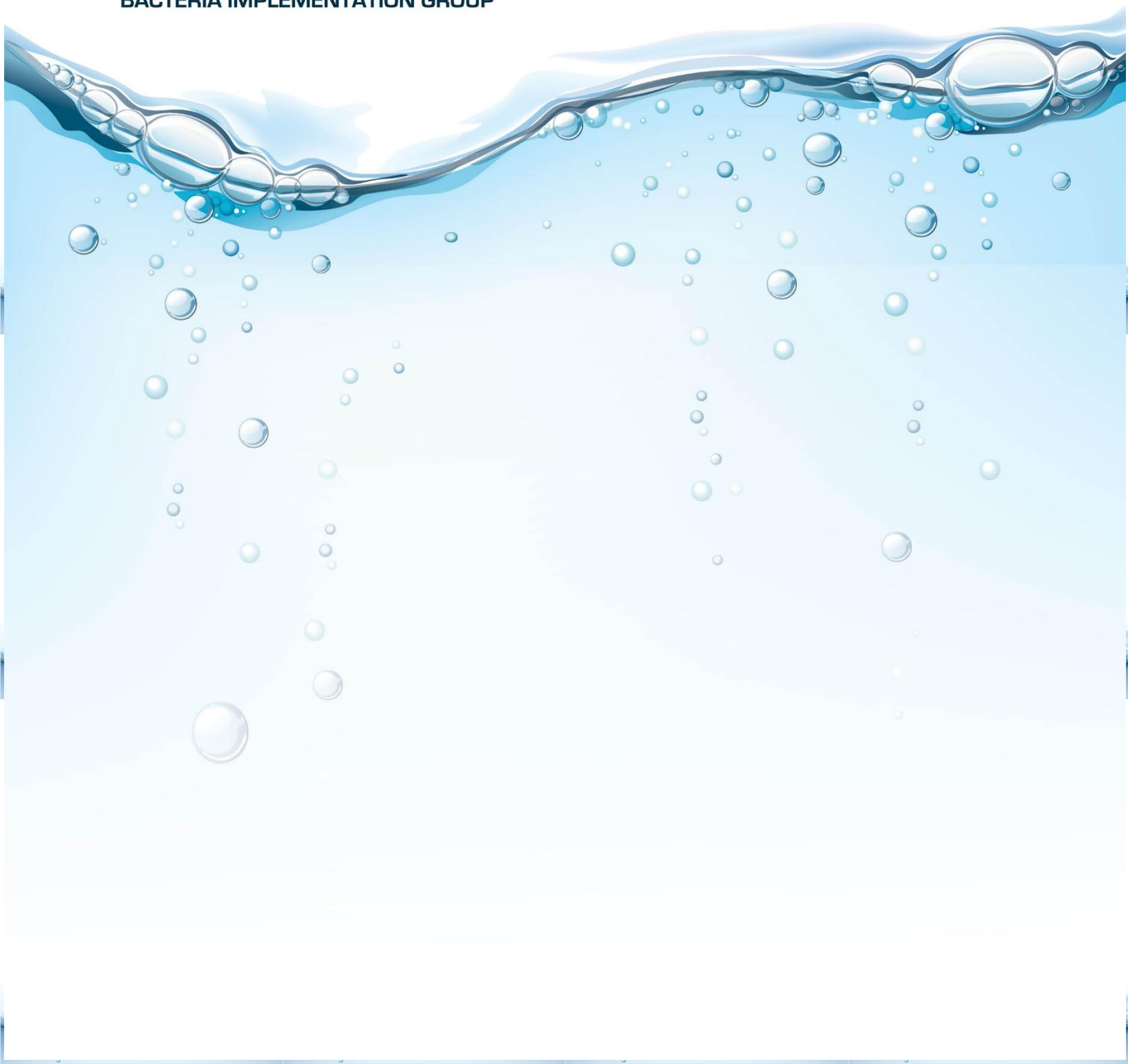




BACTERIA IMPLEMENTATION GROUP

2024 ANNUAL REPORT

JANUARY 1, 2023–DECEMBER 31, 2023



IMPLEMENTING THE BIG I-PLAN

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

BIG MEMBERS*

Lauren Boggs, Harris County (Urban County)

Rodger Brookes, City of Cleveland (Rural City)

Ralph Calvino, Terracon (Business/Industry)

Gordon Cranner, Schwartz, Page & Harding, LLP (Utility District)

Jesuina Chipindula, City of Houston (Large City)

Tom Douglas, Houston Sierra Club (Conservation)

Colleen Gilbert, Greens Bayou Coalition (Conservation)

Teague Harris, IDS Engineering Group (Utility District)

Sam Hill, Texas A&M Forest Service (Agriculture)

Andrew Isbell, Walker County (Rural County)

Courtney Klaus, Harris County (Urban County)

Michael Lee, US Geological Survey (Resource Agency/Academia)

Keith Miles, Montgomery County (Rural County)

Lisa Montemayor, City of Houston (Large City)

Bob Naeger, Houston Canoe Club (Recreation)

Paul Nelson, Bayou Preservation Association (Conservation)

Becky Olive, AECOM (Business/Industry)

Linda Pechacek, LDP Consultants, Inc. (Public)

Sonia Phillips, City of League City (Small City)

Jim Robertson, Cypress Creek Flood Control Coalition (Conservation)

Christine Santiny, City of Conroe (Small City)

Jamie Shakar, City of Houston (Large City)

Linda Shead, Texas Coastal Partners (Conservation)

Brian Shmaefsky, Lone Star College, Kingwood (Resource Agency/Academia)

Shane Simpson, San Jacinto River Authority (Business/Industry)

Robert Snoza, Harris County Flood Control District (Urban County)

Liz Stone, Quiddity Engineering (Business/Industry)

Michael Thornhill, SI Environmental (Utility District)

Scott Tuma, (Business/Industry)

Joanna Wilson, Gulf Coast Authority (Business/Industry)

Natasha Zarnstorff, Galveston Bay Foundation (Conservation)

Vacant, (Agriculture)

Vacant, (Agriculture - County)

* Member list effective as of June 3, 2025.

Parenthetical indicates type of organization represented



BIG ALTERNATES*

Cody Arnold, City of Cleveland
Shaun Austin, Gulf Coast Authority
Paola Belloni, Terracon
Camila Biaggi, Quiddity Engineering
Matt Carpenter, SI Environmental (Utility District)
Nuguent Cotton, Harris County
Libby Decker, Terracon
Tom Douglas, Public
Robert Fiederlein, Greens Bayou Coalition
Brittani Flowers, Bayou Preservation Association
Arnelle Gonzalez, Quiddity Engineering
Wade Guy, Harris County
Greg Hall, City of Conroe
Forest Hartmann, City of Houston
Jody Hooks, City of League City
Steve Hupp, Cypress Creek Flood Control Coalition
Karen Kottke, AECOM
Leeanne Kincer, Montgomery County
Haile Leija, Galveston Bay Foundation
Avery Lewis, Harris County Flood Control District
Jeff Lu, Harris County
Zulimar Lucena, US Geological Survey
Reuben Martinez, Montgomery County
Carl Masterson, Texas Coastal Partners
Jonathan D. Mills, US Geological Survey
Lisa Montemayor, City of Houston
Mitchell Page, Schwartz, Page & Harding, LLP
Scott Saenger, Quiddity Engineering
Aaron Schindewolf, San Jacinto River Authority

Julia Schmidt, Texas A&M Forest Service
Lisa Scobel, Galveston Bay Foundation
Rose Sobel, Bayou Preservation Association
Desta Takie, City of Houston
Rachel Thorne, Galveston Bay Foundation
Lam Tran, City of Houston
Roberto Vega, Harris County Flood Control District

Jim Williams, Sierra Club

**Alternate list effective as of June 3, 2025.*

Many stakeholders participated in actions in support of the I-Plan, many of which are documented in this Annual Report

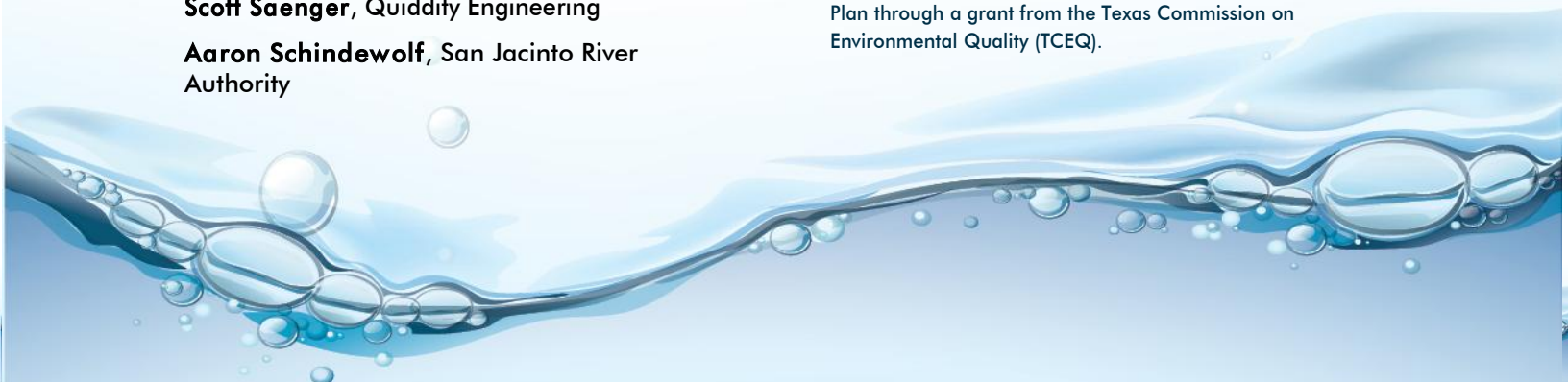
Be Part of the Solution

The BIG project is and will continue to be successful in no small part to the individual actions of each stakeholder. We are eager to build on each success and seek the continued commitment of our partners and renewed interest and participation of our stakeholders.

Most of the implementation activities in the I-Plan are voluntary. Municipal Separate Storm Sewer Systems (MS4) Phase I and Phase II operators, local governments, farmers and ranchers, septic system owners, pet owners, and residents can help reduce the number of bacteria entering waterways by selecting one or more of these activities to implement.

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

The Houston-Galveston Area Council (H-GAC) facilitates the BIG and supports and supplements implementation of the I-Plan through a grant from the Texas Commission on Environmental Quality (TCEQ).



EXECUTIVE SUMMARY

Nearly half of the Houston-Galveston region's stream and shoreline miles continue to have bacteria levels higher than state standards for contact recreation¹. High bacterial concentrations may cause gastrointestinal illnesses or skin infections in swimmers or others who come into direct contact with the water (Figure 1). Fecal wastes come from a variety of sources, including human, pets, domesticated animals, wildlife, and invasive species, such as feral hogs.



Figure 1. *Water is always a big draw for recreation*²

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. The Texas Commission on Environmental Quality (TCEQ) approved the I-Plan (formally known as the Implementation Plan for Seventy-Two Total Maximum Daily Loads

(TMDL)³ for Bacteria in the Houston-Galveston Region) on January 31, 2013.

The 2024 Annual Report is designed to track progress made in the BIG Project Area (Figure 2) from January 1, 2023, to December 31, 2023.

MAKING PROGRESS

The good news is we are making a difference. Overall, bacteria levels for waterways in the BIG project area have decreased or remained stable since the BIG began working to address the problem in 2008. Even during a period of continued population growth and area-wide development pressure.

Bacteria levels in waterways have decreased from above six times the state's primary contact recreation (PCR) standard to four times the PCR standard (Figure 3). Since 2013, bacteria conditions have improved in 6 assessment units (AU), remained stable in 120, while deteriorating in 18 of the 144 AUs reviewed within the BIG Project area. Two AUs, 1004_01 and 1004D_01 on the West Fork of the San Jacinto River and Crystal Creek, respectively, now meet the contact recreation standard and were delisted as reported in the TCEQ's 2016 Texas Integrated Report⁴.

As a region, we have seen progress, however as Figure 3 shows, the bacteria trend has leveled out with a perceptible increase in recent years. There is more work to do for the BIG and the region if goals of the I-Plan – to reduce bacteria concentrations in the region's waters and eventually fully support contact recreation are to be accomplished.

¹ 2025 Basin Highlights/Summary Reports - <https://www.h-gac.com/clean-rivers-program/basin-highlights-summary-reports>

² Greens Bayou Regatta recreation and bayou cleanup. Photo from the Greens Bayou Coalition

³ BIG I-Plan - <https://www.h-gac.com/bacteria-implementation-group/reports>

⁴ 2016 Texas Integrated Report - https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_delist.pdf

BIG Project Area

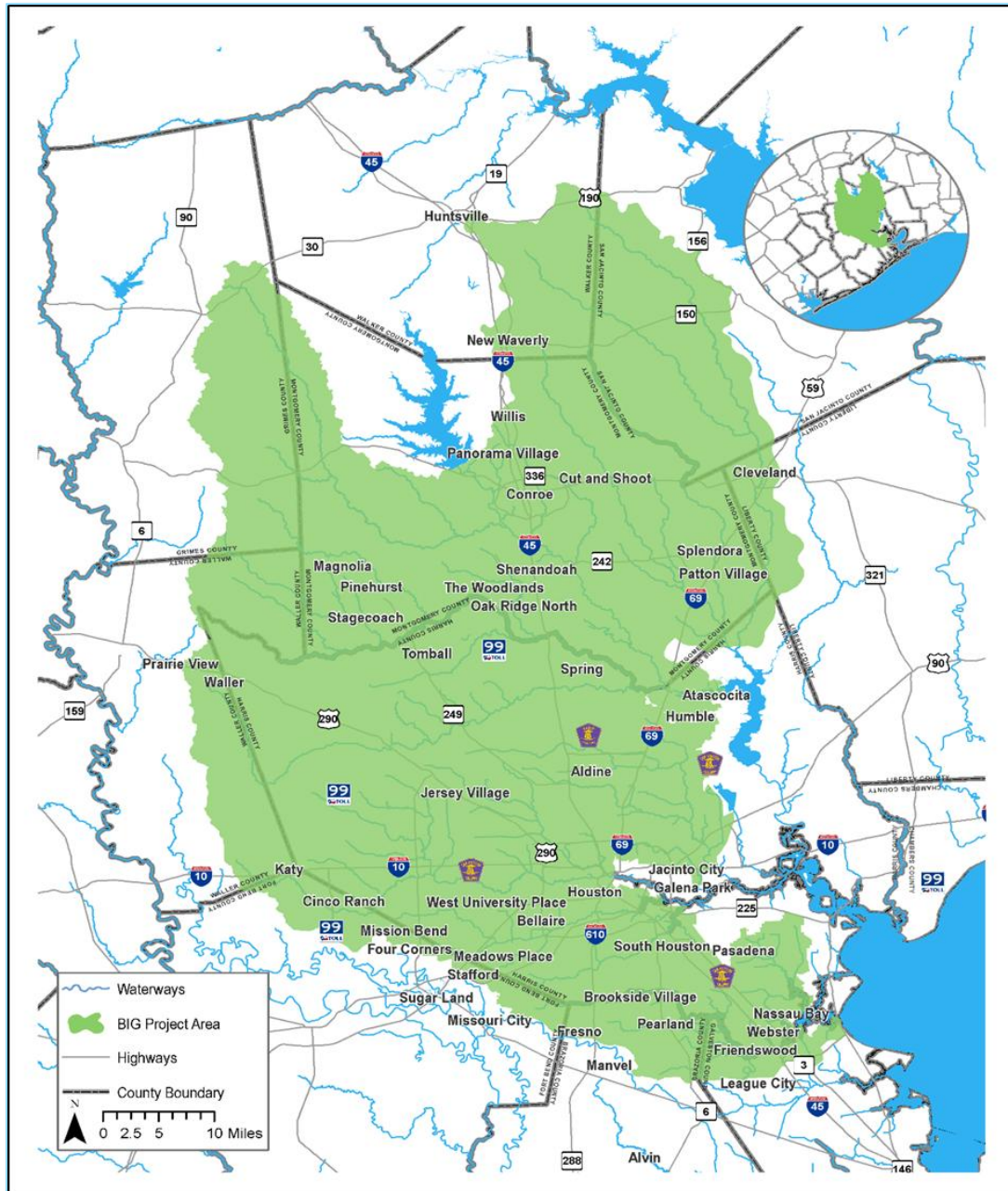


Figure 2. The BIG project area is approximately 3,260 square miles and has a population of nearly five million people. The area encompasses part of 10 counties much of the City of Houston and all or part of another 63 cities.

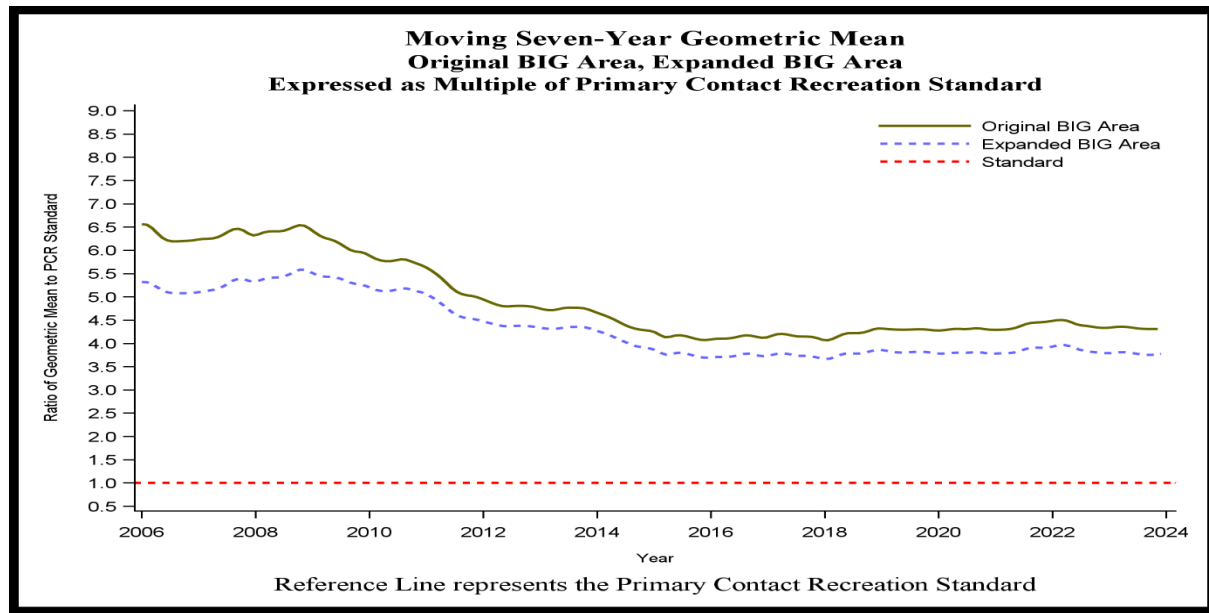


Figure 3. Bacteria trend lines for the BIG Area, Original Project Area and Expanded Project Area 2006-2023, compared with the normalized PCR standard.

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 municipal separate storm sewer system (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 (Figure 4).



Figure 4. Rain barrel education⁵

By working together, the BIG and its partner organizations can continue to identify what is working and what remains to be implemented.

⁵ Galveston Bay Foundation rain barrel event. Winner of 2024 WISE Award. Photo courtesy of GBF.

Since the first annual report was published in 2013, the BIG project area (Figure 2) has expanded. The first expansion included the Armand Bayou TMDL project area in 2015. The second expansion in 2016 included the East and West Fork of the San Jacinto TMDL project Area. The last expansion incorporated the Jarbo Bayou watershed in 2018. 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 126 TMDLs.

WATERSHED PROTECTION PLANS

H-GAC is working with the Texas Commission on Environmental Quality to expand watershed protection plans (WPP) within the BIG Project Area. WPPs are similar in process to the I-Plan established for the BIG. WPPs that are created will focus on smaller watersheds within the BIG project area. The goal of each watershed protection plan will be to encourage local watershed stakeholders to participate in plan development, to address water quality concerns, and for eventual plan execution.

The result of the watershed protection plan enactment within the BIG project area is expected to be more granular. Implementation of WPPs is anticipated to happen alongside implementation of the BIG I-Plan.

H-GAC has established stakeholder groups within seven watersheds⁶. The plans have been

completed in five, having been approved by the U.S. EPA. Two are in development (Figure 5). The seven watershed WPPs are:

- West Fork of the San Jacinto River WPP, approved 2019.
- Spring Creek WPP, approved 2023.
- Cypress Creek WPP, approved 2022.
- Clear Creek WPP, approved 2024.
- East Fork of the San Jacinto River WPP, approved 2024.
- Greens Bayou WPP (in development)
- Sims and Brays Bayous WPP (in development)

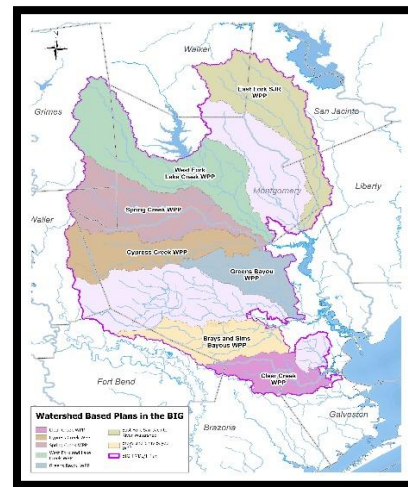


Figure 5. Watershed Protection Plan projects within the BIG project area

⁶ www.westfork.weebly.com
www.cypresspartnership.com
www.springcreekpartnership.com
www.clearcreekpartnership.com

www.eastforkpartnership.com

SPOTLIGHT ON SUCCESS

Highlighting successful projects is an important part of the BIG Annual Report. The BIG hopes by focusing on model 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 the expanded use of bacteria reduction projects 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 in 2023.

City of Houston Wastewater Consent Decree Update

The City of Houston (Houston) maintains one of the largest most complex sanitary sewer systems in the U.S. (Figure 6), an expansive wastewater infrastructure system that, as of January 1, 2025, includes:

- 38 Wastewater Treatment Plants
- 2 Wet Weather Facilities
- 374 Lift Stations
- 5,796 Miles of Gravity Sewers
- 303 Miles of Force Mains
- 134,753 Manholes
- ~500,000 Service Connections

The work being implemented under Houston's Consent Decree includes:

- Upgrading and improving the collection and treatment system
- Fix aging infrastructure
- Early action projects
- Capacity assessment and remediation

- Capacity Maintenance Operations and Maintenance (CMOM)

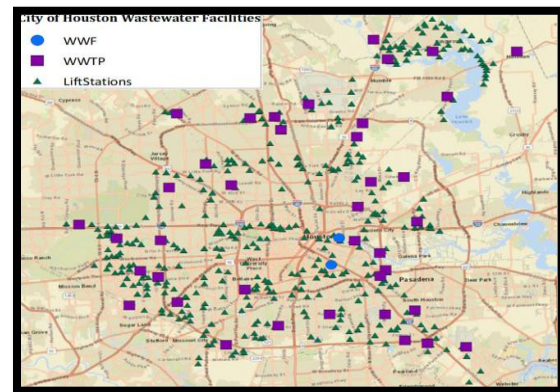


Figure 6. City of Houston Wastewater Facilities Map

Houston's efforts under the Consent Decree have resulted in a 32% reduction in sanitary sewer overflows (SSOs) from gravity mains since 2021.⁷

Houston has identified important ways that the public can help reduce SSOs and improve water quality in the region, which it advertises through its Protect Our Pipes educational outreach campaign. This program includes educating the public on how to prevent SSOs caused by fats, oils, and grease (FOG) and rags/wipes that can cause blockages. When homeowners and system users dispose of FOG and rags/wipes down the drain, those materials solidify and clog pipes, leading to sewer overflows.

Houston's Protect Our Pipes program has focused on outreach to educate residents on how they can reduce SSOs, including:

- Over 120k Protect Our Pipes mailers sent to customers
- 325k impressions on social media
- 2.6 million people reached via radio ads
- 32 million people reached via TV ads

⁷ Excluding the effects of the 2024 Derecho Storm and Hurricane Beryl natural disasters.

- 1 million people reached via Google and Airport ads
- 250k people reached via gas station ads
- 36k people reached in 2024 at various in-person events
- 12k outreach materials in the form of pamphlets, cards, stickers, garden signs, etc. distributed by Houston Health Department (HHD)
- Over 115 community outreach and one-on-one meetings held by HHD at Civic associations, Homeowners associations, multifamily apartments addressing residents, apartment managers and maintenance crews
- "Protect Our Pipes" radio jingles (for Holidays and Summer) aired over 50 convenience stores/gas stations

Additional information can be found on www.ProtectOurPipes.org on how communities can actively help improve water quality by reducing SSOs.

Sanitary Sewer Overflow Prevention Program

The City of West University Place installed an SSO prevention program begin in 2018 with the objective of reducing intake, increasing infrastructure resiliency, and mitigating risk associated with overflow events. This program employs a range of strategic interventions aimed at decreasing the influx of extraneous water into the sanitary sewer network. These interventions include:

- **Annual sewer line maintenance:** Proper maintenance ensures that the sanitary sewer lines are functioning at optimal capacity, allowing wastewater to flow freely without encountering obstructions. This helps to prevent backups and overflows, especially during periods of heavy rainfall or increased usage.
- **Manhole lining (Figures 7 and 8):** By lining manholes with impermeable materials such as concrete or fiberglass, the likelihood of groundwater and stormwater entering the sanitary sewer system through cracks and joints is significantly diminished. This helps maintain the

system's capacity by preventing excess water from infiltrating, which can overwhelm treatment facilities during heavy rain events and lead to sanitary sewer overflows. Consequently, manhole lining serves as a vital defense mechanism against environmental contamination and infrastructure damage, ensuring the integrity and efficiency of sewer networks. Under the city's current manhole lining plan, all manholes are estimated to be relined by the end of 2024.



Figure 7. Map of manholes within the City of West University



Figure 8. Manhole lining⁸

- **Street sweeping:** Routine cleaning of streets is conducted weekly in West University Place. This process aims to remove debris, sediment, and other materials that can contribute to pollutants in the receiving stream. Prevention of blockages and obstructions that impede the flow of stormwater, reducing the likelihood of localized flooding and sewer overflows as well as decreasing illicit discharges into local waters.
- **Improvements to the Supervisory Control and Data Acquisition System (SCADA):** In 2023, West University Place completed improvements to its SCADA system that is used to monitor and control the City's water system. In the water system, the city has control over booster pumps,

⁸ Photo courtesy of the City of West University

water wells, and surface water valves. The city can now manage these components manually or automatically and can turn them off if needed. They can control surface water—turn it on or off—and adjust the percentage the valve opens. The city can also control pressure settings for the water system.

Since the program's inception, the city has seen a reduction in flows from outside the wastewater system (Table 2).

Table 1. Yearly daily peak inflow to wastewater system, City of West University⁹

Year	Peak Intake (MGD)
2019	7.00
2020	6.44
2021	2.86
2022	2.14
2023	2.33

With the reduction of inflow to the system, the city estimates they are mitigating pollution and contamination associated with a reduction in overflow events, safeguarding public health and aquatic habitats. The city expects to realize reductions in city expenditures through less staff hours inspecting the system and reductions in maintenance and emergency repair costs do to increased infrastructure resiliency and reliability.

Project received a WISE Award in 2024.

Buffalo Bayou Park Revegetation and Biostabilization Project

This project is a partnership of the Harris County Flood Control District, Buffalo Bayou Partnership, SWA Group Houston (Landscape Architect), Biohabitats, Inc. (Planting Plan), Resource Environmental Solutions (RES), LLC (Contractor). The goal of the project was to use biostabilization and native vegetation in areas of Buffalo Bayou Park to provide enhanced channel stability and resiliency compared to

traditional turfgrass vegetation or hardened streambank armoring (Figure 9).

Additional objectives were to supplement Hurricane Harvey streambank repairs recently completed in this area and to address vulnerable areas identified by a geomorphic assessment of Buffalo Bayou. Successful implementation and establishment of native vegetation and biostabilization features are being measured during a 2-year maintenance and monitoring period.



Figure 9. Buffalo Bayou Park Stream Bank Restoration¹⁰

The project improves water quality by providing enhanced streambank stabilization to Buffalo Bayou. This includes native vegetation specifically adapted to the variable water level and flow conditions that Buffalo Bayou experiences. Additionally, temporary erosion control blankets and sediment logs composed of 100% biodegradable materials (coconut coir fibers) designed to stabilize the soil was utilized while vegetation became fully established. These enhanced bank stabilization measures have reduced sediment runoff and erosion thereby reducing sedimentation as a water quality impairment.

Reducing sedimentation from the streambanks will have secondary water quality benefits by allowing more sunlight penetration into the water to combat harmful bacteria and related pollutants that affect human health, as well as

⁹ Data provided by the City of West University

¹⁰ Photo courtesy of Harris County Flood Control District

reduce the input of pollutants attached to sediment particles, like excess nutrients from nitrogen and phosphorus. Lastly, enhanced bank stabilization with these vegetative measures will provide additional shading of the water, which cools the water, allowing the water to hold more oxygen and create improved habitat for aquatic organisms.

The project's innovative use of native vegetation and biostabilization features has been a successful enhancement to streambank stability and reduced the potential for erosion and sedimentation, thereby improving water quality (Figure 10).



Figure 10. Buffalo Bayou Park Bank Restoration¹¹

Project received a WISE Award in 2024.

Chrysalis Lake LID Project

Located off Grand Parkway and Bridgeland Creek Parkway, Chrysalis Lake's LID design is intended to reverse decades of human environmental degradation and enhance stormwater management practices. Chrysalis Lake is part of an extensive green stormwater management system that will ribbon through Prairieland Village.

The objective of Chrysalis Lake was to focus on low impact development (LID), to restore flora and fauna to the area, and to reverse the declining pollinator population, which has been severely affected by habitat loss, disease, parasites, and environmental contaminants. In addition, the 61.5-acre Chrysalis Lake – spanning a 22-acre lake and 39.5 acres of upland forests and bottomland meadows – was designed to improve stormwater management and air quality; serve as a sanctuary for hundreds of bird species; and provide a recreational and educational amenity for Bridgeland residents of all ages.

Bridgeland accomplished its objective to preserve and protect pollinators by installing more than 58,000 vibrant pollinator plants across 95 species. The plants, which attract more than 50 species of pollinators, combat the declining population providing habitat and food source.

Howard Hughes employed LID strategies – including the use of bioswale flumes – to improve the quality of stormwater being treated on-site (Figure 11). Eight bioswales collect and clean stormwater runoff, removing approximately 90% of pollutants – total suspended solids, nutrient, metals, oil and grease – before releasing it into the lake. Annually, the bioswales cleanse approximately 29 million gallons of rainwater. When stormwater runs off roofs and roads, it travels through green streets, a stormwater management strategy that

¹¹ Photo courtesy of Harris County Flood Control District.

incorporates vegetation; across thoughtfully placed stones designed to prevent erosion; through soils and native plants further breaking down and removing pollutants such as heavy metals, oil and chemicals; and then, into Chrysalis Lake.



Figure 11. Bioswale in Prairieland Village, Bridgeland¹²

Serving as a recreational amenity for Bridgeland residents, Chrysalis Lake boasts a series of bridges, boardwalks and overlooks – all pedestrian, kayak and canoe friendly – as well as trail and kayak/canoe under crossings, connecting residents to the east side of Grand Parkway (Figure 12). Trails feature interpretive learning graphics, encouraging residents to learn more about the lake's function and habitat. For residents raising families in the neighborhood, Chrysalis Lake provides an opportunity to cultivate a love of nature and respect for the environment from a young age.

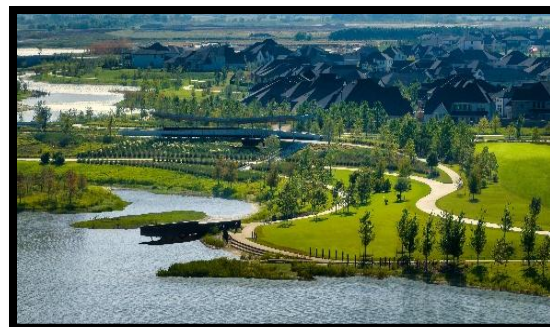


Figure 12. Chrysalis Lake recreational community amenities, including water recreation¹³

Project received a WISE Award in 2024.

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 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.

This report is based on information given to H-GAC through the workgroup process by stakeholders already involved in the BIG's planning effort. This report includes activities through December 2023.

¹² Photo courtesy of Howard Hughes Holdings, Inc.

¹³ Photo courtesy of Howard Hughes Holdings, Inc.

I-PLAN

There are 11 implementation strategies, and 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 2023 calendar year are presented for each (Table 3).

The BIG is revising the I-Plan. The goal of the revision is to:

- Update the I-Plan with new information and lessons learned after five years of implementation;
- Adjust strategies and activities due to the expansion of the project area and need to include management of forest lands and boater wastes; and
- Address activities that have not seen significant progress or have been completed.

THREE BIG IDEAS TO CONSIDER

With 11 strategies that include 38 activities (Table 3), the BIG focused and prioritized implementation. A review of available data and an assessment of current actions taken by BIG stakeholders suggest three key implementation strategies for local communities to consider addressing when committing resources to reduce bacteria. The first two BIG Ideas, Reduce or Eliminate Sanitary Sewer Overflows and Address Failing Onsite Sewage Facilities, directly target untreated or partially treated sewage. The third, Reduce Peak Stormwater Runoff, is a broader strategy that expands the landscape's capacity to naturally reduce bacteria and can be an important component of a robust stormwater management plan.

1. **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 (Figure 13). Coordinate with other partners to 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 Protect Our Pipes and the Galveston Bay Foundation's Cease the Grease programs.



Figure 13. Aging infrastructure

2. **Address Failing On-Site Sewage Facilities (commonly referred to as septic systems)** – On-site sewage facilities are wastewater infrastructure, albeit on a much smaller and localized scale than wastewater treatment facilities. H-GAC estimated in 2021, that there were 154,126 OSSFs (57,739 permitted and 182,096 non-registered) in the BIG project area. Like all infrastructure, on-site sewage facilities require periodic inspections, routine maintenance, and eventual replacement to function properly. Residents, cities, and counties should

participate in on-site sewage facility function and maintenance training, encourage real estate on-site sewage facility inspections at the time of property sale, and increase the number of resident or water professional inspections. Local governments, as needed, should seek, and make funding available to help incentivize onsite sewage facility rehabilitation or replacement and promote connections to centralized waste treatment for areas with chronically failing on-site sewage facilities.

3. **Reduce Peak Stormwater Runoff** –

Concrete and other impervious surfaces, particularly when linked together (i.e., gutter to driveway to roadway) increase the speed at which stormwater – and the bacteria it carries – reaches a water body. Pervious surfaces, such as native grasses and specialized, pervious concrete, interrupt the flow and decrease the volume of water to a water body and create a more disconnected drainage system (Figure 14). This allows natural processes time to mitigate bacteria. Consider expanding traditional development methods to include alternative practices that decrease use of and/or disconnect impervious surfaces in redevelopment and new built areas. LID and green infrastructure along with other best practices are 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.



Figure 14. Exploration Green Stormwater Best Management Practices¹⁴

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 on H-GAC’s website¹⁵. 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.

¹⁴ Exploration Green LID Project. 2024 WISE Award winner. Photo courtesy of the Clear Lake Water Authority

¹⁵ BIG Ideas for Cleaner Water. 2017. [Bacteria Implementation Group Reports | Houston-Galveston Area Council \(H-GAC\)](#)

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 (Figure 15)
9. Monitoring and I-Plan Revision
10. Research
11. Geographic Priority Framework



Figure 15. Finding your watershed, Outreach and Education at the Kemah Boardwalk - Bay Day 2019.



2023 IMPLEMENTATION

The assessment of each activity includes determining progress made toward achieving the activity's interim goal: Not Started, Initiated, In Progress, or Completed (Table 3).

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 (Table 3). Completed and in Tracking 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 and be tracked.

Overall, six activities have been completed and 32 are In Progress. The six completed activities and five of the In Progress activities have been placed into Tracking (Figure 17) to evaluate changes over time or are identified to be reviewed during the I-Plan update. Three activities were considered Ahead of Schedule and 23 On Schedule (Figure 17, Table 3). The BIG began a plan review beginning with 2019 reporting year and focused review on the activities that are Behind Schedule or those Completed and In Tracking to determine if the activities were appropriate and the measures valid. The I-Plan update will incorporate this review..

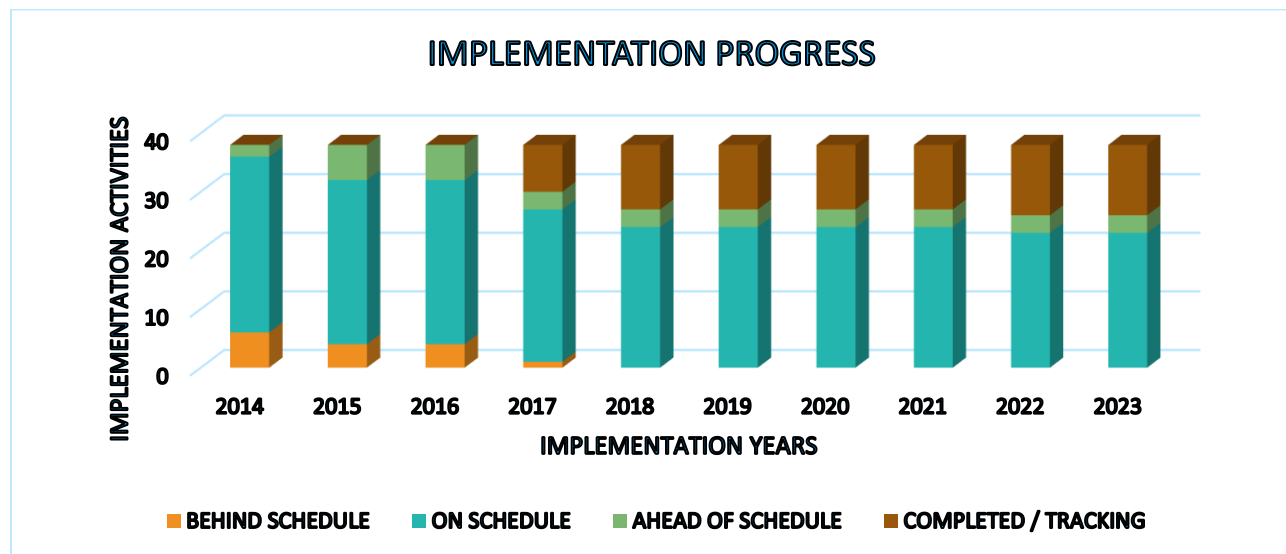


Figure 16. Implementation tracking for all 38 I-Plan Activities. Note: Completed and in Tracking is a new category added for the 2019 Annual Report.



Table 2. 2023 Implementation Progress

Strategy	#	Activity	Achievements	Progress	Status
1.0 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 in 2017. It was determined that the monitoring frequency can be changed at the request of the wastewater treatment facility. A general adjustment of the frequency to the recommendation found in the I-Plan would not be carried out. No change is to the status of this measure is reported, the BIG is modifying this measure with the I-Plan update.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	1.2	Impose Stricter Bacteria Limits for WWTF Effluent	More stringent limits have been implemented for wastewater permits. Activity is programmatically complete. In 2023, there were 775 active permits in the project area, with 568 submitting discharge monitoring reports (DMRs)¹⁶ and 546 reporting bacteria in their DMRs. Wastewater treatment facilities with bacteria permits: 530 domestic and 16 Industrial. 449 (85%) reported 63 cfu/100 mL as their limit in 2023.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	1.3	Increase Compliance and Enforcement by the TCEQ	A review of WWTF discharge monitoring reports yielded a 95.6 percent compliance in 2023 with their permit limit. This is down from 97.5 percent the year prior (Grab/Max).	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking

¹⁶ [Enforcement and Compliance History Online | US EPA](#)

Strategy	#	Activity	Achievements	Progress	Status
	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 wastewater treatment facility standards and criteria. In 2023, Harris County reviewed 116 wastewater treatment facility plan sets and specifications for compliance with state disinfection standards. None required referral to outside consultants for in-depth plan review. March 16, 2023 – H-GAC hosted the Future of Texas' Water Workforce Roundtable, with 35 attendees. The group discussed ways to increase a new generation of wastewater professionals, as many are beginning to retire.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	1.5	Upgrade Facilities	TCEQ's Permit Central Registry ¹⁷ provides general information on the number of wastewater treatment facility upgrades by county. The information lacks specificity on the number of non-compliant wastewater treatment facilities that have been upgraded.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	1.6	Consider Regionalization of WWTFs	The U.S. Environmental Protection Agency (EPA) and TCEQ maintain non-compliant lists. TCEQ through the latest Chapter 217 requires new wastewater treatment facilities to consider regionalization if an existing plant is within a three-mile radius. As part of the North Corridor Consolidation Program, the Northgate Wastewater Treatment Plant (WWTP) was successfully diverted to the Intercontinental Airport Houston (IAH) WWTP in December 2023. Additionally, other consolidation projects are currently in various stages of planning and construction.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking

¹⁷ Central Registry - Texas Commission on Environmental Quality - www.tceq.texas.gov

Strategy	#	Activity	Achievements	Progress	Status
	1.7	Use Treated Effluent for Facility Irrigation	TCEQ's Permit Central Registry provides general information on the number of wastewater treatment facility applications for reuse by County.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
2.0 Sanitary Sewer Systems	2.1	Develop Utility Asset Management Programs (UAMPs) for Sanitary Sewer Systems	TCEQ's voluntary sanitary sewer overflow initiative has 16 wastewater treatment facility operators participating as of 2018. H-GAC, TCEQ and EPA offer technical training and workshops tailored to encourage the use of life-cycle maintenance and dedicated wastewater treatment facility and sanitary sewer funding. The City of Houston and the EPA have agreed to the city's plan to address the city's sanitary sewer overflows. A review of this effort is presented under 'Spotlight on Success' section.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	2.2	Address Fats, Oils, Grease, and Wipes	Several model fats, oils, and grease (FOG) programs are available from the City of Houston¹⁸, San Jacinto River Authority¹⁹ and H-GAC²⁰. The largest number of SSOs were attributed to rainfall and infiltration at 370 and seconded by line blockages due to grease blockages at 330, releasing an estimated 779,870 gallons and 254,640 gallons, respectively, of untreated sewage into the waterways.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking

¹⁸ <https://www.protectourpipes.org>

¹⁹ <http://www.pattypotty.com/>

²⁰ <https://coastalcommunitiestx.weebly.com/materials.html>

Strategy	#	Activity	Achievements	Progress	Status
	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 requirements²¹. Any changes to 30 Texas Administration Code (TAC) 317 should be addressed as well as 30 TAC 217. 30 TAC 217 are regulations designed for facilities that was designed during or after 2008 while 30 TAC 317 addresses facilities designed prior to 2008. 30 TAC 317.3(e) details emergency requirements in the event of a power outage, spill containment structures and alarm system regulations²². TCEQ's Permit Central Registry provides general information on the number of Lift Station applications made by county. It was noted that while not causing the largest number of SSOs, the largest volume at 10.03 million gallons was attributed to 55 incidents of lift station failures.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	2.4	Improve Reporting Requirements for SSOs	There is not a searchable database online. H-GAC receives annual updates on the number of sanitary sewer overflows in the project area through a request to TCEQ. TCEQ appears to be notified of sanitary sewer overflows as required. There were 948 reported SSOs in 2023, similar to the number, 969 reported in 2022²³. The average number per year between 2015 and 2023 is 1,174. From those reported SSOs in 2023, the total volume was 11.6 million gallons, down from 76.57 million gallons in 2022. The average between 2015 and 2023 is 16.08 million gallons. The largest number of SSOs were attributed to rainfall and infiltration at 370 and seconded by line blockages due to grease blockages at 330, releasing an estimated 779,870 gallons and 254,640 gallons, respectively, of untreated sewage into the waterways. TCEQ extended the electronic reporting rule till December 21, 2025 that may require MS4 Phase II permittees to report SSOs electronically.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	2.5	Strengthen Controls on	TCEQ was asked via letter from the BIG to consider adding a permit requirement to document subscriber systems or require	Not Started	Behind Schedule

²¹ 30 TAC 217: https://texas-sos.appianportalsgov.com/rules-and-meetings?chapter=217&interface=VIEW_TAC&part=1&title=30

²² 30 TAC 317: [https://texas-sos.appianportalsgov.com/rules-and-meetings?\\$locale=en_US&interface=VIEW_TAC_SUMMARY&queryAsDate=10%2F16%2F2025&recordId=174663](https://texas-sos.appianportalsgov.com/rules-and-meetings?$locale=en_US&interface=VIEW_TAC_SUMMARY&queryAsDate=10%2F16%2F2025&recordId=174663)

²³ 2023 Data received via personal communication with TCEQ TMDL Program

Strategy	#	Activity	Achievements	Progress	Status
		Subscriber Systems	subscriber system permits. There are no plans to add subscriber systems as permittees. H-GAC maintains subscriber system sample contracts via its website.	Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	2.6	Penalties for Violations	The TCEQ documents its enforcement process through the Enforcement Initiation Criteria, currently revision 18 ²⁴ . TCEQ inspectors can conduct focused sanitary sewer overflow investigations during rain events even if the facility has never reported a sanitary sewer overflow.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	3.0 Onsite Sewage Facilities	Identify and Address Failing Systems	H-GAC maintains the on-site sanitary sewage facility permit database that shows permits by age, authorized agent, and the number of on-site sewage facilities per square mile. In 2021, there were 57,739 permitted OSSFs and an estimated 124,357 without permits. H-GAC received paper copies of older Harris County permits in 2023. These are being digitized and an update will be made for 2024. Harris County and the East Aldine Management District has worked to install sewer service in the East Aldine region using grant funding, \$57.6 M. There have not been any new sewer connections since 2019, as the partners await future funding. Harris County and East Aldine Management District had made 846 connections and abandoned a total of 1,493 systems since 2014. Many of the abandoned OSSFs were failing as evidenced by violations. Harris County and the Airline Improvement District continued to install sewer service in the Airline region using \$15.8 million of grant funding. Harris County and the Airline Improvement District made 39 new connections to sanitary service, bringing the total to 384 since 2017. Seventy-two OSSFs were abandoned in 2023, for a total of 630 since 2017. Many of the abandoned OSSFs were failing, as evidenced by violations.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking

²⁴ Enforcement Initiation Criteria (EIC) - Texas Commission on Environmental Quality - www.tceq.texas.gov

Strategy	#	Activity	Achievements	Progress	Status
			H-GAC addresses failing systems through a supplemental environmental project. No new systems were repaired or replaced in 2023. Since 2018, 11 systems have been repaired or replaced, while 12 await funding.		
	3.2	Address Inadequate Maintenance of OSSF	Model on-site sewage facility regulations and policies are available online. H-GAC created a website for homeowners, homebuyers, local governments, and real estate professionals. In 2023, Harris County hosted its 13th Annual OSSF Seminar for wastewater professionals. The one-day, in-person event welcomed a total of 135 attendees and featured presentations on new innovations, best practices, and updates on rules and enforcement.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	3.3	Legislation and Other Regulatory Actions	House Bill 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. In 2023, Harris County hosted its 13th Annual OSSF Seminar for wastewater professionals. The one-day, in-person event welcomed a total of 135 attendees and featured presentations on new innovations, best practices, and updates on rules and enforcement.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
4.0 Stormwater & Land Development	4.1	Continue Existing Programs	Two phase I municipal separate storm sewer systems (MS4s) permits (Joint Task Force [JTF- City of Houston, Harris County, and the Harris County Flood Control District] and Pasadena), One general permit – Texas Department of Transportation, and 133 MS4 phase II permits ²⁵ are partially or fully found in the BIG project area. About 42.21% of the BIG project area can be classified as within the US Census Urbanized Area as defined by 50,000 population qualifying for Phase II designation.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule

²⁵ Extracted from the TCEQ Central Registry: [TCEQ - WQ General Permits Search](#)

Strategy	#	Activity	Achievements	Progress	Status
			TCEQ renewed the MS4 Phase II permit on January 24, 2019. The agency was revising the permit in 2023, which was completed and became effective on August 15, 2024²⁶. The renewal permit adds clarification that permittees discharging to impaired water bodies with a TMDL for bacteria must refer to the I-Plan for BMPs or implement proposed and approved BMPs. Also added more specific BMPs and measurable goals, activities, and deadlines. Galveston Bay Foundation's WaterMyYard Tool²⁷ was used by 43,945 residents in 2023 to reduce water consumption and help reduce stormwater runoff.	Completed	Tracking
	4.2	Model Best Practices	Harris County Flood Control District continues to host and update the Regional BMP Database ²⁸ . H-GAC manages a LID/Green Infrastructure online resource ²⁹ .	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	4.3	Encourage Expansion of Stormwater Management Programs	There are over 133 municipalities and utility districts in the BIG project area subject to the MS4 Phase II General Permit. City of Houston GI Incentive Program was kicked off and underway in 2021. The program is ongoing, though set to expire August 28, 2026. The city inventoried its parklands for potential green infrastructure opportunities. In 2023, a Master Plan³⁰ was approved by City Council which includes a comprehensive inventory of the city's park system with a blueprint improvement plan over the next 20 years. Among	Not Started	Behind Schedule
				Initiated	On Schedule

²⁶ General Permit TXR040000 for Phase II (Small) MS4s - Texas Commission on Environmental Quality - www.tceq.texas.gov

²⁷ <https://www.galvbaygrade.org/cover-stories/2023/08/water-my-yard/>

²⁸ www.bmpbase.org

²⁹ www.h-gac.com/community/go/LID

³⁰ [2023 Master Plan](#)

Strategy	#	Activity	Achievements	Progress	Status
			other goals the plan aims to incorporating green infrastructures elements like permeable surfaces, native plantings, and wetland enhancements for stormwater absorption and flood mitigation. In addition, the City of Houston Park and Recreation Department also worked in with TCEQ and EPA to develop a Water Management Plan (WMP). With this plan, HPARD seeks to identify potential contaminants occurring within parks and establish a series of BMPs for minimizing internal use of potential pollutants while implementing strategies for mitigating external contaminants through green infrastructure and other nature-based solutions. The following objectives illustrate how HPARD can integrate improved water quality through reduced contamination potential throughout HPARD's operations. Harris County maintains a detention offset program for developers that incorporate stormwater quality practices within their projects. In 2023, GBF hosted 8 rain barrel workshops in the region.³¹ H-GAC was evaluating BMP monitoring data to recommend practices best suited to this region. Project funding was awarded in 2020 and the project was underway in 2023. In 2023, workshops were held to encourage the use of bacteria reduction measures. 1. August 16, 2023: Clean Waters Initiative – Stormwater Programs and Impaired Waters³², hosting 82 attendees.	In Progress	Ahead of Schedule
				Completed	Tracking
	4.4	Promote Recognition Programs for Developments that Voluntarily Incorporate Bacteria	H-GAC developed an award program, Water Innovation Strategies of Excellence Awards (WISE). The program was released in 2018. The awards following Covid-19 were handed out in 2024, covering 2023. There were nine awards given out, six specifically to work within the project area:	Not Started	Behind Schedule
				Initiated	On Schedule

³¹ <https://galvbay.org/work/water-protection/>

³² Clean Water Initiative Workshop Agendas and Presentations: [Clean Waters Initiative Workshops](#) | [Houston-Galveston Area Council \(H-GAC\)](#)

Strategy	#	Activity	Achievements	Progress	Status
		Reduction Measures	- Program Performance Winner: City of West University Place – Sanitary Sewer Overflow Program (highlighted in the ‘Spotlight on Success’ section). - Completed Effort Greater than \$200,000 Winner: Howard Hughes Holdings, Inc. – Bridgeland – Chrysalis Lake (highlighted in the ‘Spotlight on Success’ section). - Research and Monitoring Winner – Harris County Flood Control District, et al., - Buffalo Bayou Park Revegetation and Biostabilization Project (highlighted in the ‘Spotlight on Success’ section). - Education and Public Awareness Winner: Galveston Bay Foundation – Rain Barrel Workshop Program ((highlighted in the ‘Spotlight on Success’ section – 2022 Annual Report). - Policy and Planning Winner: Clear Lake City Water Authority & SWA Group – Exploration Green (highlighted in the ‘Spotlight on Success’ section – 2021 Annual Report). - Special Recognition for Water Quality Protection Technology: City of West University Place – SCADA Improvements. City of Houston included a reward program as part of their initiative to expand the use of green infrastructure practices in development projects within the city. The City Engineer’s office is continuously implementing this program, and it is part of the City’s, Code of Ordinances Chapter 44 - TAXATION ARTICLE IV. - TAX ABATEMENT Sec. 44-132. - Green stormwater infrastructure tax abatement.	In Progress	Ahead of Schedule
				Completed	Tracking
	4.5	Provide a Circuit Rider Program	H-GAC maintains a LID and green infrastructure website and toolkit ³³ . There are 90 projects that can be located via an interactive map on the website.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking

³³ www.h-gac.com/community/go/LID

Strategy	#	Activity	Achievements	Progress	Status
	4.6	Petition TCEQ to Facilitate Reimbursement of Bacteria Reduction Measures	TCEQ reimburses for water quality features. Contact TCEQ for questions or coordination for reimbursement.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
5.0 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 onsite education is a big factor in ensuring compliance.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
6.0 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. A model wet and dry weather discharge monitoring program for local governments is available online³⁴. The City of Houston and the EPA have agreed to the city's plan to address the city's sanitary sewer overflows. This includes remote monitoring of manholes and direct connecting them to 311 reporting. A review of this effort is presented under 'Spotlight on Success' section. City of West University Place – Sanitary Sewer Overflow Program (highlighted in the 'Spotlight on Success' section)	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking

³⁴ <https://www.h-qac.com/getmedia/aa375f0d-1c20-42ec-aaed-ff3ae5d10bca/Top5-Least5-Final%20Report-06-5-17.pdf>

Strategy	#	Activity	Achievements	Progress	Status
			includes re-lining manholes to prevent inflow, street sweeping and annual sewer line maintenance.		
	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-GAC³⁵. Citizen reporting tools are available to assist local governments find illicit discharges and illegal dumping – 311³⁶ and the Galveston Bay Action Network³⁷ are examples. - In 2023, there were 19 pollution reports to GBAN. Of these, one was identified as a sanitary sewer overflow, one was a fish kill, two were for unknown chemicals, three were abandoned vessels, and the other 10 were for trash and litter. There is some talk that GBF will discontinue supporting this report tool. - City of Houston has noted that work under their consent decree has included remote sensing of manholes with direct electronic reporting to the city's 311 program.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	6.3	Monitor & Control Waste Hauler Activities	No change to this strategy or to effective implementation. Previously reported: - 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 (e.g., Track My FOG³⁸). Dallas maintains a program that uses Scantron device (XC2 and Pearson Scan Tool Software) to upload manifests.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking

³⁵ <http://www.h-gac.com/community/environmental-enforcement/workshops.aspx>

³⁶ www.CleanBayous.org

³⁷ www.galvbay.org/gban

³⁸ <https://www.trackmyfog.com/>

Strategy	#	Activity	Achievements	Progress	Status
7.0 Animals, Agriculture	7.1	Promote Increased Participation in Existing Programs for Erosion Control Nutrient Reduction, and Livestock Management	Natural Resources Conservation Service and Texas State Soil and Water Conservation Board manage and promote land management programs in the project area. The Texas A&M Forest Service promotes sustainable forestry practices that align with water conservation through logger and landowner trainings, silvicultural BMP implementation monitoring, and education and outreach. Stakeholders recommended expanding the use of water quality management plans and conservation management plans. One suggestion is to seek a modification to property tax assessments to allow stacking of water quality property tax exemption on to an agriculture or conservation land exemption. Implementing workshops within watersheds under watershed protection plans. This has included securing funding from the Texas A&M Forest Service for grant funding to implement sustainable forestry practices that support water conservation within the BIG area.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	7.2	Promote the Management of Feral Hog Populations	No change to this strategy. Previously reported: - County Extension Agents report holding one-on-one meetings with landowners to address feral hogs. - Texas AgriLife, lead agency for feral hog management, is looking into baiting research. - H-GAC estimated watershed level feral hog populations within the BIG – total population estimated at 7,891.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
8.0 Residential	8.1	Expand Homeowner Education Efforts Throughout the BIG Project Area	H-GAC continued the series of Clean Water Initiative workshops³⁹: - April 28, 2022 – H-GAC Web Tools - June 16, 2022 – Education, Outreach, and Volunteer Coordination. In 2023, Galveston Bay Foundation provides outreach and education, including: - Rain barrel workshops – 202 barrels distributed to 290 participants at eight events.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule

³⁹ www.h-gac.com/cwi

Strategy	#	Activity	Achievements	Progress	Status
			- Boater waste education – 145 education bags distributed. - Cease the Grease Campaign Delivered 400 funnels and scrapers. - Hosted three native plant sales within local communities, delivering 1,500 native plants. - The Water My Yard tool was used by 43,945 residents in 2023 to reduce water consumption and help reduce stormwater runoff. - In 2023, GBF collected and analyzed 228 water quality samples and processed 113 bacteria samples with the assistance of 39 water quality monitoring volunteers at 32 bay-wide locations. Texas AgriLife Extension’s seminars, programs, and on-call technical assistance for homeowners to encourage proper horticultural and pest management techniques included: - Home Grown Lecture Series, Pesticide Applicators’ Educational Programs, and the Master Gardener Program and Course. - WaterStar Landscaping, EarthKind Landscaping, and the Healthy Lawns Healthy Waters Program promoting sustainable yard and water conservation practices. - Green Thumb Gardening Series, Ask a Master Gardener events, and Speakers Bureau presentations supporting public education and community outreach efforts. Bayou Preservation Association⁴⁰ – 20th Annual Symposium September 20-21, 2023: Coastal Watershed Symposium. Texas Water Resource Institute⁴¹ – October 10, 2023, the semi-annual Watershed Coordinators Roundtable was held at H-GAC on the topic of Implementation Plans & Watershed Protection Plans.	Completed	Tracking
9.0 Monitoring and I-	9.1	Continue to Utilize Ambient Water Quality		Not Started	Behind Schedule

⁴⁰ [Home | Bayou Preservation](#)

⁴¹ [Home - Texas Water Resources Institute](#)

Strategy	#	Activity	Achievements	Progress	Status
		Monitoring and Data Analysis	The region's Clean Rivers Program's ⁴² 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 of 19 Texas Stream Team volunteers.	Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	9.2	Conduct and Coordinate Non-Ambient Water Quality Monitoring	Harris County Flood Control District continues to monitor water quality at several detention basins. Data is uploaded to their BMP database. In 2023, GBF collected and analyzed 228 water quality samples and processed 113 bacteria samples with the assistance of 39 water quality monitoring volunteers at 32 bay-wide locations. Of these samples, 23 of the bacteria samples (approximately 20%) exceeded the single grab recreational limit of 104 MPN. H-GAC and BPA continue to seek funding to carry out Targeted Monitoring. Received funds will begin monitoring in 2023 and 2024. The Houston Advanced Research Center⁴³ is working with the City of Houston on installing several LID/Green Infrastructure Practices that include monitoring.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	9.3	Create and Maintain a Regional Implementation Database	H-GAC maintains an online Regional Implementation database ⁴⁴	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule

⁴² [Clean Rivers Program | Houston-Galveston Area Council \(H-GAC\)](#)

⁴³ [HARC - Houston Advanced Research Center: Houston Advanced Research Center](#)

⁴⁴ [Interactive BIG Report](#)

Strategy	#	Activity	Achievements	Progress	Status
	9.4	Assess Monitoring Results and Modify I-Plan.	The BIG produces an annual report. The I-Plan has been modified through four addendums that expanded the project area and added additional TMDLs. In 2019 there were 126 impaired AUs with TMDLs. The BIG is currently revising the I-Plan.	Completed	Tracking
				Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
10.0 Research	10.1	Evaluate the Effectiveness of Stormwater Implementation Activities	Harris County Flood Control District continues to monitor BMPs installed at detention basins. H-GAC received a grant from the TCEQ's Galveston Bay Estuary Program to evaluate available performance data to develop a recommended list. Project continued in 2023. The Houston Advanced Research Center⁴⁵ is working with the City of Houston on installing several LID/Green Infrastructure Practices that include monitoring.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
	10.2	Further Evaluate Bacteria Persistence and Regrowth	No local or regional programs were identified in 2023. Recent discussions suggest that this work is complete.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking

⁴⁵ [HARC - Houston Advanced Research Center: Houston Advanced Research Center](#)

Strategy	#	Activity	Achievements	Progress	Status
	10.3	Determine Appropriate Indicators	EPA continues to study the use of Coliphage as surrogates for pathogens. EPA evaluated validations for two coliphage measurements methods for ambient water with an aim to publish draft criteria in 2018⁴⁶. Recent paper was published in 2019.⁴⁷ Work by researcher at Texas A&M and UH Clear Lake are studying DNA, Coliphage and other techniques along with rapid testing. Foundation work will support efforts to identify future standards.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	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 on-site sewage facility permit fee. Eligible projects include research and demonstration projects for on-site sewage facility treatment technology that improves water quality, reduces costs, and/or wastewater reuse.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	Tracking
11.0 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 continues to be used to target areas. One model project The Top Five / Least Five project was completed in 2017⁴⁸, which can form the basis for local government investigations.	Not Started	Behind Schedule
				Initiated	On Schedule

⁴⁶ John F. Griffith, SCCWRP Commission, Sept. 8, 2017

⁴⁷ Boczek, L. U.S. EPA: Proposals and Method for Coliphage as Surrogates for Environmental Pathogens. WEFTEC, Chicago, Illinois, Sept. 21-25, 2019

⁴⁸ <http://www.h-gac.com/community/water/tmdl/BIG/reports.aspx>

Strategy	#	Activity	Achievements	Progress	Status
			Based on the model project and previous investigations by BPA and BIG stakeholders, H-GAC and Bayou Preservation Association with TCEQ completed in 2021, a targeted monitoring survey of five AUs within the BIG project area.	In Progress	Ahead of Schedule
			H-GAC with the Environmental Institute of Houston using Clean Rivers Program funding completed a targeted monitoring survey of 10 AUs in 2021, most of which were located within the BIG project area.	Completed	Tracking
			H-GAC and BPA continue to seek funding to carry out Targeted Monitoring. Both received funds in 2022 and began monitoring late in 2022 and into 2023. H-GAC received additional funding via TCEQ to conduct targeted monitoring in 2024 and 2025.		

Appendix A

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Appendix B

Bacteria Trends

The area's relative geometric mean is just above four times the state's water quality standard for bacteria (Appendix B - Figure 18). This is down overall from over six times the standard in 2006. While the overall bacteria trend in the BIG project area continues to decline, it appears to have leveled out with a potential increase with recent geometric means. The background, those areas outside of the BIG project area has also seen a general rise over the same timeframe.

Appendix B - Figure 18 illustrates how the rolling seven-year geometric mean for bacteria levels has changed over time (2005-2023). It is based on ambient water quality data collecting indicator bacteria samples (*E. coli* and Enterococci) from all Clean Rivers Program monitoring stations within the BIG project area through the calendar year 2023. Included are bacteria trend lines for the BIG (solid brown line), the Expanded BIG (dashed blue line) including Armand Bayou, Jarbo Bayou and East and West Fork of the San Jacinto River (EF/WF SJR), Armand Bayou (short dashed purple line), EF/WF SJR (long dashed brown line), Jarbo Bayou (long-short dashed purple line) and bacteria trend for CRP areas outside of the BIG project area (solid bright green line).

The lines were generated using a ratio of the geometric mean of the rolling seven years with that of the state's primary contact recreation (PCR) standard, either *E. coli* used in freshwater or Enterococci used in marine and brackish water, 126 colony forming units (cfu)/100mL or 35 cfu/100mL, respectively. The short dashed red 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.

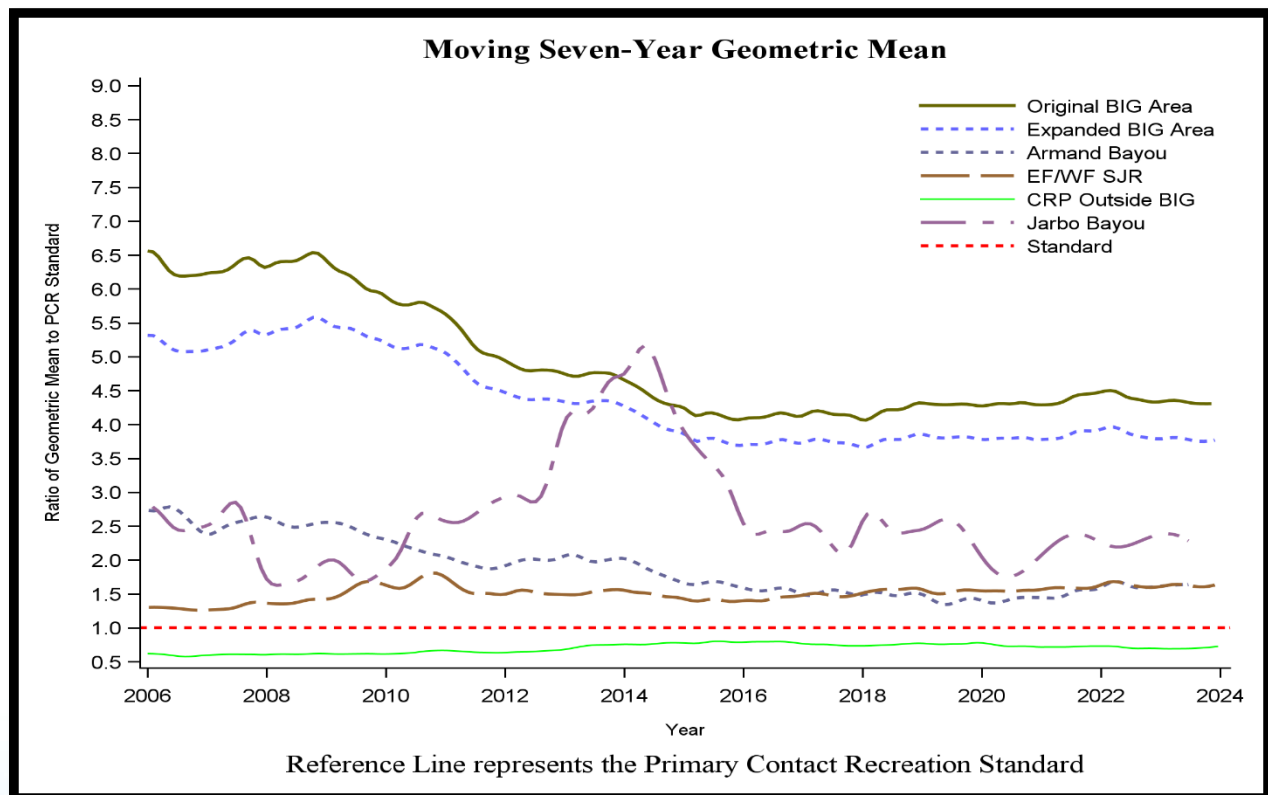


Figure 17. BIG Project Area, including subwatersheds, geometric mean trend lines, CRP Outside the BIG Project Area, and the normalized PCR standard

Appendix C

Implementation Resources

IMPLEMENTATION RESOURCES			
RESOURCE	NAME	USE	WEBSITE
FUNDING and TECHNICAL ASSISTANCE	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 Silviculture Nonpoint Source Measures	https://www.tsswcb.texas.gov/programs/texas-nonpoint-source-management-program
	320 Estuary Program	Water Quality Improvement, Conservation, Restoration, Public Outreach and Education, and Research	https://gbep.texas.gov/
	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	https://www.epa.gov/waterfinancecenter
	Low Impact Development / Green Infrastructure	Guidance on use and maintenance (H-GAC)	https://www.h-gac.com/low-impact-development
		City of Houston Incentives for Green Infrastructure	http://www.houstontx.gov/igd/
	Natural Resources Conservation Services Environmental Quality Incentives Program	Resource Conservation for Agriculture and Silviculture	https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives
	Onsite Sewage Facility	Homeowner, real estate, and inspector technical assistance and funding	https://www.h-gac.com/on-site-sewage-facilities

IMPLEMENTATION RESOURCES			
RESOURCE	NAME	USE	WEBSITE
	Texas Parks and Wildlife Landowner Incentive Program	Enact conservation practices on private lands	https://tpwd.texas.gov/landwater/land/private/lip/#menu
	Texas Water Infrastructure Coordination Committee	Identify and develop solutions to water and wastewater	https://twicc.org/resources/funding.html
	USDA Rural Development Grant	Rural Wastewater Infrastructure	https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program
	USDA Waste and Environmental Program	Multiple assistance programs	https://www.rd.usda.gov/programs-services/all-programs/water-environmental-programs
	Water Quality Management Plan	Soil and Water Conservation for Agriculture and Silviculture	www.tsswcb.texas.gov/index.php/programs/water-quality-management-plan
Outreach and Education	Clean Waterways	Water quality outreach and education	www.cleanwaterways.org
	Clean Waters Initiative Workshops	Technical workshops covering a variety of water quality information	https://www.h-gac.com/clean-water-initiative-workshops
	Coastal Communities	Nonpoint source outreach and education information	https://www.h-gac.com/coastal-communities
	Fats, Oils, Grease, Wipes	Cease the Grease	http://ceasethegrease.net/
		Protect Our Pipes	https://www.publicworks.houstontx.gov/protect-our-pipes
		Patty Potty	www.pattypotty.com
	Lone Star Healthy Streams	Agriculture BMPs	http://lshs.tamu.edu/bmps/
	My Yard	Reduce water consumption and stormwater runoff	https://www.galvbaygrade.org/cover-stories/2023/08/water-my-yard/
	Municipal Public Education	Regional Public Education Services Program	https://www.hcfd.org/Resources/Education-Materials/Regional-Public-Education-Services-Program
		Coastal Communities	https://www.h-gac.com/coastal-communities
	Onsite Sewage Facility	Public outreach and education	https://www.h-gac.com/on-site-sewage-facilities
	Pet Waste	Basic information on pet wastes	www.h-gac.com/community/pet-waste/default.aspx

IMPLEMENTATION RESOURCES			
RESOURCE	NAME	USE	WEBSITE
Reporting	City of Houston Bureau of Pollution Control and Prevention	Service helpline and pollution reporting	www.houstontx.gov/311 and 713.837.0311
	Galveston Bay Action Network	Pollution reporting in five counties surrounding Galveston Bay	www.galvbay.org/gban
	HCFCF Citizen's Service Hotline	Telephone reporting system	713.684.4197
	Illegal Dumping	Pollution reporting system for MS4s	www.cleanbayous.org
Data	Clear Rivers Program	Ambient monitoring data	https://www.h-gac.com/clean-rivers-program/data
	EPA Enforcement and Compliance History Online	Permit tracking and compliance database	https://echo.epa.gov/
	HCFCF BMP Database	Best Management Practices Monitoring	www.bmpbase.org
	LID Tracking	Low Impact Development Resource	https://www.h-gac.com/low-impact-development/designing-for-impact
	Onsite Sewage Facility	Mapping tool	https://datalab.h-gac.com/ssf/
	Wastewater and Stormwater	Permit look up	www.tceq.texas.gov/agency/data/lookup-data/status-stormwater-wastewater.html



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