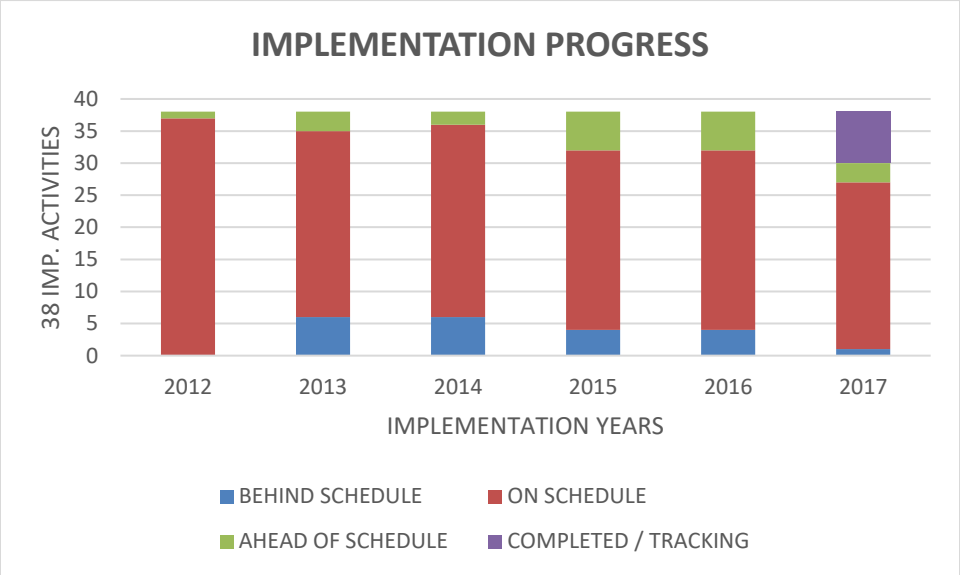
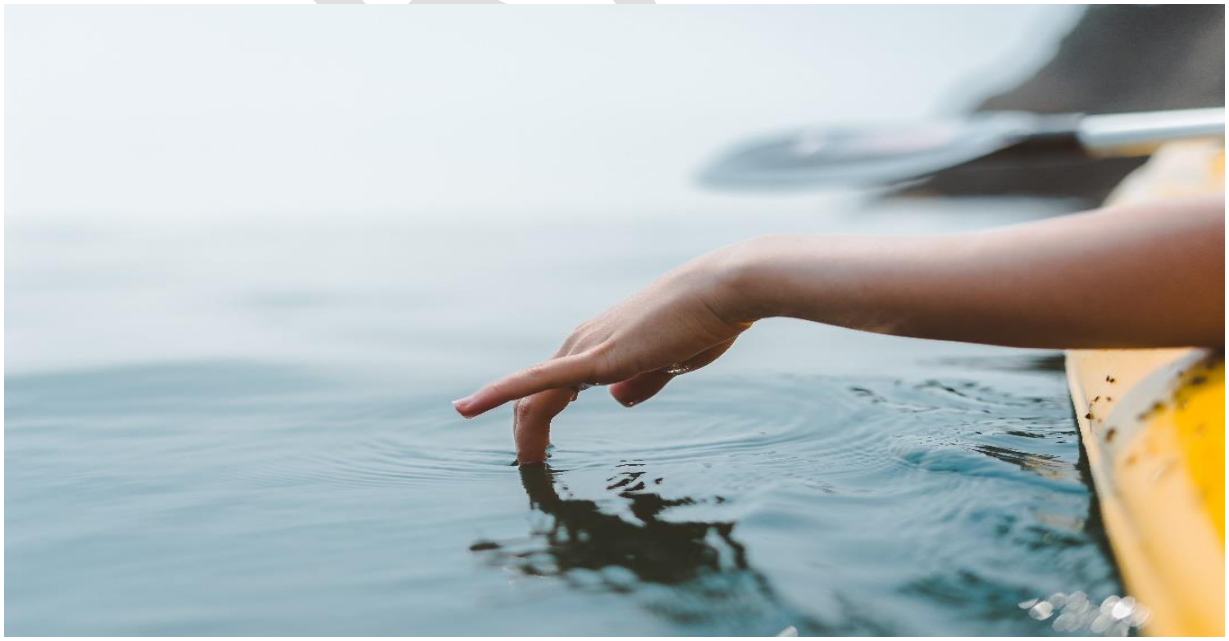


Figure 3 Implementation tracking for all 38 I-Plan Activities. Note: Completed and in Tracking is a new category added for the 2018 Annual Report. When reviewing this figure, it is possible that in a prior year assessment, one or more activity might have been considered for this category.



Strategy	#	Activity	Achievements	Progress	Status
Wastewater Treatment Facilities	1.1	Impose More Rigorous Bacteria Monitoring Requirements	More strict monitoring frequency requirements found in the I-Plan have not shown up in wastewater permits. The BIG submitted a letter which requested TCEQ consider this measure.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	1.2	Impose Stricter Bacteria Limits for WWTF Effluent	More stringent limits have been implemented for wastewater permits. Activity is programmatically complete. There are 640 active permits in the project area, 568 submit DMRs with 532 reporting bacteria. 449 (84%) reported 63 MPN/100mL as their limit in 2017.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	1.3	Increase Compliance and Enforcement by the TCEQ	The TCEQ reports performing compliance and enforcement capabilities within the BIG region. The BIG requested in 2017 TCEQ share data to track implementation.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	1.4	Improved Design and Operation Criteria for New Plants	Title 30 Chapter 217 of the Texas Administrative Code was updated to reflect current permitting practices of TCEQ and updated WWTF standards and criteria. Harris County reviews new WWTF plan sets and specifications. In 2017, Harris County screened 35 WWTF plan sets for compliance with state disinfections standards. None needed to be referred to outside consultants for in-depth plan review.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking

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Strategy	#	Activity	Achievements	Progress	Status
	1.5	Upgrade Facilities	TCEQ's Permit Central Registry provides general information on the number of WWTF upgrades by county. The information lacks specificity on the number of non-compliant WWTFs that have been upgraded. Seventy-three WWTF plans and specification applications were submitted in 2016 to improve, rehabilitate, and/or upgrade. H-GAC hosted a workshop in May 2017, with the topic of Trends and Technology in Waste Water.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	1.6	Consider Regionalization of WWTFs	Harris County updates the BIG on the number of Harris County plants undergoing regionalization. No plants in 2016 considered regionalization. EPA and TCEQ maintain non-compliant lists. TCEQ through the latest Chapter 217 requires new WWTFs to consider regionalization if an existing plant is within a three-mile radius.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	1.7	Use Treated Effluent for Facility Irrigation	TCEQ's Permit Central Registry provides general information on the number of WWTF applications for reuse by County. TCEQ received two applications in 2016 for reuse.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
Sanitary Sewer Systems	2.1	Develop Utility Asset Management Programs (UAMPs) for Sanitary Sewer Systems	TCEQ's voluntary sanitary sewer overflow (SSO) initiative has 32 WWTF operators participating. H-GAC, TCEQ and EPA offer technical training and workshops tailored to encourage the use of life-cycle maintenance and dedicated WWTF and sanitary sewer funding. H-GAC hosted a workshop in May 2017, with the topic of Trends and Technology in Waste Water.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	2.2	Address Fats, Oils, and Grease	Several model FOG programs are available from the City of Houston (https://www.publicworks.houstontx.gov/pud/corral_grease.html), San Jacinto River Authority (http://www.pattypotty.com/) and H-GAC (https://coastalcommunitiestx.weebly.com/materials.html).	Not Started Initiated	Behind Schedule On Schedule

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Strategy	#	Activity	Achievements	Progress	Status
				In Progress Completed	Ahead of Schedule Tracking
	2.3	Encourage Appropriate Mechanisms to Maintain Function at Lift Stations	The TCEQ upgraded portions of Title 30, Chapter 217 of the TAC, which addressed emergency power requirements. TCEQ's Permit Central Registry provides general information on the number of Lift Station applications made by county. Forty-seven applications for Lift Stations, including 2 generators, were noted in 2016.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	2.4	Improve Reporting Requirements for SSOs	H-GAC receives annual updates on the number of SSOs in the project area through a request to TCEQ. TCEQ appears to be notified of SSOs via 24-hour verbal and 5-day written notice requirement. There is not a searchable database online. In 2017, there were 2,339 SSOs and an estimated 13,719,000 gallons of untreated effluent.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	2.5	Strengthen Controls on Subscriber Systems	TCEQ was asked to consider adding a permit requirement to document subscriber systems or require subscriber system permits.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	2.6	Penalties for Violations	The TCEQ is currently revising its Enforcement Initiation Criteria, revision 15. TCEQ inspectors can conduct focused SSO investigations during rain events even if the SSS facility has never reported an SSO. TCEQ reported no inspections in 2017.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking

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Strategy	#	Activity	Achievements	Progress	Status
OSSF	3.1	Identify and Address Failing Systems	H-GAC maintains an OSSF permit database that shows permits by age, authorized agent, and OSSFs per square mile. 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 78 connections to new sanitary sewer systems in 2017 for a total of724 connections since 2104. 130 OSSFs were abandoned in 2016 for a total of 1,279 abandoned since 2014. Harris County and East Aldine Management District began grant funded projects in 2017 that made 138 connections to new sanitary sewer systems in 2017. 328 OSSFs were abandoned in 2017. Many of the abandoned OSSFs were failing as evidenced by violations.	Not Started Initiated **In Progress** Completed	Behind Schedule On Schedule **Ahead of Schedule** Tracking
	3.2	Address Inadequate Maintenance of OSSF	Model OSSF regulations and policies are available online. H-GAC created a website for homeowners, home buyers, local governments, and real estate professionals. Harris County hosted the 7th Annual Onsite Wastewater Seminar on May 15, 2017, with 159 water quality professionals in attendance.	Not Started Initiated **In Progress** Completed	Behind Schedule **On Schedule** Ahead of Schedule Tracking
	3.3	Legislation and Other Regulatory Actions	H.B. 2771 was enacted in September 2017 to create a dedicated fund using $10 from OSSF application fees. TCEQ will use the fund for competitive research grants. Harris County hosted the 7th Annual Wastewater Seminar on May 30, 2017. The day-long event presented new innovations, best practices, and rules and enforcement updates.	Not Started Initiated **In Progress** Completed	Behind Schedule **On Schedule** Ahead of Schedule Tracking
Stormwater & Land Development	4.1	Continue Existing Programs	Two Phase I municipal separate storm sewer systems (MS4s) permits (Joint Task Force [JTF] and Pasadena) and 129 MS4s phase II permits are partially or fully found in the BIG project area. A review of MS4 Phase II permit annual reports continues to see these programs identify best practices, begin linkages to impaired waters, and support educational opportunities.	Not Started Initiated **In Progress** Completed	Behind Schedule On Schedule Ahead of Schedule **Tracking**

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Strategy	#	Activity	Achievements	Progress	Status
	4.2	Model Best Practices	HCFCD continues to host and update the Regional BMP Database: www.bmpbase.org. H-GAC manages a LID/Green Infrastructure online resource: www.h-gac.com/community/go/LID. H-GAC hosted a series of workshops that focused on the six minimum control measures required in an MS4 permit. International Erosion Control Association held a LID and Green Infrastructure Workshop on June 7, 2017, in Houston.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	4.3	Encourage Expansion of Stormwater Management Programs	There are over 130 municipalities and utility districts in the BIG project area subject to the MS4 Phase II General Permit. H-GAC hosted a workshop on MS4 Minimum Control Measures, April 4, 2017.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	4.4	Promote Recognition Programs for Developments that Voluntarily Incorporate Bacteria Reduction Measures	H-GAC is developing an awards program, Water Innovation Strategies of Excellence Awards (WISE). The program will be released in 2018 and the first awards will be given in 2019.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	4.5	Provide a Circuit Rider Program	H-GAC is working with the cities of Pearland and Mont Belvieu to review development ordinances and evaluate opportunities to expand the use of LID and green infrastructure. Project concludes in 2018.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	4.6	Petition TCEQ to Facilitate Reimbursement of Bacteria	Letter submitted to TCEQ requesting development of a guidance document to standardize the reimbursement process.	Not Started Initiated	Behind Schedule On Schedule

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Strategy	#	Activity	Achievements	Progress	Status
		Reduction Measures		In Progress Completed	Ahead of Schedule Tracking
Construction	5.1	Increase Compliance with and Enforcement of Stormwater Management Permits	The City of Houston and Harris County manage mature programs to address construction site compliance. City of Houston reports education onsite is a big factor in ensuring compliance. H-GAC hosted a workshop on MS4 Minimum Control Measures, April 4, 2017.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
Illicit Discharge Detection and Elimination	6.1	Detect and Eliminate Illicit Discharges	Analysis of MS4 annual reports indicated that MS4 operators have regulatory mechanisms in place and procedures for detecting illicit discharges, including mapping to meet 10-year goal. Reporting of the number identified and addressed remains a work in progress. H-GAC and its partners completed a model IDDE program to serve as a guide for interested local governments. Citizen reporting tools are available to assist local government: 311, www.CleanBayous.org, and Galveston Bay Action Network, www.galvbay.org/gban.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	6.2	Improve Regulation and Enforcement of Illicit Discharges	MS4 Phase II operators review and implement regulations as a permit requirement. H-GAC continues to compile existing regulations. H-GAC maintains an online resource of enforcement topical presentations given at environmental workshops held at H-GAC: http://www.h-gac.com/community/environmental-enforcement/workshops.aspx	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	6.3	Monitor & Control Waste Hauler Activities	No waste hauler tracking fleet program has been identified for a pilot project. City of Houston maintains a mature waste hauler tracking program. Potential online tracking programs have been developed by vendors like: https://www.trackmyfog.com/. Dallas maintains a program that uses Scantron device (XC2 and Pearson Scan Tool Software) to upload manifests. The Illicit Discharge work group will review and consider these potential programs in 2018.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking

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Strategy	#	Activity	Achievements	Progress	Status
Animals, Agriculture	7.1	Promote Increased Participation in Existing Programs for Erosion Control Nutrient Reduction, and Livestock Management	Natural Resource Conservation Service and Texas State Soil and Water Conservation Board manage and promote land management programs in the project area. Lonestar Healthy Streams workshop on Grazing Cattle was held in Waller County on March 31, 2017. H-GAC hosted the Land Use Management workshop on March 13, 2017.	Not Started Initiated **In Progress** Completed	Behind Schedule **On Schedule** Ahead of Schedule Tracking
	7.2	Promote the Management of Feral Hog Populations	Bait evaluation continues for sodium citrate and warfarin.	Not Started Initiated **In Progress** Completed	Behind Schedule **On Schedule** Ahead of Schedule Tracking
Residential	8.1	Expand Homeowner Education Efforts Throughout the BIG Project Area	Texas Community Watershed Partners of TX AgriLife hosted the WaterSmart: Strategies for Water Efficient Landscapes Seminar on June 30, 2017 (https://tcwp.tamu.edu/). H-GAC continues a series of Clean Water Initiative workshops covering topics from water quality data, watershed-based plans, MS4 minimum control measures and waste water technology. Information available at www.h-gac.com/cwi.	Not Started Initiated **In Progress** Completed	Behind Schedule **On Schedule** Ahead of Schedule Tracking
Monitoring and I-Plan Revision	9.1	Continue to Utilize Ambient Water Quality Monitoring and Data Analysis	The region's Clean Rivers Program's ambient monitoring data forms the backbone of assessments used in this report. Eight monitoring partners collect ambient data at 208 monitoring sites in the BIG project area. Additional data is provided by the network 19 Texas Stream Team volunteers.	Not Started Initiated **In Progress** Completed	Behind Schedule On Schedule Ahead of Schedule **Tracking**
	9.2	Conduct and Coordinate Non-Ambient Water	HCFCD continues to monitor water quality at several detention basins. Data is uploaded to their BMP database. Harris County wrapped up monitoring at Birnamwood Drive LID project.	Not Started Initiated	Behind Schedule **On Schedule**

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Strategy	#	Activity	Achievements	Progress	Status
		Quality Monitoring		In Progress Completed	Ahead of Schedule Tracking
	9.3	Create and Maintain a Regional Implementation Database	H-GAC maintains an online Regional Implementation database: http://h-gac.maps.arcgis.com/apps/MapSeries/index.html?appid=a75ba4bb46ca40658066c5755a8dba6e. .	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	9.4	Assess Monitoring Results and Modify I-Plan.	H-GAC produces an annual report. The I-Plan has been modified through three addendums that expanded the project area and added additional TMDLs. In 2017 there were 102 impaired AUs with TMDLs.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
Research	10.1	Evaluate the Effectiveness of Stormwater Implementation Activities	HCFCD continues to monitor BMPs installed at detention basins. HCFCD modeled BMPs in White Oak Bayou to determine the number and cost to effectively meet the contact recreation standard.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	10.2	Further Evaluate Bacteria Persistence and Regrowth	Texas Water Resource Institute is conducting a bacteria source tracking project in the region beginning in 2017.	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking

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Strategy	#	Activity	Achievements	Progress	Status
	10.3	Determine Appropriate Indicators	EPA presented new coliphage measurement methods at national conference in 2017. EPA has completed validations for two coliphage measurements methods for ambient water with an aim to publish draft criteria in 2018 (John F. Griffith, SCCWRP Commission).	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
	10.4	Additional Research Topics	House Bill 2771 went into effect on September 1, 2017. The bill requires TCEQ to award competitive grants using funds collected from the $10 OSSF permit fee. Eligible projects include research and demonstration projects for OSSF treatment technology that improves water quality, reduces costs, and/or wastewater reuse	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking
Geographic Priority	11.1	Consider Recommended Criteria When Selecting Geographic Locations for Projects	H-GAC developed the Top 10 “Most Likely to Succeed” and “Most Wanted” Streams lists to help local stakeholders prioritize water quality improvements. Geographic prioritization was used for the Top Five / Least Five project. The Top Five / Least Five project was completed in 2017, (http://www.h-gac.com/community/water/tmdl/BIG/reports.aspx).	Not Started Initiated In Progress Completed	Behind Schedule On Schedule Ahead of Schedule Tracking

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Appendix A

Acknowledgments

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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 2017 (December 31, 2017). Included are bacteria trend lines for the BIG (dashed purple line), the BIG (solid blue line) including Armand Bayou and East and West Fork of the San Jacinto River (EF/WF SJR), Armand Bayou (dashed blue line), EF/WF SJR (solid grey line), and bacteria trend for CRP areas outside of the BIG project area (dashed green line).

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 Most Probable Number (MPN)/100mL or 35 MPN/100mL, respectively. The red dashed line represents the standard normalized by dividing by the standard. This allows both standards to be used on the same graph. The geometric means were also divided by the appropriate standard.

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.

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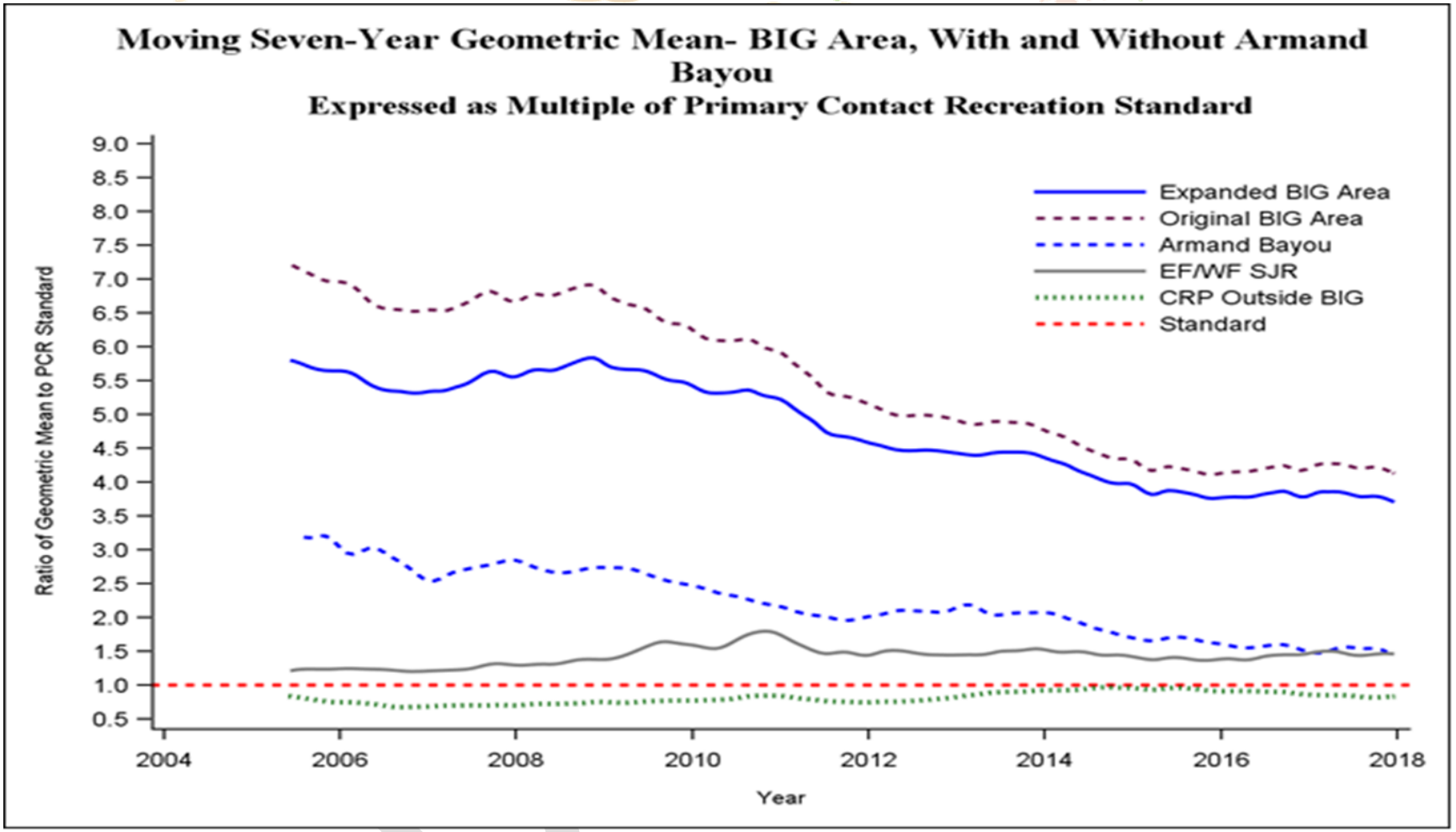

Appendix B Figure 1. Moving Seven-year Bacteria Trend in the BIG Project Areas, with and without Armand Bayou and East and West Fork of the San Jacinto River watersheds.

Appendix C

Implementation Resources

ONLINE IMPLEMENTATION RESOURCES			
IMPLEMENTATION	NAME	USE	WEBSITE
FUNDING	USDA Rural Development Grant	Rural Wastewater Infrastructure	https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program
	319 Nonpoint Source Grant	Non permitted Nonpoint Source Reduction Measures	https://www.tceq.texas.gov/waterquality/nonpoint-source/grants
	319 Nonpoint Source Grant	Agriculture and Siviculture Nonpoint Source Measures	https://www.tsswcb.texas.gov/programs/texas-nonpoint-source-management-program
	320 Estuary Program	Water Quality Improvement	https://gbep.texas.gov/
	USDA Waste and Environmental Program	Multiple assistance programs	https://www.rd.usda.gov/programs-services/all-programs/water-environmental-programs
	NRCS EQUIP	Resource Conservation for Agriculture and Silviculture	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
	Water Quality Management Plan	Soil and Water Conservation for Agriculture and Silviculture	https://www.tsswcb.texas.gov/index.php/programs/water-quality-management-plan
	Clean Water State Revolving Fund	Low cost financial assistance for wastewater, reuse, and stormwater infrastructure	http://www.twdb.texas.gov/financial/programs/CWSRF/
	EPA Water Infrastructure and Resiliency	Resource to explore innovative finance solutions	http://water.epa.gov/ infrastructure/ waterfinancecenter.cfm
	Texas Water Infrastructure Coordination Committee	Identify and develop solutions to water and wastewater	www.twicc.org
	Texas Parks and Wildlife Landowner Incentive Program	Enact conservation practices on private lands	https://tpwd.texas.gov/landwater/land/private/lip/#contact
Outreach and Education	Fats, Oils, Grease, Wipes	Cease the Grease	http://galvbay.org/ceasethegrease/
		Corral the Grease	www.publicworks.houstontx.gov/pud/corral_grease.html
		Patty Potty	www.pattypotty.com
	OSSF	OSSF mapping system	http://arcgis02.h-gac.com/ossf/
		Public outreach and education	www.h-gac.com/go/septic
	Clean Waters Initiative Workshops	Technical workshops covering a variety of water quality information	www.h-gac. com/CWI
	Coastal Communities	Nonpoint source outreach and education information	http://www.h-gac.com/coastal-communities/default.aspx
	Clean Water Clear Choice	Water quality outreach and education	www.cleanwaterways.org
	Loanstar Healthy Streams	Agriculture BMPs	http://lshs.tamu.edu/bmps/
	Pet Waste	Basic information on pet wastes	www.h-gac.com/community/pet-waste/default.aspx
Reporting	Galveston Bay Action Network	Pollution reporting in five counties surrounding Galveston Bay	www.galvbay.org/gban
	Illegal Dumping	Pollution reporting system for MS4s	www.cleanbayous.org
	HCFCD Citizen's Service Hotline	Telephone reporting system	713.684.4197
Data	Wastewater and Stormwater	Permit look up	https://www.tceq.texas.gov/agency/data/lookup-data/status-stormwater-wastewater.html
	Clear Rivers Program	Water Resource Information System	www.h-gac.com/go/wrim
	HCFCD BMP Database	Best Management Practices Monitoring	www.bmpbase.org
	LID Tracking	Low Impact Development Resource	www.h-gac.com/community/go/LID

Appendix C Table 1. Available online resources for implementing I-Plan activities.

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