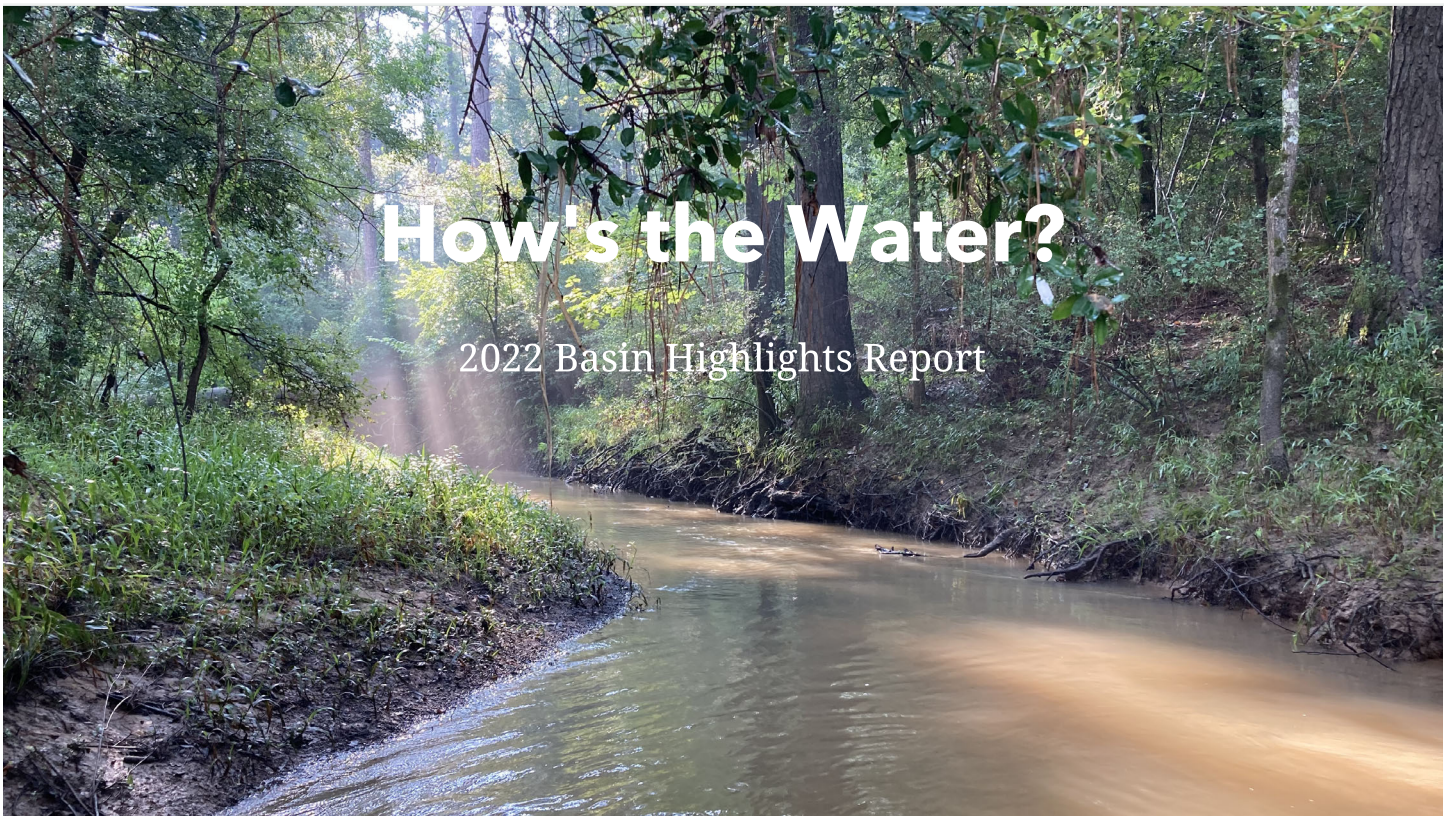

Introduction

Purpose of Report

The Houston-Galveston region has a population of more than 7 million residents and includes the fourth-largest city and third-most populous county in the nation. It is also home to the largest petrochemical complex in the United States, as well as the third largest port in the United States. This concentration of people and industry can place significant strains on the quality of surface water in our region.

This region contains more than 16,000 miles of waterways and shoreline, which are broken down into 55 Stream segments. More than 90 percent of those stream segments have a concern for or fail to meet one or more state water quality standards. The most common water quality indicators tested

for the state water quality standards are bacteria , dissolved oxygen , chlorophyll , nutrients[1] and PCBs/dioxin .

Each year, Texas Clean Rivers Program partners are responsible for developing an annual report about water quality and issues affecting their basins. This year, H-GAC's report will provide:

- an update on major basin activities, changes, and events
- an update of basin water quality monitoring activities
- an update on the top water quality concerns and issues in the basin
- a summary of findings from special studies
- maps showing the location of sampling sites; major water quality issues and the basin or watershed within the state
- an update on public outreach and educational activities
- links to additional resources

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[1] There are no numeric criteria for nutrients (forms of phosphorus, ammonia, and nitrogen), but excessive concentrations are considered concerns.

Background to Understand the Scope of the Clean Rivers Program

Established in 1991, the Texas Clean Rivers Program (CRP) is a state fee-funded, non regulatory program that was created to provide a framework and forum for managing water quality issues in a more holistic manner. The focus of the program is to work at the watershed level within each basin by coordinating the efforts of many diverse organizations from federal, state and local levels.

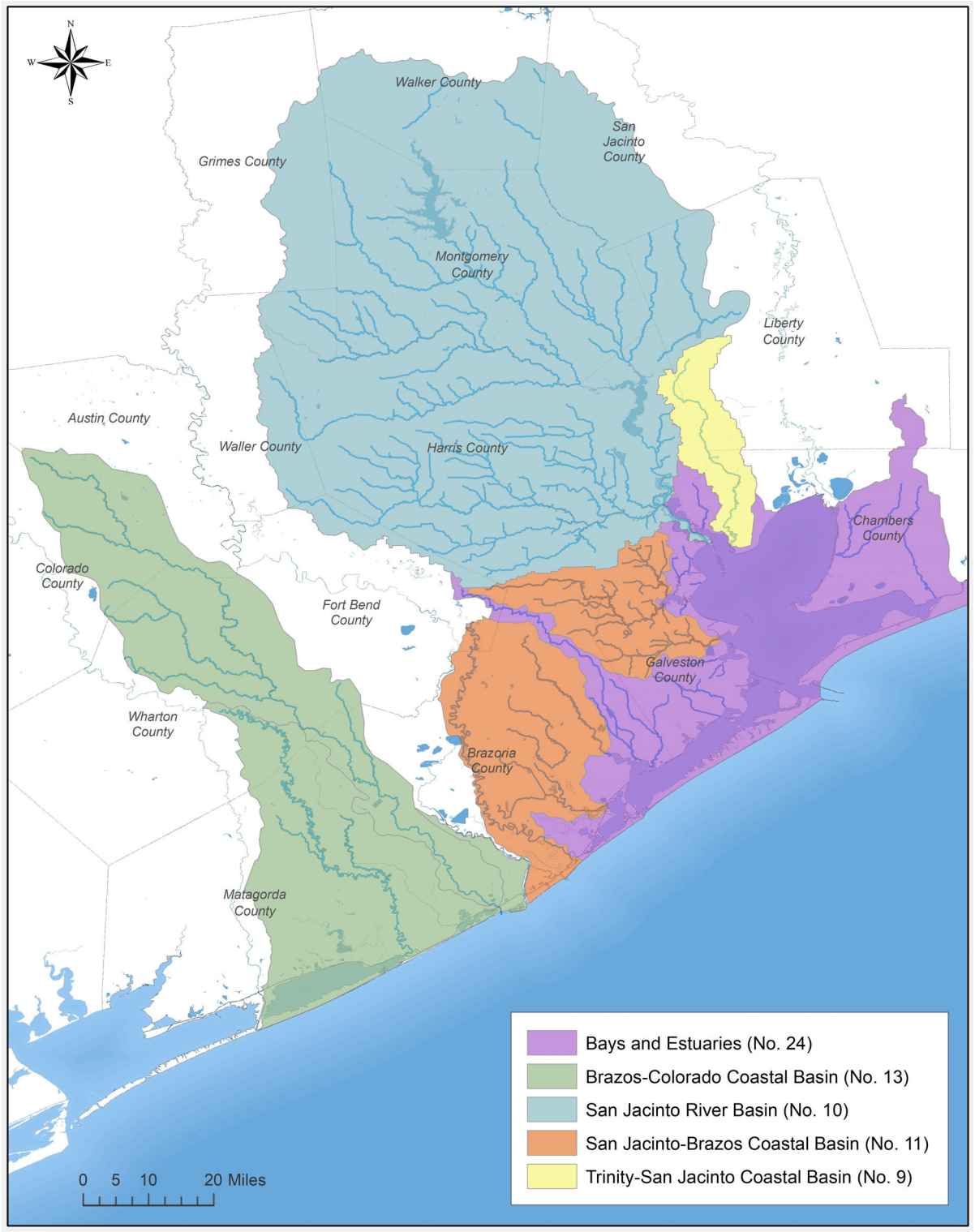
The Houston-Galveston Area Council (H-GAC) coordinates water quality monitoring, assessment, and stakeholder outreach in one river basin, three coastal basins, and the Bays and Estuaries draining into Galveston Bay, through the Texas Clean Rivers Program. Those basins include all or portions of 15 counties.

The four basins in H-GAC's Clean Rivers Program study area are:

- San Jacinto River Basin
- Brazos-Colorado Coastal Basin
- San Jacinto-Brazos Coastal Basin
- Trinity-San Jacinto Coastal Basin

The 15 counties include:

- Austin
- Brazoria
- Chambers
- Colorado
- Fort Bend
- Galveston
- Grimes
- Harris
- Liberty
- Matagorda
- Montgomery
- San Jacinto
- Walker
- Waller
- Wharton



Map 1 – H-GAC's Clean Rivers Program Basins

H-GAC's Clean Rivers Program collects and shares valuable information to promote efforts to protect the region's waterways.

What Information is Provided in this Report?

Since the 2021 Basin Summary Report included an in-depth review of the previous five years of water quality issues, this 2022 Basin Highlights Report will focus on three special projects completed in the summer of 2021: Targeted Bacteria Monitoring, a Monitoring Efficiencies Analysis, and the development of a new App used in monitoring field work. The report also includes updates on public outreach, and updates of water quality changes that may have occurred due to additional data being added to the seven-year average.

Spring Creek

This Year's Highlights

Special Projects

During each two-year contract period, the H-GAC Clean Rivers Program strives to conduct projects that not only collect and analyze information to determine the health of our local water bodies, but also improve water quality. Our program also is continually looking to improve processes and make our work more efficient.

This 2022 Basin Highlights Report features three such projects. The first is the Monitoring Efficiencies project, designed to ensure that the monitoring and analyses being conducted are not redundant and provide robust data for water quality assessors. It also takes an in-depth look at data management processes to identify better ways of handling water quality monitoring data.

The second special project is the creation of a water quality monitoring application for use in the field by H-GAC and local monitoring staff. The intent is to reduce errors in data entry through an easy-to-use application that can be used on a smart phone or tablet.

The third project is the Targeted Bacteria Monitoring project, designed to look for and remove bacteria sources in some of the most bacteria impaired streams in the region.

Please take a moment to look at these projects a bit more in detail. We hope you find these projects inspiring and that they contribute to water quality improvements and improved efficiencies in our work.

Monitoring Efficiencies Analysis

In September 2019, H-GAC Clean Rivers Program staff, in coordination with the Technical Advisory Group, initiated a Monitoring Efficiencies Analysis study.

Throughout Fiscal Years 2020 – 2021, H-GAC conducted an evaluation of its Clean Rivers Program to identify areas where the program could be improved or made to be more efficient, with a goal of using any identified costs savings to fund special studies projects in future contract periods.

Figure 1 - Monitoring Efficiencies Analysis Report

This project examined the monitoring and data management components of our program to ensure that these programs were being managed efficiently and that the data generated was meeting TCEQ's needs. Monitoring site location analysis revealed very few redundancies.

H-GAC identified and implemented ways to improve the efficiency of our program, particularly as it relates to data submission from our numerous partners and the review, analysis, and management of that data.

The Monitoring Efficiencies Analysis Report is available on H-GAC's website at the following location:

https://www.h-gac.com/getmedia/42db1165-b9bd-44ea-8d1f-f47fc9c26623/MEA-Report FINAL-2021-08-10.pdf

Monitoring Application

H-GAC recently embarked upon the development of a software solution for documenting Clean Rivers Program field data during actual collection activities. This application, developed using ArcGIS Survey123, allows for documentation of field parameter results and observations using a cell phone or tablet, eliminating or greatly reducing the need for physical hardcopies of forms.

The program also includes a mapping functionality and links to reference manuals and resources (such as the Surface Water Quality Monitoring manual). Additionally, the software allows for attachment of images and video. Once fully implemented, the software should not only assist field collectors with the documentation of their data, but also allow H-GAC to have a more consistent data format for processing while reducing the data input phase of data management.

Figure 2 - Monitoring Application PC interface

One of the most advantageous aspects of the application is that field staff do not have to collect, save, copy, and then distribute the hardcopy forms to data managers. The data manager has instant access to the collected data within minutes of collection via the ArcGIS Online web interface.

This method enables immediate quality assurance of the data, rather than reviewing months after collection. Data and captured media can be analyzed immediately while the field staff has moved on to the next station.

H-GAC staff have used this application side-by-side in the field with paper forms and found that it performs as intended for the H-GAC monitoring team. Local monitoring partners are currently piloting the application alongside their paper documentation to help identify any issues within their monitoring program.

H-GAC plans to demonstrate the application to TCEQ and other Clean Rivers Program partners this year to ultimately get approval to use the application in our routine data collection program.

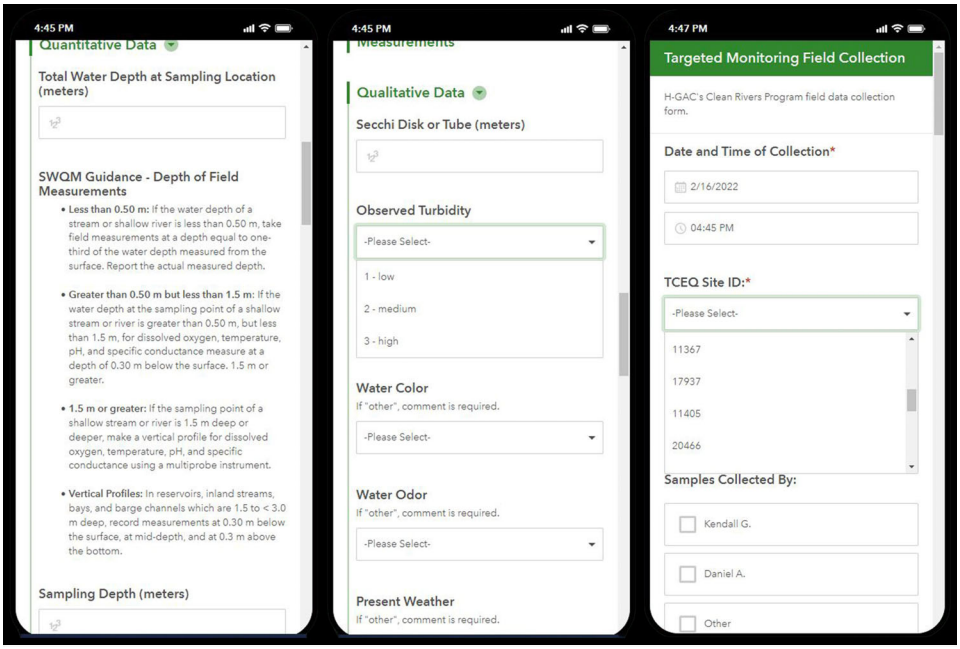


Figure 3 - Monitoring Application Phone Interface

Targeted Monitoring Project

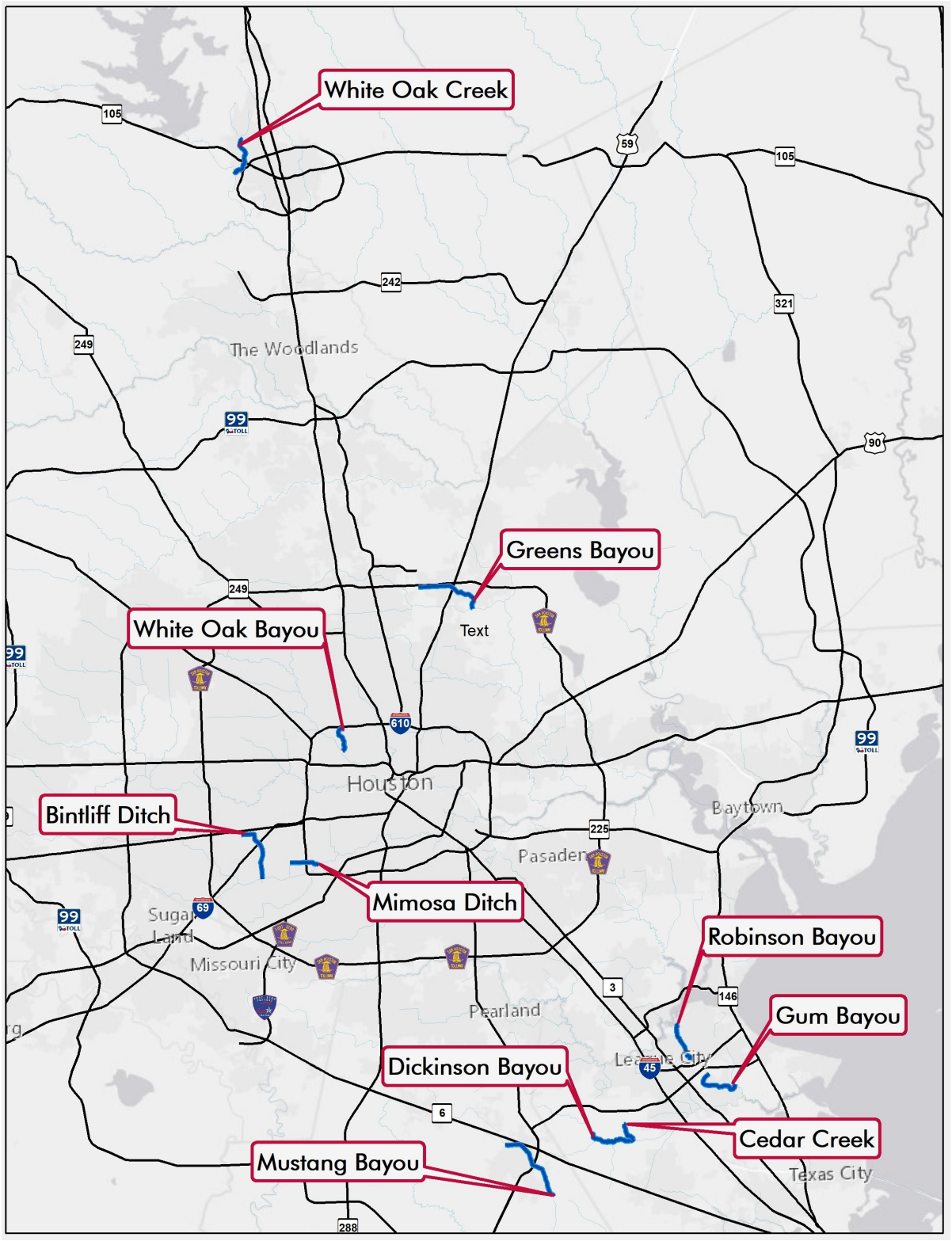
Nearly half of the stream miles in the Houston-Galveston region have a bacteria level higher than the state standard for contact recreation. General ambient water quality monitoring is not designed to identify sources of these bacteria. In FY2020-2021, H-GAC's Clean Rivers Program implemented a *Targeted Monitoring Project* to locate the sources of the

bacteria in ten watersheds from various land cover types – urban, suburban, and rural.

First, a seven-year geometric mean analysis defining the severity of impairment was performed on each assessment unit (AU) within the H-GAC region.

Second, each AU was assigned a landcover type using urban, suburban, or rural characteristics. Once the highest geometric means were identified in each category (four urban AUs, four suburban AUs, and two rural AUs), H-GAC evaluated accessibility to the stream and feasibility of the watershed for field investigations to be completed.

Some AUs were just too large in size and/or contained too many tributaries with multiple branches. Subsequently, ten AUs were selected for the *Targeted Monitoring Project*.



Map 2 - Targeted Monitoring Project Locations

A windshield survey was conducted in each selected AU to determine where areas of high bacteria concentrations existed. Results of the surveys were used to prioritize

intensive field investigations along each waterway. Bacteria samples were collected from every active dry-weather flow draining into these waterways.

Outfalls that were sampled included non-regulated pipes, ditches, and tributary waterways. Results of these targeted monitoring investigations were shared with the organization/agency responsible for maintenance of the waterway, outfalls, and tributaries as time allowed.

Figure 4 - Targeted Monitoring Project Report

Of the 343 samples collected during the field investigations, 52 of those sites were identified for referral. Five of the ten AUs were sent to the proper authorities for further investigation and remediation.

Two AUs were recommended for additional field investigations as some high bacteria concentrations had no sources identified and could not be explained. H-GAC plans to initiate additional targeted monitoring in the future.

The *Targeted Monitoring Report* is available on H-GAC's website at the following location:

https://www.h-gac.com/getmedia/3a9a542a-9336-4318-848b-4ce24eb1521b/Targeted-Monitoring-Project-FY2020-2021

Christmas Bay

Public Involvement

Public Involvement is the cornerstone of the Clean Rivers Program. The ability to receive and share information about water quality and the issues that concern all of us is critical. H-GAC's Clean Rivers Program has several avenues for sharing information.

Basin Steering Committee

H-GAC's Clean Rivers Program is guided by a Steering Committee that serves as the primary forum for discussion of various water quality issues raised during the assessment process. Representatives from local government, state and federal agencies, key interest groups, and several members of H-GAC's Natural Resources Advisory Committee make up the committee membership. Meetings allow the Steering

Committee to advise H-GAC staff on Clean Rivers Program matters, including:

- Developing work plans and budgets
- Monitoring progress toward project milestones
- Reviewing draft and final basin reports
- Focusing monitoring and implementation efforts to priority areas
- Providing regional perspective and local expertise to the assessment process
- Communicating information between member representative groups and the Clean Rivers Program
- Providing opportunities for public comments and questions about program activities

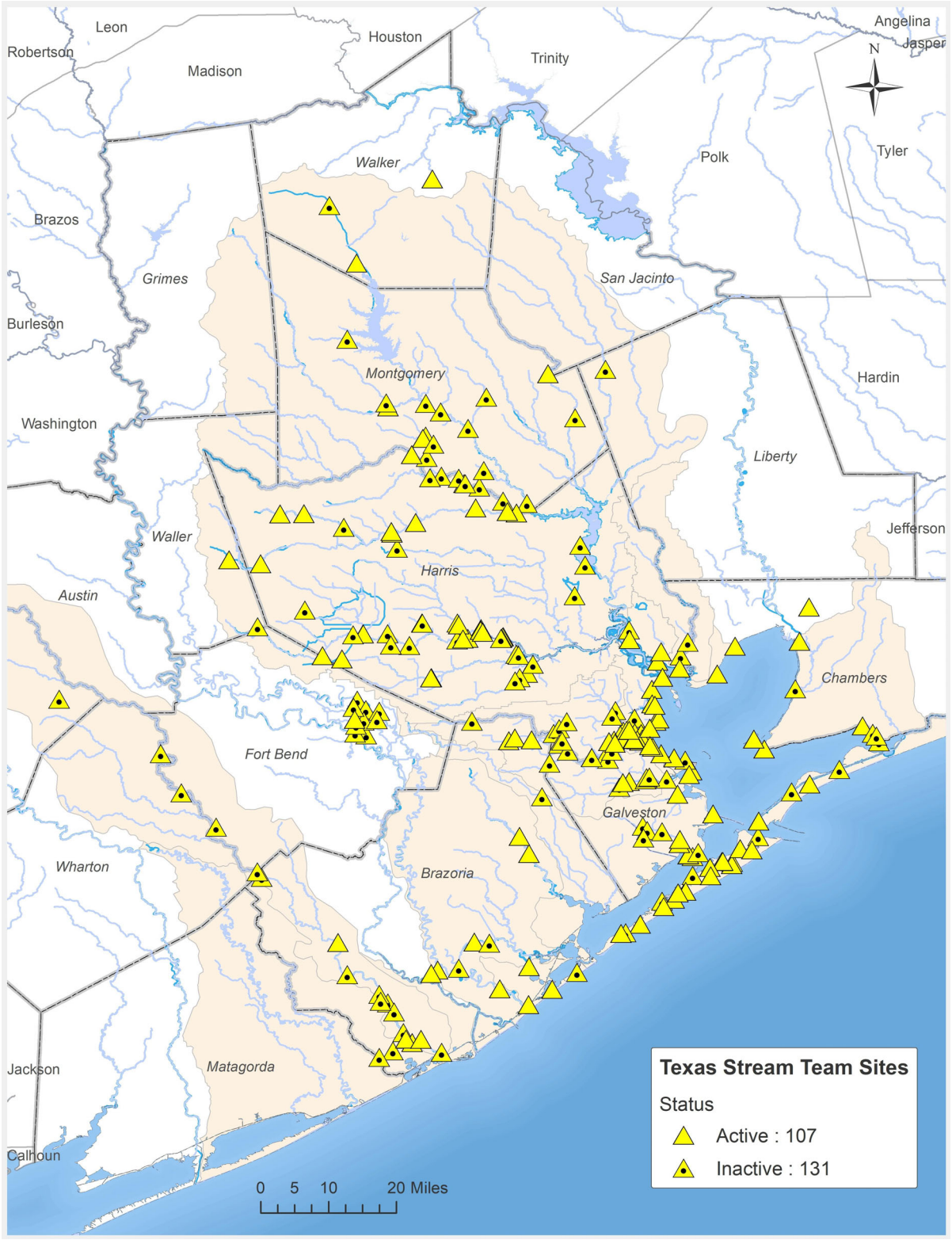
The Steering Committee normally meets one or two times per year depending on project objectives and administrative needs. The Steering Committee met virtually twice during FY2021 due to COVID. The committee will meet once during FY2022.

Regional Monitoring Workgroup

The Regional Monitoring Workgroup is comprised of field and laboratory staff from each of the local Clean River Program partner agencies. The group meets quarterly to provide updates on individual monitoring programs, discuss quality assurance issues and explore solutions to common problems found in field and/or laboratory settings. The workgroup holds a coordinated monitoring meeting in the spring to discuss data gaps and set the monitoring schedule for the coming fiscal year. All monitoring is conducted under a TCEQ-approved Multi-Basin Quality Assurance Project Plan (QAPP).

Texas Stream Team

H-GAC has been a Texas Stream Team Partner since 1993, training and certifying citizen scientist water quality monitors who sample monthly at monitoring sites on their local waterways. H-GAC's regional program is funded by the Clean Rivers Program and collaborates with local Texas Stream Team partners like the Bayou Preservation Association and Galveston Bay Foundation to maintain a network of over 60 citizen scientists and their associated monitoring stations.



Map 3 - Texas Stream Team Monitoring Locations

While the ongoing public health situation has reduced the number of active Texas Stream Team sites, the program expects to return to previous numbers when training classes resume in 2022.

You can view the Water Resources Information Map (WRIM) at the following web address: https://arcg.is/9rHb9

For more information about the Texas Stream Team, visit the H-GAC Texas Stream Team webpage at https://www.h-gac.com/texas-stream-team

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Trash Bash

The River, Lakes, Bays 'N Bayous Trash Bash® was established by the Clean Rivers Program and hosted its first annual cleanup in 1994. The event has evolved into the largest single-day waterway cleanup in Texas, promoting environmental stewardship by using hands-on education and encouraging partnerships between environmental, governmental, and private organizations.

Trash Bash® was held virtually in 2021 to protect the health and safety of volunteers, and videos and activities were provided on the event website to maintain the educational element of the cleanup. During the virtual cleanup, 765 volunteers removed over 5.5 tons of trash and 51 illegally dumped tires from their local watersheds. To see the 2021 results and the cumulative results from over two decades of cleanups visit the Trash Bash® website. Trash Bash® looks forward to returning to an in-person cleanup in 2022 for its 28th annual event.

For more information on the 'River, Lakes, Bays 'N Bayous Trash Bash, visit their website at: https://www.trashbash.org/

Link to the 'River, Lakes, Bays 'N Bayous Trash Bash Results' webpage: https://www.trashbash.org/results.html

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Trash Free Texas

The Trash Free Texas: Basin-wide Community Engagement Strategies to Reduce Aquatic Debris project is a partnership between H-GAC, the North Central Texas Council of Governments, and the Meadows Center for Water and the Environment. The project aims to reduce the land-based litter that accumulates along our roads, rivers, and beaches. Efforts toward this goal have included promoting and recruiting partners for the Trash Free Texas Adopt-A-Spot Map, a web-based resource to help connect volunteers to places in need of routine litter cleanup.

The Adopt-a-Spot Map allows local governments, nonprofits, and other organizations to post adoptable cleanup locations in their community to effectively reach volunteers while maintaining control of their litter cleanup program. Toolkits have been developed to help communities plan and implement litter cleanup efforts, with resources such as checklists, promotional language and materials examples, links to other programs and tools, and more. The Trash Free Texas project is also working with stakeholders to determine tools to reduce the use of single-use plastics in restaurants.

Link to H-GAC Trash Free Texas project webpage:
https://www.h-gac.com/trash-free-texas

Link to Trash Free Texas website with Adopt-A-Spot Map:
https://www.trashfreetexas.org/

Link to Toolkits on the Trash Free Texas website:
https://www.trashfreetexas.org/adoptaspot-resources

Clean Waters Initiative Workshop

The Clean Waters Initiative workshop series serves the Clean Rivers Program as well as watershed-based plans such as total maximum daily load implementation plans and watershed protection plans. These workshops offer education and information to local governments, nonprofit organizations, landowners, and residents to develop effective strategies to reduce pollution in local waterways. Additionally, diverse stakeholder groups may use these workshop environments as a networking opportunity.

In 2021, the Clean Waters Initiative workshop focused on specific tools and programs supported by the Houston-Galveston Area Council to improve water quality throughout the region. This half-day workshop included presentations on septic system outreach and education, non-point source education, discussions on urban forestry/riparian cover and green infrastructure, and an overview of H-GAC's targeted monitoring project. The workshop also had breakout sessions to discuss specific watershed-based plans (Big Creek and Cotton Bayou watershed protection plans).

In the current fiscal year, a Clean Waters Initiative workshop was held in February 2022 that focused on assisting local governments with navigating the process of applying for Texas Water Development Board grants and loans for water and wastewater infrastructure. Future planned topics for this year include presentations on H-GAC's interactive web applications, such as the Water Resources Information Map (WRIM), Regional Equity Tool, and OSSF Mapping Tool, as well as volunteering, outreach, and education activities and water quality monitoring programs.

Learn more about the Clean Waters Initiative at https://www.h-gac.com/clean-water-initiative-workshops.

Outreach During COVID

During this past year COVID has affected nearly every part of our lives. Opportunities for public outreach and engagement were very limited. Face-to-face events were frequently canceled or, when possible, turned into virtual outreach events. During a "normal" year, H-GAC staff would participate in nearly a dozen events, which would include hosting a booth or making a presentation.

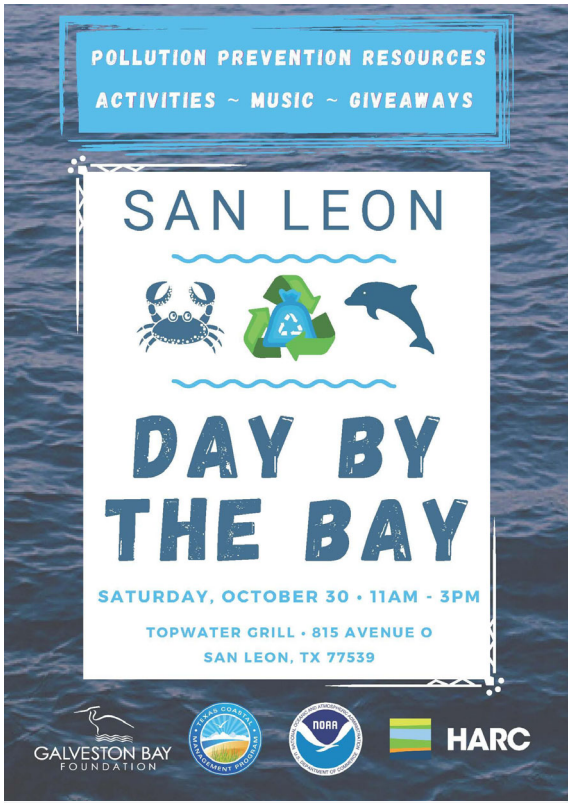


Figure 5 - Day By the Bay Promotional Flyer

In 2021, H-GAC staff were only able to attend one event in-person. One event where H-GAC staff attended and used every outreach/educational display related to water quality and pollution prevention along with related hand-outs was the San Leon community's '*Day By The Bay*' held at the Topwater Grill's outside pavilion.

Water Quality Management Plan

H-GAC conducts water quality management planning as part of a Clean Water Act Section 604(b) grant program funded by the EPA through the Texas Commission on Environmental Quality. The Water Quality Management Plan Update, completed annually, describes a series of data collection, special study, and coordination activities completed through this project. The purpose of these activities is to provide data and analysis regarding wastewater infrastructure, watershed planning, and sources or nonpoint source pollution that affect water quality in the Houston-Galveston region.

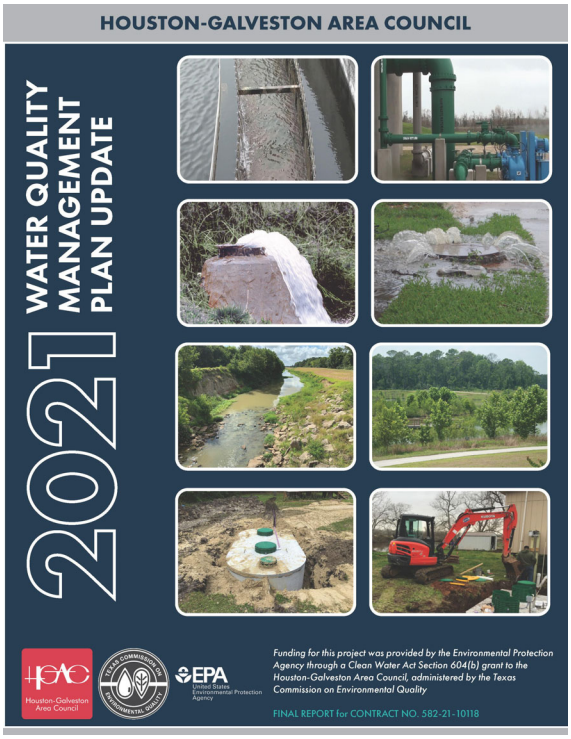


Figure 6 - Water Quality Management Plan Report

Data acquired and assessed through this project include geospatial data for wastewater treatment plant outfalls and service area boundaries, self-reported effluent monitoring data, and occurrences of sanitary sewer overflows. Updates to the on-site sewage facility information system mapping tool are coordinated through this project. The OSSF database is located HERE.

The quality-assured data from this project are used extensively to inform decisions in multiple watershed projects and programs, such as the Clean Rivers Program, Bacteria Implementation Group, and numerous watershed protection plan and total maximum daily load projects. Data are also made available to project partners and H-GAC member entities for use in their water quality planning activities.

Through this project, H-GAC also coordinates the Homeowner Wastewater Assistance program, performs outreach and education for on-site sewage facilities, provides support and coordination for urban forestry projects, and facilitates the Natural Resources Advisory Committee.

The most recent Water Quality Management Plan Update Report can be found HERE.

On-site Sewage Facility Database

H-GAC maintains and updates an on-site sewage facility database using data acquired from Authorized Agents within the region. This database includes permitted on-site sewage facility locations and related permit data. H-GAC staff also evaluate and estimate the probable locations of unpermitted systems, such as those installed before permitting was required. As of December 31, 2020, there were a total of 111,021 permitted on-site sewage facilities in the database, with 4,638 new permitted systems added that year.

There are also an estimated 199,006 unpermitted systems in the region based upon census block and parcel data, for an estimated total of 310,027 on-site sewage facilities in the 13-county region. With an estimated failure rate of 12 – 20% in the region, it is important that these systems be monitored as failing systems can be a significant source of bacteria and nutrients entering local waterways.

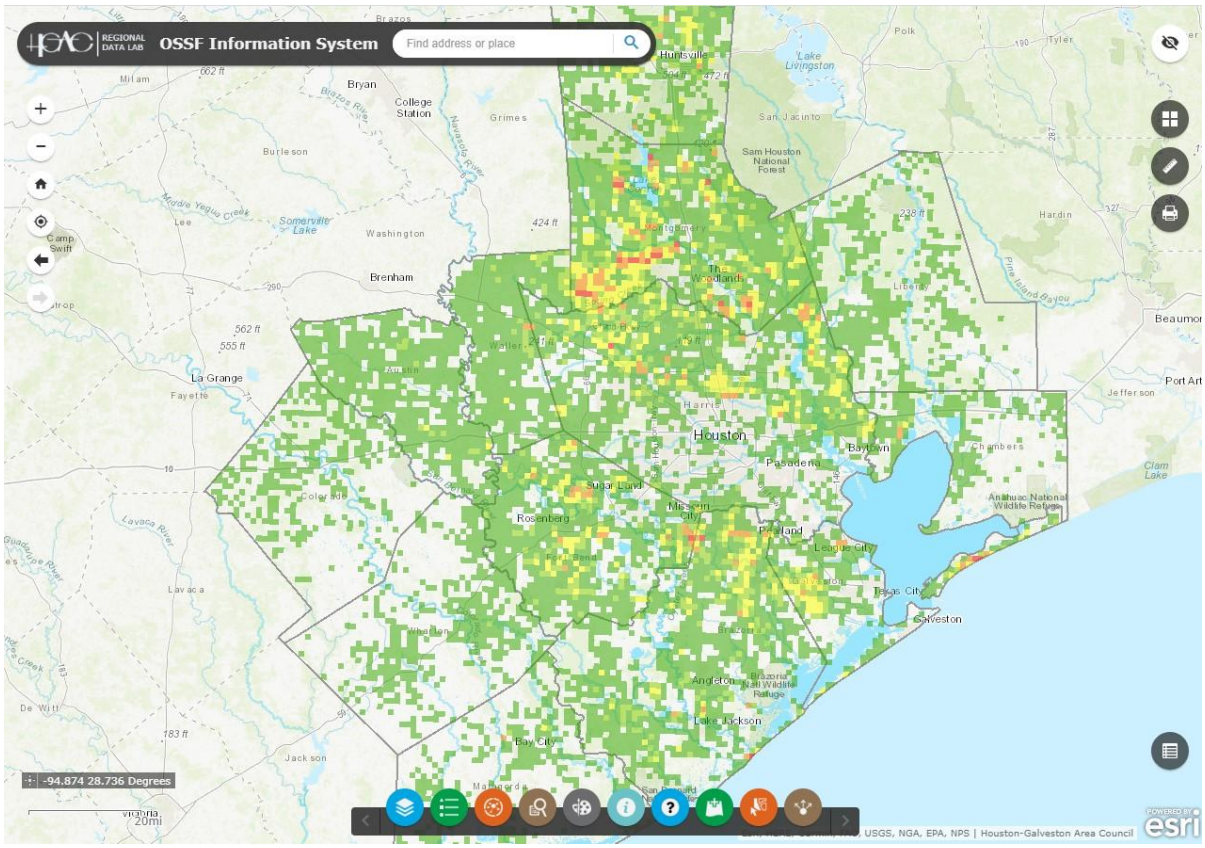


Figure 7 - OSSF Mapping Tool Interface

Data for on-site sewage facilities within the region are available online through H-GAC's OSSF Mapping Tool.

Overview to Watershed Based Planning

The IR is compiled using CRP monitoring data; in fact, the Houston-Galveston region CRP provides approximately 70 percent of the data used in the IR for the region. The IR dictates watershed project priorities for the region and acts as a catalyst for planning and mitigation strategies to address impairments and concerns including bacteria, DO, nutrients, and PCB/dioxin. H-GAC used the 2020 IR for this report.

Every two years, the TCEQ submits the Texas Integrated Report (IR) to the EPA for approval. The IR provides an assessment of existing water quality in the State of Texas and the extent to which these waters attain the Texas Surface Water Quality Standards.

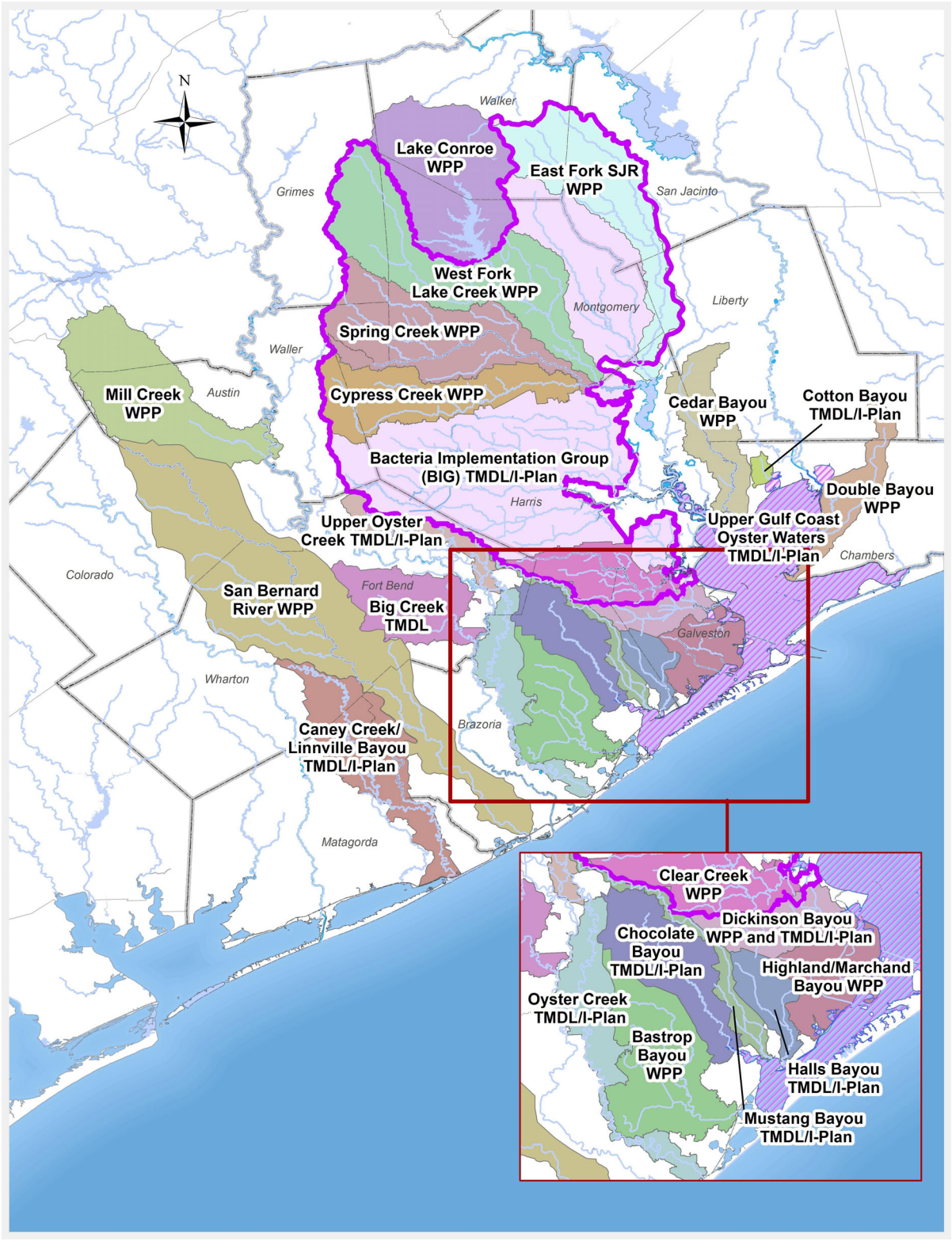
White Oak at Memorial Drive

After a water body is identified as impaired, there are two primary watershed planning paths for resolution available: conducting a Total Maximum Daily Load (TMDL) / Implementation Plan (I-Plan) or a Watershed Protection Plan (WPP).

Total Maximum Daily Load (TMDL)/ Implementation Plan (I-PLAN)

TMDL is a regulatory process triggered when a waterway is listed as impaired for one or more waterbody standard criterion. The TMDL calculates the maximum amount of a pollutant that a water body can receive and still meet water quality criterion. An I-Plan is then completed with the

assistance of watershed stakeholders to reduce pollutant loads to meet the pollutant criterion. The I-Plan contains a series of recommended regulatory and/or non-regulatory best practices, identifies funding sources and implementing partners, and determines a project timeline.



Map 4 - TMDL and WPP Projects in the Houston-Galveston Region

Once a watershed-based plan is established, the waterbody is moved from a Category 5 (impaired waters listing requiring a TMDL or other management strategy) to a Category 4 to track implementation for signs of improvement.

H-GAC with support from the TCEQ facilitates seven TMDL projects within the H-GAC planning area and partners on two others. These projects are shown in Table 1.

Table 1 - Total Maximum Daily Load (TMDL) / Implementation Plan (I-Plan) Project Summary

WATERSHED / PROJECT NAME	TMDL PROJECT AREAS	IMPAIRMENT TYPE	I-PLAN STATUS
Bacteria Implementation Group (BIG)	Buffalo and Whiteoak Bayou, Clear Creek, Houston Metropolitan, East and West Fork of San Jacinto River and Upper Lake Houston, Jarbo Bayou, and Armand Bayou	Bacteria	I-Plan complete and in implementation
Upper Oyster Creek	Upper Oyster Creek	Bacteria, Dissolved Oxygen	I-Plan complete and in implementation
Basin 11	Chocolate Bayou, Oyster Creek, Halls Bayou, Willow Bayou, Mustang Bayou, Persimmon Bayou, New Bayou	Bacteria	I-Plans in development
Basin 13	Caney Creek and Linnville Bayou	Bacteria	I-Plans in development and under review by TCEQ
Cotton Bayou	Cotton Bayou*	Bacteria	I-Plan in development
Big Creek	Big Creek*	Bacteria	I-Plan in development
Dickinson Bayou	Dickinson Bayou	Bacteria, Dissolved Oxygen	Bacteria I-Plan is complete; Dissolved Oxygen I-Plan in development
Upper Texas Gulf Coast Oyster Waters	Chocolate Bay, Bastrop Bay, Christmas Bay, Drum Bay and Galveston Bay: Upper, Trinity, East, West, and Lower Bays	Bacteria	I-Plan is complete and in implementation
Houston Ship Channel	San Jacinto River Tidal, Houston Ship Channel, Buffalo Bayou Tidal, Upper Galveston Bay, and tidal tributaries	Dioxin and PCBs in Fish Tissue	Legacy pollutant sites under Superfund; no TMDL I-Plan is planned

* These projects are located in basins covered by other Clean Rivers Program partners

Note: Higher resolution images can be found on the online StoryMap here : https://arcg.is/1qinez

For more information on the TMDL projects in the Houston-Galveston region, please go to the individual project websites.

- **BIG Project** - https://www.h-gac.com/bacteria-implementation-group

- **Upper Oyster Creek** - https://www.h-gac.com/watershed-based-plans/upper-oyster-creek-tmdl-and-implementation-plan

- **Basin 11** - https://www.h-gac.com/watershed-based-plans/san-jacinto-brazos-coastal-basin-tmdl-and-implementation-plan

- **Basin 13** - https://www.h-gac.com/watershed-based-plans/brazos-colorado-coastal-basin-tmdl-and-implementation-plan

- **Cotton Bayou** - https://www.h-gac.com/watershed-based-plans/cotton-bayou-tmdl

- **Big Creek** - https://www.h-gac.com/watershed-based-plans/big-creek-tmdl

- **Dickinson Bayou** - https://agrilife.org/dickinsonbayou/watershed-information/

- **Upper Texas Gulf Coast Oyster Waters** - https://www.tceq.texas.gov/waterquality/tmdl/74-uppercoastoyster.html

- **Houston Ship Channel** - https://www.h-gac.com/watershed-based-plans/houston-ship-channel-and-galveston-bay-tmdl-and-implementation-plan

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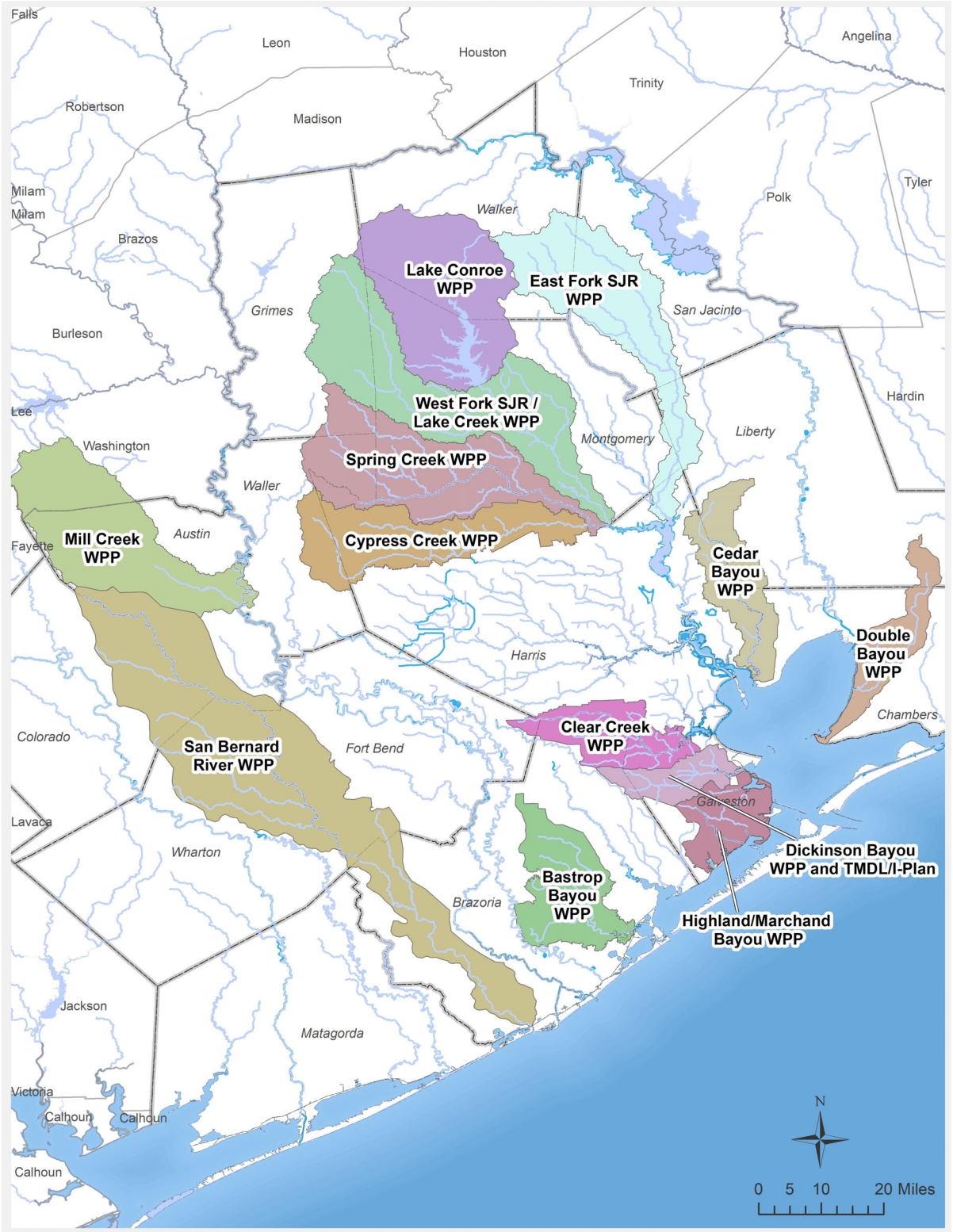
Watershed Protection Plans

Watershed protection plans (WPPs) empower local stakeholders to improve water quality issues using a voluntary, community-driven approach. Plans are based on a template developed by the U.S.

Environmental Protection Agency (EPA) that seeks to identify causes and sources of pollution, establish improvement goals, identify feasible and effective voluntary measures to address them, and establish metrics of success. WPPs are usually developed in response to an exceedance of one or more state water quality standards in a specific waterway, but they can also be implemented as a preventative measure.



Map 5-Watershed Protection Plans in the Houston-Galveston Region

Unlike TMDL projects which focus on specific impairments, WPPs can consider a wide range of stakeholder concerns related to water quality and coordinate with related efforts. Implementation activities outlined by WPPs are entirely

voluntary, contain no regulatory requirements, and generally focus on nonpoint source pollution.

WPPs are developed by voluntary partnerships of local stakeholders, including governments, residents, businesses, community organizations, and agricultural producers. WPPs currently being implemented or developed throughout the region are described in Table 2 and shown in Map 5.

Table 2 - Watershed Protection Plan (WPP) Project Summary

WATERSHED / PROJECT NAME	WATER BODIES INCLUDED	IMPAIRMENT(S)	CONCERN(S)	WPP STATUS
Bastrop Bayou WPP	Bastrop Bayou, Flores Bayou, Austin Bayou, Brushy Bayou	Bacteria, Dissolved Oxygen	Dissolved Oxygen	WPP approved by the EPA in 2016; Implementation ongoing
Cedar Bayou WPP	Cedar Bayou, Cary Bayou, Adlong Ditch	Bacteria, Dissolved Oxygen, PCBs, Dioxins	Dissolved Oxygen, Macrobenthic Community, Ammonia	WPP approved by the EPA in 2016; Implementation ongoing
Clear Creek WPP	Clear Creek, Magnolia Creek, Chigger Creek, Cow Bayou, Robinson Bayou, Mary's Creek, Hickory Slough, Turkey Creek, Mud Gully	Bacteria, Dissolved Oxygen, PCBs, Dioxins	Dissolved Oxygen, Ammonia, Nitrate, Total Phosphorus, Chlorophyll-a	In development
Cypress Creek WPP	Cypress Creek, Faulkey Gully, Spring Gully, Little Cypress Creek	Bacteria	Dissolved Oxygen, Habitat, Nitrate, Total Phosphorus	WPP approved by the EPA in 2021; Implementation ongoing
Dickinson Bayou WPP	Dickinson Bayou, Bensons Bayou, Bordens Gully, Geisler Bayou, Gum Bayou, Cedar Creek	Bacteria, Dissolved Oxygen, PCBs, Dioxins	Dissolved Oxygen	WPP approved by the EPA in 2009; Implementation ongoing
Double Bayou WPP	East Fork Double Bayou, West Fork Double Bayou	Bacteria, Dissolved Oxygen, PCBs, Dioxins	Chlorophyll-a	WPP approved by the EPA in 2016; Implementation ongoing
East Fork San Jacinto River WPP	East Fork San Jacinto River, Winters Bayou, Nebletts Creek, Boswell Creek	Bacteria	Bacteria	In development
Highland and Marchand Bayous WPP	Highland Bayou, Marchand Bayou	Bacteria, Dissolved Oxygen, PCBs, Dioxins	Dissolved Oxygen, Chlorophyll-a	WPP approved by the EPA in 2021; Implementation ongoing
Lake Conroe WPP	Lake Conroe	None	None	WPP completed in 2015
Mill Creek WPP	Mill Creek *	Bacteria	Habitat	WPP approved by the EPA in 2016; Implementation ongoing
San Bernard River WPP	San Bernard River, Gum Tree Branch, West Bernard Creek, Peach Creek, Mound Creek	Bacteria, Dissolved Oxygen	Dissolved Oxygen, Habitat, Ammonia	WPP approved by the EPA in 2017; Implementation ongoing
Spring Creek WPP	Spring Creek, Mill Creek, Panther Branch, Bear Branch, Lake Woodlands, Willow Creek, Walnut Creek, Brushy Creek	Bacteria	Bacteria, Dissolved Oxygen, Fish Community, Nitrate, Total Phosphorus, Cadmium	Draft WPP submitted for TCEQ review in 2021
West Fork San Jacinto River and Lake Creek WPP	West Fork San Jacinto River, Whiteoak Creek, Stewarts Creek, Crystal Creek, Lake Creek, Mound Creek	Bacteria	Dissolved Oxygen, Macrobenthic Community, Nitrate	WPP approved by the EPA in 2019, Implementation ongoing

* These projects are located in basins covered by other Clean Rivers Program partners

Note: Higher resolution images can be found on the online StoryMap here : https://arcg.is/1qinez

For more information on the TMDL projects in the Houston-Galveston region, please go to the individual project websites:

- **Bastrop Bayou WPP**
  http://www.houstontx.gov/planhouston/sites/default/files/plans/bb_watershed_protection_plan.pdf

- **Cedar Bayou WPP** https://www.h-gac.com/getmedia/b3ea3b36-a3c5-4ddf-bab9-e0ccdba6657b/WPP-Cedar-Bayou
- **Clear Creek WPP** www.clearcreekpartnership.com
- **Cypress Creek WPP** www.cypresspartnership.com
- **Dickinson Bayou WPP** https://agrilife.org/dickinsonbayou/watershed-information/
- **Double Bayou WPP** https://www.doublebayou.org/
- **East Fork San Jacinto River WPP** www.eastforkpartnership.com
- **Highland and Marchand Bayous WPP** https://agrilifecdn.tamu.edu/highlandbayou/files/2016/10/Highland-Bayou-WPP-Draft-14-20161215.pdf
- **Lake Conroe WPP** http://www.sjra.net/wp-content/uploads/2014/12/Lake-Conroe-Watershed-Protection-Plan.pdf
- **Mill Creek WPP** https://millcreek.tamu.edu/watershed-protection-plan/
- **San Bernard River WPP** https://www.h-gac.com/watershed-based-plans/san-bernard-river-watershed-protection-plan
- **Spring Creek WPP** www.springcreekpartnership.com
- **West Fork San Jacinto River and Lake Creek WPP** www.westfork.weebly.com

Water Quality Monitoring

Introduction

H-GAC's Clean Rivers Program is considered a model program throughout the state, thanks in large part to its coordinated approach to water quality monitoring. Between H-GAC, six local partner agencies, TCEQ and the USGS, water quality monitoring data are collected from more than 400 stations located throughout the region.

Caney Creek

Coordinating monitoring efforts through this program allows partner agencies to reduce costs by minimizing duplicated monitoring events. These savings are then reallocated to expand monitoring, conduct special studies, and improve tools to better assess regional water quality.

Partners include:

- City of Houston Drinking Water Operations
- City of Houston Health Department
- City of Mont Belvieu
- Environmental Institute of Houston
- Harris County Department of Pollution Control Services
- Houston-Galveston Area Council
- San Jacinto River Authority
- Texas Commission on Environmental Quality Region 12
- Texas Research Institute for Environmental Studies
- US Geological Survey

All quality assured data are submitted to TCEQ for use in the bi-annual *Texas Integrated Report of Surface Water Quality* (IR). The IR includes a list of water bodies evaluated, identification of impaired waters (the 303(d) List), identification of water bodies either newly listed or removed for the 303(d) List, and other supporting information.

All data used in this Basin Highlights Report were collected under H-GAC's TCEQ-approved Multi-Basin Quality Assurance Project Plan (QAPP). These data are also used as baseline data for many water quality studies and watershed based plans within the H-GAC region.

Water Quality Summary

Regional Concerns

- Most water bodies in the region are considered unsuitable for recreational activities like swimming due to high bacteria levels.
- Approximately 67% of streams are impaired for bacteria.
- A concern for nutrients is present for about 44% of streams.
- Approximately 49% of streams have low levels of dissolved oxygen.

- Nearly 71% of tidally influenced waterbodies are impaired by dioxin or PCBs in fish tissue.

Trends identified include the following:

- The good news is even though most of the region's waterways do not meet one or more state water quality standards, about 67 percent of stream segments have not seen further deterioration during the last seven years.
- Nine percent of segments have shown improvement in bacteria levels with nearly six percent of segments deteriorating over the seven-year period H-GAC selected for analysis (6/1/2014 – 12/31/2020).
- Areas in the original Bacteria Implementation Group implementation plan, which provides recommendations for bacteria reduction in the greater Houston area, have experienced a 44 percent decrease in bacteria levels since stakeholders came together as part of the TMDL process to address bacteria concentrations.
- Nine percent of segments have shown improvement in dissolved oxygen levels over the seven-year assessment period. Nearly four percent of segments are getting worse.
- Twenty-six percent of segments have shown improvement in nutrient levels over the seven-year assessment period. Just 15 percent have shown deterioration in nutrient levels. Trend analysis for nutrients was done for each nutrient parameter but the reported trends are a composite of the nutrients analyzed.

Improved water quality in the region may be attributed to several factors, including:

- increased investigations of wastewater collection system and resulting line repairs and facility improvements;

- improved regulation and maintenance of on-site sewage facilities and wastewater treatment;
- increased preservation of natural habitat and installation of water quality features in detention basins; and
- heightened public awareness and public participation.

Frog Chart (6/1/14 – 12/31/2020)

A conservative trend analysis was performed using seven years (June 1, 2014 through December 31, 2020) of quality assured data acquired from TCEQ's Surface Water Quality Information System. These analyses were performed at up to three representative monitoring stations on the 2021 Coordinated Monitoring Schedule in the classified portion of each watershed to detect trends at the watershed level for the H-GAC "Frog Chart".

The representative stations used were the same as those selected for the trend analysis that appeared in the 2021 Basin Summary Report "Frog Chart" and were chosen by comparing parameter statistics for each station to the statistics for the whole segment. Trends were identified by nonparametric correlation analysis and simple linear regression.

Because nonparametric methods are less sensitive to extreme values in the data than parametric techniques like linear regression, trends that were suggested by linear regression analysis alone were not included in the chart. Trends (for the "Frog Chart" analysis) were considered statistically significant if the p-value was below 0.0545.

Numbers shown in the "Frog Chart" represent the percent of total segment length that is impaired for each parameter. In addition to listing levels of impairments, H-GAC staff also interpreted the data and assigned one to five "frogs" to give a

snapshot of water quality. The “frog” count is based on the percentage of each segment that is impaired and the severity of the impairment.

As part of the statistical analysis, impairments that affect human health were deemed more severe than impairments for general use and are weighted more heavily in the calculation of the numerical index. Some adjustments to the final count were made by H-GAC staff on the basis of best professional judgment, in order to capture attributes not captured by the analysis.

For this report, H-GAC found an opportunity to update the stream miles that were calculated for the analysis on percent impairment/concern. Previously, stream miles for water bodies were calculated on outdated aerial imagery. With the advances of GIS tools and high-quality aerial images, the stream miles for lakes, reservoirs, estuarine systems, and bay features were re-calculated based off current digitizing methods.

Some water body features may show a difference in the percent values than previously reported due to a change in the stream miles of that segment group. For example, Lake Conroe (Segment 1012) was previously reported as 67.26 miles, while current digitizing calculated the shoreline distance at 179.85 miles. The major difference reported between these two values are due to the inclusion of the jagged shoreline edges of the lake.

These seemingly small details made a significant difference in the new calculations, especially in the extended portions of the lake and marina areas throughout the shoreline. Because values in the “Frog Chart” are calculated based upon the number of stream miles impaired, the values shown in the 2022 “Frog Chart” are in some cases much different than those

in the 2021 “Frog Chart” presented in the most recent Basin Summary Report.

2022 REGIONAL WATER QUALITY SUMMARY

The numbers represent the percent of total segment length that is impaired or of concern for each parameter. Cells without numbers (blanks) represent stream segments that are currently meeting state standards but may be improving or degrading for each parameter.

DO = Dissolved Oxygen Bact = Bacteria Chl-a = Chlorophyll-a Nutr = Nutrients PCB = PBC/Dioxins OTHER = See Below

Basin	Watershed	Segment	DO	Bact	Chl-a	Nutr	PCB	Other*	Frogs
Trinity-San Jacinto Coastal	Cedar Bayou Tidal	0901	14.2	100			85.8		
	Cedar Bayou Above Tidal	0902	82.7	82.7				**	
San Jacinto River	Buffalo Bayou Above Tidal	1014	12.0	77.9		64.7			
	Buffalo Bayou Tidal	1013	34.2	77.8		43.6		**	
	Caney Creek	1010	16.8	69.2					
	Cypress Creek	1009	18.8	80.3		80.3		10.3	
	East Fork San Jacinto River	1003		85.7					
	Greens Bayou Above Tidal	1016	6.4	95.8		85.3			
	Houston Ship Channel	1006		44.7	7.1	68.4	39.8	22.2	
	Houston Ship Channel Buffalo Bayou Tidal	1007	13.0	70.2		68.9	28.7	0.9	
	Houston Ship Channel/ San Jacinto River Tidal	1005					100		
	Lake Conroe	1012			76.6**	76.6**			
	Lake Creek	1015	40.1	12.1				30.7	
	Lake Houston	1002	9.8	19.4		9.8		0.2	
	Peach Creek	1011		100				15.4	
	San Jacinto River Tidal	1001					47.3		
	Spring Creek	1008	1.0	77.8	2.5	26.4		11.4	
	West Fork San Jacinto River	1004		53.6		**		16.6	
	White Oak Bayou Above Tidal	1017	11.7	87.0		79.6			
San Jacinto-Brazos Coastal	Armand Bayou Tidal	1113	61.7	69.6	21.4	17.0	23.4	12.1	
	Bastrop Bayou Tidal	1105	43.6	69.6					
	Chocolate Bayou Above Tidal	1108		100					
	Chocolate Bayou Tidal	1107		100			100		
	Clear Creek Above Tidal	1102	23.8	78.8		60.8	48.4	13.1	
	Clear Creek Tidal	1101	38.6	78.0	4.7	31.8	29.2		
	Dickinson Bayou Above Tidal	1104		54.5					
	Dickinson Bayou Tidal	1103	86.9	100	2.8	2.8	43.6		
	Old Brazos River Channel Tidal	1111							
	Oyster Creek Above Tidal	1110	59.3	64.5				96.8	
	Oyster Creek Tidal	1109	100	100					

FROG Chart – 2022 Regional Water Quality Summary

Basin	Watershed	Segment	DO	Bact	Chl-a	Nutr	PCB	Other*	Frogs
Brazos-Colorado Coastal	Caney Creek Above Tidal	1305	27.4	39.1	39.1	56.4		13.9	3
	Caney Creek Tidal	1304	46.8	97.9	36.8				3
	San Bernard River Above Tidal	1302	61.5	80.6	6.5	10.9		7.3	3
	San Bernard River Tidal	1301	100	100					3
Bays & Estuaries	Barbours Cut	2436				100	100		2
	Bastrop Bay / Oyster Lake ++	2433							4
	Bayport Ship Channel	2438			100	100	100	100	1
	Black Duck Bay	2428			100	100	100		2
	Burnett Bay	2430			69.2	100	100		2
	Cedar Lakes +	2442							
	Chocolate Bay	2432	35.9	86.3			33.0		3
	Christmas Bay ++	2434							4
	Clear Lake	2425		4.3	56.5	56.5	82.3	45.3	2
	Drum Bay ++	2435							4
	East Bay	2423	33.9		100		100		2
	East Matagorda Bay	2441							4
	Lower Galveston Bay	2439			92.8	13.6	92.8		3
	Moses Lake	2431		19.7	52.8		56.8		3
	San Jacinto Bay	2427				100	100		2
	Scott Bay	2429				100	100		2
	Tabbs Bay	2426				48.3	69.5		3
	Texas City Ship Channel	2437			100	100	100		2
	Trinity Bay	2422	13.3	29.1	72.7		88.5		2
	Upper Galveston Bay	2421		7.1	96.9	88.7	87.9		2
	West Bay	2424	9.1	18.0	9.4	4.5	76.3		3
	Gulf of Mexico	2501		26.4				100	4

Chart Key

1 frog
Severe, multiple water quality impairment(s) or concern(s) exist in a majority of the waterbody.

2 frogs
Significant, multiple water quality impairment(s) or concerns exist in the waterbody.

3 frogs
Water quality impairment(s) or concern(s) exist in a substantial portion of the waterbody.

4 frogs
Water quality impairment(s) or concern(s) exist in the waterbody.

5 frogs
No significant water quality impairments or concerns exist in the waterbody.

GETTING BETTER

GETTING WORSE

* Other includes parameters such as metals in water, metals in sediment, impaired habitat, impaired benthic macroinvertebrates, impaired fish communities, sediment toxicity, fecal coliform, mercury in fish tissues and fish consumption

** Frog Chart analysis differs with the TCEQ Integrated Report 2020 due to an updated period of record (6/1/14 - 12/31/20)

\+ This segment was not assessed due to insufficient data.

++ This segment was not assessed for routine parameters, but was assessed for fecal coliform in Oyster Waters

Note: Higher resolution images can be found on the online StoryMap here : https://arcg.is/1qinez

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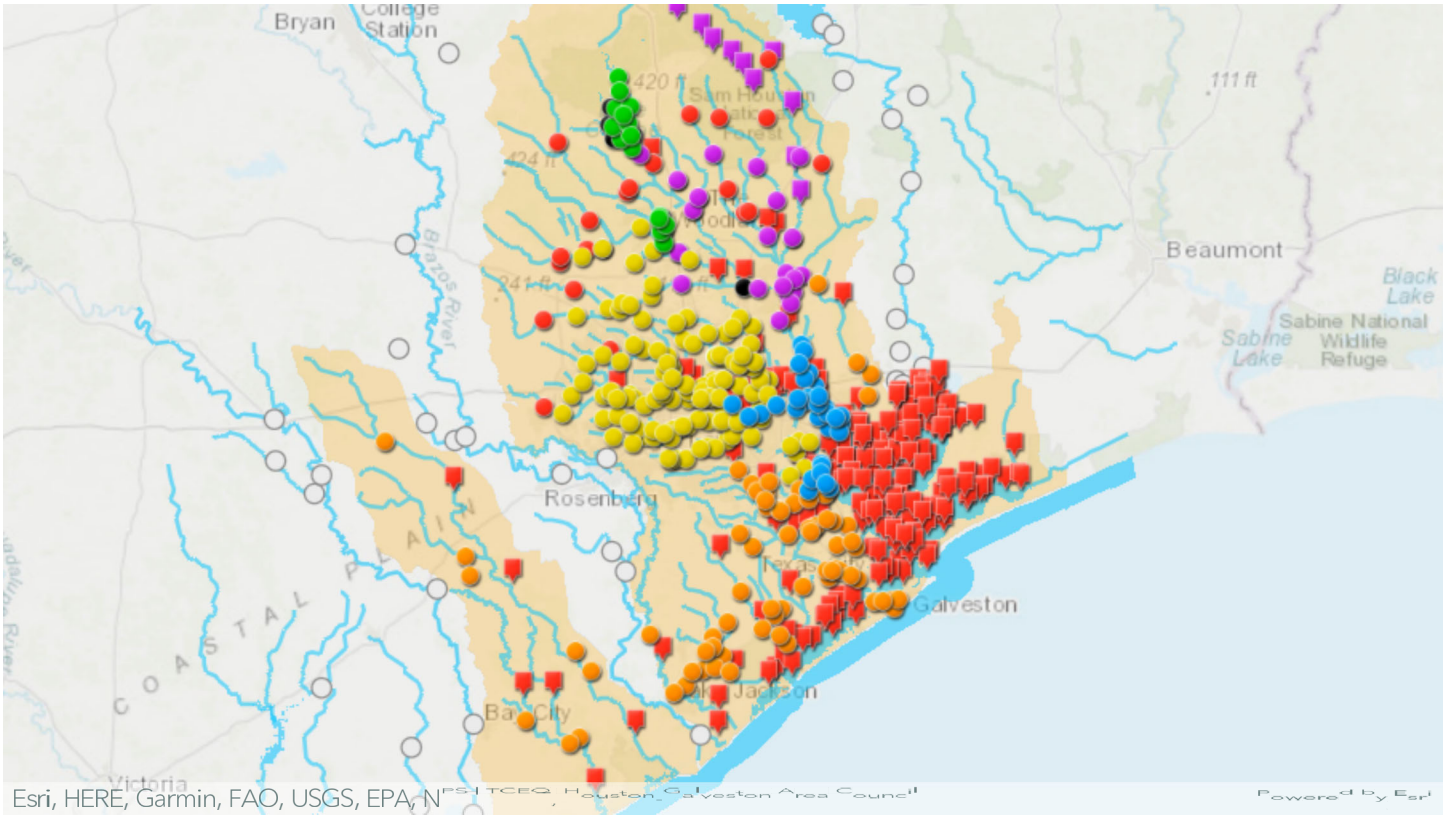
Monitoring Sites for FY2022

The Coordinated Monitoring Schedule is the combined schedule for all surface water quality monitoring in Texas. Monitoring entities within a basin or region meet annually to establish and coordinate monitoring schedules as a way to ensure appropriate coverage, reduce duplication of effort, and better utilize available resources. The Coordinated Monitoring Schedule lists:

- monitoring stations
- collecting entities
- submitting entities
- monitoring type
- parameters
- monitoring frequency



Map 6 - Monitoring Stations for FY 2022

H-GAC's Clean Rivers Program organizes and conducts ambient surface water quality monitoring and assessment in four basins. The FY2022 Coordinated Monitoring Schedule for the H-GAC region includes more than 400 stations located throughout these four basins. Additional 24-hour dissolved oxygen monitoring stations and one new partner, the City of Mont Belvieu, have enhanced the program for FY2022.

The Coordinated Monitoring Schedule is available online at cms.lcra.org.

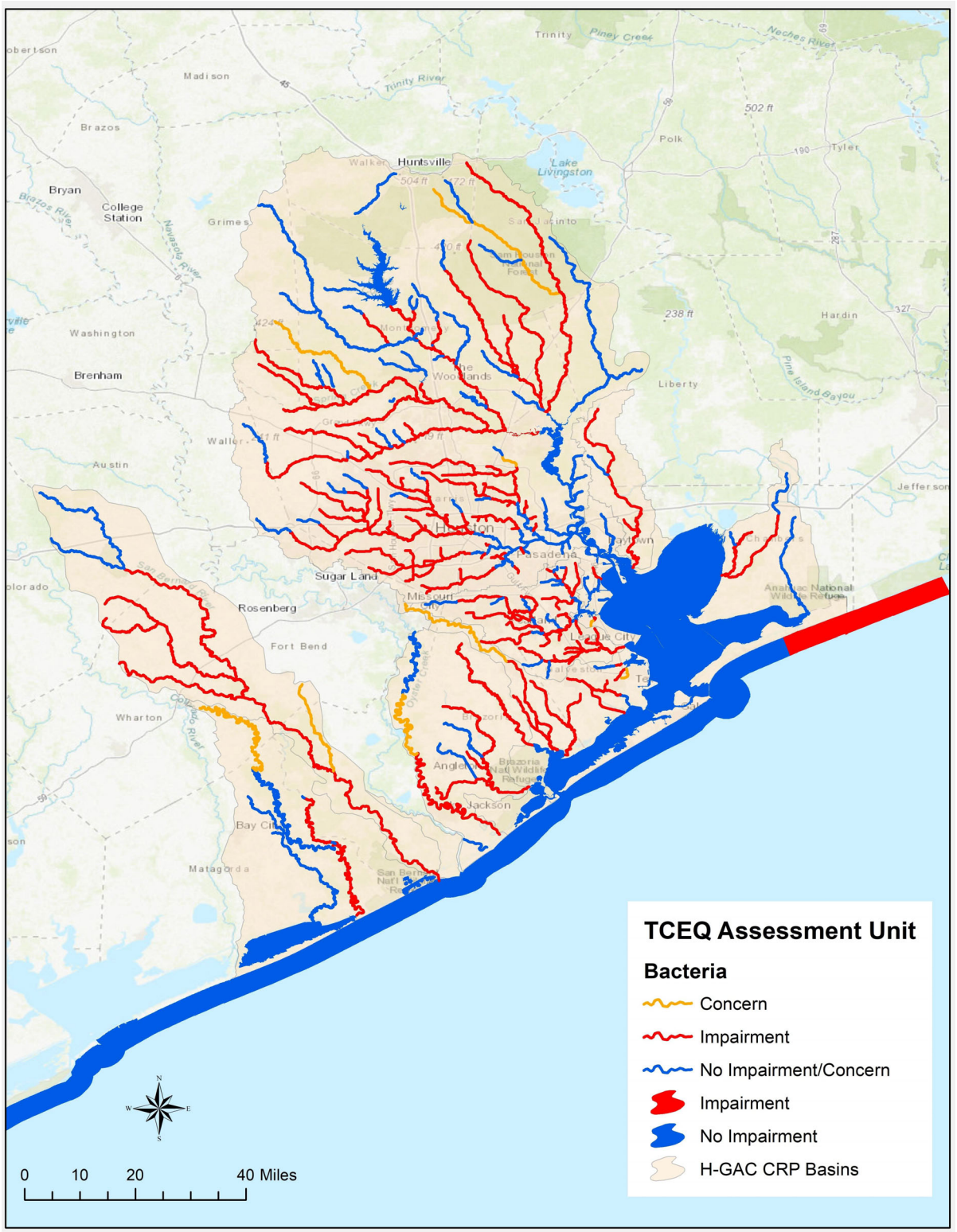
Each shape on the map represents a monitoring station. The shape and/or color designates the entity monitoring at each station. To access data for each of these stations, please visit www.h-gac.com/go/wrim. H-GAC's monitoring program is "cost effective". Reduced duplication of effort, standardized monitoring and laboratory procedures, and improved data management, makes it a model program.

Crystal creek

Changes in Bacteria Impairments

In H-GAC’s 2022 analysis, bacteria results were consistent with the findings of that last Basin Summary Report, which analyzed data from 06/01/2013 – 05/31/2020. Within H-GAC's Clean Rivers Program basins, 19% of the assessment units continue to deteriorate, almost 9% are on an improving trend, and 76% remain stable for bacteria impairments or concerns.

* The bacteria map shows impairments and concerns from the 2020 IR.

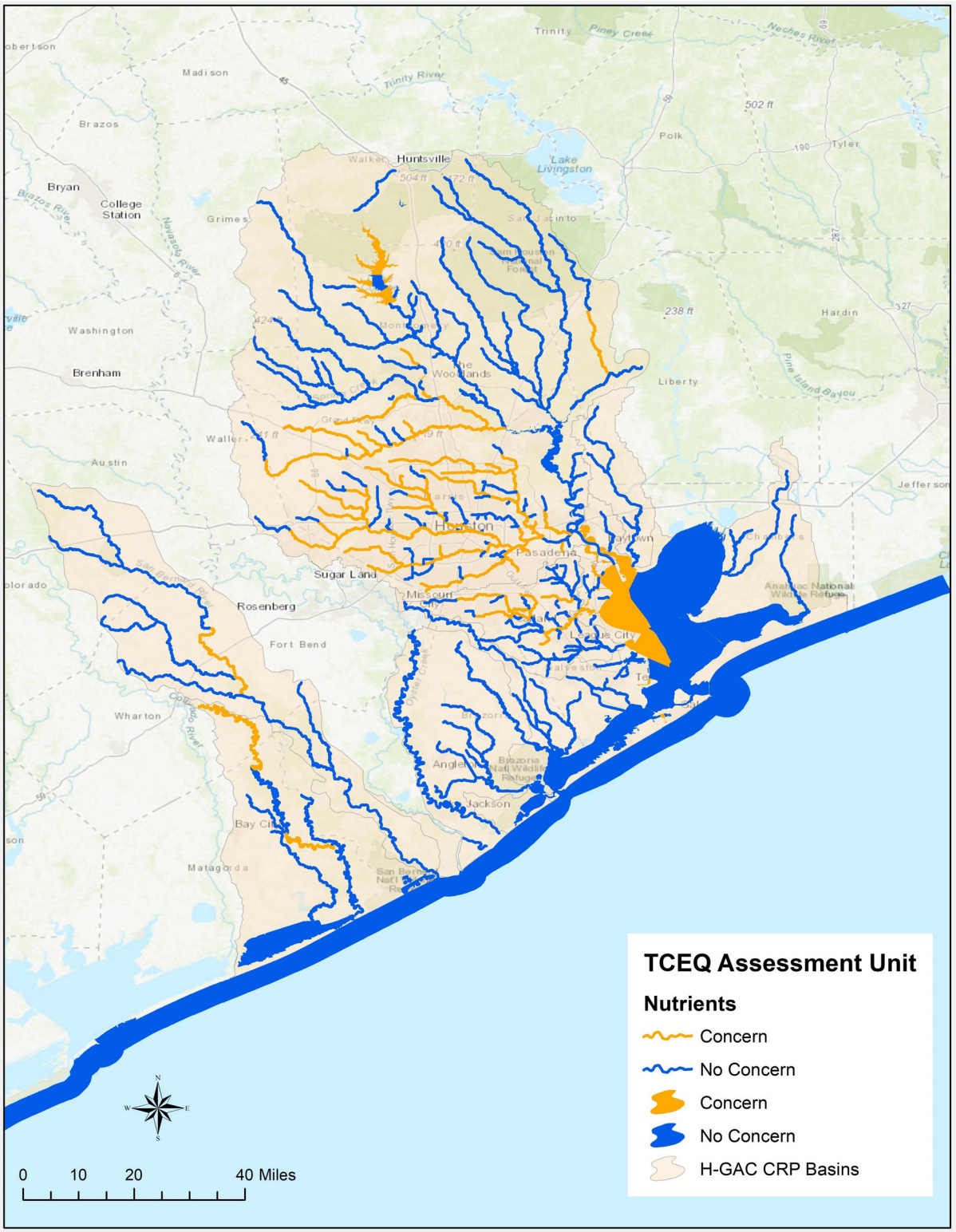


Map 7 - Regional Bacteria Impairments and Concerns, FY 2022

** Note: The percent values reported in this section differ from those reported in other sections of the report as this analysis is based on the assessment unit level, while those reported elsewhere are based on the segment unit level (including Frog Chart results).*

Changes in Nutrient Concerns

While nutrients are generally considered beneficial, especially in a natural environment, an accumulation of too many nutrients (nutrient loading) can be harmful in an aquatic environment. Nutrients such as phosphorus, nitrogen, and chlorophyll-a can accumulate to dangerous levels, thus affecting water cycle dynamics and water quality.



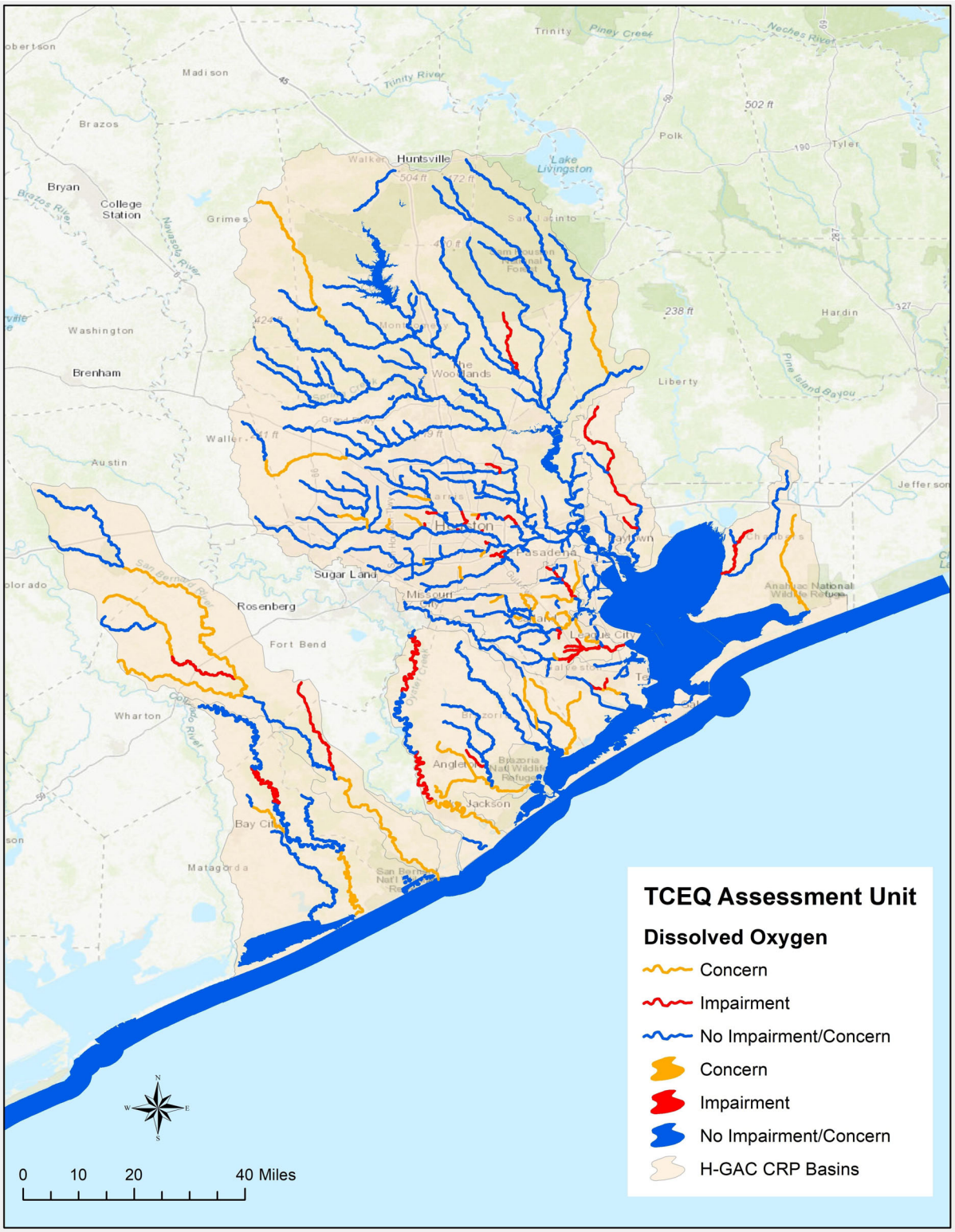
Map 8 - Regional Nutrient Concerns, FY 2022

Within the H-GAC Clean Rivers Program basins, 31% of the assessment units are on a deteriorating trend, 42% are improving, and 27% remain stable.* The nutrient map shows concerns from the 2020 IR.

**Note: The percent values reported in this section differ from those reported in other sections of the report as this analysis is based on the assessment unit level, while those reported elsewhere are based on the segment unit level (including Frog Chart results).*

Changes in Dissolved Oxygen Impairments

Although dissolved oxygen can fluctuate naturally within its environment, most times a concern or impairment exists when the concentration of oxygen gas incorporated in the water is too low to provide support to aquatic animals, plants, or aerobic microbes for their essential processes.



Map 9 - Regional Dissolved Oxygen Impairments and Concerns, FY 2022

Within the H-GAC Clean Rivers Program basins, 13% of the assessment units assessed are on a deteriorating trend, 19% are improving, and 68% are considered stable.* H-GAC's analysis shows that one assessment unit (1016D_01) may no

longer be meeting the water quality standard for dissolved oxygen.

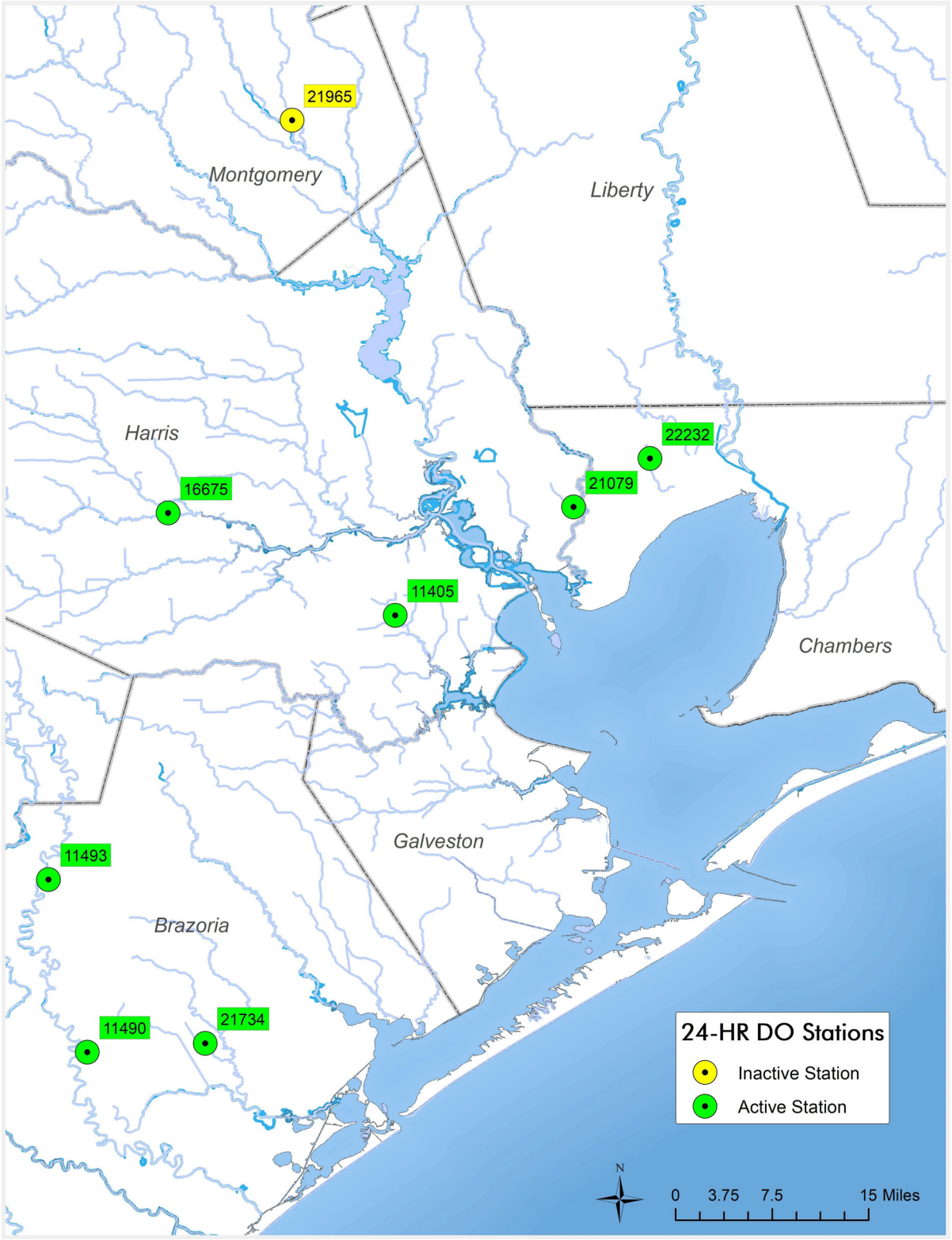
In 2021, an unclassified tributary of Greens Bayou (1016D_01) was on the concern list, while the 2022 analysis found that it is projected to be listed as an impairment moving forward. In fact, this assessment unit has a new impairment for DO in the Draft 2022 IR. However, this change only affects an additional 3.3 stream miles in the region. The DO map shows impairments and concerns from the 2020 IR.

**Note: The percent values reported in this section differ from those reported in other sections of the report as this analysis is based on the assessment unit level, while those reported elsewhere are based on the segment unit level (including Frog Chart results).*

24-Hour Dissolved Oxygen Monitoring

Aquatic Life Use (ALU) designations consisting of exceptional, high, intermediate, limited, and minimal have been established by TCEQ for all segments and many tributaries in the state. These designations are based upon established numerical criteria and are highly dependent on the desired use of the water body, the sensitivities of aquatic communities expected to be found in those water bodies, and the local physical and chemical characteristics of the waterbodies.

One of the criteria is dissolved oxygen, which includes both a 24-hour minimum and a 24-hour average. Routine monitoring generally collects dissolved oxygen grab samples only, which may identify concerns and impairments but must be verified using more intensive testing to determine a 24-hour average.



Map 10 - 24-Hour Dissolved Oxygen Monitoring Stations, FY 2022

H-GAC conducted 24-hour dissolved oxygen monitoring at seven stations before July 2020 and through the first months of FY2022 to determine the extent of their dissolved concern or impairment. Monitoring was conducted at the following sites:

21965 – Spring Branch immediately downstream of Shakey Hollow west of Woodbranch Village in Montgomery County (segment 1010C)

11490 – Oyster Creek immediately downstream of SH 35 West of Angleton (segment 1110)

11493 – Oyster Creek at FM 1462 (segment 1110)

22232 – Cotton Bayou 10 meters upstream of westbound IH-10 frontage road in Mont Belvieu (segment 0801C)

21079 – Cary Bayou immediately upstream of Raccoon Drive bridge in Baytown (segment 0901A)

11405 – Armand Bayou at Fairmont Parkway between bridges (segment 1113A)

16675 – Unnamed tributary of Buffalo Bayou at Glenwood Cemetery Road (segment 1013C)

The map shows the location of the monitoring stations discussed in this section of the report.

Spring Branch at Shakey Hollow Road (originally monitored at FM 242) was monitored through July 2021 to collect more than the minimum 10 events required to allow for a reassessment of conditions in that stream. A total of 19 events were collected on Spring Branch. The original location became inaccessible for monitoring due to bridge construction.

A new station, which is located approximately 5,000 feet downstream of FM 242, was identified and the monitoring was finished to determine if the aquatic life designation is being met. Results indicate the 24-hour dissolved oxygen average was met 17 of the 19 events and all 19 events met the 24-hour dissolved oxygen minimum.

There are two sites (11490 and 11493) being monitored for 24-hour dissolved oxygen on Oyster Creek (segment 1110). Monitoring is planned to continue through August 2022 at which time there should be a total of twelve events collected from each station.

Review of the available data indicates neither the 24-hour dissolved oxygen average or minimum met the standards on a regular basis. TCEQ will need to re-evaluate all the data, including the discharge measurements, to determine the status of the waterway.

24-hour dissolved oxygen monitoring is being conducted on Cotton Bayou, a freshwater stream in Mont Belvieu (segment 0801C) and on Cary Bayou, a tidal stream in Baytown (segment 0901A). Monitoring was initiated in October 2020 and is expected to continue for at least three years.

Through December 2021, five events have been collected from each waterway. Preliminary results look promising for Cotton Bayou with four of five results meeting the 24-hour dissolved oxygen average and five of five events meeting the standard criteria for 24-hour dissolved oxygen minimum. Cary Bayou results look less favorable with the 24-hour dissolved oxygen average and minimum meeting the standard criteria only three of five events.

Armand Bayou (segment 1113A) and an unnamed tributary of Buffalo Bayou in Glenwood Cemetery (segment 1013C) were added to the 24-hour dissolved oxygen monitoring list in the fall of 2021. With only one event collected from each location, the results are mixed. Monitoring will continue until at least 4-6 events at collected from each. At that time, a discussion with TCEQ will determine whether 24-hour dissolved oxygen monitoring will continue through at least the minimum 10 events.

The results of the 24-hour dissolved oxygen monitoring are summarized in Table 3.

Table 3 - 24-Hour Dissolved Oxygen Monitoring Results

Segment Name	Segment Number	Monitoring Station Id	Station Description	Established Aquatic Use Designation	24-Hour DO Average & Minimum Standards (mg/L)	Number of Sample Events	Number of Events Meeting 24-Hour Average	Number of Events Meeting Minimum Standard
Spring Branch	1010C	21965	Spring Branch immediately downstream of Shakey Hollow west of Woodbranch Village in Montgomery County	High	5.0/3.0	19	17	19
Oyster Creek	1110	11490	Oyster Creek immediately downstream of SH 35 West of Angleton	High	5.0/3.0	9	5	6
Oyster Creek	1110	11493	Oyster Creek at FM 1462	High	5.0/3.0	9	2	3
Cotton Bayou	0801C	22232	Cotton Bayou 10 meters upstream of westbound IH-10 frontage road in Mont Belvieu	High	4.0/3.0	5	4	5
Cary Bayou	0901A	21079	Cary Bayou immediately upstream of Raccoon Drive bridge in Baytown	High	4.0/3.0	5	3	3
Armand Bayou	1113A	11405	Armand Bayou at Fairmont Pkwy between bridges	High	5.0/3.0	1	0	1
Unnamed Tributary to Buffalo Bayou	1013C	16675	Unnamed tributary of Buffalo Bayou near Glenwood Cemetery Street	High	5.0/3.0	1	1	0

Note: Higher resolution images can be found on the online StoryMap here : https://arcg.is/1qinez

Clean Rivers Program Training Short Courses

As part of the Monitoring Efficiencies Analysis project, H-GAC's monitoring partners and contractors expressed an interest in additional training opportunities. To address this, in the Fall of 2021 H-GAC initiated a series of short-course training opportunities.

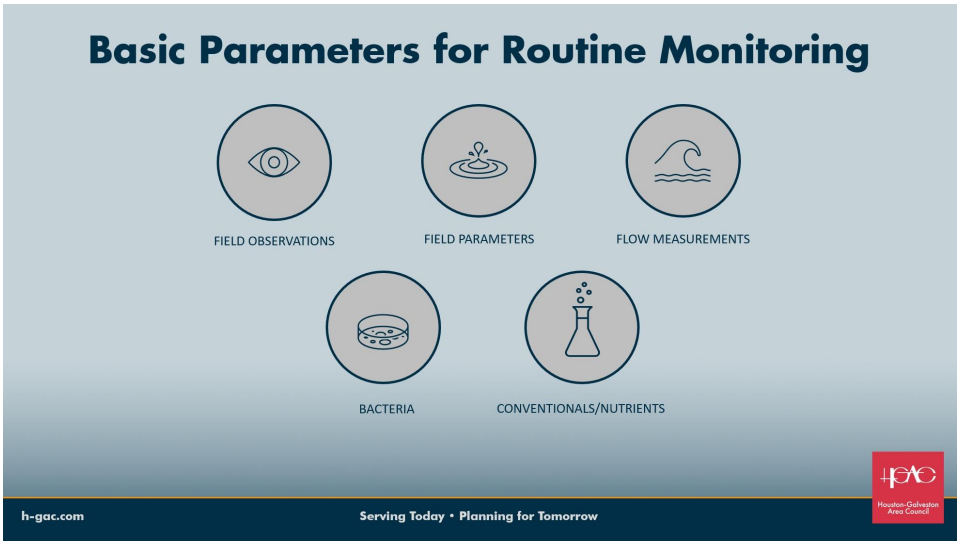


Figure 8 - Example of Clean Rivers Program Training Short Course

These short courses are no more than 30 minutes and are held once per month. These courses are designed to provide a refresher for experienced personnel and additional training for new local monitoring staff. Topics discussed so far include photographic documentation of monitoring events, the proper way to provide and format comments for monitoring events, and the parameters we collect and the interrelationships between those parameters.

Closing Statement

Understanding the health of our area's waterbodies is critical. Routine water quality monitoring is the first step in knowing where water quality problems exist and if conditions are getting better or worse. H-GAC's Clean Rivers Program is one of the most comprehensive water quality monitoring programs in Texas, with the most monitoring stations in the state thanks to in-kind monitoring and laboratory analysis by our network of local partners.

Based on the cost per routine monitoring station, H-GAC's program is also very cost effective. H-GAC has worked with state and local partners to minimize duplication of effort

throughout the region, which has helped streamline the program. H-GAC has also been extremely successful in leveraging Clean Rivers Program monitoring activities to support various other watershed programs such as watershed protection plans and TMDLs.

But monitoring programs alone cannot solve our water quality problems. This water quality information must be communicated effectively to stakeholders. They must work in tandem with other programs to help identify causes and sources of these problems and develop plans to address these issues and improve water quality. This long-standing monitoring partnership continues to provide water quality data to stakeholders and watershed-based planning efforts throughout the region, helping to determine causes and sources of pollution and develop stakeholder driven plans to make improvements.

H-GAC is continually looking for better ways to share information with the public and water resource managers to address these issues. As a stakeholder-driven program, the Clean Rivers Program must continue to pursue, investigate, and help resolve local water quality concerns and priorities. Not only must it continue to collect data, but it must also increase public outreach and education efforts and do more to address sources of contamination with specialized, targeted monitoring.

With increasing population and a continually changing landscape, there will never be a time when we can say we have figured it all out and we have no more water quality problems. Monitoring and assessment will always be a need. Our challenge is to continue to find ways to improve efficiencies and make data and information more available to all that need to see it and use it.

Because, in the end, clean water is essential, and the Clean Rivers Program is essential to clean water.

Note: Higher resolution images can be found on the online StoryMap here : https://arcg.is/1qinez