2023 WATER QUALITY MANAGEMENT PLAN UPDATE

Houston-Galveston Area Council

Texas Commission on Environmental Quality

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FINAL REPORT FOR CONTRACT NO. 582-23-40182

WATER QUALITY MANAGEMENT PLAN UPDATE

Fiscal Year 2023

PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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Prepared by the Houston-Galveston Area Council (H-GAC), in coordination with the TCEQ. This project was funded under a Clean Water Act (CWA) Section 604(b) grant; TCEQ contract number 582-23-40182.

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ACRONYMS AND ABBREVIATIONS

BIG	Bacteria Implementation Group
CCN	Certificate of Convenience and Necessity
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
DMR	Discharge Monitoring Report
ECHO	Enforcement and Compliance History Online
EPA	United States Environmental Protection Agency
FY	Fiscal Year
GBEP	Galveston Bay Estuary Program
GIS	Geographic Information System
GPS	Global Positioning System
H-GAC	Houston-Galveston Area Council
I-Plan	Implementation Plan
MGD	Million Gallons Per Day
MPN	Most Probable Number
MUD	Municipal Utility District
NCTCOG	North Central Texas Council of Governments
NRAC	Natural Resources Advisory Committee
OSSF	On-Site Sewage Facility
PUC	Public Utility Commission of Texas
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCI	Regional Conservation Initiative
SAB	Service Area Boundary
SEP	Supplemental Environmental Project
SSO	Sanitary Sewer Overflow
TCEQ	Texas Commission on Environmental Quality
TMDL	Total Maximum Daily Load
TPDES	Texas Pollutant Discharge Elimination System
TWC	Texas Water Code
TWDB	Texas Water Development Board
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan
WWTF	Wastewater Treatment Facility

DEDICATION

H-GAC lost a dear member of our family when Brian Sims, Senior Environmental Planner and Clean Rivers Program Laboratory Contract Manager, passed away unexpectedly on April 3, 2023. Brian championed the development of our regional Water Quality Management Plan and worked tirelessly to innovate the preparation of this report in more elegant and accessible ways to better serve the stakeholders in the Houston-Galveston region. His talent for conveying his profound knowledge of technical information through well-written and beautifully designed documents was unique among his peers. Brian also managed H-GAC's Homeowner's Wastewater Assistance Program through which he helped dozens of families repair or replace their on-site sewage facilities. He was passionate about upholding the ideals of fairness and justice in our community, and was an active member of the H-GAC Equity and Inclusion Advisory Council.

Beyond his professional excellence, Brian was known for his integrity, generosity, selflessness, and humor by friends and colleagues alike. We are all better people for having known him, and consider ourselves lucky to have worked alongside him. Brian will be deeply missed, and we dedicate this report to his memory in the hopes of upholding his tremendous legacy.

INTRODUCTION

Within the Houston metropolitan region and surrounding counties there are a variety of water quality issues, with elevated levels of bacteria being the most prevalent. Contaminants from both point and nonpoint sources continue to impair the region's streams, rivers, lakes, and bays. To address water quality impairments and concerns and develop and implement watershed-based plans, it is important to have current and accessible data, including geospatial data of regional wastewater infrastructure. Evaluating effluent discharge quality and quantity, as well as the frequency, amounts, and potential causes of unauthorized discharges, is also an important component of planning efforts to address water quality in the region.

H-GAC's Regional Water Quality Management Plan (WQMP) Update helps to address the water quality issues affecting the region by acquiring, compiling, and analyzing water and wastewater data and subsequently making this data accessible to various programs, projects, and stakeholder groups who use the data for planning purposes. The WQMP is updated annually, and these updates are used to guide planning and implementation measures to support current and future efforts and inform decision-makers in their evaluations.

This WQMP Update is a report from H-GAC on the Fiscal Year (FY) 2023 activities conducted under Contract 582-23-40182, with funding through an EPA CWA § 604(b) grant administered by the TCEQ. This report will focus on the progress achieved in the primary task objectives set forth in the Project Scope of Work. These tasks are:

1. Project Administration
2. Quality Assurance
3. Wastewater Infrastructure, Data and Permit Update
4. Conformance Review for Clean Water State Revolving Fund (CWSRF) Projects
5. Support Watershed Planning
6. On-Site Sewage Facility (OSSF) Planning, Coordination, and Outreach Activities
7. OSSF Mapping Tool Expansion Feasibility Study
8. WQMP Coordination
9. Final Report

The H-GAC's WQMP Update Report will become part of the State's WQMP after completion of its public participation process, acceptance by the H-GAC's Board of Directors, and certification by the TCEQ.

PROJECT BACKGROUND

H-GAC is a voluntary association of local governments in the Houston-Galveston region, an area that covers approximately 12,500 square miles and is home to more than 7 million people. H-GAC's service area encompasses 13 counties: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton (**Map 1**). H-GAC is the designated water quality planning agency for the region and is responsible for the development of the regional WQMP.

The annual WQMP Updates are used to guide planning for implementation measures that control and/or prevent water quality problems. The purpose of this WQMP Update is to support current and future planning decisions concerning water quality efforts, wastewater infrastructure development, watershed management, and related issues on both a regional and state level.

Development of the WQMP Update involves acquiring, compiling, and evaluating water and wastewater data, as well as a series of special studies and coordination activities, as requested by the State. The data and information compiled by H-GAC are combined with data from the TCEQ to form a series of integrated data sets to allow for meaningful evaluation of infrastructure and water quality decisions. The CWA § 604(b) grant requires the WQMP to be updated as needed to fill information gaps and to revise earlier approved and certified plans. Any updates to the plan need include only the elements of the plan that are new or require modification. This update revises only the information specifically addressed in the included sections. Previously certified and approved WQMPs remain in effect.

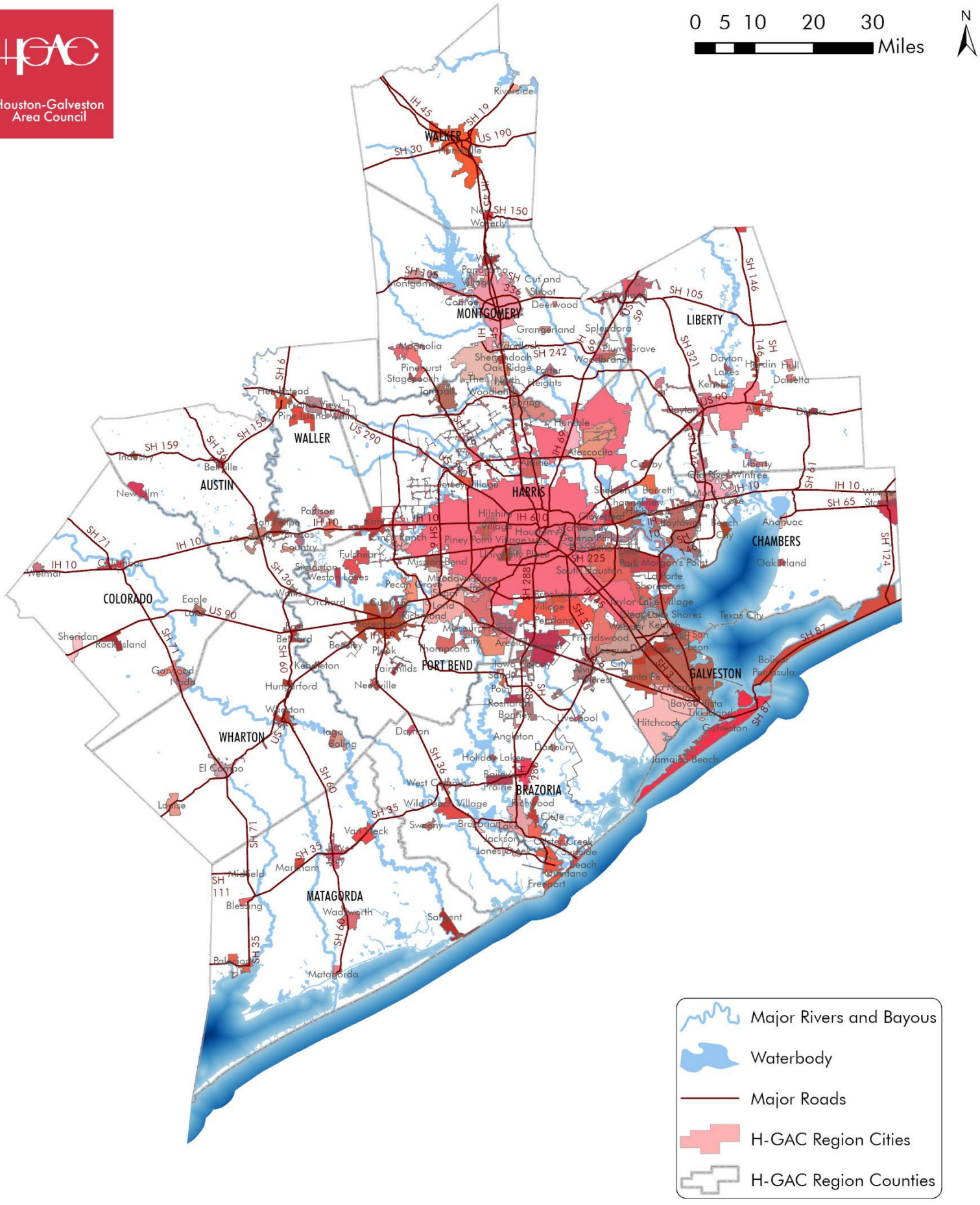
The annual WQMP Update is reviewed by the Natural Resources Advisory Committee (NRAC), a policy and technical advisory committee that advises H-GAC's Board of Directors on issues related to natural resources. Its membership includes diverse representatives from local governments, natural resource management agencies, environmental organizations, and the private sector. An opportunity is provided to both the NRAC and the public to review and submit comments on the WQMP Update before the report is finalized. After review, comments are incorporated into the report to produce the final plan, which is submitted to H-GAC's Board of Directors. Once accepted by the Board, the report is submitted to the TCEQ for review and approval. H-GAC's WQMP Update will become part of the State WQMP after it is certified by the TCEQ.

HISTORICAL WQMP UPDATES

Under previous WQMP projects, H-GAC sought to address aspects of the information and data needs related to water quality issues facing the region. These projects typically have been a mix of both ongoing efforts and short-term special studies. Some of the project efforts have been continuous, such as wastewater data collection and maintenance and development of an online OSSF mapping tool. Other efforts have been stand-alone research relating to specific data needs or questions, such as Geographic Information System (GIS) analyses for infrastructure consolidation, Phase II stormwater permit implementation, and support for the Coastal Communities project. This balance of continuous and stand-alone efforts allows for the long-term accumulation of data while retaining flexibility to address specific issues.

The ongoing efforts in the FY 2023 WQMP project focused on:

- Updating and improving existing regional wastewater infrastructure databases (wastewater treatment facility (WWTF) outfalls and service area boundaries (SABs))
- Improving spatial datasets of potential unpermitted OSSF locations using 9-1-1 addressing,
- Support of local watershed-based plans,
- Coordination and public outreach in support of a Supplemental Environmental Project (SEP) to repair or replace failing OSSFs within the region, and
- Outreach and education related to H-GAC's OSSF Mapping Tool



Map 1. H-GAC Regional Map

PROJECT SIGNIFICANCE

Already one of the largest metropolitan statistical areas in the United States, the Houston-Galveston region continues to grow at a rapid pace, resulting in a proportional increase in population growth and land development. Development, and its accompanying utility infrastructure, continues into counties beyond the urban core. Existing water and wastewater infrastructure systems continue to age and face challenges related to drought and flooding events. With the region expected to gain several million additional residents by 2040, these challenges will only be exacerbated in the future.

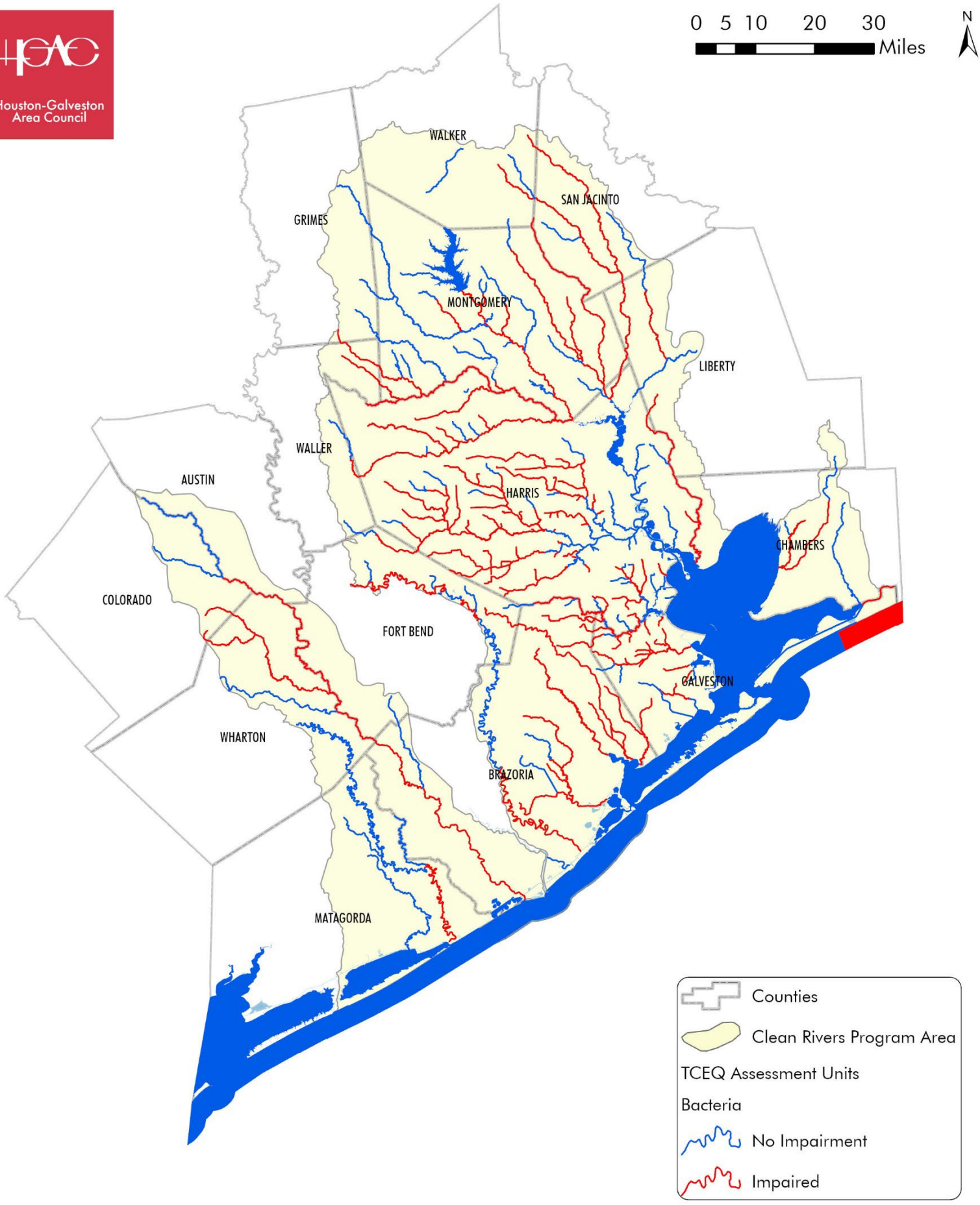
Within the region, there are a variety of water quality impairments and concerns. The majority of stream segments in the region fail to meet the criteria as defined in the *Texas Surface Water Quality Standards*. Many of those water bodies are listed with impairments or concerns in the 2022 *Texas Integrated Report of Surface Water Quality*. Approximately 80 percent of the region's streams are unable to meet one or more state water quality standards, with the most pervasive issue being elevated bacteria levels in exceedance of the primary contact recreation standard (Map 2). The bacteria in the region's lakes, creeks, streams, and bayous come from a variety of sources, including human waste, domestic animal waste, pet waste, and wildlife. These wastes may enter the water through point sources (discrete "end-of-pipe" discharges, such as wastewater effluent) or diffusely through nonpoint sources, carried by precipitation runoff flowing over the land. While some bacteria are naturally occurring, development brings additional bacterial sources and a greater potential impact to water bodies. Careful planning is necessary to address these additional sources.

In addition to the identified water quality issues, numerous developmental challenges exist in the region as well. The wastewater infrastructure that serves the region's increasing population has expanded and developed much like the region itself. As the population has expanded and spread into less urban areas, there has been a proliferation of smaller sized WWTFs and the creation of a diffuse network of infrastructure to provide utility service to this population. This is partially due to the area's flat topography, as larger centralized WWTFs would require a significant number of costly lift stations to consolidate flow. Due to the availability to fund infrastructure through political subdivisions like Municipal Utility Districts (MUDs) and other special districts, many areas of the region have a wastewater treatment network that is relatively widespread rather than limited by the bounds of a traditional, centralized model. Development through this model has created a patchwork of wastewater infrastructure, which offers both future challenges and opportunities for local decision-makers.

One of the primary objectives of this WQMP is to collect and analyze data related to wastewater infrastructure in the region. Wastewater infrastructure is a potential contributor of bacteria into area waterways through improperly treated effluent discharges, or through sanitary sewer overflows (SSOs) from the treatment facilities or throughout the collection

systems. Self-reported data from WWTF Discharge Monitoring Reports (DMRs) and SSO violation reports can be analyzed to better evaluate the potential impacts these sources have on bacteria impairments throughout the region. As the population continues to increase at a rapid pace and the infrastructure continues to age, the integrity of these treatment and collection systems may be harmed. It is important to continuously monitor these systems over time to ensure decision-makers and water resource managers have the necessary information to implement best management practices, repairs, or system replacements in areas with the most need.

The population is expected to continue to rapidly grow in the coming decades, and the ability to make informed decisions regarding water quality and wastewater infrastructure development will be crucial in planning for the region's future. The accumulation, maintenance, and analysis of regional wastewater and effluent quality data can help inform regional solutions to water quality issues.



Map 2. Regional Bacteria Impairments (from the 2022 *Texas Integrated Report of Surface Water Quality*)

In areas that are not served by a sanitary sewer collection system, which includes a sizable portion of the region, wastewater is treated through use of decentralized OSSFs, such as aerobic treatment units or conventional septic systems. These OSSFs collect, treat, and disperse wastewater generated by a home or business at the site where it was generated (hence the name "on-site"). The use of an OSSF is allowable to treat up to 5,000 gallons of wastewater per day. For volumes above that threshold, a wastewater discharge permit from TCEQ is required.

When properly designed, sited, and maintained, these systems are an effective form of wastewater treatment. However, if an OSSF fails, which can occur for numerous reasons (improper design, system overload, improper operation, mechanical failure, lack of proper maintenance, etc.), it can contribute to groundwater or surface water contamination through the release of untreated or partially- treated wastewater.

One of the primary objectives of the WQMP is to maintain a geospatial database of permitted OSSFs and an estimation of the number and locations of unpermitted OSSFs. Typically, these unpermitted OSSFs are those "grandfathered" systems that were installed prior to 1989, when the State began requiring that these systems be permitted. For the FY 2023 WQMP Update, H-GAC developed a new methodology using 9-1-1 addressing for estimating the potential locations of these unpermitted systems.

From a regional perspective, the water quality and wastewater infrastructure decisions facing the region are more effectively considered on a watershed basis, as contaminants do not adhere to political boundaries along waterways. This is particularly important for watersheds that serve as significant sources of drinking water, such as Lake Houston. H-GAC maintains a large store of relevant and accessible data to provide useful information, analysis, and viable recommendations. The data collection and analysis tasks completed under this WQMP Update project have significant value for a variety of efforts in the region, such as the development of watershed protection plans (WPPs) and Total Maximum Daily Loads (TMDLs) to address known water quality issues in local waterways.

HOW DOES H-GAC UTILIZE THE DATA ACQUIRED THROUGH THE WQMP PROJECT?

Internal Data Collection and Regional Data Sharing

The wastewater permit data, SABs, and OSSF location data acquired under this WQMP Update project serve to augment existing data sets, inform project decisions on related efforts, and expand internal capabilities of both the H-GAC and TCEQ to incorporate and produce future data and analyses. For example, WQMP acquired data were used by the Houston-area Bacteria Implementation Group (BIG), Basins 11 and 13 TMDL efforts, the Galveston Bay Estuary Program (GBEP), the Clean Rivers Program, and others.

Regional Project Coordination

Maintaining and expanding data resources allows the H-GAC and TCEQ to better understand and facilitate regional coordination between parties involved in wastewater infrastructure decisions and general water quality/watershed protection efforts. Participation in regional groups and coordination efforts helps ensure decisions benefit from the resources compiled under the WQMP. More examples of the uses for data acquired through the WQMP are listed in **Table 1**.

Table 1. Uses for Data Acquired through the WQMP

Source Water Protection	CWSRF Project Review	Education and Outreach
A large portion of the region's population is served by treated surface water originating in local rivers and lakes. The infrastructure planning and watershed coordination activities of this WQMP Update project help foster a greater understanding of the relationship between water quality issues and steps to help protect drinking water sources.	Data and analyses allow H-GAC staff to assist state and federal granting agencies in the review of regional grant applications. These reviews ensure potential projects concur with regional priorities and regional data projections.	Data gathered under this WQMP Update project have been used as a focal point or basis for several education efforts, including the OSSF location database and various facilitated meetings, such as the ongoing NRAC.

PROJECT TASK OBJECTIVES

The WQMP Update is a report from H-GAC on the FY 2023 activities conducted under Contract 582-23-40182, with funding through a CWA § 604(b) grant by the U.S. EPA and administered through the TCEQ.

This WQMP Update report focuses on the progress achieved in the Task Objectives set forth in the Project Scope of Work. The Task Objectives for this project are:

1. Project Administration
2. Quality Assurance
3. Wastewater Infrastructure, Data and Permit Update
4. Conformance Review for CWSRF Projects
5. Support Watershed Planning
6. OSSF Planning, Coordination, and Outreach Activities
7. OSSF Mapping Tool Expansion Feasibility Study
8. WQMP Coordination
9. Final Report

This WQMP Update Report, the contract deliverable for Task 8, will focus on the data acquisition and analysis performed under Tasks 3 to 7. Project-related tasks (Tasks 1 and 2) will be discussed in a separate Project Final Report (Task 9). A description of each project task is provided in **Table 2**.

Each of the primary data acquisition and analysis Task Objectives serves to maintain, expand, or implement H-GAC's store of water quality and wastewater infrastructure data. Each Task Objective is described in a separate section of the WQMP Update report, and includes methodologies, results and observations, and discussion (as appropriate). Some of the deliverables generated for this project are large electronic data sets unsuitable for full inclusion in a printed version of this Final Report. However, copies of the full electronic data are available, with representative portions of the data included in this report.

For some analyses presented in this report, such as the WWTF outfalls, a 15-county area (to include Grimes and San Jacinto counties) is considered due to the location of watersheds of interest. These counties are included in the area monitored by H-GAC as part of its ambient surface water quality monitoring program (known as the Clean Rivers Program).

Table 2. WQMP Project Task Objective Descriptions, FY 2023 Workplan

Task	Objective	Description
1	Project Administration	To administer, coordinate, and monitor all work performed under this project including technical and financial supervision and preparation of status reports.
2	Quality Assurance	To refine, document, and implement data quality objectives and quality assurance/quality control (QA/QC) activities that ensure data of known and acceptable quality are generated by this project. This task includes reviews, revisions, and updates to the Quality Assurance Project Plan (QAPP).
3	Wastewater Infrastructure, Data and Permit Update	To collect and integrate wastewater infrastructure and permit data to support planning for WWTFs and water quality projects in H-GAC's region, and to support TCEQ in their WQMP Update process.
4	Conformance Review for CWSRF Projects	To review and provide input on CWSRF loan applications in H-GAC's region and ensure conformance with the latest WQMP.
5	Support Watershed Planning	To support watershed planning and sharing of regional information on water quality and related topics in H-GAC's region.
6	OSSF Planning, Coordination, and Outreach Activities	To administer and coordinate H-GAC's OSSF program activities. These activities include maintaining and continuing to develop H-GAC's existing spatial database of permitted OSSFs and projected unpermitted OSSF locations. These activities will provide coordination in support of an existing SEP to repair or replace failing OSSFs within the watershed, coordinate regional water quality and wastewater infrastructure projects, and provide outreach and educational activities.
7	OSSF Mapping Tool Expansion Feasibility Study	To determine the feasibility and interest of using H-GAC's current OSSF Mapping Tool to host OSSF data from an interested partner, specifically North Central Texas Council of Governments (NCTCOG), with the purpose to provide a repository for OSSF permit data for use in watershed-based planning activities by the partner. As part of the NCTCOG Scope of Work Subtask 3.4 in this Work Plan, NCTCOG plans to determine the feasibility of aligning NCTCOG's OSSF inventory and spatial dataset with the existing approach already in use in the Houston-Galveston region. This will assist partners and H-GAC to better target additional programs and tasks towards disadvantaged communities and vulnerable populations.
8	WQMP Coordination	To provide TCEQ with a comprehensive report on water quality management planning activities for the Gulf Coast region as well as documentation that H-GAC's Board of Directors has accepted the FY 2023 Final WQMP Update Report.
9	Final Report	To produce a Final Report that summarizes all completed activities and conclusions reached during the project. The Final Report will discuss the extent to which project goals and purposes have been achieved. The Final Report should emphasize successes, failures, and lessons learned. The Final Report will summarize all the Task Reports either in the text or as appendices.

WASTEWATER INFRASTRUCTURE, DATA, AND PERMIT UPDATE

The goal of this Task is to collect and integrate wastewater infrastructure and permit data to support planning for WWTFs and water quality projects in the Houston-Galveston region and to support TCEQ in their WQMP Update process. The primary components of this task are:

- Wastewater Infrastructure Data Update
- Wastewater DMR Data Analysis

The acquisition and analysis of data collected under this task adhered to approved QAPPs and QA/QC methods.

WASTEWATER INFRASTRUCTURE DATA UPDATE

For the Wastewater Infrastructure Data Update task, H-GAC acquires data and updates the SABs and related permitted domestic wastewater outfalls for the region's wastewater collection and treatment facilities. The annual updated GIS map layers include the boundaries of the wastewater collection systems within the region and the geographic location of WWTF outfalls.

To update the WQMP, H-GAC utilizes a series of data sets related to the Texas Pollutant Discharge Elimination System (TPDES)-permitted wastewater facilities in the region. These are the SAB data set and the Wastewater Outfalls data set. A primary task under this Project is to update and continue to integrate these data sources.

To approach this task, H-GAC set out to address the following questions:

- Is there a corresponding SAB for every domestic outfall?
- What are the differences between the current and previous outfall locations for current domestic permits?
- Are there any data errors that need to be reported to TCEQ?

Wastewater Outfall GIS Layer Update

The wastewater outfall layer is maintained by TCEQ. This GIS layer identifies the location of TPDES-permitted WWTF outfalls for the state. Each year, as part of the WQMP Update process, H-GAC acquires an updated wastewater outfalls GIS data set from TCEQ. The Wastewater Outfalls data were acquired from TCEQ's using their GIS website[1].

[1] https://gis-tceq.opendata.arcgis.com/datasets/wastewater-outfalls/explore

The data for this year's report were acquired on 2/28/23.

For this Project, H-GAC examined the domestic wastewater outfalls in the 15-county region for the period of 1/1/22 to 12/31/22. In the metadata for the GIS layer provided by TCEQ, the outfalls are classified with descriptors. The outfalls examined for this project include those categorized as "D" or "W" in the data dictionary. The "D" category represents domestic outfalls at <1 millions of gallons per day (MGD) domestic sewage. The "W" category includes wastewater outfalls ≥1 MGD domestic sewage or process water, including WWTF discharge.

As the focus of this analysis is on domestic discharges, the "D" category was automatically included in H-GAC's evaluation. To determine which facilities in the "W" category were domestic and which were industrial, the permit numbers were queried using TCEQ's water quality permit registry[2].

Permits in the "W" category identified as Public Domestic Wastewater or Private Domestic Wastewater were included in the domestic wastewater outfall layer. Industrial discharges were excluded from analysis, as these are tied to a single location and not a traditional SAB.

SAB GIS Layer Update

The SAB data set is a GIS layer maintained by H-GAC. This file contains a spatial representation of the SABs of the permitted domestic wastewater dischargers in the region. Typically, these boundaries include municipalities, MUDs, Water Control and Improvement Districts, other public districts, and private utilities that serve an area greater than a single facility. Industrial permittees are not included in the SAB data set as these dischargers typically only serve a single facility.

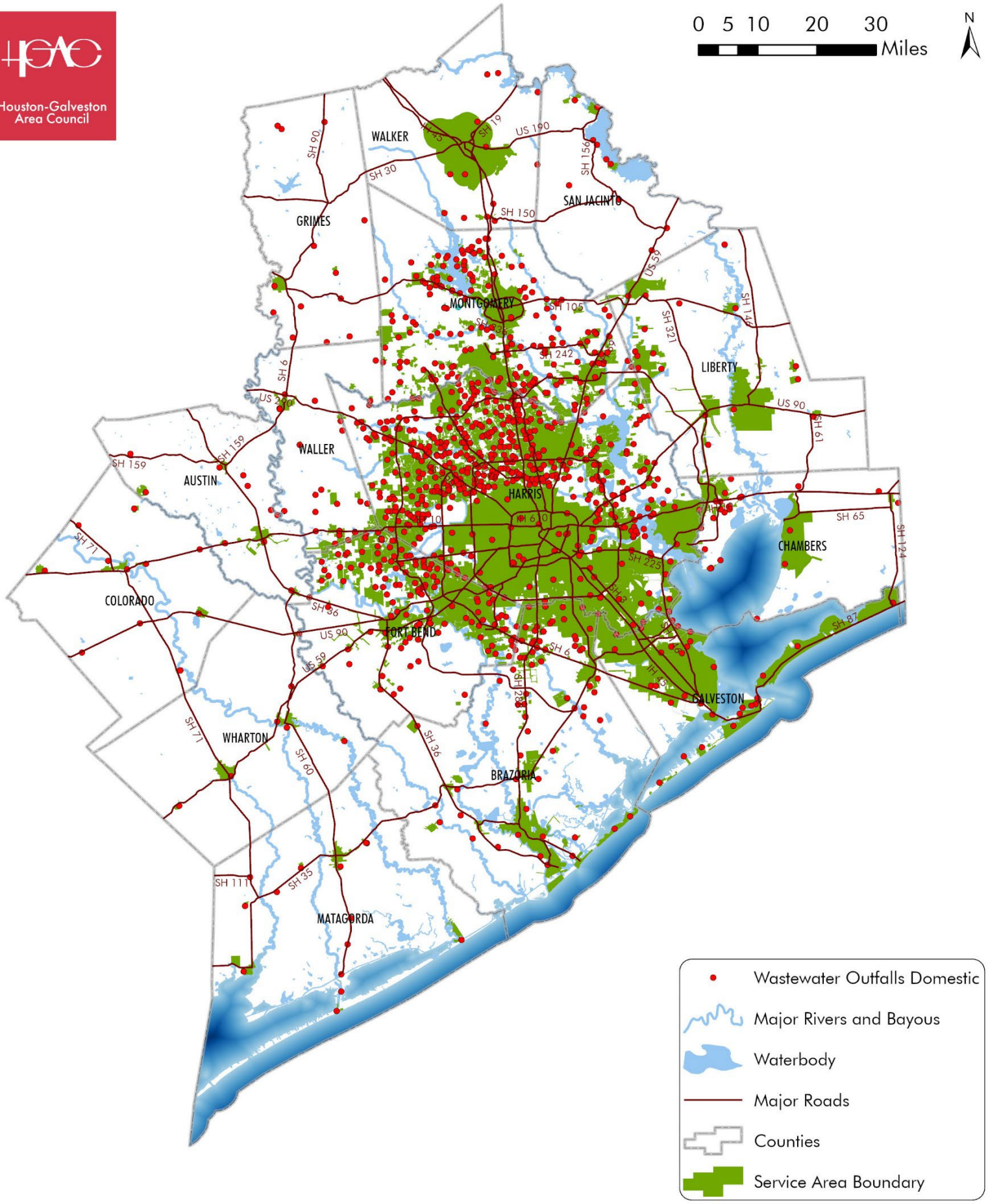
H-GAC utilizes data from multiple sources (MUD records, EPA and TCEQ permit databases, etc.) to update the SAB and outfall layer data sets. In addition, H-GAC also utilized the Public Utility Commission of Texas' (PUC) Certificates of Convenience and Necessity (CCN) data set to match outfalls to SABs. A CCN grants the holder the exclusive right to provide retail water and/or sewer utility service to a defined geographic area. If a CCN is issued, it may serve as a proxy for the SAB, as the CCN holder is required to provide continuous and adequate service within its CCN boundary.

A manual review of the GIS outfall layer and SABs was performed to identify outfalls without an associated SAB. To address small private systems without an associated SAB, and to help develop boundaries for these systems, the SAB data set was compared to other sources of boundary data, such as city boundaries and the CCNs available through the PUC. These city boundaries and CCNs can serve as proxies for the SAB until H-GAC staff can receive verification from these individual entities. These proxy boundaries were added to the SAB GIS layer.

[2] https://www6.tceq.texas.gov/wqpaq/index.cfm

Updated data sets were submitted to TCEQ in digital format with this report. These data sets created under this project are listed in Appendix A. These data are too large to include in the report, but are available upon request.

The SABs alongside the domestic outfalls locations are shown in **Map 3**. The new Outfalls and SAB GIS layers will be used to inform other programs and projects, such as the Clean Rivers Program, the BIG, and various TMDL and WPP projects.



Map 3. Domestic Wastewater Outfalls and SABs, 2022

WASTEWATER DMR DATA ANALYSIS

The Wastewater DMR Data Analysis for this project involves the acquisition and analysis of self-reported discharge monitoring data for regional permitted facilities. The WQMP Update specifically evaluates bacteria discharges, but other constituents may be evaluated if a water body-specific or facility-specific need is identified, or if requested by stakeholders.

As part of the analysis for the WQMP Update, H-GAC acquired self-reported DMR data for permitted facilities through TCEQ and EPA to evaluate bacteria permit limit exceedances for the period of 2018 to 2022.

As defined in the *Texas Surface Water Quality Standards*, the *Escherichia coli* (*E. coli*) geometric mean criterion for primary contact recreation for ambient surface water is 126 most probable number (MPN) per 100 milliliters (mL), and 399 MPN/100 mL for single grab samples. For enterococci, which is the designated indicator organism for tidal segments, the criterion for the geometric mean is 35 MPN/100 mL, with a single sample criterion of 89 MPN/100 mL. TCEQ does not apply the single sample criterion for their assessment. In most cases, these standards are generally applied as an effluent permit limit for WWTFs. In the region, the majority of TPDES permits have effluent limitations set for *E. coli*. However, some permits have enterococci as the indicator organism where the effluent is discharged into tidal waters. Select WWTFs may have more stringent bacteria permit limits depending on site-specific conditions or participation in TMDL projects such as the BIG.

Effluent discharges from WWTFs are regulated by TCEQ, with water quality limits specified in each discharger's permit. Both TCEQ and Harris County Pollution Control Services perform effluent monitoring for compliance with water quality permits through their inspection and enforcement programs. These effluent discharge limits are also monitored by WWTF personnel on a frequency dependent on facility size, location, wastewater type (domestic or industrial), and other factors. Results from field measurements (pH, dissolved oxygen, instantaneous flow, etc.) and laboratory analyses (biochemical oxygen demand, total suspended solids, ammonia, etc.) from these required monitoring events are submitted to the TCEQ monthly as a DMR.

Evaluating trends in permit exceedances for indicator bacteria is important in understanding the impact WWTFs may have on overall surface water quality. DMRs are the most comprehensive data available for the broad regional evaluations conducted under the WQMP Update, even though there are some inherent uncertainties. As with any self-reported data, there is an expectation that some degree of uncertainty or variation from normal conditions may occur. Additionally, samples are collected at the weir and not at the end of the outfall pipe, so results generated do not take into account potential bacterial regrowth in the outfall pipe.

The data acquired under this task continues to be widely used by local projects and entities. Water quality protection efforts, including the various WPPs, TMDLs, and the Clean Rivers

Program, use the data to guide and inform planning decisions.

For this project, H-GAC staff evaluated the occurrence of self-reported bacteria violations through domestic WWTF DMRs in the region for the period of 2018 to 2022. Evaluations were based on the regulatory permit limits specific to each facility and consider the number of exceedances and bacteria loadings by year and by WWTF size. The data analyzed for this project are self-reported by WWTFs.

DMR data for this analysis were acquired from EPA's Enforcement and Compliance History Online (ECHO) ICIS- NPDES Permit Limit and Discharge Monitoring Datasets webpage[3] on 2/21/23.

Additional wastewater permit limit data was acquired from TCEQ's Permit Application and Registration Information Systems (PARIS) database[4] on 4/12/23.

The acquisition and analysis of wastewater DMR data and effluent permit limit data adhered to updated QAPPs and QA/QC methods.

Permitted Outfalls in the Region

The number of permittees can change from year to year, and multi-year comparisons are based on the current wastewater outfall GIS layer. Therefore, slight variations may be present from the data presented in this report and previous or subsequent reports. Differences between the TCEQ and EPA data sets are likely due to new permits approved by TCEQ but not yet entered into the EPA Registry. The data presented in this report are accurate as of the date the data were acquired, but previous or subsequent data could be slightly different based upon the number of outfalls present at the time of that data acquisition.

Based on the GIS data acquired from TCEQ, there are 1,363 permittees in the TCEQ Outfall Layer for 2022, with the EPA Registry showing 1,299 permittees (**Table 3**). For 2021, there were 1,262 permittees in the TCEQ Outfall Layer and 1,259 in the EPA Registry. Compared to the 2021 data set, there was an increase of 101 permittees in the TCEQ Outfall Layer and 40 permittees in the EPA Registry for 2022. Of the permittees in the EPA Registry, self-reported DMR data (of any type) were submitted in 2022 for 1,026 outfalls, with bacteria data being submitted for 899 of the outfalls.

[3] https://echo.epa.gov/tools/data-downloads/icis-npdes-dmr-and-limit-data-set
[4] https://www6.tceq.texas.gov/wqpaq/index.cfm?fuseaction=home.AdvanceSearch

Table 3. Wastewater Permittees in the Houston-Galveston Region, 2021 and 2022

WWTF Type	Number of Permittees 2021	Number of Permittees 2022	Difference
Permittees in the TCEQ Outfall Layer	1,262	1,363	101
Permittees in the EPA Registry	1,259	1,299	40
Permittees submitting DMR data (any type)	1,004	1,026	22
Permittees submitting DMR bacteria data	890	899	9

A summary of the WWTFs submitting DMR data in 2021 and 2022 is provided in **Table 4**. Of the permittees submitting bacteria DMR data in 2022, 819 are domestic WWTFs, and 207 are industrial facilities.

The number of permittees (all WWTF types) submitting DMR data increased from 1,004 in 2021 to 1,026 in 2022 (**Table 4**). The number of permittees submitting bacteria data increased from 890 to 899. For the domestic WWTFs in 2022, 815 submitted DMR data, and 84 industrial facilities submitted bacteria data.

Table 4. Permittees Submitting DMR Data, 2021 and 2022

WWTF Type	Permittees Submitting DMR Data (any type) in 2021	Permittees Submitting DMR Bacteria Data in 2021	Permittees Submitting DMR Data (any type) in 2022	Permittees Submitting DMR Bacteria Data in 2022
Domestic	803	801	819	815
Industrial	201	89	207	84
TOTAL	**1,004**	**890**	**1,026**	**899**

The subsequent analyses presented in this report pertain to the domestic WWTFs, as these provide wastewater treatment for a defined service area, unlike an industrial facility that provides treatment for a single location. In order to determine permit exceedance rates, analyses only consider those results from WWTFs with a permit limit. If a facility reports results but has no established effluent permit limit, those results are not included in the analyses.

For many of the analyses in this report, WWTFs are evaluated on relative facility size, as categorized by daily flow in MGD. Those facility size categories and the number of facilities per category are shown in **Table 5**.

The total number of dischargers submitting bacteria DMR data shown in **Table 4** (899 WWTFs) differs from that in **Table 5** (913 WWTFs) due to a difference in the time frame the data represent. The data in **Table 4** show that total of 899 permittees submitted bacteria DMR data in 2022. The total number of facilities reporting bacteria DMR data shown in **Table 5** (913) are calculated using data from 2018 to 2022 so permit exceedance rates by year and facility size can be determined.

Table 5. Number of WWTFs Reporting Bacteria DMR Data by WWTF Relative Facility Size

WWTF Facility Size by MGD	Number of Facilities, 2018 to 2022	Percentage of Facilities
Variable/Intermittent	67	7.34%
<0.1 MGD	276	30.23%
0.1 to 0.5 MGD	223	24.42%
0.5 to 1 MGD	143	15.66%
1 to 5 MGD	149	16.32%
5 to 10 MGD	34	3.72%
>10 MGD	21	2.30%
TOTAL	**913**	**100.00%**

Within the region, the largest number of WWTFs are in the <0.1 MGD category (30.23% of facilities) followed by those in the 0.1 to 0.5 MGD category (24.42% of facilities). Combined, these two categories represent over half of the permitted domestic facilities submitting bacteria data in the region. Considering regional growth patterns and the proliferation of MUDs and other special districts, it is expected that the number of these smaller facilities would be very high in the region. WWTFs in the >10 MGD category represent the smallest group, at 2.30% of all facilities.

Bacteria DMR Data Analysis and Permit Exceedances

In 2022, WWTFs within the Region self-reported a combined 8,661 bacteria geometric mean results and 8,843 bacteria daily maximum/single grab sample results. These records include only those outfalls with permit limits. Facilities that test and report data but do not have a permit limit are not included in these numbers. The number of reported results by year (2018 to 2022) are shown in **Table 6** and **Table 7**.

Table 6. Bacteria DMR Data Permit Geometric Mean Samples by Year

Bacteria Parameter	2018	2019	2020	2021	2022
E. coli	6,624	7,031	7,134	7,261	7,414
Enterococci	1,068	1,144	1,216	1,253	1,247
TOTAL	**7,692**	**8,175**	**8,350**	**8,514**	**8,661**

Table 7. Bacteria DMR Data Permit Daily Maximum/Grab Samples by Year

Bacteria Parameter	2018	2019	2020	2021	2022
E. coli	6,902	7,155	7,277	7,418	7,575
Enterococci	1,094	1,162	1,228	1,267	1,268
TOTAL	**7,996**	**8,317**	**8,505**	**8,685**	**8,843**

Of these reported results for 2022, 70 of the geometric mean results (0.81%) and 242 of the daily maximum/single grab sample results (2.74%) exceeded permit limits (**Table 8**). Overall, there is a 99.19% compliance with geometric mean permit limit results, and a 97.26% compliance for daily maximum/single grab sample results for effluent monitoring samples reported in 2022.

Table 8. Bacteria DMR Data Reported and Permit Exceedance Rates, 2022

Bacteria Data Reported	Geometric Mean Results	Daily Maximum / Single Grab Sample Results
Total Results Reported	8,661	8,843
Total Exceeding Limit	70	242
Percent Exceedance	0.81%	2.74%
Percent Compliance	99.19%	97.26%

Geometric mean and single grab bacteria effluent reporting and compliance data for 2022 were also evaluated by relative facility size. The data in **Table 9** and **Table 10** show the number of geometric mean and daily maximum/single grab sample results reported, the number exceeding permit limits, and the percent exceedance for each of the WWTF relative facility size categories. For geometric mean results in 2022, percent exceedances ranged from 0.00% (5 to 10 MGD and >10 MGD) to 1.46% Variable/Intermittent). For daily maximum/single grab sample results, percent exceedances ranged from 1.75% (Variable/Intermittent) to 6.67% (> 10 MGD).

Table 9. Bacteria DMR Data Permit Geometric Mean Sample Exceedance Rates by Relative Facility Size, 2022

Relative Facility Size	Results Reported	Results Exceeding Permit Limit	Percent Exceedance
Variable/Intermittent	616	9	1.46%
< 0.1 MGD	1,456	15	1.03%
0.1 to 0.5 MGD	2,412	28	1.16%
0.5 to 1 MGD	1,710	4	0.23%
1 to 5 MGD	1,792	14	0.78%
5 to 10 MGD	420	0	0.00%
> 10 MGD	255	0	0.00%
TOTAL	**8,661**	**70**	**4.67%**

Table 10. Bacteria DMR Data Permit Daily Maximum/Grab Sample Exceedance Rates by Relative Facility Size, 2022

Relative Facility Size	Results Reported	Results Exceeding Permit Limit	Percent Exceedance
Variable/Intermittent	628	11	1.75%
< 0.1 MGD	1,480	29	1.96%
0.1 to 0.5 MGD	2,542	54	2.12%
0.5 to 1 MGD	1,713	36	2.10%
1 to 5 MGD	1,792	71	3.96%
5 to 10 MGD	433	24	5.54%
> 10 MGD	255	17	6.67%
TOTAL	**8,843**	**242**	**2.74%**

As presented in **Table 9** and **Table 10**, WWTFs in the 0.1 to 0.5 MGD category have the largest number of samples reported (both geometric mean and single grab samples), with the smallest number being for facilities in the > 10 MGD category. WWTFs in the Variable/Intermittent category have the highest percent exceedance for geometric mean samples at 1.46%, while the > 10 MGD category has the highest percent exceedance rate for the daily maximum/single grab samples at 6.67%. Although the daily maximum/single grab percent exceedance is highest for WWTFs in the > 10 MGD category, these facilities have a low geometric mean exceedance rate (0.00%). These facilities also collect samples at a greater frequency than other facilities due to their flow volume.

Geometric mean and single grab bacteria sampling and compliance data were also evaluated by year. The data in **Table 11** and **Table 12** show the number of geometric mean and daily maximum/single grab sample results reported, the number exceeding permit limits, and the percent of samples exceeding permit limits for each year (2018 to 2022). In general, results indicate a small number of bacteria permit exceedances are reported annually. For 2022, 70 of 8,661 geometric mean results, or 0.81%, were reported as exceedances. Of the 8,843 daily maximum/single grab samples reported, 242 results, or 2.74%, were reported as permit exceedances in the self-reported DMR data.

Table 11. Bacteria DMR Data Permit Geometric Mean Sample Exceedance Rates by Year

Year	Results Reported	Results Exceeding Permit Limit	Percent Results Exceeding Permit Limit	Percent Compliance
2018	7,692	66	0.86%	99.14%
2019	8,175	82	1.00%	99.00%
2020	8,350	72	0.86%	99.14%
2021	8,514	77	0.90%	99.10%
2022	8,661	70	0.81%	99.19%

Table 12. Bacteria DMR Data Permit Daily Maximum/Grab Sample Exceedance Rates by Year

Year	Results Reported	Results Exceeding Permit Limit	Percent Results Exceeding Permit Limit	Percent Compliance
2018	7,996	265	3.31%	96.69%
2019	8,317	294	3.53%	96.47%
2020	8,505	221	2.60%	97.40%
2021	8,685	255	2.94%	97.06%
2022	8,843	242	2.74%	97.26%

Year-to-year bacteria DMR permit exceedance data were also analyzed by relative facility size. The bacteria permit limit exceedance rates for each facility size category for geometric mean and daily maximum/single grab samples for the period of 2018 to 2022 are presented in **Table 13** and **Table 14**.

In 2022, rates of compliance were high across all relative facility size categories, with at least 98.50% of geometric mean results and 93.30% of daily maximum/single grab samples meeting effluent permit limits.

Table 13. Bacteria DMR Data Geometric Mean Sample Permit Exceedance Rates by Relative Facility Size and Year

Relative Facility Size	2018	2019	2020	2021	2022
Variable/Intermittent	2.20%	1.80%	4.10%	2.70%	1.50%
<0.1 MGD	0.80%	1.50%	1.20%	1.40%	1.00%
0.1 to 0.5 MGD	1.20%	1.30%	1.00%	0.90%	1.20%
0.5 to 1 MGD	0.10%	0.20%	0.00%	0.30%	0.20%
1 to 5 MGD	0.60%	0.90%	0.40%	0.70%	0.80%
5 to 10 MGD	1.60%	1.50%	0.70%	0.00%	0.00%
>10 MGD	1.10%	0.00%	0.00%	0.80%	0.00%

Table 14. Bacteria DMR Data Geometric Mean and Daily Maximum/Single Grab Sample Permit Exceedance Rates by Relative Facility Size and Year

Relative Facility Size	2018	2019	2020	2021	2022
Variable/Intermittent	5.00%	3.90%	7.30%	4.50%	1.80%
<0.1 MGD	1.80%	3.00%	2.00%	1.90%	2.00%
0.1 to 0.5 MGD	2.20%	2.40%	1.50%	1.50%	2.10%
0.5 to 1 MGD	1.40%	2.00%	1.50%	1.90%	2.10%
1 to 5 MGD	5.60%	5.60%	3.80%	4.70%	4.00%
5 to 10 MGD	7.90%	6.90%	3.30%	5.20%	5.50%
>10 MGD	10.60%	7.10%	4.80%	10.30%	6.70%

Permit exceedances for geometric mean permit limits are generally low. In 2020, WWTFs in the Intermittent/Variable category had the highest rate of bacteria permit exceedances for geometric mean data.

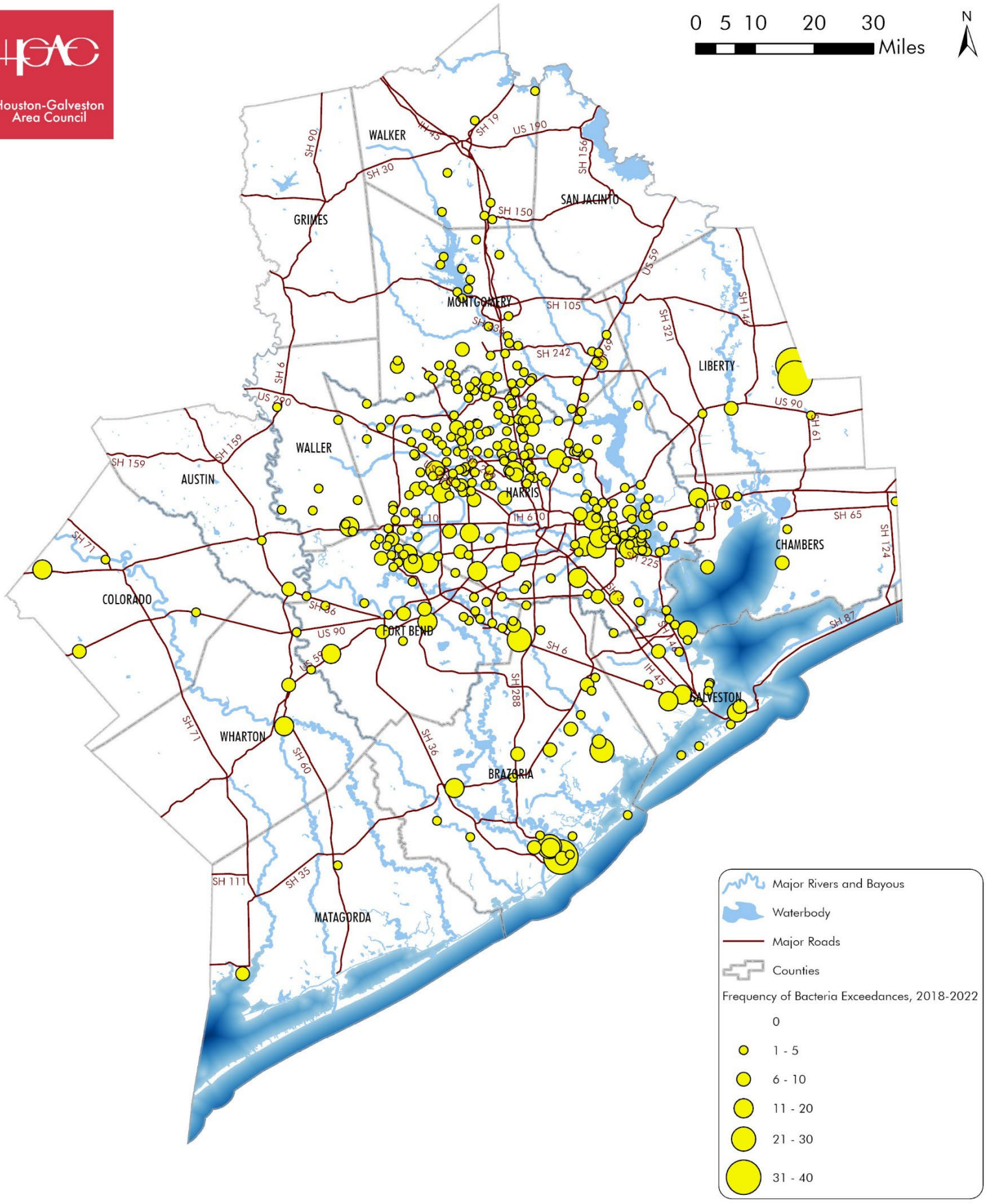
Higher permit exceedance rates are observed with the daily maximum/single grab samples as compared to the geometric mean results. However, this is to be expected. For smaller facilities, dischargers may only have to sample once per quarter or once per month. For larger facilities with higher flow volumes, sampling frequency may increase to weekly or daily, with multiple single grab results for each facility each month, but only one geometric mean result reported.

Overall, bacteria permit limit exceedance rates are low and WWTFs in the region are typically within permit compliance. However, it is important to remember that these DMR data are self-reported and therefore have some inherent uncertainty. In many cases, these samples are collected at the same time each day, which may bias the results if sample collection is postponed until conditions are ideal.

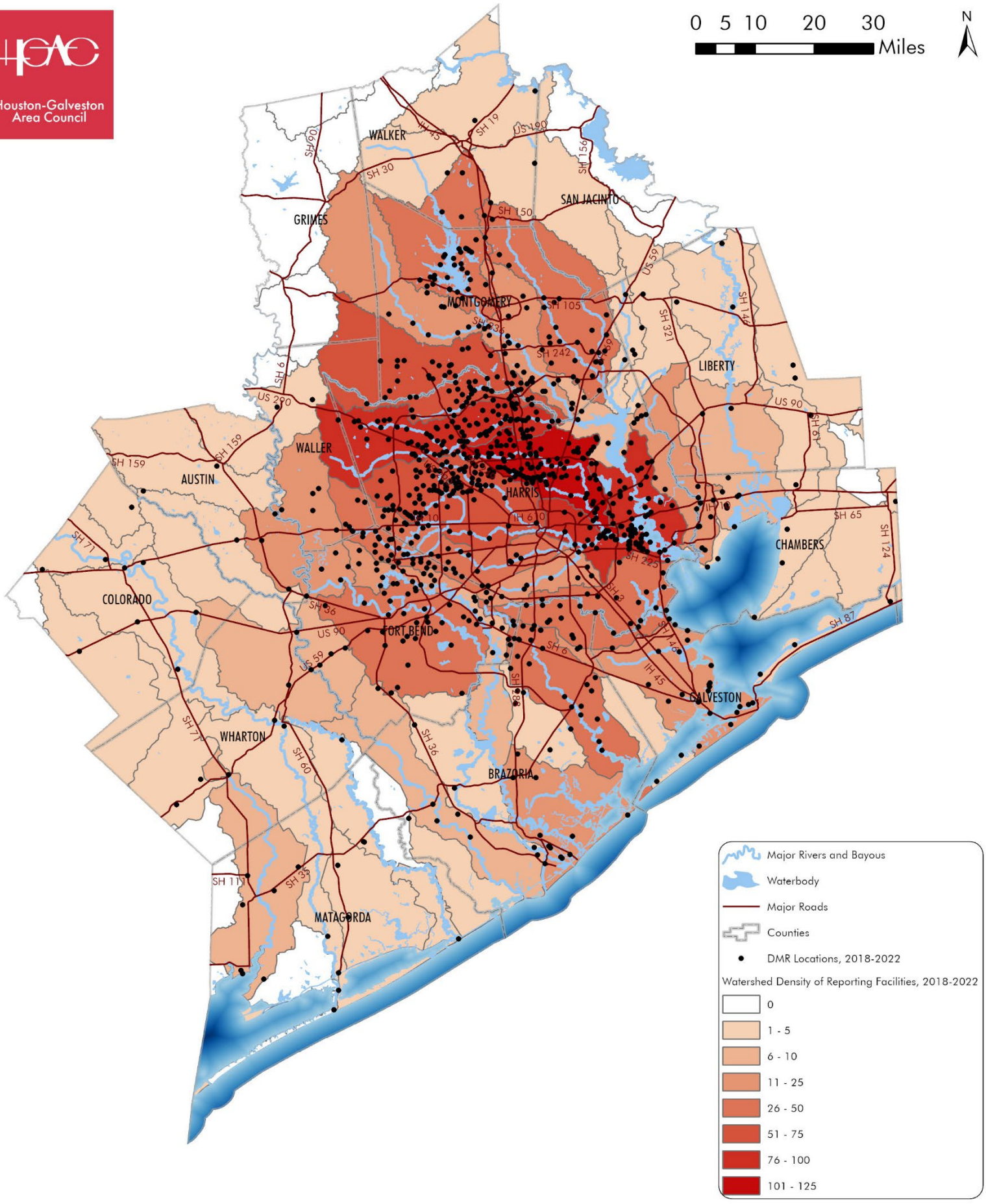
Frequency and Density of Permit Exceedances

Violations are mapped based on WWTF addresses and SAB data. **Map 4** and **Map 5** show the frequency of bacteria exceedances and density of reporting facilities for the period of 2018 to 2022, respectively. **Map 6** and **Map 7** show the frequency of bacteria exceedances and density of reporting facilities for 2022, respectively. On **Map 5** and **Map 7**, watersheds that have no outfalls located within their boundary are shown in white to indicate that there are no data. Note that H-GAC has no data for a facility on the coast of Chambers County in 2022 that was previously captured in the analysis of facilities in preceding years. This leads to a discrepancy in coloring in the subwatersheds of Chambers County between **Map 5** and **Map 7.** On **Map 4** and **Map 6**, no symbols appear in areas with no reported exceedances.

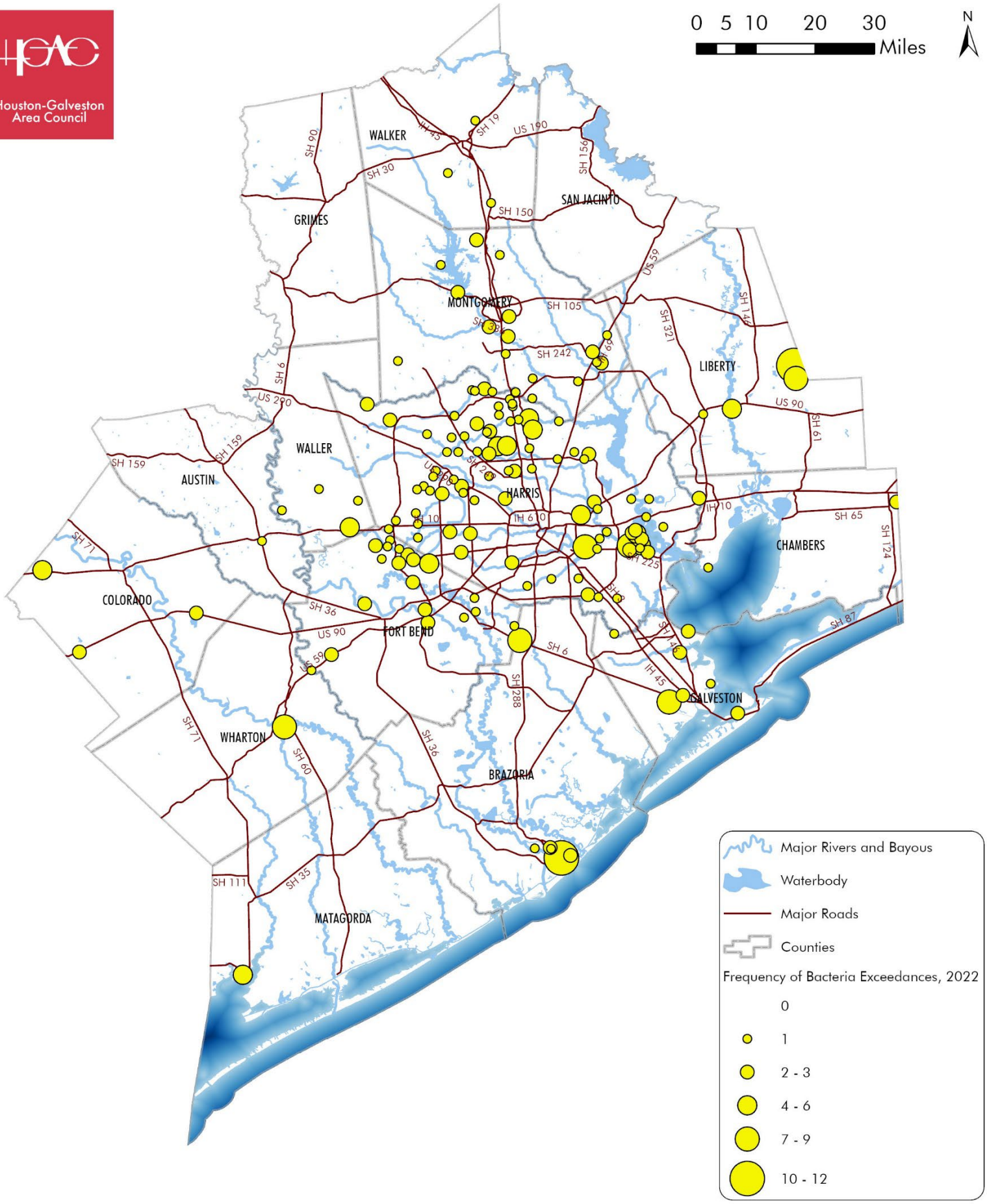
These maps illustrate areas in the region that have the highest rate of permit exceedances based on the reported DMR data acquired from TCEQ and EPA. It is evident that the more populated urban and suburban areas present in the region experience the greatest number of bacteria violations compared to more rural watersheds along the region's perimeter. It should be noted that spatial analysis of DMR exceedances are based on the location of WWTF outfalls. The density of WWTF outfalls in urban and suburban centers is much greater than the less populated watersheds in the region, therefore it would be expected that the number of DMR bacteria violations would also be higher.



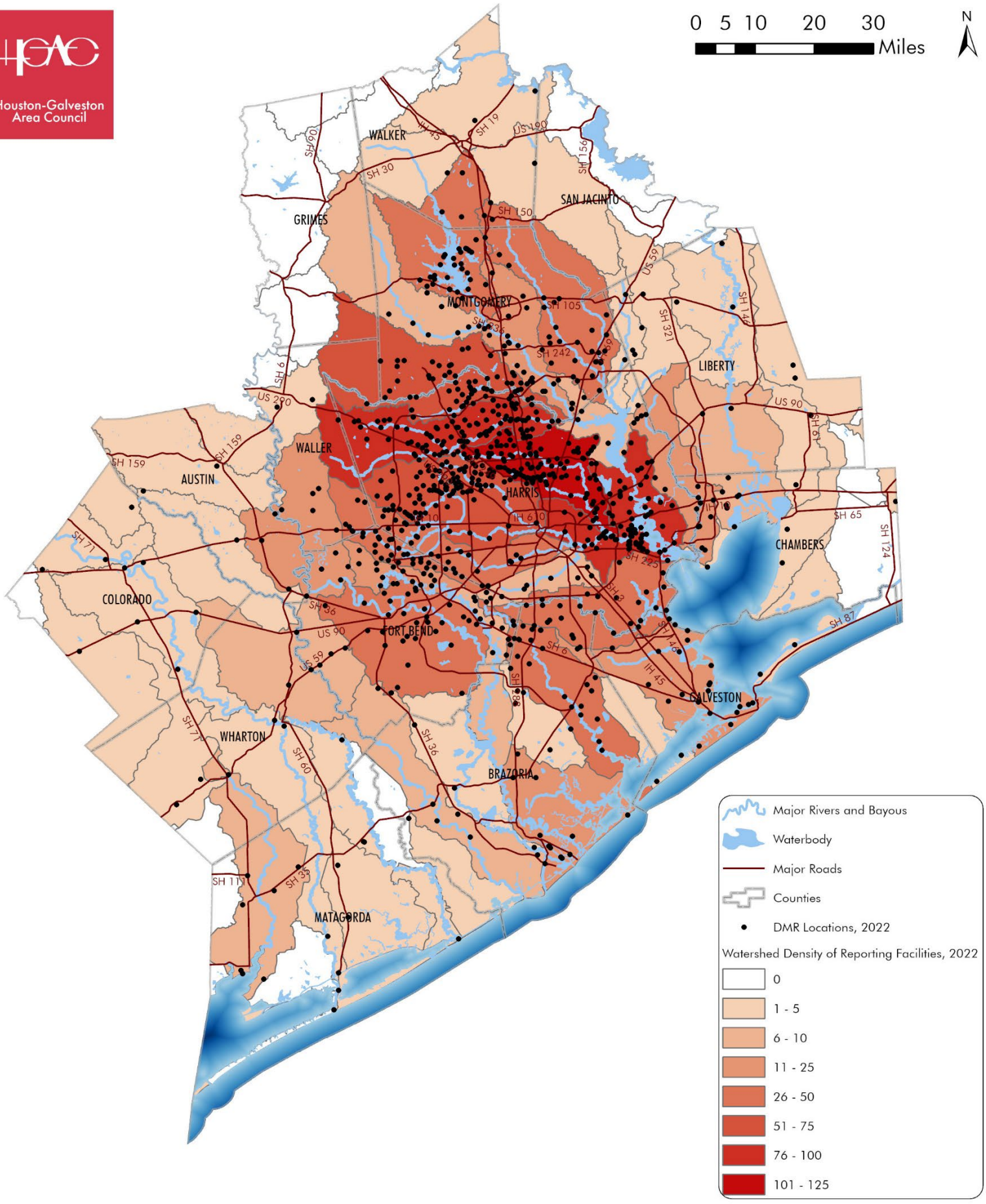
Map 4. DMR Bacteria Violation Occurrences, 2018 to 2022



Map 5. DMR Bacteria Violation Density by Watershed, 2018 to 2022



Map 6. DMR Bacteria Violation Occurrences, 2022



Map 7. DMR Bacteria Violation Density by Watershed, 2022

Total WWTF Annual Discharge

The total discharge from domestic WWTFs for each year was calculated based upon the reported average daily discharges as reported in the DMRs. These results, reported in MGD, are shown in **Table 15**. For 2022, there was a total reported discharge of 548 MGD.

Table 15. Total Reported Discharge (in MGD) from Domestic WWTFs by Year

Discharge	2018	2019	2020	2021	2022
Total Reported Discharge, MGD	570	579	554	592	548

Estimated WWTF Daily *E. coli* Load

The estimated *E. coli* daily loads (in Millions MPN per day) from domestic WWTFs are shown in **Table 16**. Results are shown by year and relative facility size, and are based on WWTF effluent discharge rates and average *E. coli* geometric mean concentrations reported by facility size.

For the period of 2018 to 2022, WWTFs in the 1 to 5 MGD size category contributed the most bacteria loading. In 2022, the estimated bacteria loading for this facility size category was 17,493.40 Million MPN/Day (or 1.75×10^{10} MPN/Day). WWTFs in the <0.1 MGD size category contributed the least amount of bacteria loading. Although this category represents the largest number of facilities—276 WWTFs, or 30.23% of the total number of facilities (as shown in **Table 5**)—the relatively low flow rates for this category helps minimize the amount of bacteria loading entering local waterways. Load calculations were not performed for the Intermittent/Variable facility due to the infrequent nature of their discharges and variability of their flow rates.

Table 16. Estimated Daily *E. coli* Load (in Million MPN/Day) from Domestic WWTFs by Relative Facility Size and Year

Relative Facility Size	2018	2019	2020	2021	2022
<0.1 MGD	358.20	511.50	305.30	335.40	291.40
0.1 to 0.5 MGD	3,280.20	3,267.50	2,314.20	2,492.20	2,530.70
0.5 to 1 MGD	3,367.90	3,953.40	3,627.60	4,088.20	3,854.60
1 to 5 MGD	18,109.50	16,501.80	17,576.10	20,179.20	17,493.40
5 to 10 MGD	4,786.70	4,304.30	4,953.10	4,845.80	5,129.30
>10 MGD	14,808.70	10,114.30	11,963.20	14,472.50	10,611.80

SSO DATA ANALYSIS

What is an SSO?

SSOs are defined as any type of unauthorized discharge of untreated or partially treated wastewater from a collection system or its components (e.g., manholes, lift stations, clean-outs, etc.) before reaching a treatment facility. Issues such as blockages, significant inflow and infiltration of excess water flowing into sewer pipes from stormwater (inflow) or groundwater (infiltration), poor operation and maintenance, or inadequate capacity to collect, store, or treat the wastewater can result in SSOs.

Unlike treated WWTF effluent, SSOs represent a high, if episodic, risk because they can have bacterial concentrations several orders of magnitude higher than treated sewage. Untreated sewage can contain large volumes of raw fecal matter, making areas with sizable and/or chronic SSO issues a significant human health risk under certain conditions.

SSOs are self-reported to the TCEQ, with each event linked to the water quality permit number for the facility or subscriber reporting the violation. A permitted facility may be a municipality, municipal water district, private individual, or company. A subscriber system is a sewer system that conveys flow to a WWTF that is owned by a separate entity. The term is not intended to indicate individual private laterals, such as a homeowner's connection to a sewer system.

As specified in 30 TAC § 327.32(c), permitted facilities are required to report SSOs to TCEQ within 24-hours of becoming aware of the event, and provide a written notification within 5 days. A monthly summary is also required. Exceptions are made for accidental discharges of less than 1,000 gallons, which only have to be reported monthly provided they are controlled or removed before entering a water way or adversely affecting a source of public or private drinking water. Information reported must include (at a minimum) the location, volume, and content of the discharge, a description of the discharge and its cause, dates and times of the discharge, and steps taken to reduce, eliminate, and prevent recurrence of the discharge.

SSO Data Analysis Methods

H-GAC incorporated SSO violation data for the period of 1/1/22 to 12/31/22 into their ongoing analysis. Statewide SSO data were acquired from TCEQ on 7/28/23 and filtered to examine data from TCEQ Region 12 (Houston). Analysis included an overview of the total number of permittees reporting SSOs, the causes of SSOs, and the estimated overflow volume by cause.

SSO volumes are self-reported estimates based on visual observations or estimated calculations. Therefore, the values reported can be subjective based on the best professional judgment of the individual reporting the event. Additionally, it is possible that SSOs may go undetected in certain conditions and are therefore not documented or

reported to the TCEQ. However, self-reported SSO violation reports are the most comprehensive source of data that can be used to evaluate SSO events and their potential impact to regional water quality.

The frequency of SSO violations by watershed was also evaluated and mapped for this project. Violations were mapped based on the SAB linked to each WWTF reporting the event. SAB data was acquired through municipality, private utility, and public MUD records. SABs are updated on an annual basis to reflect things like collection system expansions and other changes or updates. However, spatial analysis of SSOs is limited due to unavailable or unusable SAB information. Private utilities in smaller communities, for example, may not maintain usable records of their SABs while SABs do not exist for most package facilities, industrial WWTFs, and other subscribers.

Additionally, due to inconsistent reporting of SSO event addresses and location data, frequency maps were generated using the address of the WWTF's permitted outfall itself rather than the actual location of the SSO event. Therefore, watersheds with insufficient SAB data or no WWTF located within its boundaries may be mapped as having no data (as is done in **Map 9**) even if SSO events were common in those areas.

Domestic Wastewater Permittees Reporting SSOs

H-GAC evaluated the number of domestic wastewater permittees submitting SSO violation reports by year compared to the number of permittees in the region submitting DMR data. The number of domestic WWTFs submitting DMRs and reporting SSOs for the period of 2018 to 2022 are presented in **Table 17**.

Table 17. **Domestic WWTFs Submitting DMRs and Reporting SSOs Each Year**

Year	Domestic Permittees Submitting DMRs	Domestic Permittees Reporting SSOs	Percentage Permittees Reporting SSOs
2018	766	237	30.94%
2019	780	224	28.72%
2020	789	234	29.66%
2021	801	225	28.09%
2022	819	164	20.02%

In 2022, SSO violations are being reported for 21.00% percent of the domestic WWTFs that submit DMR data within the region.

Number and Volume of SSOs

The total number of SSO violations and the estimated flow volume for the region was calculated based upon the self-reported data. This information is presented in **Table 18**. In 2022 there were 690 events reported in the data provided by TCEQ. The total volume for these events was 76,395,601 gallons. The total reported volume for 2022 was greater than expected. After reviewing the dataset, an outlying event was identified in a report submitted on 11/21/22 due to a line blockage caused by concrete. This report estimated a discharge of 75,000,000 gallons and was reported by a facility with a 0.2 MGD discharge limit. Exempting that event, the total estimated discharge volume for 2022 would equal 1,395,601 gallons.

Table 18. Reported SSOs and Estimated Discharge Volume, 2022

Year	Number of SSOs Reported	Estimated Volume (x1000 Gallons)
2022	690	76,395.60[1]

[1] Excluding unusually high-volume one-time event reporting an estimated 75 million gallon discharge, total volume would equal 1,395,601 gallons

Causes of SSOs

In order to determine the primary causes of SSO events, the number of SSO events by reported SSO cause (as reported to TCEQ by the permittees) was calculated. It should be noted, however, that categorization depends on the accuracy of the data reported by the permittees and that while a single cause is listed on the SSO report, many SSOs are caused by a combination of factors. For example, fats/oils/grease collecting in lift station pumps can cause overflows in high rain events when excess water is in the system. The event may be listed as lift station failure, but fats/oils/grease and inflow and infiltration of stormwater were both causative elements in this example.

In reviewing the data, H-GAC evaluated not only the listed cause, but also the comments associated with the event to determine if a different cause was more appropriate. For example, if the cause was listed as equipment failure but the equipment failed due to a power failure, then the cause was changed to power outage for this analysis. If the cause was listed as inflow and infiltration but a blockage by grease was mentioned in the comments field, the cause of the SSO was changed to line blockage – fats/oils/grease, as the blockage would have caused the excess water to backup and overflow.

The number of SSOs for 2022 by cause and the volume of discharge (in thousands of gallons) for each reported cause is shown in **Table 19**. The most common cause listed for reported SSOs in 2022 is line blockage – fats/oils/grease with 315 events reported for this source. Combined with the 62 line blockages due to rags/wipes and other causes, line blockages of all types represent 377 SSO events. The reported source with the largest volume of discharge was line blockage – other causes at 75,071,900 gallons. As mentioned previously, this includes the unusually high one-time discharge event estimated at 75,000,000 gallons. If that event is not considered, the cause with the highest associated discharge volume would be rain/inflow/infiltration at approximately 500,500 gallons.

It must be pointed out that many of these SSO events are due to multiple causes and are reported as a single cause based upon the best professional judgment of the person reporting the SSO. Because of the uncertainty and variability of estimating discharge from these events, volumes reported should only be considered to be estimates.

Table 19. Number and Volume of Reported SSOs, 2022

Reported Cause	Number of SSO Events	Percentage of SSO Events	Volume (x1,000 gallons)	Percentage of SSO Discharge Volume	(Percentage of SSO Discharge Volume[2])
Collection System Structural Failure	50	7.25%	160.2	0.21%	(11.48%)
WWTF Operation or Equipment Malfunction	58	8.41%	182.8	0.24%	(13.10%)
Lift Station Failure	48	6.96%	118.1	0.15%	(8.46%)
Power Failure	1	0.14%	2.4	0.00%	(0.17%)
Rain/Inflow/Infiltration	151	21.88%	500.5	0.66%	(35.87%)
Severe Weather/ Natural Disaster	-	0.00%	-	-	-
Line Blockage – Fats/Oils/Grease	315	45.65%	344.6	0.45%	(24.69%)
Line Blockage – Rags/Wipes	6	0.87%	2.5	0.00%	(0.18%)
Line Blockage – Other Causes	56	8.12%	75,071.9	98.27%	(5.15%)
Human Error	2	0.29%	12.0	0.02%	(0.86%)
Unknown Cause	3	0.43%	0.6	0.00%	(0.04%)
TOTAL	**690**	**100.00%**	**76,395.6**	**100.00%**	**(100.00%)**

[1] Excluding unusually high-volume one-time event reporting an estimated 75 million gallon discharge, line blockage – other causes volume would equal 71,900 gallons

[2] Percents calculated excluding unusually high-volume one-time event reported in line blockage – other causes category

As noted earlier, line blockage – fats/oils/grease is the most commonly reported source of SSOs, with line blockage – other causes or rain/inflow/infiltration having the largest volume of discharge depending on the inclusion of one unusually high discharge event. Once again, it is important to consider that SSO events are typically due to a multitude of causes, such as inflow and infiltration backing up due to a line blockage or equipment failing due to a power failure. These events are listed as reported by the permittee based upon their best professional judgment but may not present a true and accurate accounting of these events due to limitations in the reporting system. More specifically, the reporting system allows for only one cause to be listed.

Figure 1 shows the reported cause categories as a percentage of the total number of SSO events. **Figure 2** shows the percentage of total volume discharged for each cause category with the one-time high-volume event reported for line blockage – other causes exempted.

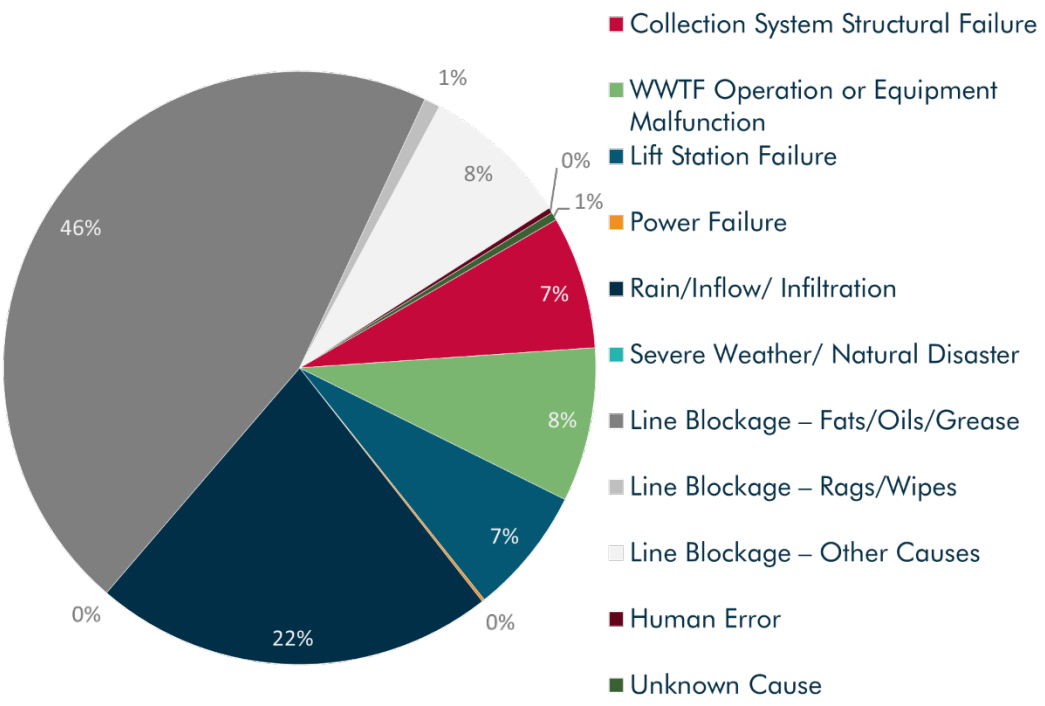


Figure 1. Number of Reported SSO Events, 2022

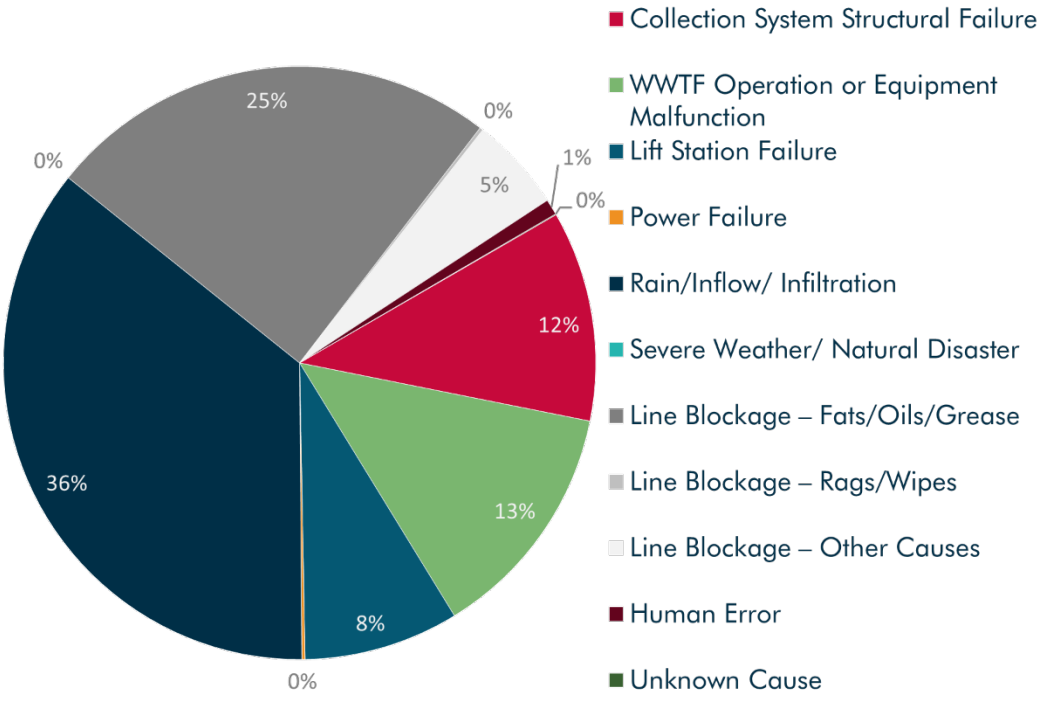


Figure 2. Volume of Reported SSO Events, 2022

Year- To- Year Comparison of SSO Causes

The number of SSO events by cause category were determined for each year from 2018 to 2022. These data are shown in **Table 20**.

Table 20. Number of Reported SSOs by Cause

Reported Cause	2018	2019	2020	2021	2022
Collection System Structural Failure	100	75	245	173	50
WWTF Operation or Equipment Malfunction	144	97	286	251	58
Lift Station Failure	67	81	104	123	48
Power Failure	3	4	2	6	1
Rain/Inflow/Infiltration	198	226	162	275	151
Severe Weather/Natural Disaster	1		1	21	
Line Blockage – Fats/Oils/Grease	516	450	471	412	315
Line Blockage – Rags/Wipes	18	42	72	71	7
Line Blockage – Other Causes	420	191	217	148	55
Human Error	3	5	1	1	2
Unknown Cause	65	6	2	1	3
TOTAL	**1,535**	**1,177**	**1,563**	**1,482**	**690**

The percentages of SSO events by cause category for each year from 2018 to 2022 are shown in **Table 21** and in **Figure 3**. Line blockages – fats/oils/grease is consistently the largest percentage of SSO events (45.65% in 2022). Clogged pipes due to fats/oils/grease can also be an underlying cause to SSO events reported in other cause categories, such as rain/inflow/infiltration.

Table 21. Percentage of Reported SSOs by Cause

Reported Cause	2018	2019	2020	2021	2022
Collection System Structural Failure	6.51%	6.37%	15.67%	11.67%	7.25%
WWTF Operation or Equipment Malfunction	9.38%	8.24%	18.30%	16.94%	8.41%
Lift Station Failure	4.36%	6.88%	6.65%	8.30%	6.96%
Power Failure	0.20%	0.34%	0.13%	0.40%	0.14%
Rain/Inflow/Infiltration	12.90%	19.20%	10.36%	18.56%	21.88%
Severe Weather/Natural Disaster	0.07%	0.00%	0.06%	1.42%	0.00%
Line Blockage – Fats/Oils/Grease	33.62%	38.24%	30.14%	27.80%	45.65%
Line Blockage – Rags/Wipes	1.17%	3.57%	4.62%	4.79%	0.87%
Line Blockage – Other Causes	27.36%	16.23%	13.88%	9.98%	8.12%
Human Error	0.20%	0.42%	0.06%	0.07%	0.29%
Unknown Cause	4.23%	0.51%	0.13%	0.07%	0.43%
TOTAL	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

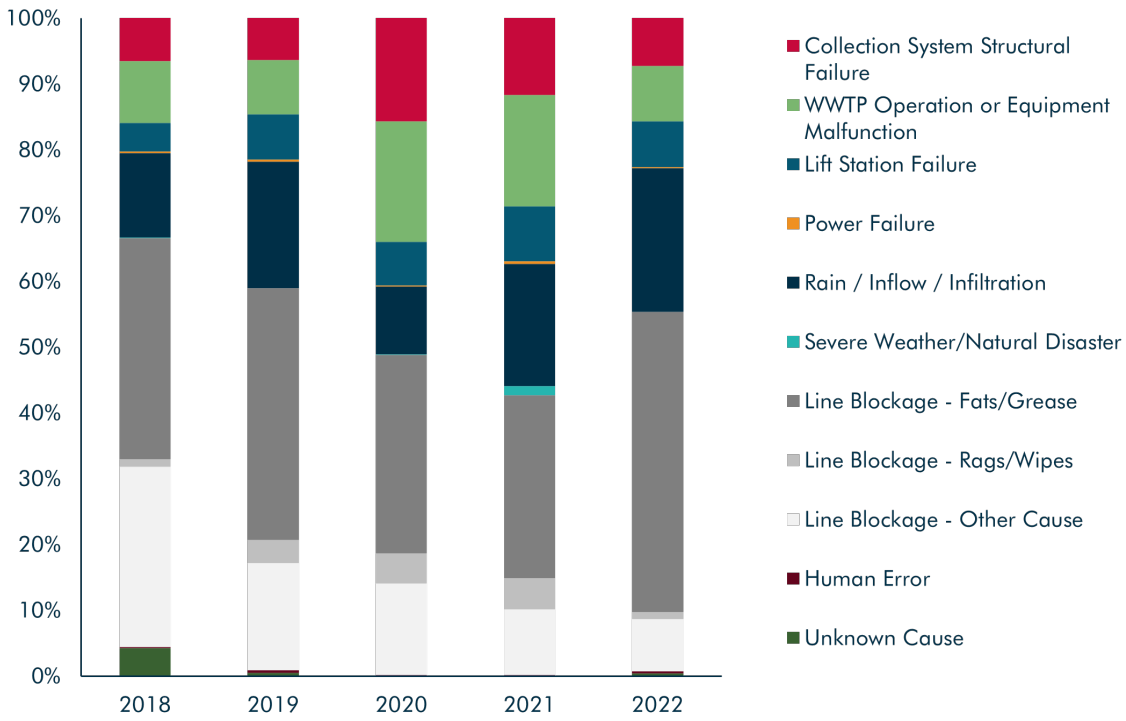
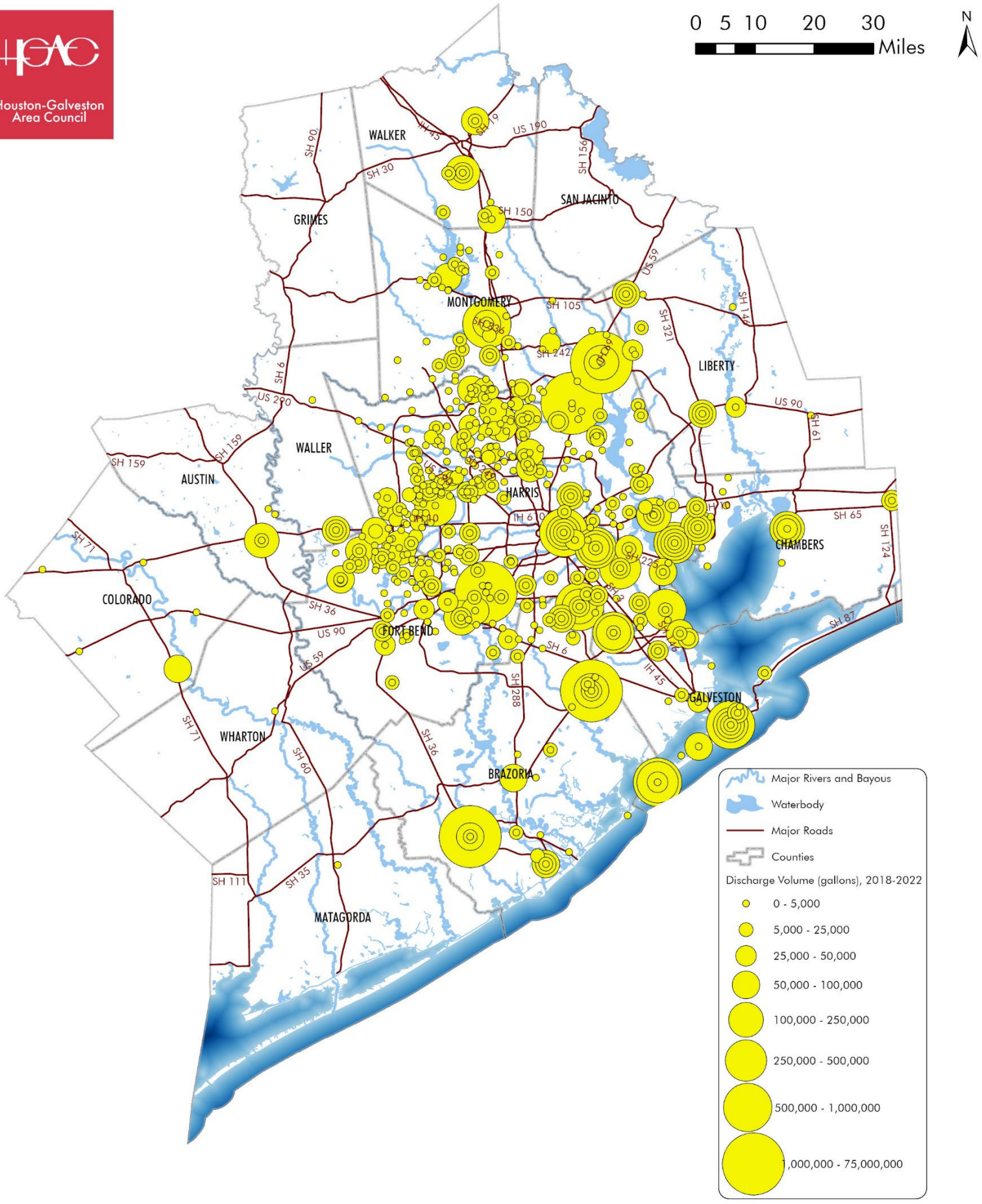


Figure 3. Percent Reported SSO Events by Cause, 2018 to 2022

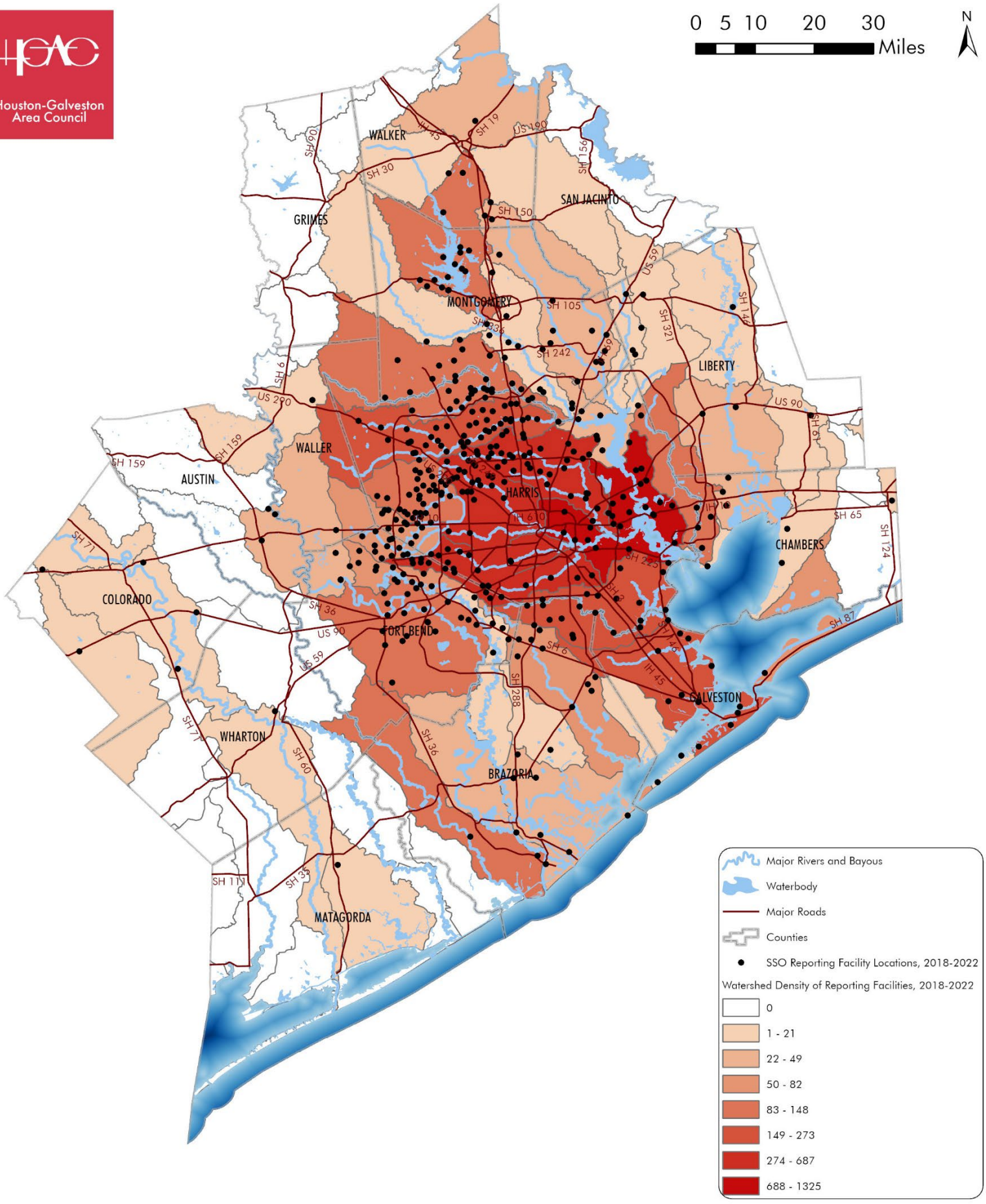
Frequency and Density of SSO Occurrences

SSO events are mapped based on WWTF addresses and SAB data. **Map 8** and **Map 9** show the volume and density of SSOs for the period of 2018 to 2022, respectively. **Map 10** and **Map 11** show the volume and density for 2022, respectively. On **Map 9** and **Map 11**, watersheds with no SSOs reported within their boundary are shown in white to indicate that there are no reported data (all potential reporting entity locations are indicated in **Map 3**). On **Map 8** and **Map 10**, no symbols appear on areas where SSOs were not reported.

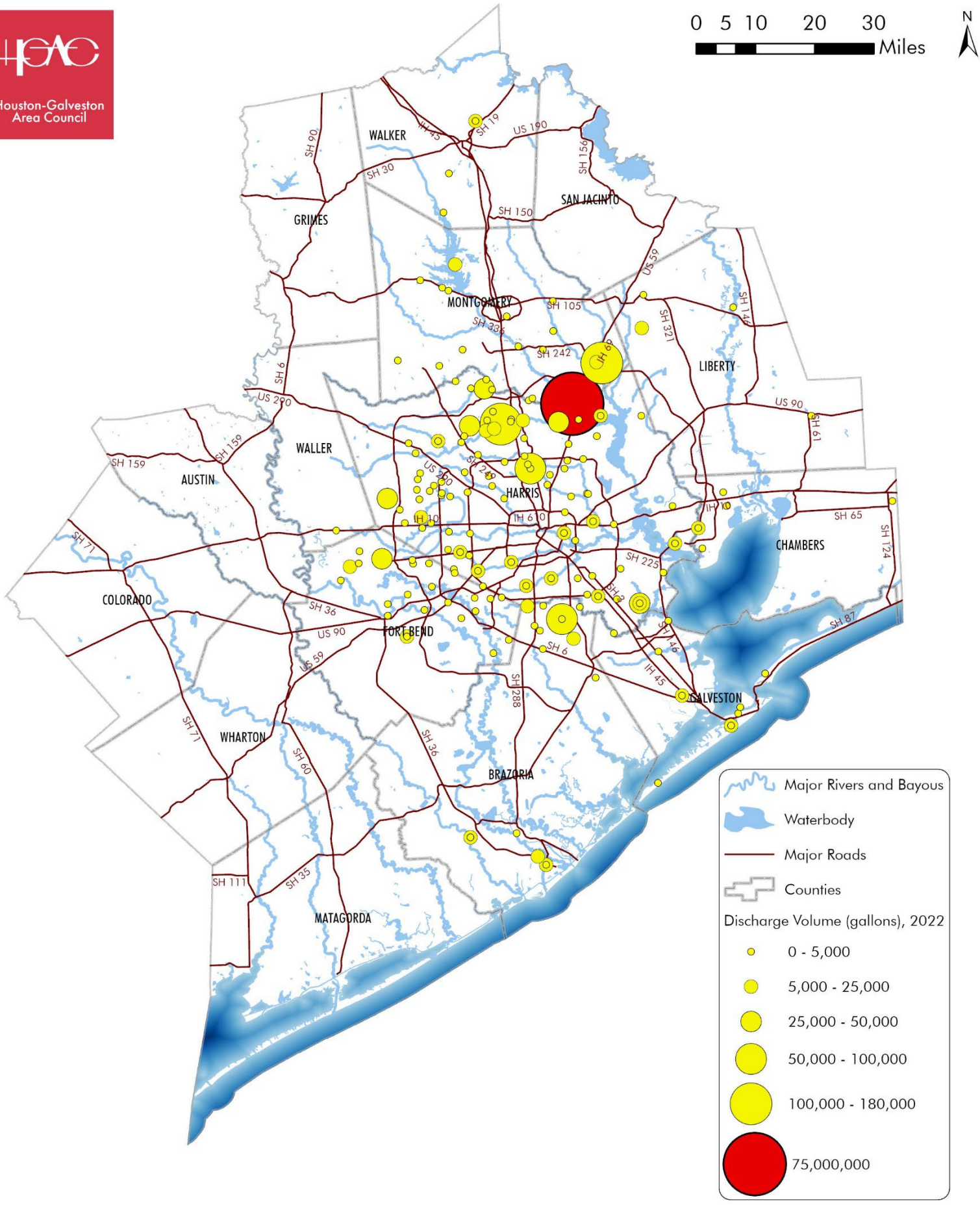
With the exception of central Harris County which has a low density of outfalls, more populated urban and suburban watersheds throughout the region are experiencing higher rates of SSO events compared to the more rural, smaller communities. This is likely due to larger populations putting added strain on the collection systems overall, including contributing fats/oils/grease to the collection system, resulting in a greater frequency of blockages. However, it should be noted that some rural communities with small WWTFs and package facilities may be underrepresented due to staff and resource limitations resulting in a greater likelihood of SSOs going undetected. Also, the amount of impervious cover in urban areas may make SSOs more visibly identifiable, whereas rural systems may have long runs of pipe between connections or running though undeveloped areas where they may go unseen. Further, the age of the infrastructure should be considered, as older systems will be more likely to experience structural failures such as line breaks.



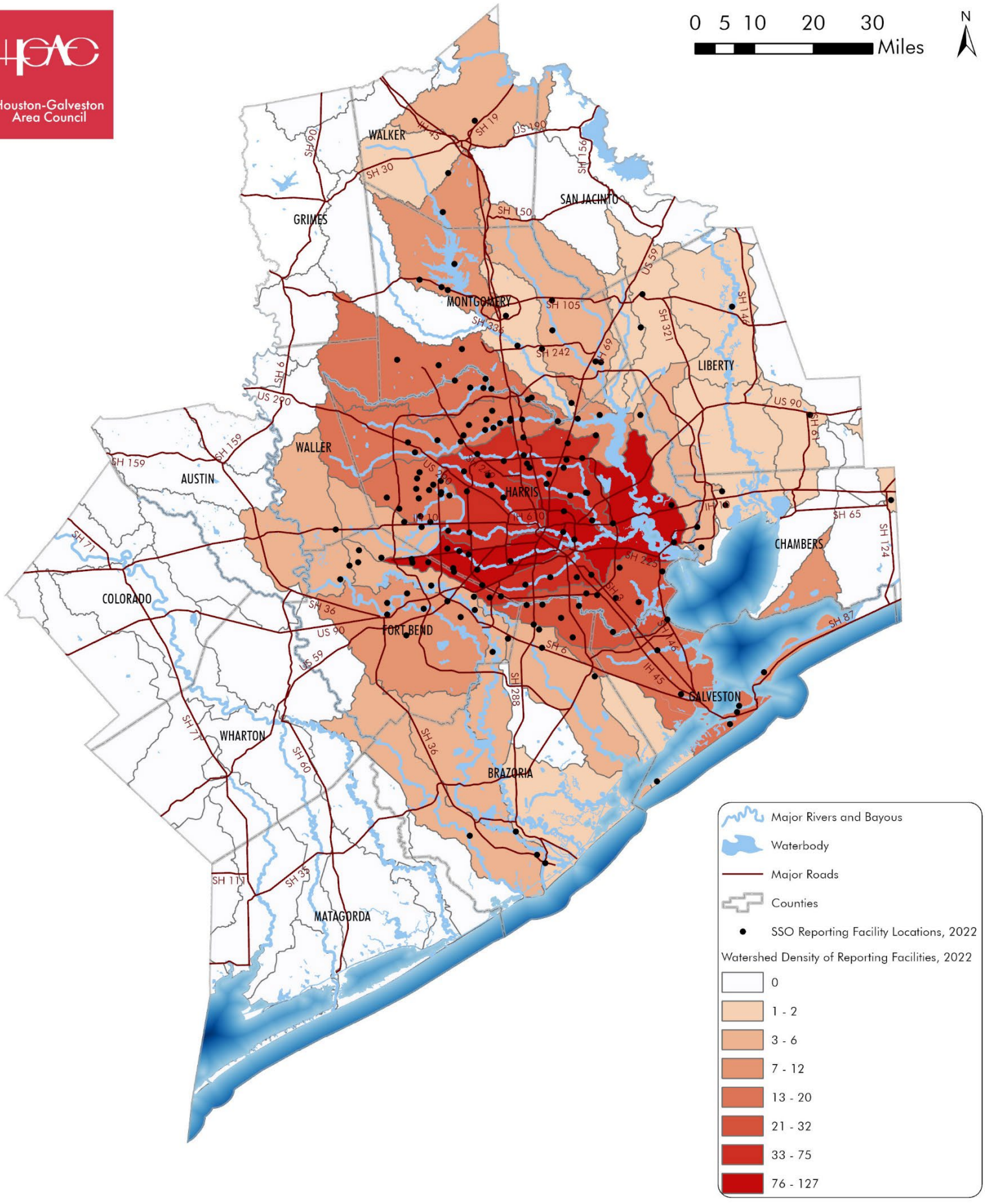
Map 8. SSO Occurrences, 2018 to 2022



Map 9. SSO Density by Watershed, 2018 to 2022



Map 10. SSO Occurrences, 2022



Map 11. SSO Density by Watershed, 2022

CONFORMANCE REVIEW FOR CWSRF PROJECTS

The goal of this Task is to review and provide input on CWSRF loan applications in the Houston-Galveston region and assure compliance with the latest WQMP. H-GAC responds to requests from TCEQ to review CWSRF applications and assists applicants and TCEQ in the resolution of conflicts between proposed project information and H-GAC's most recently approved WQMP.

In conjunction with H-GAC's role as a regional planning group and the local council of governments for the Houston- Galveston area of the Upper Gulf Coast, staff regularly provides comments on grant proposals of varying types. For the WQMP Update, H-GAC reviews proposals for projects under the Texas Water Development Board (TWDB) CWSRF program. These reviews help ensure regional goals are represented in project funding decisions at a variety of governmental levels.

Entities with WWTF and transport infrastructure make loan applications to TWDB to assist in the cost of improvements. These applications are reviewed by TCEQ. If requested by TCEQ, H-GAC also completes a review to determine if the applicant has conformed to the regional WQMP. H-GAC reviews the grant application and associated engineering documentation (such as the Preliminary Engineering Report, Environmental Review, population projections, etc.) for concurrence with broad regional planning priorities and goals (such as improving water quality, protecting waterways, reducing bacteria or nutrient loading, etc.).

During this review process, H-GAC staff looks for:

- Population projections that match TWDB, H-GAC, or other relevant forecasts;
- Alternatives that may impact water quality considerations; and
- Concurrence with regional priorities and goals (water quality impacts, etc.)

As part of this Project, H-GAC staff used data gathered under this and previous projects to review and provide comments on three CWSRF project applications during the FY 23 WQMP Update period. The outcomes of those reviews are shown in **Table 22**. The CWSRF projects reviewed during this year were consistent with regional goals of the WQMP.

Table 22. CWSRF Application Review, FY 2022

Project ID	Requesting Entity	Project Summary	Findings
73934	San Leon MUD	The project would rehabilitate the sanitary sewer collection system through trenchless technology using pipe-bursting and Cured-in-Place Pipe construction methods, service line reconnection, and manhole rehabilitation.	H-GAC staff finds that by mitigating inflow and infiltration and associated SSOs, this project is consistent with regional goals.
73938	City of Magnolia	The proposed project is for the expansion of the existing Nichols Sawmill WWTP (City of Magnolia WWTP) from a design average daily flow 1.3 MGD to 2.0 MGD.	Though population estimates referenced in the proposal are high, H-GAC staff finds this project is consistent with regional goals.
73945	Northgate Crossing MUD No. 2	The proposed project is for the construction of a regional wastewater treatment plant reclaimed water system to minimize the amount of groundwater used for irrigation.	H-GAC staff finds this project is consistent with regional goals. Reuse of treated effluent to for non-potable needs conserves groundwater for other uses.

SUPPORT WATERSHED PLANNING

The goal of this Task is to support watershed planning in the Houston-Galveston Region and to support regional information sharing on water quality and related topics. Work performed under this task includes:

- Coordination of water quality planning efforts with flood mitigation, resilience, and habitat conservation processes in areas with existing WPPs
- Support for watershed-based plans that are not covered under other contracts.
- Facilitation of the NRAC
- Urban Forestry support and coordination

COORDINATION OF WATER QUALITY PLANNING EFFORTS

WQMP project staff work closely with other H-GAC staff in the development of watershed-based plans, including TMDLs and WPPs. Data acquired and analyzed under this project are used to inform decisions for these other watershed projects. More information on watershed-based plans in the region is available on the H-GAC website[5].

SUPPORT FOR WATERSHED-BASED PLANS

Facilitation of regional communication, coordination, and cooperation on water quality efforts through staff presence and participation is an essential component of the WQMP. H-GAC staff routinely attend meetings of, or otherwise support, numerous other organizations involved in water quality efforts throughout the region. Due to the density of work in the Houston-Galveston Region, coordination and communication are essential.

During the current project term, staff helped coordinate activities and provide data for several projects, including both internal programs and outside organizations. Examples of the groups and projects staff worked with this year include:

- GBEP subcommittee memberships;
- Coordination with the Clean Rivers Program on the development of the Basin Highlights Report;
- Participation in the BIG OSSF and Illicit Discharge Regional Workgroup;
- Promotion of OSSF projects, including the SEP for the Homeowner Wastewater Assistance Program;
- Preparation of OSSF education and outreach programs and materials for the Coastal Communities project;
- Participation in the Watershed Coordinator's Roundtable;
- Coordination with ongoing TMDL, WPP, and other efforts, such as:

[5] https://www.h-gac.com/watershed-based-plans

- Houston-Area BIG TMDL
- San Jacinto-Brazos Coastal Basin TMDL
- Brazos-Colorado Coastal Basin TMDL
- Upper Oyster Creek TMDL
- Chocolate Bayou TMDL
- East Fork San Jacinto River TMDL
- Big Creek TMDL
- Cotton Bayou TMDL
- West Fork San Jacinto River and Lake Creek WPP
- Cypress Creek WPP
- Spring Creek WPP
- Clear Creek WPP
- East Fork San Jacinto River WPP
- Implementation of the combined WPPs for the West Fork San Jacinto River, Lake Creek, Spring Creek, and Cypress Creek watersheds

TMDL Projects in the Houston- Galveston Region

TMDL is a regulatory process triggered when a waterway is listed as impaired for one or more water body standard criterion as defined in the *Texas Surface Water Quality Standards*. The TMDL calculates the maximum amount of a pollutant that a water body can receive and still meet water quality criteria. An Implementation Plan (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.

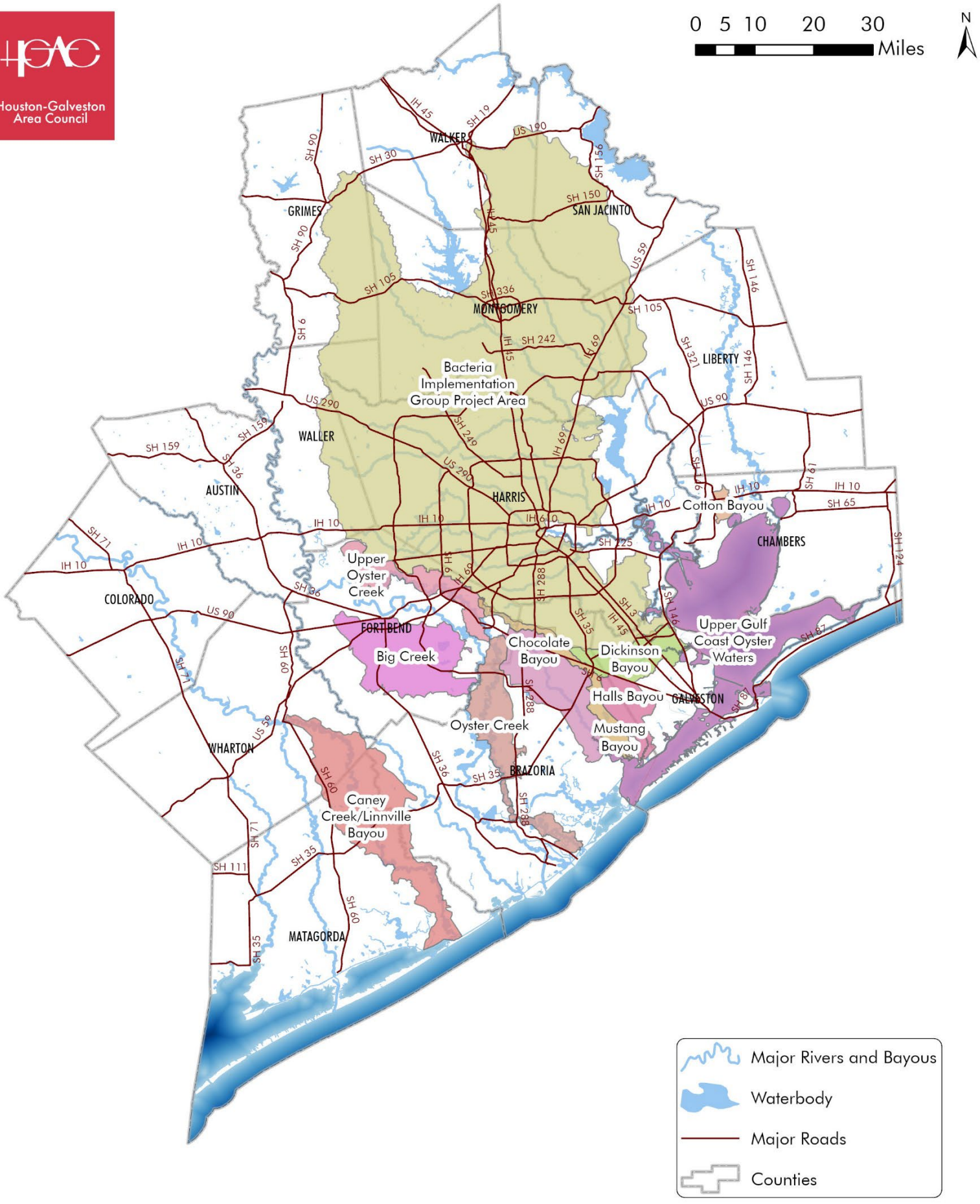
One of the ways the region is addressing bacteria issues is through projects such as the BIG—a partnership between H-GAC, local governments, businesses, and community leaders who developed and implement a shared plan to reduce bacteria. The BIG Project area (**Map 12**) is a combination of more than 100 TMDLs in adjacent watersheds. The BIG heavily relies on the information acquired and analyzed under this project.

As part of the WQMP project, H-GAC provided support for public outreach activities for completed TMDL projects and other TMDL projects being developed in the region, including activities necessary to plan and conduct meetings. H-GAC with support from the TCEQ facilitates seven TMDL projects within the H-GAC planning area and partners on two others. Links to the websites for the TMDL projects are included in the Additional Resources section of this report. These projects are shown in **Table 23** and **Map 12**. Please note that the BIG TMDL project area overlaps with several of the WPP and other TMDL projects.

Table 23. FY 23 Regional TMDL and I-Plan Project Summary

Project Name	TMDL Project Areas	Impairment(s)	I-Plan Status
Houston-Area 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-Plan complete and under review for final approval by TCEQ
Cotton Bayou	Cotton Bayou	Bacteria	I-Plan in review by TCEQ
Big Creek	Big Creek	Bacteria	TMDL 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 complete and in implementation
Houston Ship Channel*	San Jacinto River Tidal, Houston Ship Channel, Buffalo Bayou Tidal, Upper Galveston Bay, and tidal tributaries	Dioxin, PCBs in Fish Tissue	Legacy pollutant sites under Superfund; no TMDL I-Plan is planned

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



Map 12. TMDL and I-Plan Projects in the Houston-Galveston Region, FY 2023

WPPs in the Houston- Galveston Region

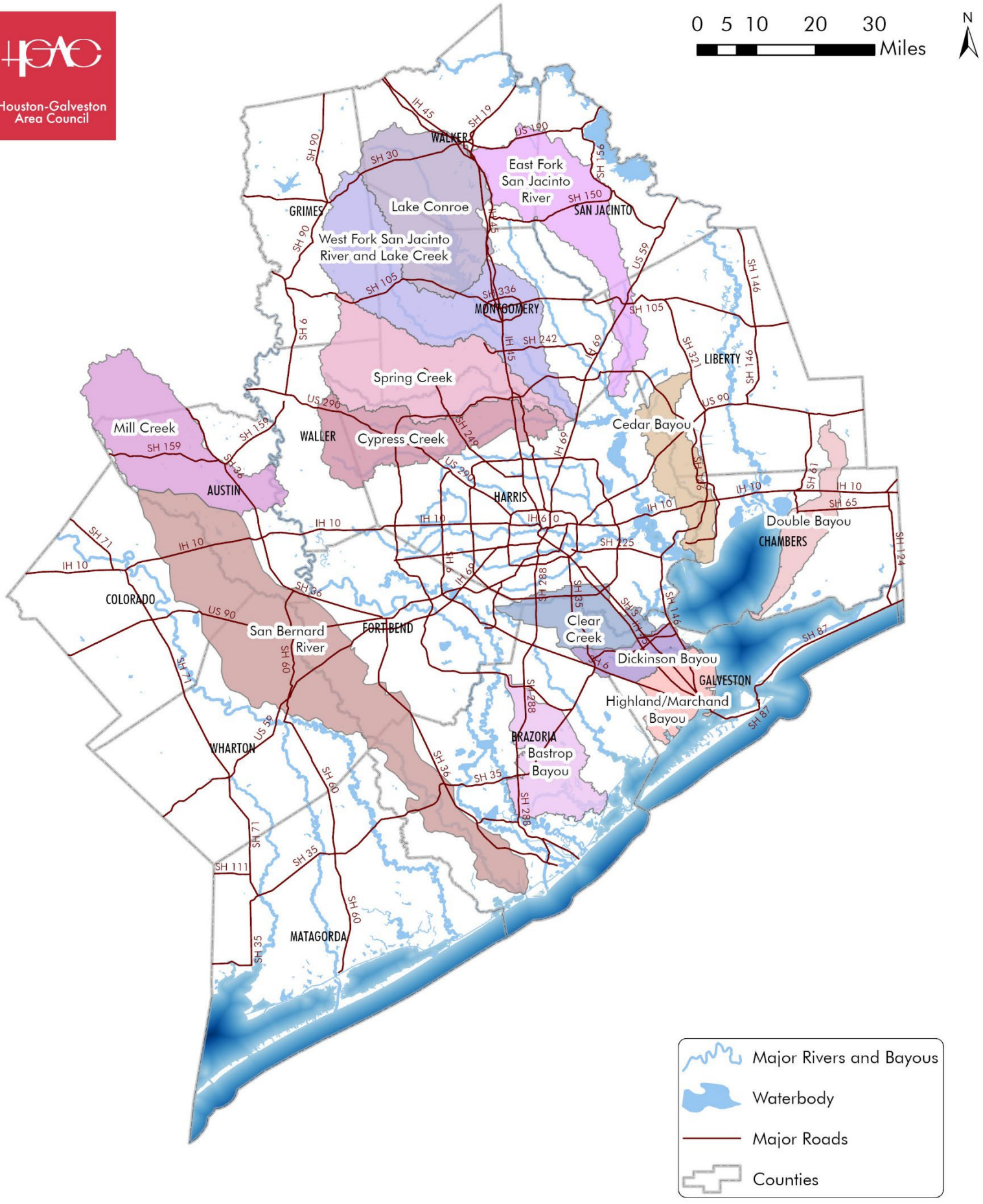
WPPs empower local stakeholders to improve water quality issues using voluntary, community-driven approach. Plans are based on a template developed by the EPA that seeks to identify causes and sources of pollution, establish improvement goals, identify feasible and effective voluntary measures to address 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. 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 24 and Map 13. Links to the websites for the WPP projects are included in the Additional Resources section of this report.

Table 24. FY 23 Regional WPP Project Summary

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 accepted 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 accepted by the EPA in 2016; Implementation ongoing
Clear Creek WPP*	Clear Creek, Magnolia Creek, Chigger Creek, Cowart 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, Senger Gully, Lemm Gully	Bacteria	Dissolved Oxygen, Habitat, Nitrate, Total Phosphorus	WPP accepted 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 accepted 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 accepted 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 accepted 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 accepted by the EPA in 2016; Implementation ongoing
San Bernard River WPP*	San Bernard River, Gum Tree Branch, West Bernard Creek, Peach Creek, Mound Creek, Turkey Creek, Snake Creek	Bacteria, Dissolved Oxygen	Dissolved Oxygen, Habitat, Ammonia	WPP accepted 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	WPP accepted by the EPA in 2023; Implementation ongoing
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 accepted by the EPA in 2019; Implementation ongoing

* H-GAC facilitated projects



Map 13. WPP Projects in the Houston-Galveston Region, FY 2023

Facilitation of the NRAC

As an extension of H-GAC's role as a coordinator of regional planning efforts, H-GAC staff members develop and maintain relationships with other local and state governments, community groups, and other organizations involved in efforts related to the aims of this Project. Through this task, H-GAC provides staff for the quarterly NRAC meeting to address regional watershed management and related natural resource issues. The NRAC provides policy recommendations for H-GAC's Board of Directors and serves as a regional roundtable for coordinating environmental efforts. This committee provides an efficient communication network and point of contact for H-GAC staff with other local and regional water quality decision makers.

Four NRAC meetings were held during the Project term. Topics discussed at these meetings are presented in **Table 25**.

Table 25. NRAC Meetings, FY 2023

Date	Topics Discussed
11/3/2022	• Membership Updates • Environmental Committee Highlights • Environmental Program Highlights • Subcommittee Reports • Presentation on soil health and conservation best management practices
2/2/2023	• Membership Updates • Environmental Committee Highlights • Environmental Program Highlights • Subcommittee Reports • Presentation on green infrastructure practices and stormwater controls
5/4/2023	• Membership Updates • Environmental Committee Highlights • Environmental Program Highlights • Subcommittee Reports • Presentation on Bipartisan Infrastructure Law funding
8/3/2023	• Membership Updates • Environmental Committee Highlights • Environmental Program Highlights • Subcommittee Reports • Presentation on the FY 23 WQMP Update

Urban Forestry Support and Coordination

Through the Urban Forestry Support and Coordination subtask, H-GAC supports regional efforts to coordinate water quality and forestry efforts, with a focus on riparian and urban areas. These efforts have been closely coordinated with H-GAC's Regional Conservation Initiative (RCI), an ongoing effort to promote conservation projects by local governments and partners. Time and effort on some forestry projects was augmented by staff capacity from the RCI. Staff from H-GAC continue to serve on and/or coordinate with the following forestry projects:

- Cities in Forests national association of municipal forestry programs
- Texas Forests and Drinking Water Partnership (leadership role)
- Houston Area Urban Forestry Council (leadership role)
- H-GAC RCI
- Bayou Preservation Association Stream Corridor Restoration Committee

H-GAC staff also actively participated in continuing to develop and implement the Green Futures corporate sustainability program with Texas A&M Forest Service to promote and fund riparian reforestation plantings in the Houston region, with one planting held during this year. For this planting, hundreds of trees were planted in the Kashmere Gardens neighborhood of Houston, transforming miles of a denuded major streetscape and providing stormwater benefits to the community.

H-GAC has supported our local governments and organizations with direct support through:

- Assisting the City of Houston with coordination support
- Assisting the City of Bellaire with a comprehensive canopy assessment of all city parks and public facilities
- Assisting the Houston Area Urban Forestry Council in the planning for its annual tree planting competition planting event and urban forestry education events
- Assisting various entities with letters of support, funding research, program coordination, or other minor data projects to support forestry efforts.

H-GAC staff has also presented at various events, including as a featured speaker on forestry and conservation at a Cities in Forests national workshop.

H-GAC has also continued to represent forestry practices and goals as part of broader projects, including TCEQ TMDL and WPP grant projects in the region. H-GAC has focused on increasing forestry presence and activity in these and other water quality efforts, and has built forestry-based recommendations into these plans and guidances.

OSSF PLANNING, COORDINATION, AND OUTREACH

The goal of this Task is to administer and coordinate H-GAC's OSSF program activities. These activities include maintaining and continuing to develop the existing spatial database of permitted and projected unpermitted OSSF locations. These activities also provide coordination in support of an existing SEP to repair or replace failing OSSFs within the region, coordinate regional water quality and wastewater infrastructure projects, and provide outreach and education activities.

Work performed under this task includes:

- Permitted OSSF Update
- Unpermitted OSSF Update
- Authorized Agent Coordination
- SEP Coordination and Outreach
- OSSF Outreach and Education

OSSFS IN THE HOUSTON GALVESTON REGION

Decentralized OSSFs are a widespread wastewater treatment technology in the region. OSSFs are relied on for the treatment and disposal of wastewater in areas not conducive to centralized sanitary sewer service. Although they produce treated effluent of a high grade when functioning properly, OSSFs can be appreciable sources of bacterial contamination if they are not properly maintained and functioning. Annually, thousands of OSSFs are designed, sited, permitted, and installed within the region, especially in the rapidly developing unincorporated areas of northern Harris and Montgomery counties, as well as the rural counties along the region's outer boundary. While new systems are subject to permit requirements as specified in Title 30 Texas Administrative Code Chapter 285 (30 TAC §285), many systems installed prior to 1989 did not require a permit. Specific locations of these unpermitted systems may be unknown. Information regarding these unpermitted systems is particularly significant because they represent a majority of all OSSFs in the H-GAC service area.

TCEQ has authority over the regulation and permitting of OSSFs in Texas. In many cases, that authority is delegated by TCEQ to Authorized Agents (counties, municipalities, river authorities, and other responsible entities). As there is no centralized repository for OSSF permitting data, the Authorized Agents have traditionally maintained these data in a variety of formats. To ensure a regional, uniform set of data for use by Authorized Agents and water quality planning efforts, H-GAC developed a comprehensive inventory of permitted system locations and likely unpermitted system locations under previous grant contracts.

During this Project year, new data provided by the Authorized Agents were added to H-GAC's regional OSSF permit database. Additionally, H-GAC developed and initiated a new method to estimate the projected locations of unpermitted OSSFs in the region. In previous project years, H-GAC utilized parcel and census block data for its estimations. Beginning in FY 2022, this process switched to using 9-1-1 address data to perform the location analysis. This allows H-GAC to estimate the location of these systems with a much higher level of specificity.

PERMITTED OSSF UPDATE

For the Permitted OSSF Update, H-GAC staff continued to update the OSSF location database with data from Authorized Agents, including permitted OSSF locations and related permit data as appropriate.

The intent of the OSSF database is to provide a comprehensive, spatially-explicit inventory for all permitted OSSF locations throughout the region. No such inventory existed prior to the initiation of H-GAC's initial database development. The initial work had collected location data for permitted OSSFs and developed a program under which participating Authorized Agents would submit new system data on a regular basis, including spatial locations using Global Positioning System (GPS) units provided by H-GAC.

This information is updated annually and is available to the public through H-GAC's online interactive OSSF Information System[6]. This ArcGIS mapping tool (**Figure 4**) allows the user to view the locations of permitted OSSFs by age, Authorized Agent or permitting authority, and the number of permits per square mile.

[6] https://datalab.h-gac.com/OSSF/

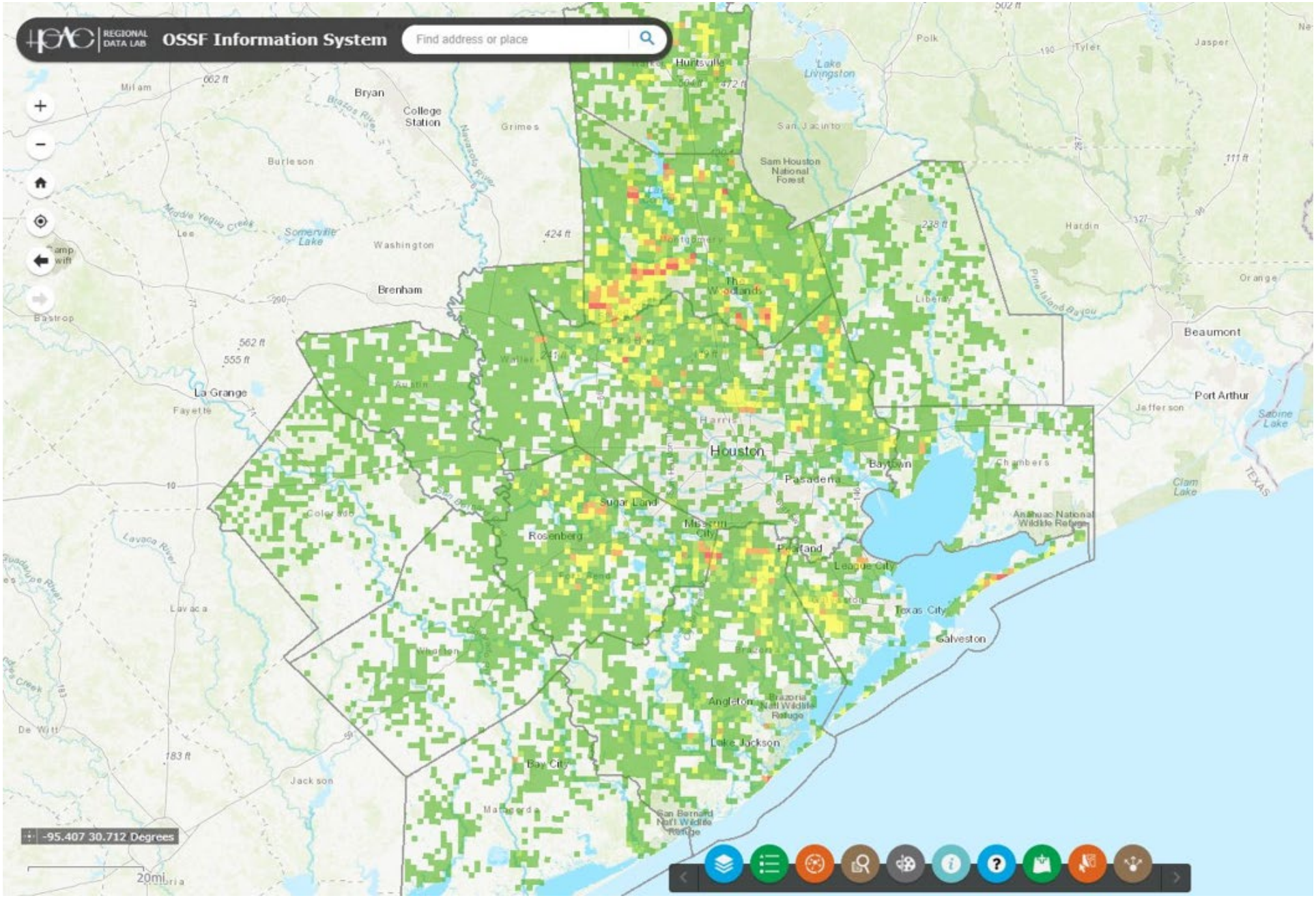


Figure 4. H-GAC's Interactive OSSF Information Systems Mapping Tool

Acquisition of OSSF Permit Data

Authorized Agents typically submit data to H-GAC in electronic format. Data received from Authorized Agents are reviewed by H-GAC staff and reformatted as necessary for inclusion into the geospatial database. The methods employed in the update of the OSSF database are described in further detail in the *H-GAC WQMP Data Acquisition and Geospatial Data QAPP*. Any data errors (incorrect GPS coordinates, typographical errors, etc.) were corrected, while duplicate records were removed.

The FY 2023 update brings the database current through the end of calendar year 2022. There were a total of 5,442 permitted systems added to the database for 2022. This included the addition of 321 permitted OSSFs in Grimes County. Grimes County is not a part of H-GAC's 13-county region, but it, along with San Jacinto County, are a part of H-GAC's Clean Rivers Program area. Watersheds that H-GAC monitors extend into a part of these counties, so H-GAC has been seeking this OSSF permit data for a long time to use in watershed-based planning efforts in these areas. Unfortunately, attempts to acquire data from San Jacinto County continue to be unsuccessful.

As of 12/31/22, there are a total of 125,422 permitted OSSFs in the database. Austin, Colorado, Matagorda, and Walker counties did not report any data to H-GAC for 2022. Attempts have been made to resume acquisition of this data.

Table 26 shows a breakdown of the number of permitted systems by county. Appendix C contains maps of the locations of permitted and projected unpermitted OSSFs by county.

Table 26. Permitted OSSFs by County, 2021 and 2022

County	Permitted Systems 2021	New Permitted Systems 2022	Total Permitted Systems 2022
Austin	3,175	Not Reported	3,175
Brazoria	16,074	510	16,584
Chambers	1,450	169	1,619
Colorado	595	Not Reported	595
Fort Bend	14,062	514	14,576
Galveston	6,694	409	7,103
Grimes*	4,363	321	4,684
Harris	24,227	879	25,106
Liberty	1,502	505	2,007
Matagorda	1,669	Not Reported	1,669
Montgomery	34,012	1532	35,544
San Jacinto*	No Data Available	No Data Available	No Data Available
Walker	6,043	Not Reported	6,043
Waller	4,655	371	5,026
Wharton	1,459	232	1,691
TOTAL	**119,980**	**5,442**	**125,422**

* These counties are outside H-GAC's 13-County Region, but are within H-GAC's Clean Rivers Program area.

Processing Notes for OSSF Permit Data

It is often necessary to further process the data that is received from Authorized Agents. This includes such tasks as making sure that data is in a consistent format, removing duplicates, verifying or removing permits that are located outside an Authorized Agent's county boundaries, geocoding street addresses to determine latitude and longitude, correcting GPS coordinates that may have been entered incorrectly, and verifying locations using Star*Map or Google Earth.

Table 27 documents data processing notes related to the most recent update, including data corrections.

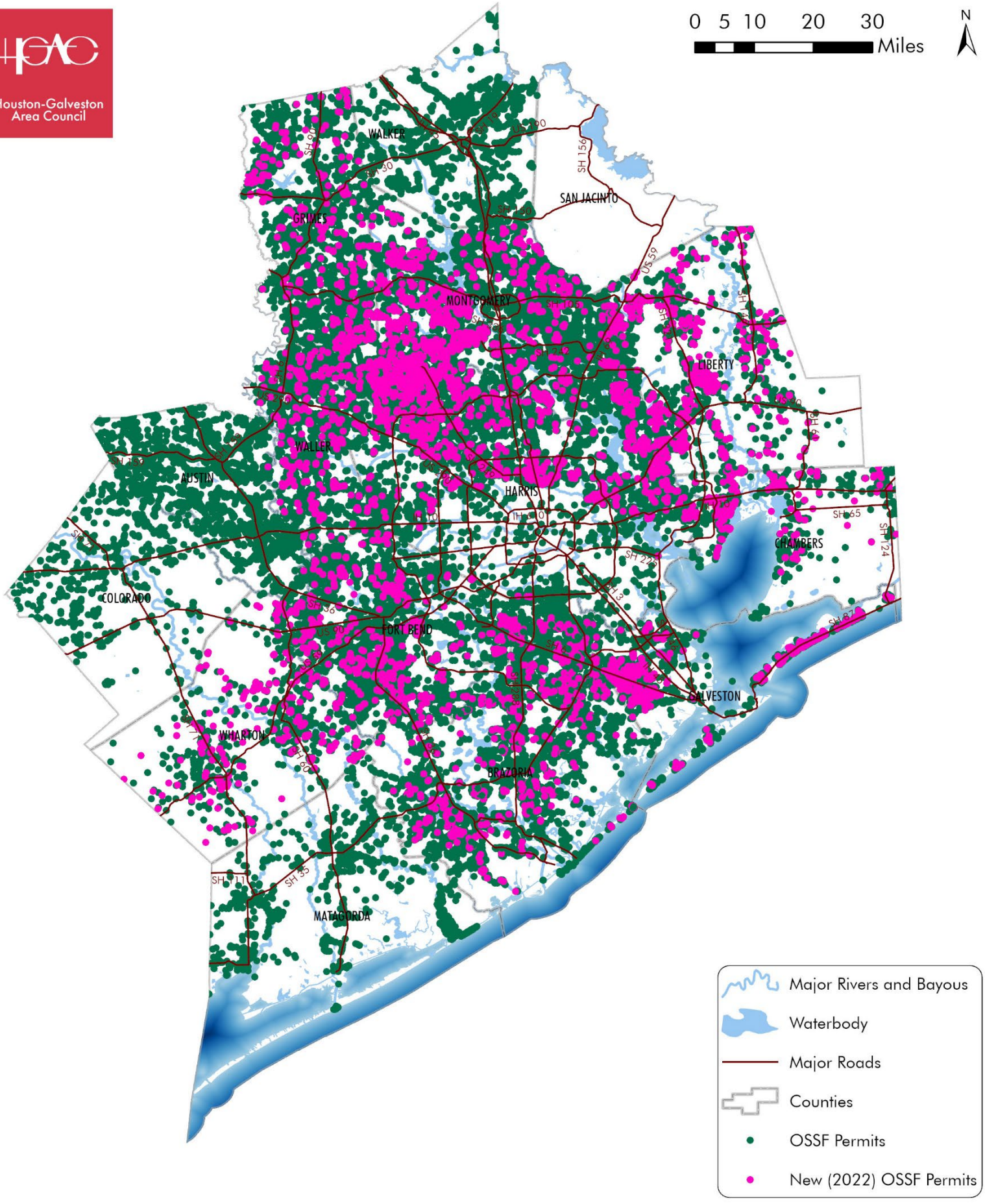
Table 27. OSSF Data Processing and Database Update Notes

County or Authorized Agent	Update Notes
Austin	Did not submit data
Brazoria	Submitted monthly data, records updated and processed
Chambers	Submitted monthly data, records updated and processed
Colorado	Did not submit data
Fort Bend	Submitted annual data, records updated and processed
Galveston	Submitted monthly data, records updated and processed
Grimes*	Submitted annual data, records updated and processed
Harris	Submitted annual data, records updated and processed
Liberty	Submitted annual data, records updated and processed
Matagorda	Did not submit data
Montgomery	Submitted annual data, records updated and processed
San Jacinto*	Did not submit data
San Jacinto River Authority	Did not submit data
Walker	Did not submit data
Waller	Submitted monthly data, records updated and processed
Wharton	Submitted annual data, records updated and processed

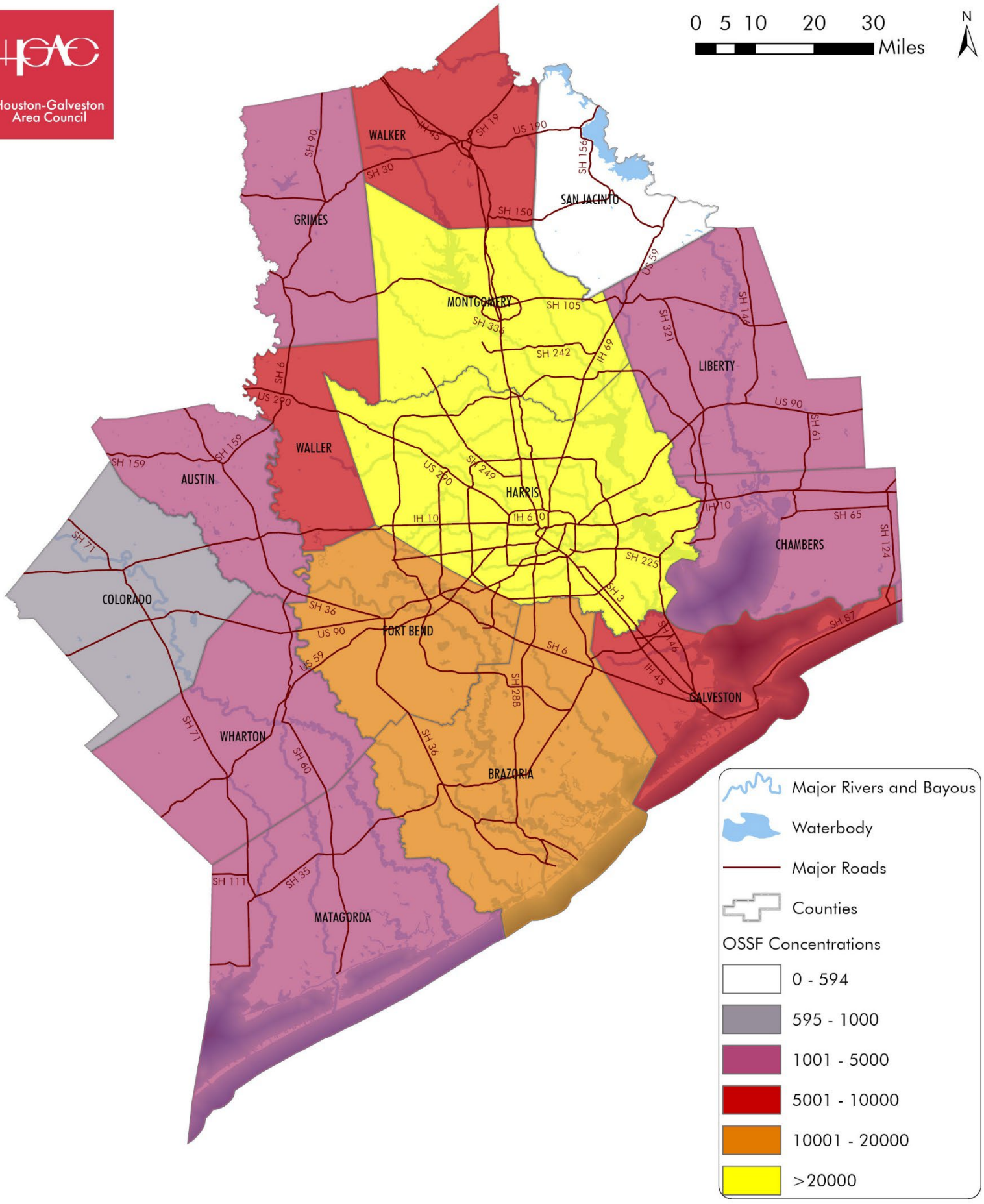
* These counties are outside H-GAC's 13-County Region, but are within H-GAC's Clean Rivers Program area.

Locations and Concentrations of Permitted OSSFs in the Houston-Galveston Region

The locations and concentrations of permitted OSSFs in the Houston-Galveston region are shown in Map 14 and Map 15. For the OSSF permits, existing permits are shown in purple and new permits (those added in calendar year 2022) are shown in red. All permits for Grimes County are shown in red as this is the first year those permits were added to the regional permit database.



Map 14. Permitted OSSFs in the Houston-Galveston Region, 2022



Map 15. Concentration of Permitted OSSFs in the Houston-Galveston Region by County, 2022

UNPERMITTED OSSF UPDATE

The OSSF inventory data developed by H-GAC deals specifically with permitted OSSFs. For most Authorized Agents, systems began to be permitted after 1989. OSSFs installed prior to this date were not necessarily required to have a permit (depending on county). These systems are considered to be "grandfathered" and, in most cases, are not actively tracked unless violation data exist for that site. While many of these systems are well-maintained, aging systems in general pose a greater threat of failure and contamination of groundwater and surface water sources. Many of these older systems may be of a type that is not appropriately suited for the soil type. These unpermitted systems represent an appreciable portion of the systems in service.

The OSSF data have already been used for a variety of watershed protection efforts and other local planning projects. With the projected population expansion and aging infrastructure, additional information about unpermitted system locations will be vital to utility planning and developing watershed-based plans to address water quality impairments and concerns throughout the region.

For the Unpermitted OSSF Update, H-GAC staff estimated the number and probable locations of unpermitted systems, which were typically installed prior to the requirement that OSSFs be permitted. In previous project years, this analysis was performed using polygons representing parcel and census block data. For the current project year, H-GAC used 9-1-1 addressing to estimate the projected locations of potentially unpermitted OSSFs on a county level. This method used an automated script to interpolate the addresses of these unpermitted systems.

The Unpermitted OSSF Update was performed in compliance with the *H-GAC WQMP Data Acquisition and Geospatial Data QAPP*.

Previous Methodology Using Parcel and Census Block Data

For the current project, H-GAC used the unpermitted analysis method applied in FY 2022. These methods differed from previous years, in which unpermitted locations were deduced through a comparison of polygons (known parcels/census blocks), known locations of OSSFs, and known sanitary sewer systems service boundary data. In previous iterations of this analysis, parcels with occupied structures that are located outside of established service areas and do not have a permitted OSSF were assumed to have an unpermitted OSSF.

As originally performed, the unpermitted OSSF update identified the locations of unpermitted OSSFs by tax parcel polygon or census block data using H-GAC's comprehensive parcel database. Tax appraisal parcels allowed for numeric estimations of unpermitted OSSFs. However, there are some limitations to this method. For example, the centroid of the parcel is usually identified as the location of the OSSF. As properties vary in size and shape, the centroid in many cases is not adjacent to the actual system. It is also assumed that there is a 1:1 ratio of OSSFs to parcels. This potentially underestimates the

number of OSSFs, as there is typically only one OSSF per parcel for a single-family residency use, but there likely could be more than one system per parcel under certain uses (such as a mobile home community).

For the counties for which H-GAC does not have digitized tax parcels available (Austin, Chambers, Matagorda, Walker, and Wharton), census blocks were used to complete the analysis. However, use of the census blocks is not ideal either. Using this methodology, areas containing unpermitted OSSFs could be established, but it is difficult to ascertain a numeric estimation or the exact physical location of systems. A 1:1 ratio is also used for the census blocks to provide a conservative estimate, but it is almost a certainty that there will be multiple households per census block, so the number of OSSFs will be underestimated using census block data.

Updated Methodology Using 9- 1- 1 Addresses

While parcel and census block data have been extremely useful in prior project years for identifying potential locations of unpermitted OSSFs, H-GAC found it necessary to refine the process by utilizing the 9-1-1 address data set. The QAPP has been revised to allow use of the 9-1-1 address points, and H-GAC staff have developed a methodology to begin using these data to generate a more accurate and detailed estimation of the numbers and potential locations of unpermitted OSSF systems.

To begin using 9-1-1 addressing to better delineate the location and number of potential unpermitted OSSFs, H-GAC's Data Analytics and Research Department developed an automated methodology using code written in Python. The general workflow performed by the code is detailed in **Figure 5**.

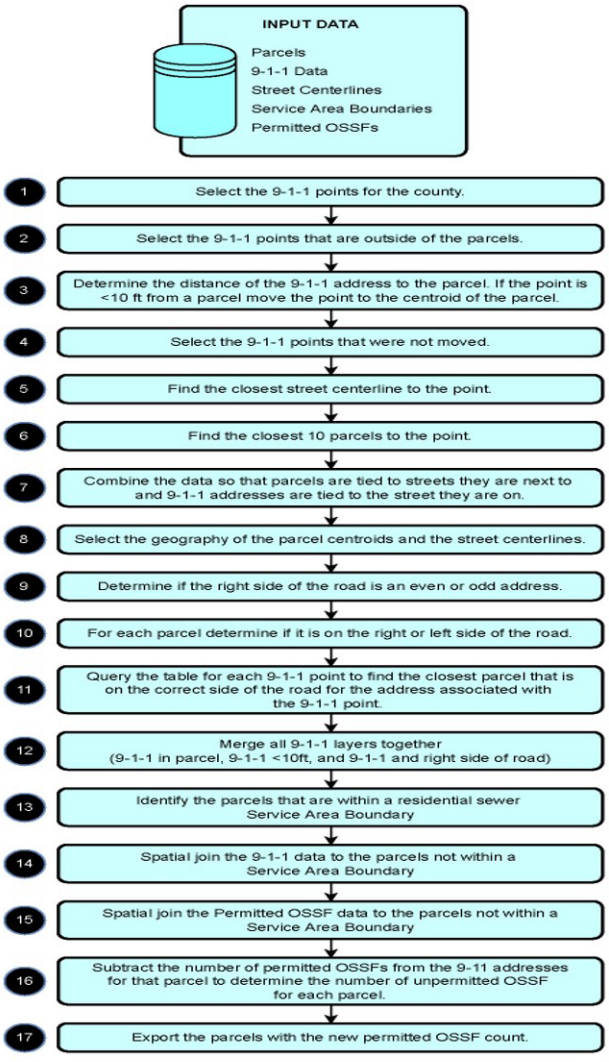


Figure 5. OSSF Workflow

For the analysis of unpermitted OSSFs in the region, the following data inputs are used:

- Parcel Data
- 9-1-1 Addresses
- Street Centerlines
- SABs
- Permitted OSSF Data

The use of 9-1-1 address data presents some challenges, as these points are sometimes assigned through address interpolation. Although many of the address points will be correctly assigned to a parcel, this process can also assign the 9-1-1 address point to the centerline of the street. It is necessary to correct the 9-1-1 address data to assign the address points to the parcel. In order to accomplish this task, the code determines if the 9-1-1 address point is already in a parcel, if the address is odd or even, and the location of the closest parcels for comparison.

The code examines the 9-1-1 address and if it is <10 feet from a parcel, assigns it to that parcel. If the 9-1-1 address is not matched to a parcel, the code then looks to the next 10 closest parcels in order and determines if the parcels are on the left or right side of the road to determine the closest odd or even numbered parcel relative to the address point. The code then fixes the 9-1-1 address points so that they are assigned to the centroid of the parcels (**Figure 5**).

Next, the code spatially joins the 9-1-1 layer and the Permitted OSSF layer to the parcels. Points that are within a known SAB are excluded, as it is assumed that these homes are connected to residential sewer. The code then calculates the number of 9-1-1 address points and the number of permitted OSSFs for each parcel (**Figure 6**).

Figure 5. Fixing of 9-1-1 Address Points to Assign to Parcels

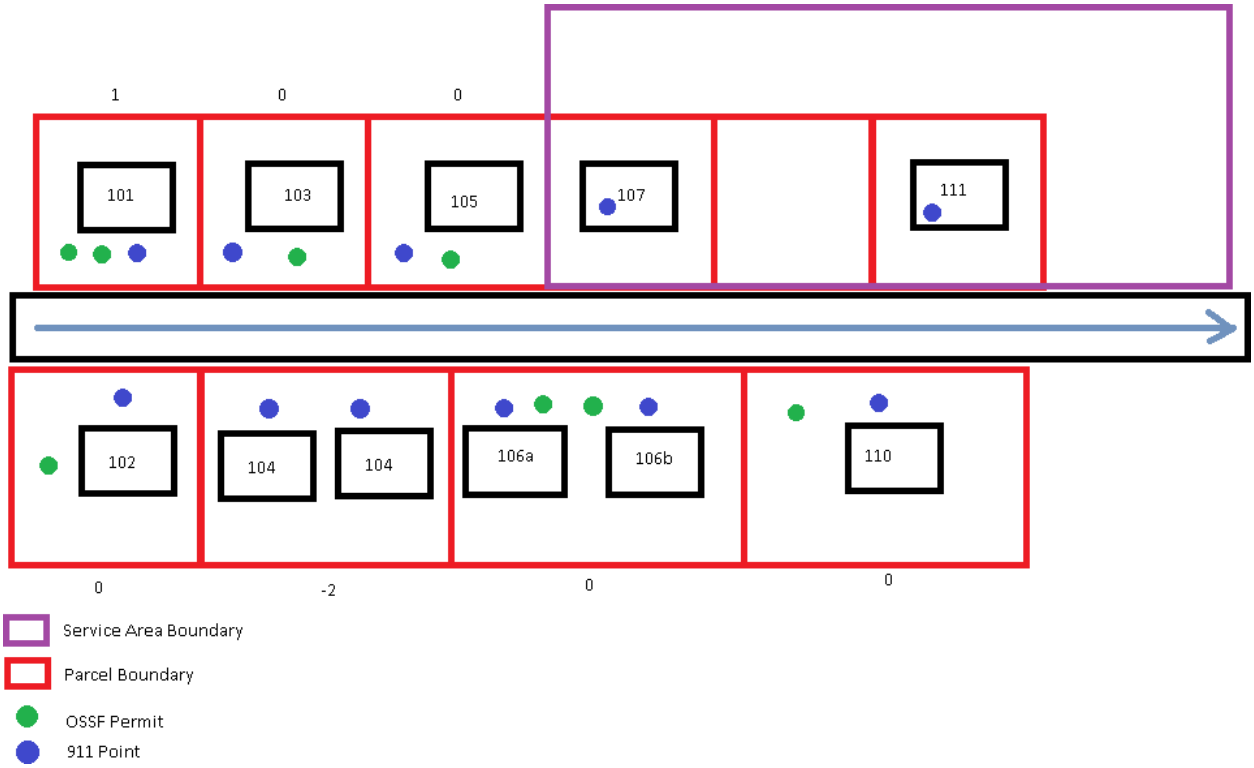


Figure 6. Fixing of 9-1-1 Address Points to Assign to Parcels

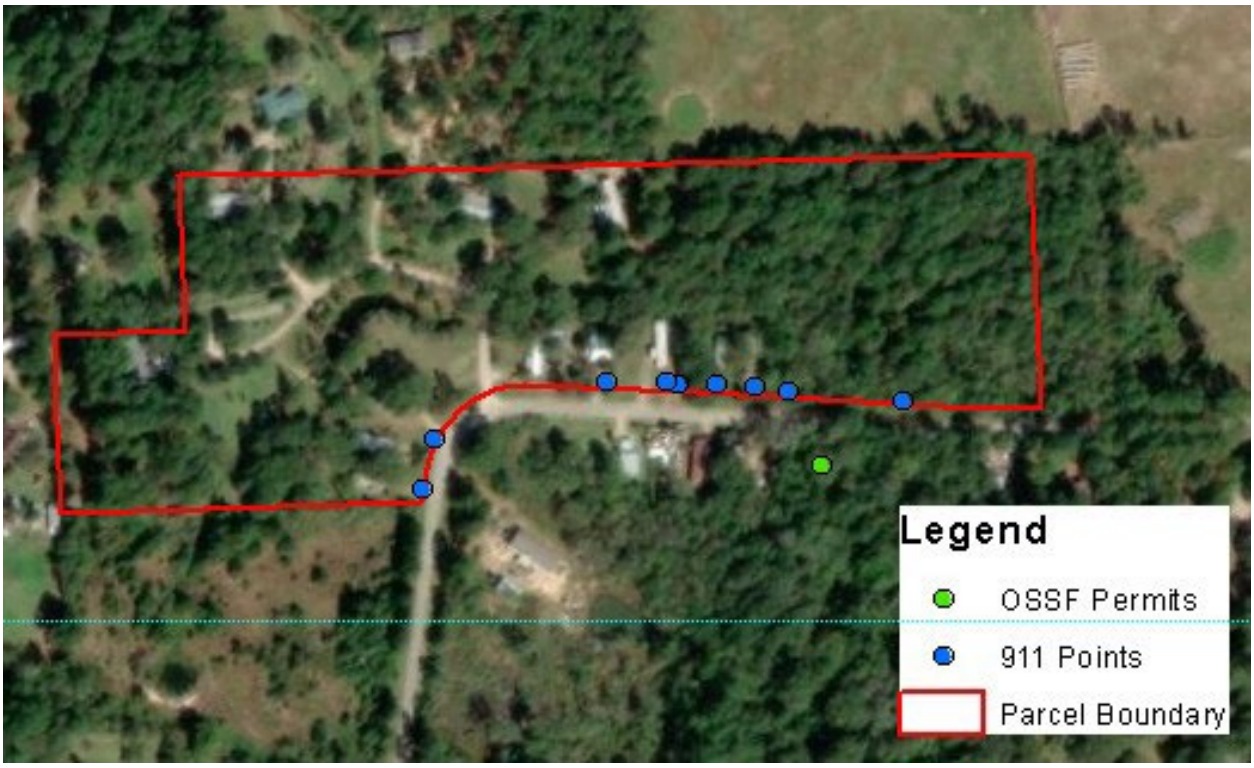


Figure 7. Aerial Imagery Verification of Unpermitted OSSFs

Appendix D lists parcels that were removed from the unpermitted analysis following verification that these parcels were unlikely to contain unpermitted OSSFs.

The difference between the number of permitted OSSFs and the number of 9-1-1 address points is used to estimate the number of unpermitted OSSFs within a parcel. For example:

- If there is one address and one OSSF, the difference is 0, meaning that there are as many addresses as there are OSSFs. There are no unpermitted OSSFs counted for this parcel.
- If you had one permitted OSSF but three addresses on a parcel, the difference would be -2. This would indicate that there should be two additional unpermitted OSSFs on this parcel.
- If there is a greater number of permitted OSSFs than addresses, that typically reflects cases where the parcel data is not updated, so for example, the parcel data may not reflect a new subdivision that is being built. It may also indicate that multiple permitted OSSFs are associated with a single 9-1-1 address, such as the address for a mobile home community. These parcels need to be verified.

In cases where the number of permitted OSSFs exceed the number of addresses, it is necessary to verify the data. This is done through a combination of review of aerial imagery (**Figure 7**) and by contacting the owner of the parcel to determine the source of the discrepancy.

Results of Unpermitted OSSF Analysis Using 9- 1- 1 Addresses

Based upon H-GAC's Unpermitted OSSF analysis using 9-1-1 address data, it is projected that there are a total of 229,481 potentially unpermitted OSSFs within the region for calendar year 2022. This number includes an estimated 3,863 unpermitted OSSFs in Grimes County.

Table 28. Summary of Permitted and Unpermitted OSSFs by County, 2022

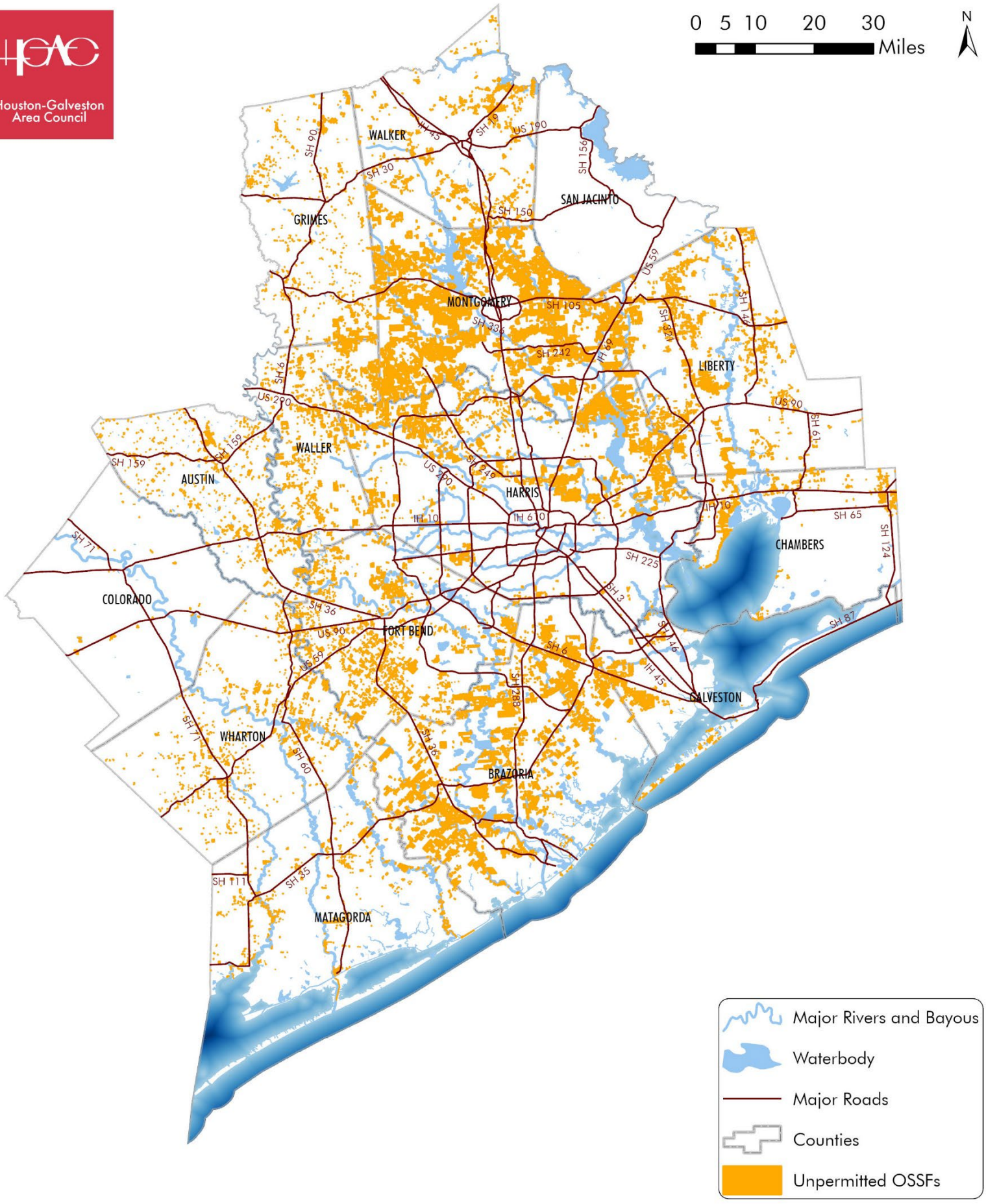
County	Permitted Systems 2022	Unpermitted Systems 2022	TOTAL OSSFs 2022
Austin	3,175	3,122	6,297
Brazoria	16,584	25,063	41,647
Chambers	1,619	6,010	7,629
Colorado	595	299	894
Fort Bend	14,576	8,208	22,784
Galveston	7,103	7,545	14,648
Grimes	4,684	3,863	8,547
Harris	25,106	84,739	109,845
Liberty	2,007	16,101	18,108
Matagorda	1,669	4,663	6,332
Montgomery	35,544	50,654	86,198
San Jacinto	No Data Available	No Data Available	No Data Available
Walker	6,043	5,541	11,584
Waller	5,026	8,182	13,208
Wharton	1,691	5,491	7,182
TOTAL	**125,422**	**229,481**	**354,903**

For the most recent analysis of 2022 data, there were 125,422 permitted OSSFs and 229,481 potential unpermitted OSSFs, for an estimated total of 354,903 OSSFs within the Houston-Galveston region.

Limitations of the Unpermitted OSSF 9- 1- 1- Analysis Methodology

Although H-GAC staff feels that the updated methodology utilizing 9-1-1 address data provides for a more accurate estimation of the number and locations of the potential unpermitted OSSFs within the region (**Map 16**), this method is not without limitations. The main limitation for this method is that the process is only as good as the input data. For example, if the street centerline data is sparse, the resulting counts and locations will not be as accurate. Another limitation is that the large geographical area and population makes ground-truthing of the data through direct observation impractical. Because of this, verification is performed using aerial imagery. While the aerial imagery for populous counties such as Harris and Montgomery is high resolution, this fine level of detail is not always available for rural counties. The imagery that H-GAC has was also taken at the end of 2019, and there has been a significant amount of development since that time.

Because of these limitations, H-GAC will work in future project years to refine this methodology. However, staff feels that even with its limitations, the new process brings us one step closer to having a more accurate estimation of potential unpermitted OSSFs than the method that relies on strictly parcel and census block data.



Map 16. Unpermitted OSSFs in the Houston-Galveston Region, 2022

AUTHORIZED AGENT COORDINATION

H-GAC staff works in coordination with Authorized Agents and their Designated Representatives to receive OSSF permit data submissions for inclusion into the regional OSSF database. For counties in the Coastal Zone (Brazoria, Chambers, Galveston, Harris, and Matagorda), H-GAC facilitates data gathering and sharing with Texas A&M AgriLife Extension, who are currently developing a Coastal Zone OSSF database for TCEQ.

Several counties did not submit data for inclusion in this year's OSSF database update, with some not having submitted data in several years. Staff changes among H-GAC staff and some of the Authorized Agents have led to the need to meet with those entities' Designated Representatives and reestablish working relationships. While staff have had discussions with several of the Designated Representatives, further meetings are necessary to resume receiving data from the other permitting authorities.

H-GAC staff reached out to the Designated Representatives for both San Jacinto County and Grimes County. Although both of these counties are outside H-GAC's 13-County area, H-GAC does conduct water quality monitoring in those counties. Additionally, H-GAC is the lead agency on watershed-based plans being developed for water bodies in those counties. Information on OSSF location and density is very important for TMDL implementation or making recommendations in WPPs.

SEP COORDINATION AND OUTREACH

H-GAC is the Third-Party Administrator for a SEP through the TCEQ (Agreement No. 2012-15). H-GAC's Homeowner Wastewater Assistance Program funds the repair or replacement of malfunctioning or failing OSSFs for homeowners who meet certain income requirements. Funding from this project may also be used to provide extension of first-time sewer service, pump-out service, and water conservation equipment. Homeowners are not charged for any portion of the cost of the work performed.

Funding for the SEP program is provided through voluntary contributions by respondents in a TCEQ enforcement action. These respondents negotiate an agreement to perform a TCEQ-approved SEP to offset a portion of the assessed administrative penalty. In addition to the funding through TCEQ, the Harris County District Attorney's Office also provides funding through their enforcement actions.

Homeowners under enforcement for violation of TCEQ rules set forth in 30 TAC § 285 are not eligible for assistance under the TCEQ SEP. However, the additional funding from the Harris County District Attorney's Office does not have that same requirement. Additionally, since Harris County is concerned about water quality on a regional level, their funding is not limited to just Harris County and can be used to address OSSF issues throughout the region. Funding has also been supplied by industrial partners for projects in Brazoria County.

Coordination of H-GAC's Homeowner Wastewater Assistance Program occurs through the WQMP project. The WQMP contract does not fund any OSSF repair and replacement projects, as that funding strictly comes from one or more of the SEP funding sources. However, the WQMP supports the SEP program as a component of the water quality planning process, particularly the outreach and education component of the SEP. Through the SEP, H-GAC can identify failing OSSFs, either through homeowner self- disclosure or reported through referrals from Authorized Agents or OSSF professionals. This is an important planning tool used by H-GAC in addressing failing or malfunctioning OSSFs as a major contributor to bacterial impairments in the region. By identifying these systems and then targeting them for repair, replacement, or decommissioning through the SEP, H-GAC can actively contribute to the remediation of these systems.

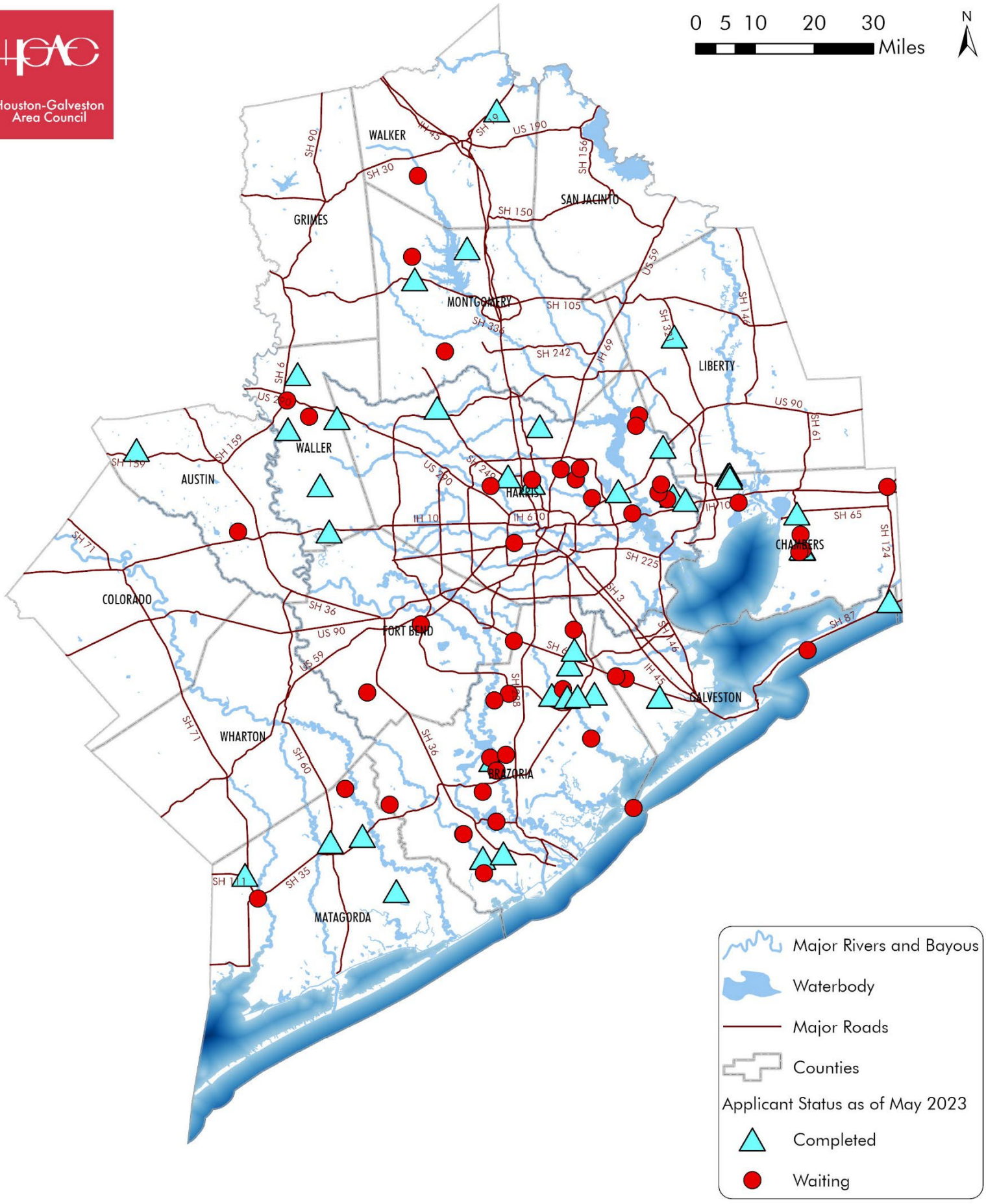
H-GAC's efforts largely target priority watersheds (such as those monitored by the Clean Rivers Program or subject to a WPP or TMDL) to identify areas with failing OSSFs and evaluate best management practices to address the issue. Efforts are coordinated with the appropriate H-GAC staff for each watershed project, as well as the local permitting and enforcement agencies.

SEP activities supported by the WQMP include coordinating with elected government officials and enforcement agencies to promote the program and presenting at numerous meetings to inform homeowners and OSSF professionals about the program and the qualifications that applicants must meet to qualify.

As of 7/1/23, the SEP program has funded the replacement of 30 failed OSSFs and the repair of 14 malfunctioning OSSFs (**Table 29**). Due to diminished funding levels, H-GAC was only able to complete one OSSF replacement in 2022. In addition to those systems that have been repaired or replaced, H-GAC has 50 homeowners on a waiting list (**Map 17**).

Table 29. SEP OSSF Replacements and Repairs by County, 2018 to 2023

County	Replacement	Repair	Waiting
Austin	1	-	1
Brazoria	6	3	17
Chambers	6	-	5
Colorado	-	-	-
Fort Bend	-	-	2
Galveston	2	-	3
Grimes	-	-	-
Harris	5	3	13
Liberty	-	4	-
Matagorda	3	1	3
Montgomery	2	2	2
San Jacinto	-	-	-
Walker	-	1	1
Waller	5	-	3
Wharton	-	-	-
TOTAL	**30**	**14**	**50**



Map 17. OSSF Repair and Replacement Projects, 2018 to 2022

OSSF OUTREACH AND EDUCATION

Homeowner Education Courses

Through H-GAC's OSSF Outreach and Education programs, staff traditionally conduct or facilitate educational training courses on basic OSSF maintenance and fundamentals of operation. These training courses are offered to homeowners, real estate inspectors and other interested parties as requested.

Homeowner outreach conducted through the SEP is an important component of numerous watershed-based projects. H-GAC uses this program as a vehicle by which homeowners can be educated about the proper operation and maintenance of their systems. Unfortunately, no classes have been hosted during this project year. Staff intends on holding a homeowner education course later in 2023 to specific project communities if there is interest or hold a workshop in a central location where residents in different communities can attend. H-GAC will also explore opportunities to make OSSF Homeowner Education Courses available online, either through interactive presentations via Teams or Zoom, or through hosted web videos, such as YouTube.

Coastal Communities Outreach Tools

In collaboration with the H-GAC's Coastal Communities Outreach and Education program, staff prepared newsletter and social media content for distribution to residents of the Coastal Communities project area. This included not only information related to OSSFs, but also topics such as fats/oils/grease, pet waste, household hazardous waste, litter, and illegal dumping.

For OSSF outreach and education, several outreach tools were created, including flyers, bill inserts, and web banners that can be utilized by communities through the Coastal Communities Tool Kit. Examples of these outreach materials are shown in **Figure 8**.

These outreach resources were created through the project "Outreach Implementation for Galveston Bay Water Quality Projects" funded by a FY 2021 grant from GBEP. This project is a continuation H-GAC's Coastal Communities Outreach and Education program which developed an outreach roadmap and resources to assist small, non-MS4, communities in the region's coastal counties with the creation and implementation of water quality outreach and education for their residents. The initial Coastal Communities project was funded in part by the TCEQ through a grant from the EPA.

Figure 8. Outreach and Education Materials

OSSF MAPPING TOOL EXPANSION FEASIBILITY STUDY

The purpose of this Task is to determine the feasibility and interest of using the H-GAC's current OSSF Mapping Tool to host OSSF data from an interested partner, specifically NCTCOG, with the purpose to provide a repository for OSSF permit data for use in watershed-based planning activities by the partner. As part of the NCTCOG Scope of Work Subtask 3.4 in this Work Plan, NCTCOG plans to determine the feasibility of aligning NCTCOG's OSSF inventory and spatial dataset with the existing approach already in use in the Houston-Galveston region.

COLLABORATIVE PLANNING ACTIVITIES

H-GAC will coordinate and facilitate planning activities with currently identified collaborators (and future potential collaborators), specifically NCTCOG, to determine the feasibility of incorporating their OSSF permit data into H-GAC's OSSF Mapping Tool. This task will include planning meetings and presentations (virtual, hybrid, or in-person) with collaborators and TCEQ to facilitate discussion of technical issues, data quality objectives, contractual and budgetary considerations, and other pertinent issues for developing an expanded OSSF Mapping Tool in future project years. A minimum of two meetings will be held in FY 23 for in-depth discussions, supplemented by quarterly conference calls. The meeting and conference call schedules for FY 24 will be determined once a decision is made on the feasibility of the project.

H-GAC will also conduct internal planning and coordination meetings with staff from their Data Analytics and Research department to discuss technical considerations for expansion of the OSSF Mapping Tool. These discussions will include development of budgets for personnel and equipment costs associated with the possible expansion.

Continuation of this task in FY 24 is dependent upon the results of the FY 23 feasibility study. If it is determined that the proposed expansion of H-GAC's OSSF Mapping Tool will move forward, H-GAC will work with the collaborative partner(s) to begin acquiring and incorporating their data under Task 6.1 beginning in FY 24.

SUMMARY

The FY 2023 WQMP Update Report summarizes the activities conducted under TCEQ Contract 582-23-40182.

For this year's Project, H-GAC acquired and analyzed WWTF infrastructure data for the Houston-Galveston area region. Both the wastewater permitted discharger GIS layer and the SAB GIS layer were updated as part of this work, expanding the data repository that H-GAC maintains. These data are used throughout multiple H-GAC programs, such as the Clean Rivers Program, as well as in the development of watershed-based plans such as WPPs and TMDLs.

A primary component of the WQMP Update involves the acquisition and analysis of self-reported DMR data. These data are important for evaluating potential sources of bacteria in area waterways. Analysis of WWTF effluent monitoring data provides a means by which decision makers and water resource managers can evaluate the role wastewater infrastructure plays in regional water quality issues. The analysis provided in this report shows WWTFs are typically operating within compliance of their effluent discharge permit limits for bacteria. However, considering the volume of discharge and the potential for high bacteria loading in the case of a system malfunction, it is prudent to continue to monitor the DMR data closely. The DMR data acquired through this project are important for other watershed-based projects within the region, most notably the BIG TMDL project. Through addressing issues such as WWTF discharge permit limits, the BIG has been very successful in reducing bacteria loading in the region's water bodies.

As part of the WQMP Update, H-GAC also analyzed self- reported SSO data for the region. SSO data are of great interest due to the potential for acute loading of extremely elevated levels of human fecal bacteria. H-GAC analyzed the frequency, volume, and root causes of SSOs.

H-GAC continues to develop and foster relationships with interested parties in the region's watersheds and coordinate regional water quality activities. H-GAC has been a leader in TMDL and WPP efforts, and the coordination activities of the WQMP Update Project mesh well with the overall approach of outreach, targeted studies, and implementation activities. By having multiple water quality projects concurrently within the same organization, H-GAC is able to achieve vertical integration between base data sources, internal analysis, watershed planning efforts, and external coordination.

The OSSF Database development which started in previous projects continued during this year and will be an ongoing effort that will be continuously updated. This project deliverable remains useful in H-GAC's various watershed planning efforts. H-GAC acquires OSSF permit data from Authorized Agents throughout the region and consolidates that data into a regional database. An estimation of unpermitted OSSFs is also performed

through this project. The number, location, and density of these OSSFs are important considerations in the development of watershed-based plans. This information is also useful in targeting OSSF homeowner education and outreach programs or OSSF repair and replacement initiatives.

H-GAC is the Third Party Administrator for an SEP to repair or replace malfunctioning or failed OSSFs for qualifying homeowners within the region. Through this SEP, H-GAC addressed numerous failing systems. Although the WQMP Contract does not fund any OSSF repair or replacement, many of the coordination, outreach, and education activities are conducted through this Project.

The accumulated data sets, the GIS analyses, and other deliverables generated through this Project have been submitted electronically to TCEQ. Where allowable and appropriate, data from this Project will be used to support other related efforts.

This *WQMP Update Report*, once accepted by the H-GAC Board of Directors and certified by TCEQ, will be incorporated into the State's WQMP.

ADDITIONAL RESOURCES

The following resources are provided for additional information on topics discussed in this report:

HOUSTON- GALVESTON AREA COUNCIL

H-GAC Main Page
https://www.h-gac.com/Home

Water Quality Management Planning
https://www.h-gac.com/water-quality-management- planning

OSSFs
https://www.h-gac.com/on-site-sewage-facilities

OSSF Information System
https://datalab.h-gac.com/ossf

Clean Rivers Program
https://www.h-gac.com/clean-rivers-program

Clean Rivers Program 2021 Basin Summary Report
https://datalab.h-gac.com/BSR2021/

Clean Rivers Program 2023 Basin Highlights Report
https://h-gac.maps.arcgis.com/apps/instant/portfolio/index.html?appid=e8a531edfed04175bbee10e7a911696f

Water Resources Information Map (WRIM)
https://h-gac.com/go/wrim

NRAC
https://www.h-gac.com/board-of-directors/advisory-committees/natural-resources-advisory-committee

Clean Waters Initiative Workshops
https://www.h-gac.com/clean-water-initiative-workshops

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

Watershed-Based Plans
https://www.h-gac.com/watershed-based-plans

Coastal Communities
https://www.h-gac.com/coastal-communities

Coastal Communities Tools & Resources
https://www.coastalcommunitiestx.com/get-tools.html

TEXAS WATER DEVELOPMENT BOARD

CWSRF Loan Program
http://www.twdb.texas.gov/financial/programs/CWSRF/index.asp

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Permit Application and Registration Information Systems (PARIS)
https://www6.tceq.texas.gov/wqpaq/index. cfm?fuseaction=home.AdvanceSearch

TCEQ GIS Data
https://gis-tceq.opendata.arcgis.com/

Texas Surface Water Quality Standards
https://www.tceq.texas.gov/waterquality/standards

Texas Integrated Report of Surface Water Quality
https://www.tceq.texas.gov/waterquality/assessment

Texas Clean Rivers Program
https://www.tceq.texas.gov/waterquality/clean-rivers/ index.html

Surface Water Quality Segments Viewer
https://www.tceq.texas.gov/gis/segments-viewer

Surface Water Quality Web Reporting Tool
https://www80.tceq.texas.gov/SwqmisPublic/index.htm

State WQMP
https://www.tceq.texas.gov/permitting/wqmp

TMDL Program
https://www.tceq.texas.gov/waterquality/tmdl/index.html

Nonpoint Source Program

https://www.tceq.texas.gov/waterquality/nonpoint-source/ index

Wastewater and Stormwater Permitting
https://www.tceq.texas.gov/permitting/wastewater

SEP
https://www.tceq.texas.gov/compliance/enforcement/sep

OSSF Rules and Regulations
https://www.tceq.texas.gov/permitting/ossf/ossfregulators. html

GBEP
https://gbep.texas.gov/

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ECHO
https://echo.epa.gov/

ECHO Facility Search - Enforcement and Compliance Data
https://echo.epa.gov/facilities/facility- search?mediaSelected=cwa

ECHO ICIS-NPDES Permit Limit and Discharge Monitoring Datasets
https://echo.epa.gov/tools/data-downloads/icis-npdes- dmr-and-limit-data-set

ECHO Water Pollution Search
https://echo.epa.gov/trends/loading-tool/water-pollution- search/

Municipal Wastewater
https://www.epa.gov/npdes/municipal-wastewater

Septic Systems (Onsite/Decentralized Systems)
https://www.epa.gov/septic

Septic Systems Outreach Toolkit
https://www.epa.gov/septic/septic-systems-outreach-toolkit

REGIONAL TMDL PROJECTS

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

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

implementation-plan

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

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

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

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

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

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

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

REGIONAL WPP PROJECTS

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
https://cypresspartnership.weebly.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://agrilife.org/highlandbayou/files/2021/05/Highland-Bayou-Coastal-Basin-5.12.2021-FINAL.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
https://springcreekpartnership.weebly.com/

West Fork San Jacinto River and Lake Creek WPP
www.westfork.weebly.com

APPENDICES

APPENDIX A: WASTEWATER DATA UPDATE AND COORDINATION DATA DELIVERABLES

The following Contract Deliverables were submitted electronically with this report:

GIS LAYERS

- Wastewater Outfalls GIS Layer
- SAB GIS Layer

MAPS

- SAB_2023_Outfalls_Map
- DMR_frequency_2018_2022
- DMR_frequency_2022
- DMR_wtshd_density_2018_2022
- DMR_wtshd_density_2022
- SSO_discharge_volume_2018_2022
- SSO_ discharge_volume _2022
- SSO_wtshd_density _2018_2022
- SSO_wtshd_density _2022

DATA ANALYSIS

- Region 12 DMR Analysis SAS Output File

APPENDIX B: OSSF DATABASE UPDATE DATA DELIVERABLES

The following Contract Deliverables were submitted electronically with this report:

GIS LAYERS

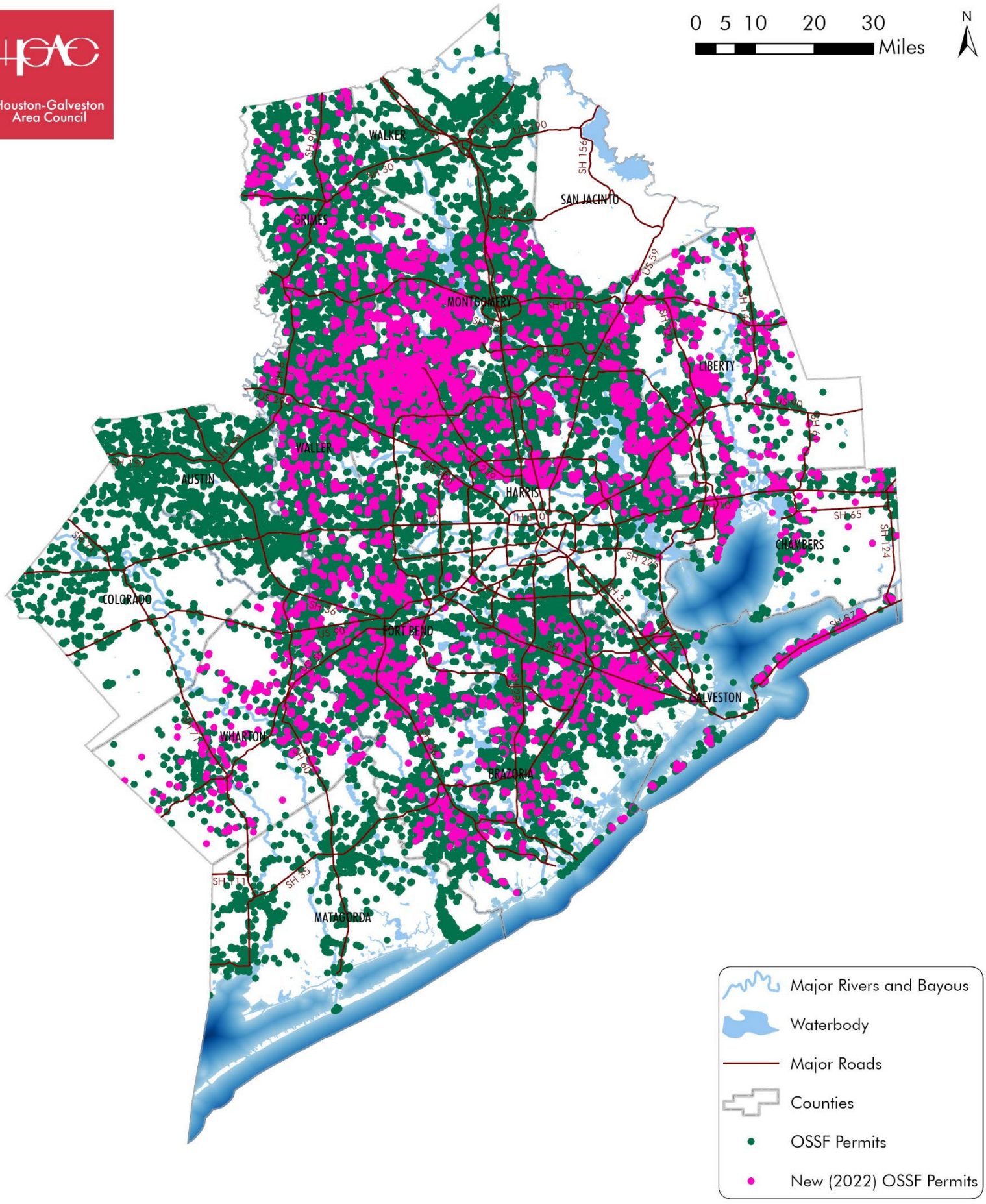
- Permitted OSSF Database
- Unpermitted OSSF Analysis

MAPS

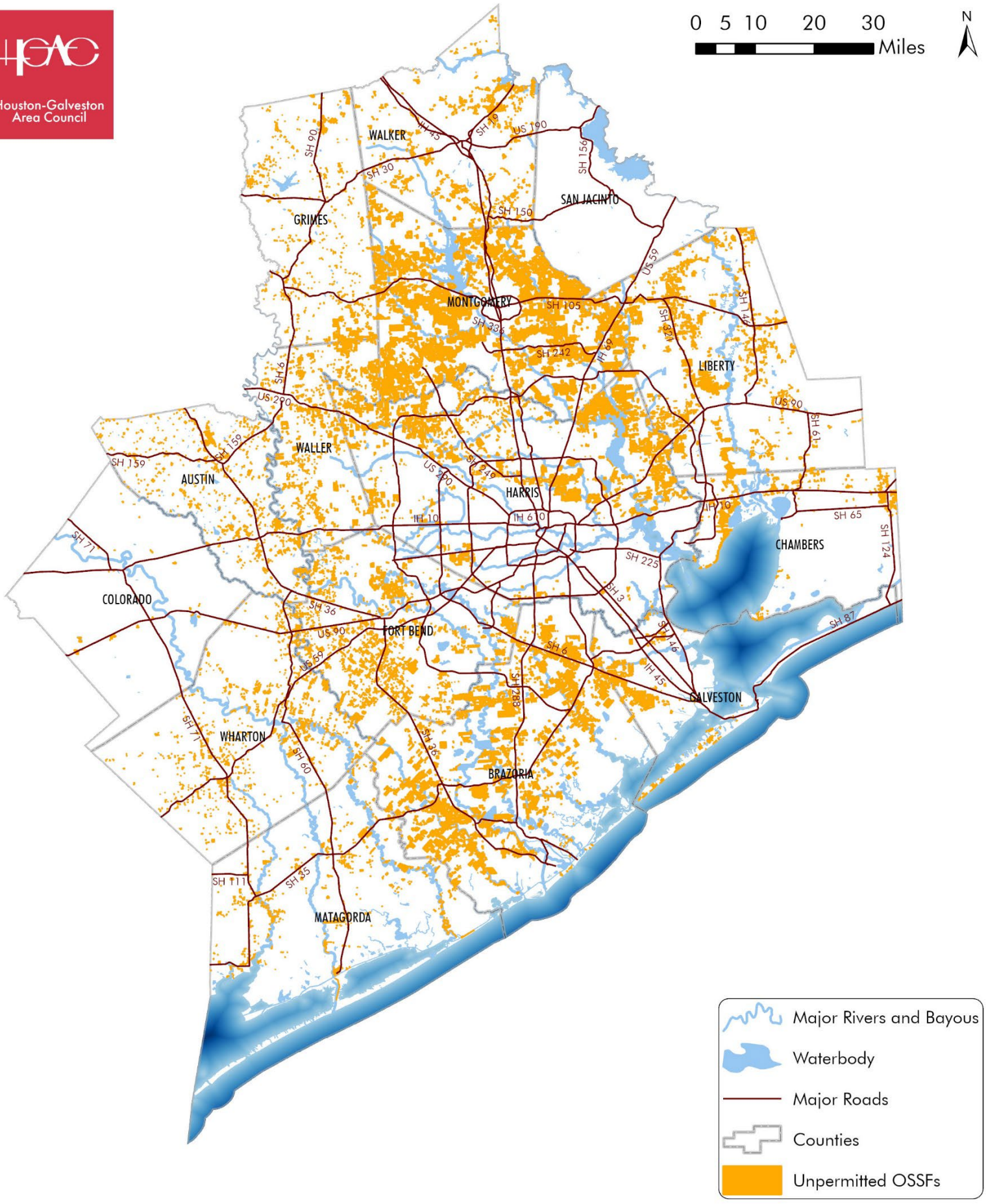
- 2022_Permitted_OSSFs
- 2022_Permitted_OSSF_Concentrations
- 2022_Unpermitted_OSSFs
- SEP_Applicants_16May23

APPENDIX C: MAPS OF PERMITTED AND UNPERMITTED OSSFS

MAP C-01A. Regional Permitted OSSFs, 2022
MAP C-01B. Regional Potential Unpermitted OSSFs, 2022



Map C-01A. Regional Permitted OSSFs, 2022



Map C-01B. Regional Potential Unpermitted OSSFs, 2022

APPENDIX D: PARCELS EXCLUDED FROM UNPERMITTED OSSF ANALYSIS

County	Parcel ID	OSSF Count	Reason for Removal
Brazoria	BZ65833	96	Imagery indicates only one house on parcel.
Brazoria	BZ112192	60	Mobile Home Community website (Creekside Community) indicates "water, sewer, and trash" are included with each lot.
Brazoria	BZ24384	31	New subdivision built 2022 that indicates water sewer to water district.
Brazoria	BZ24365	15	Imagery indicates no units on property. Most likely new community to be built.
Brazoria	BZ34083	10	Imagery indicates only one house on parcel.
Chambers	CH19131	26	Nearby home indicates public sewer in home description.
Fort Bend	FB386263	296	New subdivision is/being built. Most likely not having OSSFs. Related to FB18639.
Fort Bend	FB18639	108	New subdivision is/being built. Most likely not having OSSFs. Related to FB386263.
Fort Bend	FB2640	30	Addresses within parcel indicate newly built lease homes. Most likely not having OSSFs.
Fort Bend	FB236527	12	Recently built townhomes. Most likely not having OSSFs.
Fort Bend	FB17459	10	New community being built. Most likely not having OSSFs.
Harris	HR992100	359	New subdivision is/being built. Most likely not having OSSFs.
Harris	HR87504	141	Townhomes within Harris most likely not having individual OSSF permits.
Harris	HR1333994	126	New subdivision is/being built. Most likely not having OSSFs.
Harris	HR87506	89	Townhomes within Harris most likely not having individual OSSF permits.
Harris	HR925190	57	New subdivision is/being built. Most likely not having OSSFs.
Harris	HR87508	46	Townhomes within Harris most likely not having individual OSSF permits.
Harris	HR1315130	44	Mobile home community (Lakewood Village) website indicates public sewer.
Harris	HR1315131	44	Mobile home community (Lakewood Village) website indicates public sewer.
Harris	HR1315132	44	Mobile home community (Lakewood Village) website indicates public sewer.
Harris	HR1315135	36	Mobile home community (Lakewood Village) website indicates public sewer.
Harris	HR168358	40	Walnut Terrace Apartment homes most likely not on OSSF.
Harris	HR927271	32	New subdivision is/being built. Most likely not having OSSFs.
Harris	HR1315136	31	Mobile home community (Lakewood Village) website indicates public sewer.
Harris	HR1064318	25	New subdivision is/being built. Most likely not having OSSFs.
Harris	HR169331	24	Terra Courtyard Condos with public sewer.
Harris	HR1318293	24	Current imagery does not indicate residential units on parcel.
Harris	HR1318295	20	Current imagery does not indicate residential units on parcel.
Harris	HR1342058	20	New subdivision is/being built. Most likely not having OSSFs.
Harris	HR742943	19	New subdivision is/being built. Most likely not having OSSFs.
Harris	HR927297	18	Enclave at Northpointe subdivision. Website indicates public sewer.
Harris	HR1063890	18	New subdivision built in 2020. Most likely not having OSSFs.
Harris	HR1315134	18	Mobile home community (Lakewood Village) website indicates public sewer.
Harris	HR1305711	18	Shopping center within Kingwood.
Harris	HR1318294	15	Current imagery does not indicate residential units on parcel.

County	Parcel ID	OSSF Count	Reason for Removal
Harris	HR110509	13	Park West Apartments, most likely not on OSSFs.
Matagorda	MA12215	17	Appears as an apartment complex. Would not have individual OSSFs.
Montgomery	MG223086	175	Mobile Home Community no longer present.
Montgomery	MG64446	135	New Perry Home subdivision.
Montgomery	MG58083	103	Mobile Home Community no longer present. Possibly KB Homes Creekside Court.
Montgomery	MG52191	68	New subdivision built in 2021.
Montgomery	MG35127	33	New subdivision built in 2021.
Montgomery	MG227753	28	Riverway Properties selling land in Dec 2021. No current residential homes.
Montgomery	MG216878	20	Imagery indicates only one house on parcel.
Montgomery	MG58080	19	New subdivision built in 2021. Webpage indicates Enclave at Dobbin is served by public sewer.
Montgomery	MG73519	14	New subdivision built with indications of public sewer.
Waller	WA21750	75	Apartment Complex (newer build)
Wharton	WH27781	81	Called El Campo Village to confirm that sewer is connected to city.

APPENDIX E: WQMP UPDATE TIMELINE

The *WQMP Update Report* summarizes all contract activities and findings relevant to the water quality goals of the Houston-Galveston region. A draft of this Update Report has been made available for public comment in accordance with Texas Water Code (TWC) Section 26.037 to allow interested parties the opportunity to comment and provide input into the WQMP Update. The report has also been submitted to H-GAC's NRAC for review and comment.

Comments received will be addressed in the Final Report. A table documenting comments received and H-GAC's written response to those comments will be incorporated into the Final WQMP Report as an Appendix (see Appendix F).The Final *WQMP Update Report* will be submitted to H-GAC's Board of Directors for acceptance. Once accepted by the Board, the Update will be certified by TCEQ for inclusion in the State's WQMP.

The timeline presented in **Table E-1** was established to meet the requirements of TWC Section 26.037 related to the public comment period for the report.

Table E-1. WQMP Report Review, Acceptance, and Submittal Timeline

Task	Due Date
WQMP Update Draft Report and Project Data Deliverables due to TCEQ	7/1/2023
Thirty-Day Public Comment Period Opens	7/1/2023
Send Draft WQMP Update Report electronically to NRAC members for review	7/1/2023
Upload Draft WQMP Update Report to H-GAC's website	7/1/2023
Public Comment Period closes	8/3/2023
Revise Draft WQMP Update Report to address public comments	7/3/23 - 8/3/23
Present Final WQMP Update Report to NRAC for recommendation to Board of Directors	8/3/2023
H-GAC Board of Directors Meeting	8/15/2023
Upload Final WQMP Report to H-GAC's website	8/31/2023
Submit Final WQMP Update Report and documentation of public comment period to TCEQ	8/31/2023

APPENDIX F: WQMP UPDATE FINAL REPORT DOCUMENTATION AND COMMENTS

The following Contract Deliverables were submitted electronically with the Final version of this report:

- Documentation of Public Participation
- Comments received on the FY 2023 WQMP Update Report
- Response to comments on the FY 2023 WQMP Update Report

Documentation of Participation in the WQMP Update

- To ensure the public has an opportunity to participate in the WQMP Update and provide comments on the report, a 30- day public comment period was available. This comment period opened on 7/1/23.
- The Draft WQMP Update Report was sent electronically to members of the NRAC for review and comment on 6/30/23.
- The Draft WQMP Update Report document was posted on H-GAC's website for public review and comment on 6/30/23.
- The Public Comment period closed on 8/3/23.
- The Draft WQMP Update Report was updated to address public comments and comments from the NRAC.
- The Final WQMP Update Report, incorporating comments submitted by the public and NRAC, was presented to the NRAC on 8/3/23 as part of a public meeting.
- The Final WQMP Update Report was submitted to the H-GAC Board of Directors for acceptance on 8/15/23.
- The Final WQMP Update Report was submitted to TCEQ for certification on 8/31/23.

Public Comments on WQMP Update

From	Page #	Comment	Response
Tom Douglas, *Houston Sierra Club*	8	At the end of paragraph 4, consider saying "watershed protection plans (WPPs) and Total Maximum Daily Loads (TMDLs)" instead of using "or". In some cases, a single waterbody may have both. (see page 45)	Amended as suggested.
"	10	Table 1: Insert a white dividing line between the titles for columns 2 and 3. This formatting problem also occurs in many of the report's other tables.	This suggestion improves clarity and was incorporated in all tables throughout the document.
"	12	Table 2, Task 1: "Project Administration" instead of "Project Administrative" in column 2.	Amended as suggested.
"	12	Table 2, Task 8: I was not clear on the use of the phrase "for the Gulf Coast region". Is that report done by H-GAC, or is that a function of TCEQ?	Rearranged the language in this paragraph to improve clarity. H-GAC prepares a report on activities in the Gulf Coast region and submits it to the TCEQ.
"	14	At the end of paragraph 1, do you mean to say: "including wastewater treatment facility discharge"?	Yes, amended as suggested.
"	19	In the paragraph preceding Table 4, do you mean to say: "with 84 of those industrial facilities submitting bacteria data"?	Yes, amended as suggested.
"	21	In Table 9, I believe that it would be clearer to enter "0" instead of just a dot for those cells where no exceedances were observed. (5-10 MGD and >10 MGD) In column 4, I suggest entering 0.00% for those two categories. (This would match with usage in the text on pages 21 and 22.)	Amended as suggested.
"	22	In Table 10 there is a computational error. Instead of summing up the Percent Exceedance values from rows 1-7, the percent exceedance total in row 8 should be shown as 242/8,843 = 2.74%.	Great catch, amended as suggested.
"	22	In the paragraph below Table 10, insert a period at the end of the sentence ending in: "…highest percent exceedance rate for the daily maximum/single grab samples at 6.67%".	Amended as suggested.
"	25	Table 15 and Table 16: What are the units for the numbers in these two tables? They look way too low to be MPN/100 mL.	Unable to confirm with data analysts; removed tables from WQMP

From	Page #	Comment	Response
Tom Douglas, *Houston Sierra Club*	27, 29	The area shown in white in Chambers County on Map 8 is larger than the area shown in white in Chambers County on Map 6. Is the explanation that the southern part of that area had one or more outfalls at some time during the 2018-2021 period, but not in 2022? If so, it would deserve mention. In general, it would be helpful to distinguish watersheds that have no outfalls located within their boundary from areas for which there are no data. (perhaps show them in plain white vs. cross-hatched white)	Added supporting text.
"	32	In Table 19, there is a conspicuous decrease in the number of domestic permittees reporting SSOs in 2022. Is there a probable explanation for this? The number of SSOs reported is also much lower in 2022. (Table 22)	We have revised our methods to start with the statewide SSO dataset rather than a subset of TCEQ Region 12 (H-GAC region). While more reports were discovered for 2022 through this method, the total number of events was still low compared to previous years.
"	33	In Table 20, double check the number of SSOs reported for the year 2022. Is it by coincidence the same as the number of domestic permittees reporting SSOs for the year 2021 (from Table 19)?	Yes, this is a coincidence. The number of SSO events reported in 2021 is the same as the number of entities reporting in 2022, but these two values are not related.
"	33	In paragraph 4, the text says that: "The reported source with the largest volume of discharge was Rain/Inflow/Infiltration, at approximately 119,640.00 gallons." Given that this is an estimate, assigning a value with a precision to the nearest one-hundredth of a gallon does not seem warranted.	Amended as suggested.
"	36	Regarding Table 22, is there a probable explanation for why the number of SSOs reported for the year 2022 is so much lower than the numbers reported for the other four years?	See comment for Table 19. We acknowledge that the data is dependent on self-reported estimates, and that SSOs may go undetected in certain conditions and may not documented or reported to the TCEQ.
"	39, 41	On Map 10 and Map 12, there are two reasons that an area might be shown in white. Either there are no systems that could possibly report an SSO, or there are in fact systems present, but that they did not report any SSOs. It would be advantageous if the two possible causes of zero reports for a given area could be distinguished by the shading on the maps. (perhaps by showing them as plain white vs. cross-hatched white)	Will refer readers to Map 3 for all potential permitted locations that could submit a report for SSOs.

From	Page #	Comment	Response
Tom Douglas, *Houston Sierra Club*	37	The text in the final paragraph says that: "Based on the locations of reported SSOs, the more populated urban and suburban watersheds throughout the region are experiencing higher rates of SSO events compared to the more rural, smaller communities along the outer perimeter of the region." Contrary to that generalization, the central area of Harris County has a markedly lower number of SSOs (Map 9 and Map 11). The text description should explain the probable reason for this.	Spatially, there's not a high density of outfalls in central Harris County (Map 3) and we are limited by the self-reported data we receive from the SSO records. Added supporting text.
"	42	There is an unintended line break in Paragraph 3.	Thank you, this break has been removed.
"	46	In two rows in Table 25 (Upper Oyster Creek and Dickinson Bayou), consider inserting a comma between "Bacteria" and "Dissolved Oxygen". This would match the usage in Table 26.	Amended as suggested.
"	49	In Table 26, consider adding Cowart Creek to the list of water bodies included in the Clear Creek WPP.	Amended as suggested.
"	49	In Table 26, consider adding Senger Gully and Lemm Gully to the list of water bodies included in the Cypress Creek WPP.	Amended as suggested.
"	49	In Table 26 and its caption, consider either editing the description of the asterisk symbol or adding another symbol to identify those WPPs, such as those for Dickinson Bayou, Double Bayou, and Lake Conroe, that were developed by entities other than H-GAC.	Adjusted to indicate which projects were facilitated by H-GAC
"	49	In Table 26, consider adding Turkey Creek and Snake Creek to the list of water bodies included as part of the San Bernard River watershed. In general, shouldn't all of the named subwatersheds that are defined in the San Bernard River WPP (see page 52 of that WPP) be included?	Amended as suggested.
"	49	In the caption to Table 26, consider adding the link to regional watershed-based plans: https://www.h-gac.com/watershed-based-plans	
"	52	At the end of the first full paragraph: "For this planting, hundreds of trees were planted…"	Amended as suggested.
"	54	Remove the extra line break at the end of the second to last paragraph.	Amended as suggested.
"	62	The reference at the end of the last paragraph should be to Figure 5.	Amended as suggested.
"	66	At the end of the first paragraph, "This number includes…"	Amended as suggested.
"	70, 71	The number of homeowners on the SEP waiting list is shown as 48 in the text, but as 50 in Table 31.	The number in the text was an error, it has been amended to reflect the value in the table.

From	Page #	Comment	Response
Tom Douglas, *Houston Sierra Club*	75	In line 3, there is a duplicated comma. In lines 6 and 7, there are extra commas.	Extra commas removed.
"	87, 68	Does Map C-01B (page 87) differ from Map 17 (page 68)?	No, these maps are the same. We repeated this map and the potential unpermitted OSSF map in lieu of providing individual county maps as done in the 2022 WQMP Update as the county maps did not visually change much between the two project years.
Jim Kain, *Citizen*	General	The analyses provided in the update report show wastewater treatment facilities are typically operating within compliance of their effluent discharge permit limits for bacteria. However, considering the volume of discharge and the potential for high bacteria loading in the case of a system malfunction, it is prudent to continue to monitor the DMR data closely. The H-GAC and TCEQ should also review regional disinfection practices and make recommendations to lower Bacteria DMR Data Geometric Mean and Daily Maximum/Single Grab Sample Permit Exceedance Rates.	Thank you for this comment, we agree that continued monitoring of the data helps to keep this information front-of-mind and accessible to our stakeholders in the region. Continued improvement and reduction of risk is the primary goal of water quality planning efforts throughout the region
"	General	The density of WWTF outfalls in urban and suburban centers is much greater than the less populated watersheds in the region, therefore it would be expected that the number of DMR bacteria violations would also be higher. However, is there a difference in the percent of chlorine resistant bacteria in urban versus rural watershed areas, perhaps due to the influence of antibiotics in sanitary sewage? And, what steps can be taken to counter pathogenic microbes from developing resistance to normal disinfection processes? Are any studies planned as part of future Water Quality Management Plan Update Reports?	This is a thought-provoking point that H-GAC does not have any current data for. We would be interested in following up with key partners in the coming years to further investigate concentrations of disinfection resistant bacteria observed in treated wastewater between urban and rural communities. Further, while a number of factors could affect changes in incidences of permit exceedances for bacteria, more data on the role bacteria resistance to disinfection methods plays would undoubtedly help inform future studies.