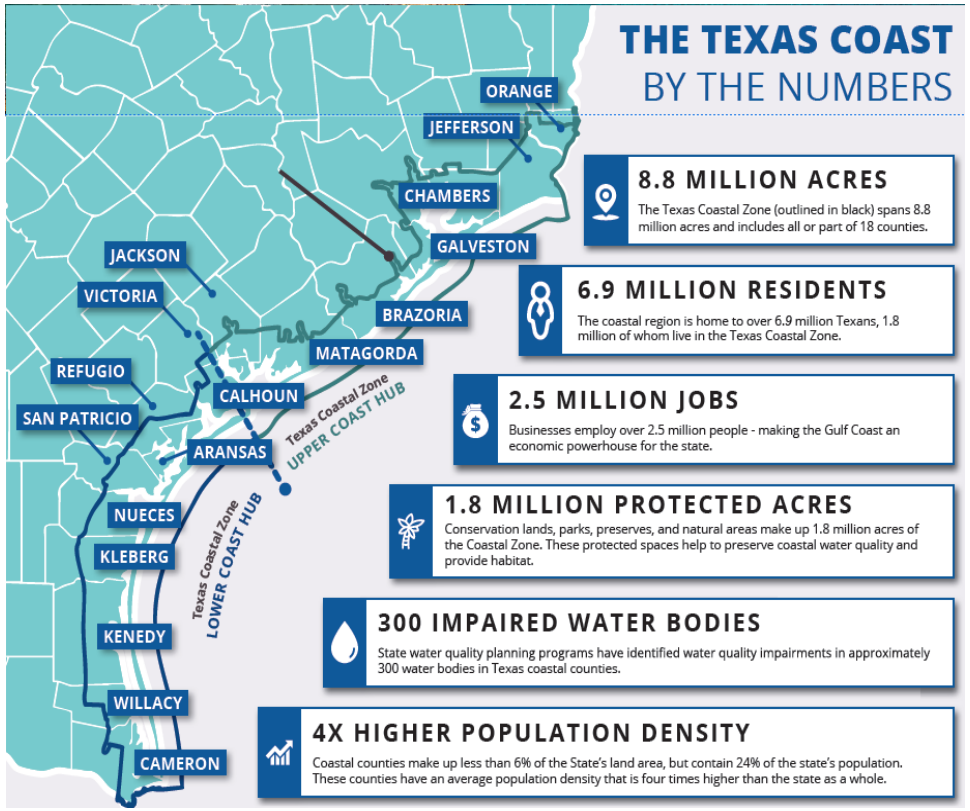
Clean Coast Texas

An Initiative of the Texas Coastal Nonpoint Source Pollution Program

Helping communities to facilitate incentive-based programs and projects to protect and restore water quality, natural habitats, and shorelines.

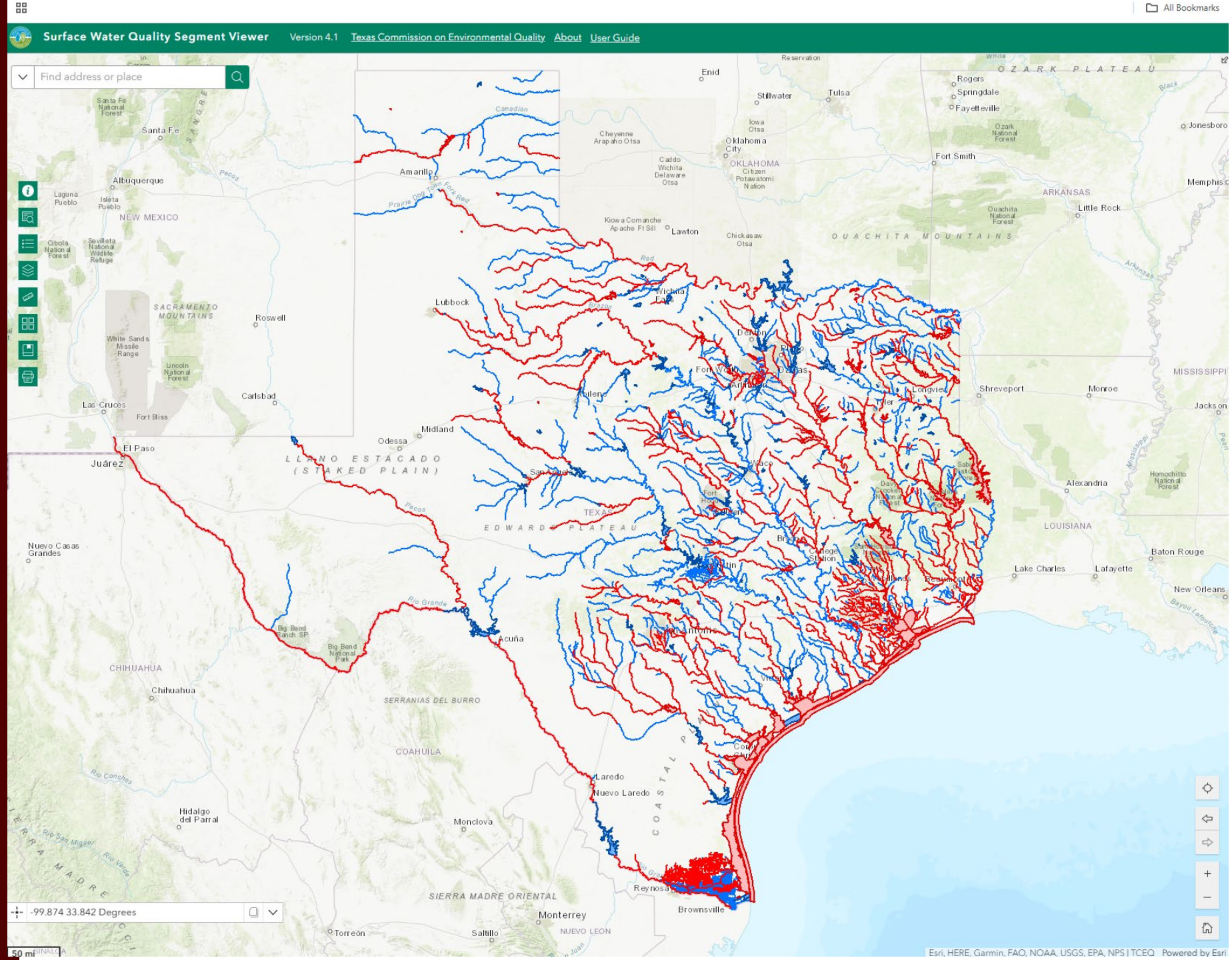
We can help with:

- Technical Assistance for Community Planning
- Implementing Stormwater Best Management Practices
- Testing and Monitoring Water Quality of local waterways
- Coordination Across Jurisdictions
- Identify and Apply for Funding



Collaborative Action

- Texas General Land Office Program Management.
- Harte Research Institute at TAMU-CC Program Coordination, Engagement, Technical Support.
- Texas A&M AgriLife Extension – Disaster Assessment & Recovery Education and Outreach including future growth and scenario planning, workshops and resources.
- Texas Sea Grant at TAMU Local Planning and Engagement Support.
- Coastal Bend Council of Government Wastewater Treatment Plant Assessment and Action Plan Development.



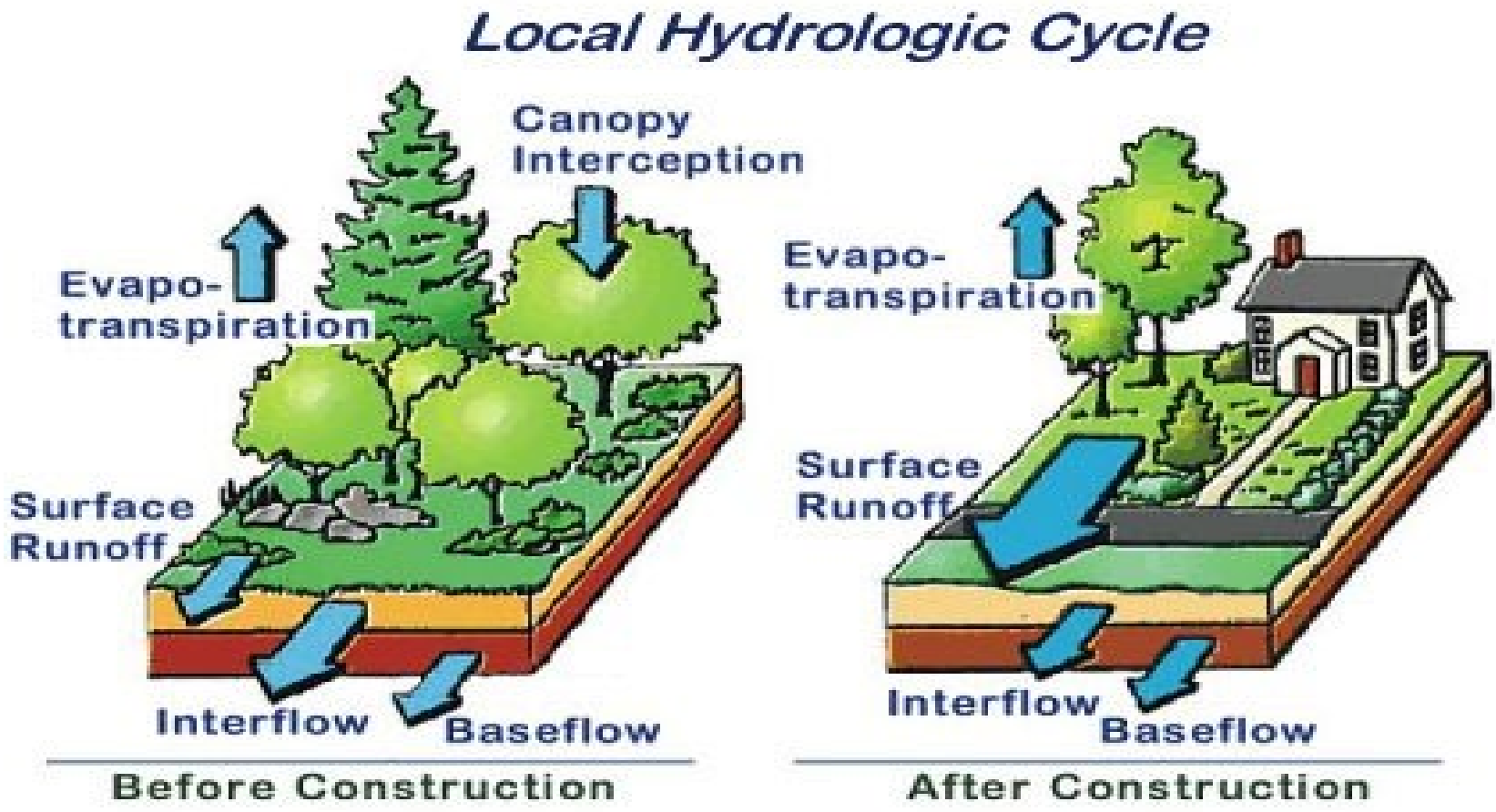
Texas A&M AgriLife Extension

Increasing bacteria levels over time, correlated with population growth

Development =

more impervious surfaces, stormwater runoff, municipal sewage effluent, fecal bacteria

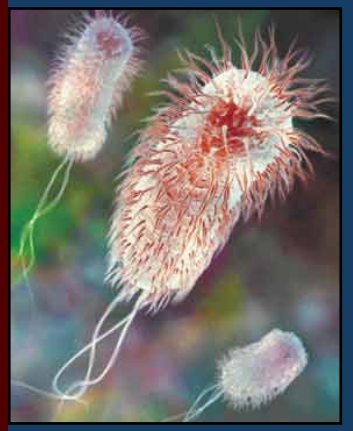
Stormwater Runoff

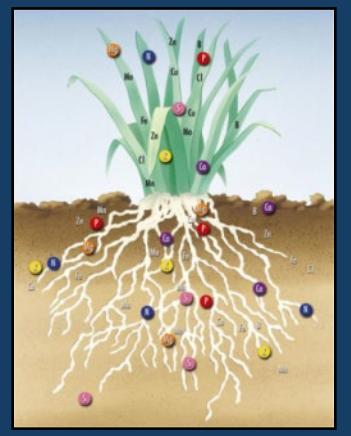


Texas A&M AgriLife Extension

Common Types of Runoff Pollution

- Pathogens/bacteria
- Nutrients
- Sediments
- Debris

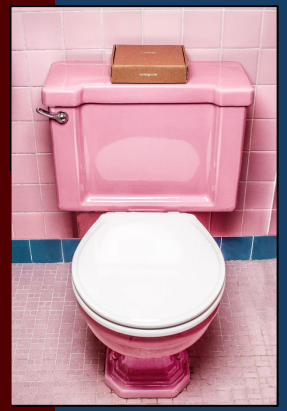




Texas A&M AgriLife Extension

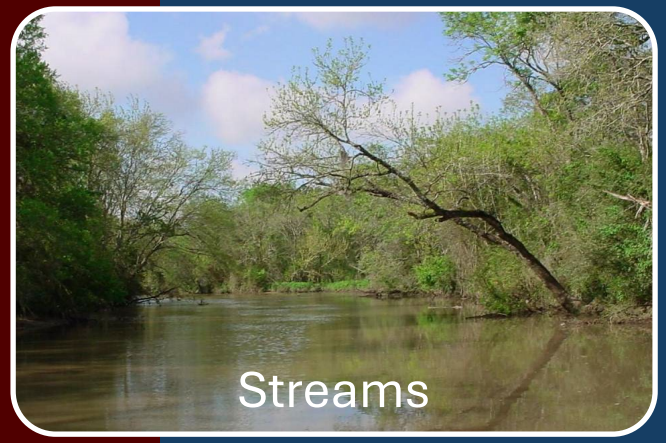
Sources of Runoff Pollution

Our everyday actions...



Texas A&M AgriLife Extension

The Path of Runoff Pollution

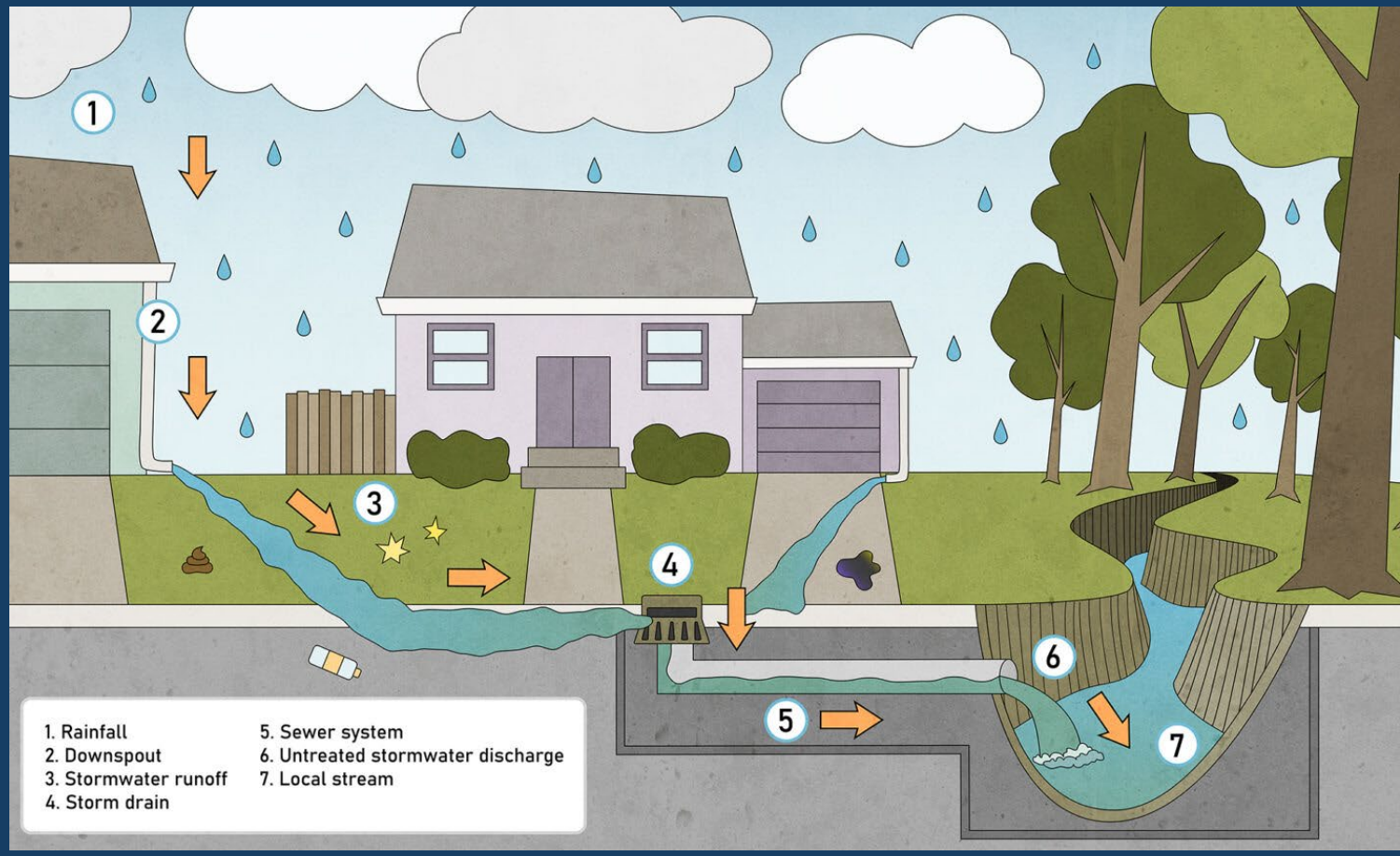


How Can We Manage Stormwater?

Stormwater is precipitation that falls on the ground and flows to sewers and local waterways.

Runoff picks up pollutants – pet waste, motor vehicle oil, gasoline, fertilizer, sediment, etc. – as it flows over land surfaces.

Stormwater runoff can degrade coastal water quality, harm ecosystems and increasing public health risk.



Slow it Down
Spread it Out
Soak it in!

Clean Coast Texas Menu of Services

Stormwater Retrofit Design & Construction

(site identification, best management practice, design & construction)

Education & Community Events

(Plan workshops for public and decision makers, coordinate community events)

Planning & Regulatory Support

(Review and update ordinances, community plans and drainage master plans)

Water Quality & Citizen Science

(Texas Stream Team trains citizen scientists to monitor water quality)

Grant Writing Assistance

(identify potential funding streams and help communities apply)

Wastewater Treatment Plant Assessments

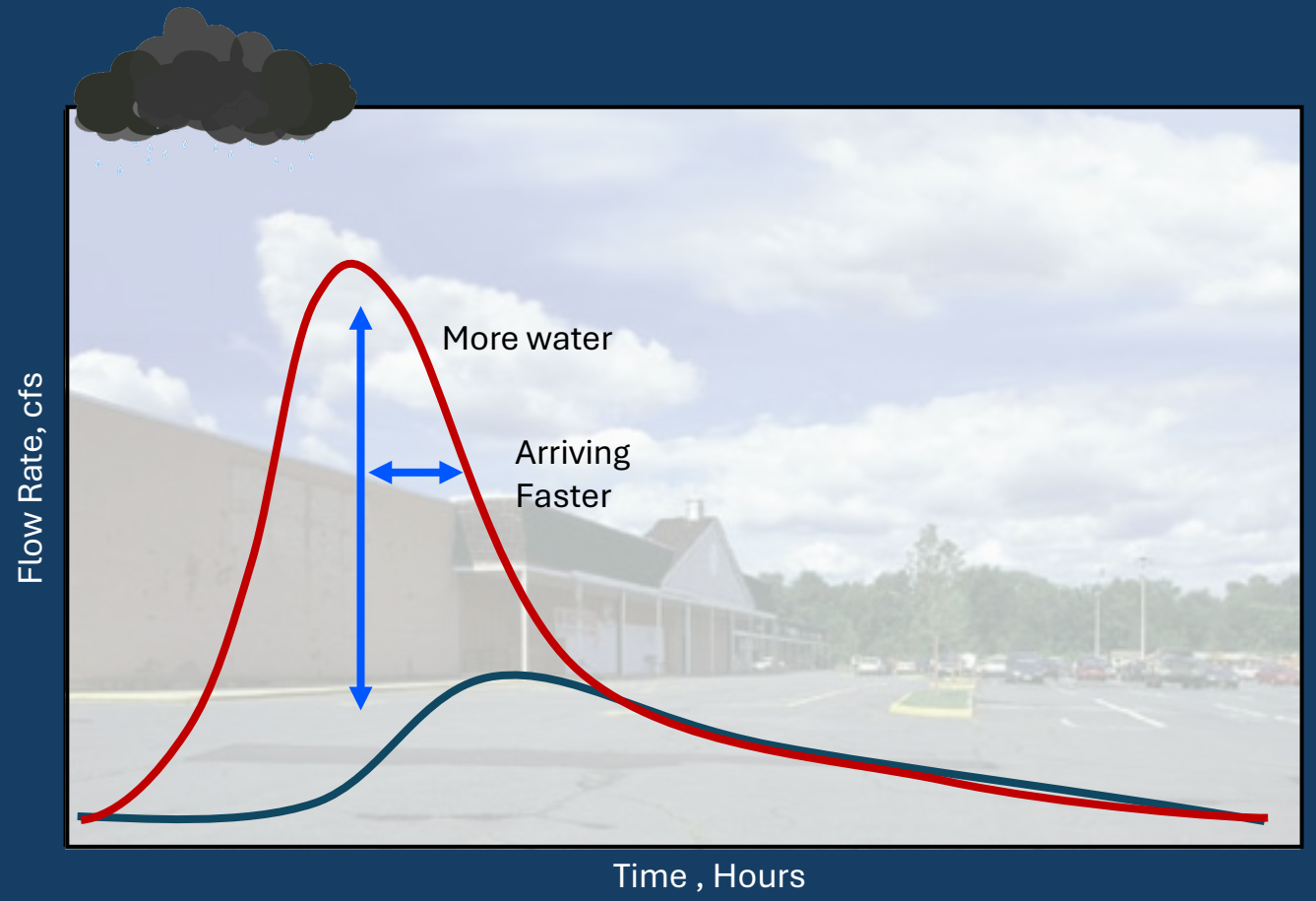
(Assess WWTP, develop action plan and identify funding opportunities)

Armand Bayou Nature Center, Pasadena, TX

Green Stormwater Infrastructure

- An approach to land development or re-development that **works with nature** to manage stormwater as **close to its source** as possible
  - Low Impact Development (LID)
  - Nature-based solutions
  - Stormwater BMPs
  - Blue-green infrastructure
  - Stormwater retrofits

Treat Stormwater Where it Falls



Texas A&M AgriLife Extension

The Path of Runoff Pollution

Why consider green infrastructure solutions?

- Create multi-use areas
- Mitigate flooding
- Improve water quality
- Meet MS4 requirements
- Increase Habitat
- Provide recreation areas


Houston Botanic Garden, Houston, TX

Rain Gardens/Bioretention

A shallow depression planted with native and adapted plants that collects rainwater from roofs, parking lots, and other surfaces.

Texas A&M AgriLife Extension

Swales

- Drainage course with gently sloping slides, typically vegetated but can have rock

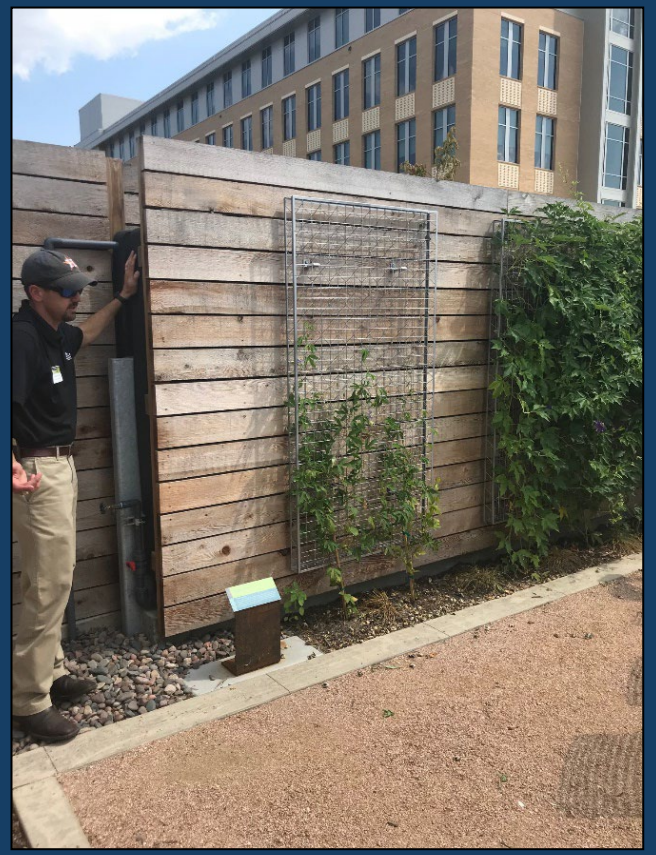
Texas A&M AgriLife

Rainwater Harvesting

- Collecting and storing runoff from an impervious surface for later non-potable usage

Victoria, TX

Galveston, TX



College Station, TX

Rainwater Harvesting - Underground

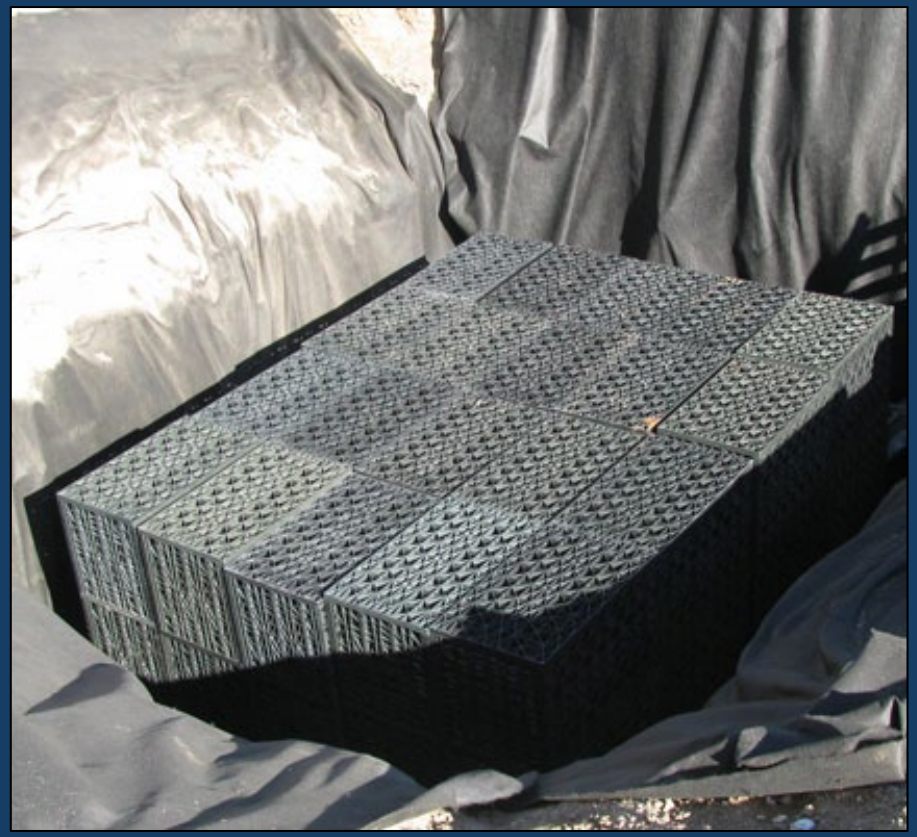


Photo from sargwatersolutions.com

Photo from tritonsws.com

Texas A&M AgriLife Extension

Pervious Pavement

- An alternative to asphalt or concrete
- Allows stormwater to drain through the porous surface into a reservoir underneath for temporary storage

Photo from hellerconcreteinc.com

Photo from deeproot.com

Texas A&M AgriLife Extension

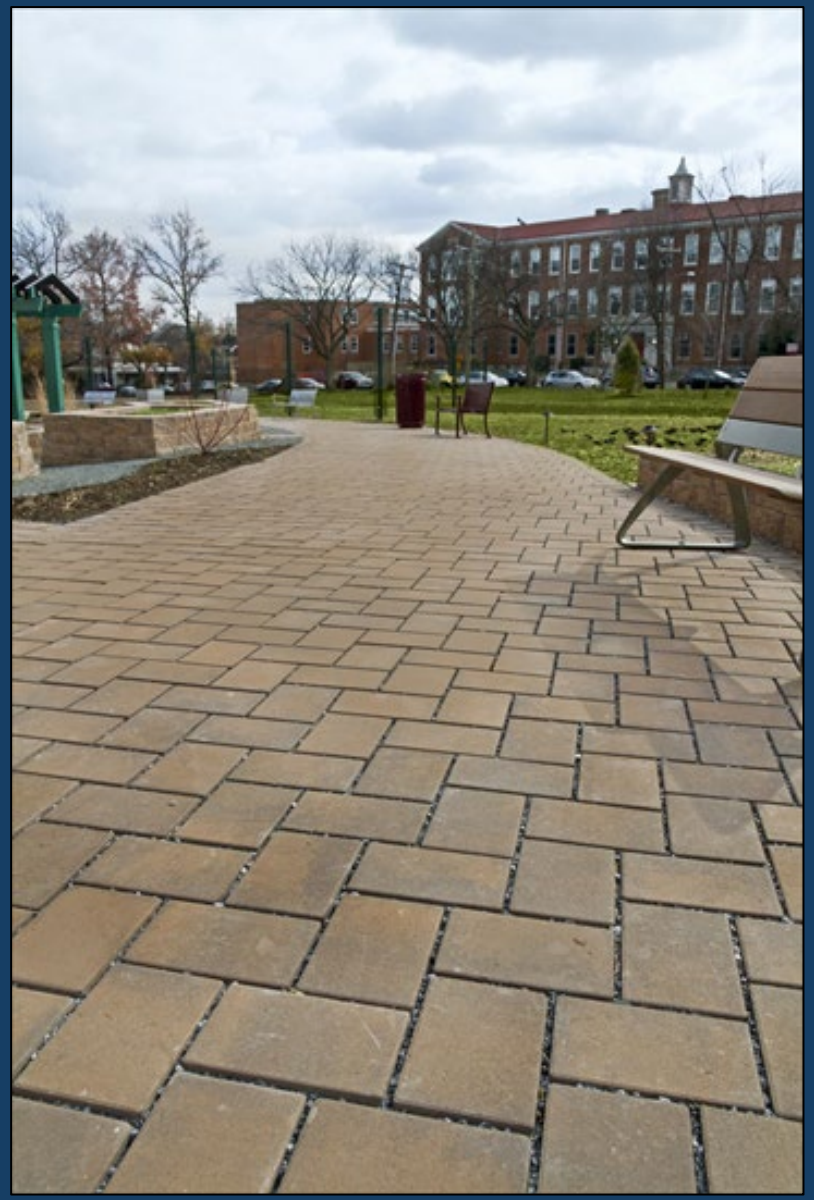
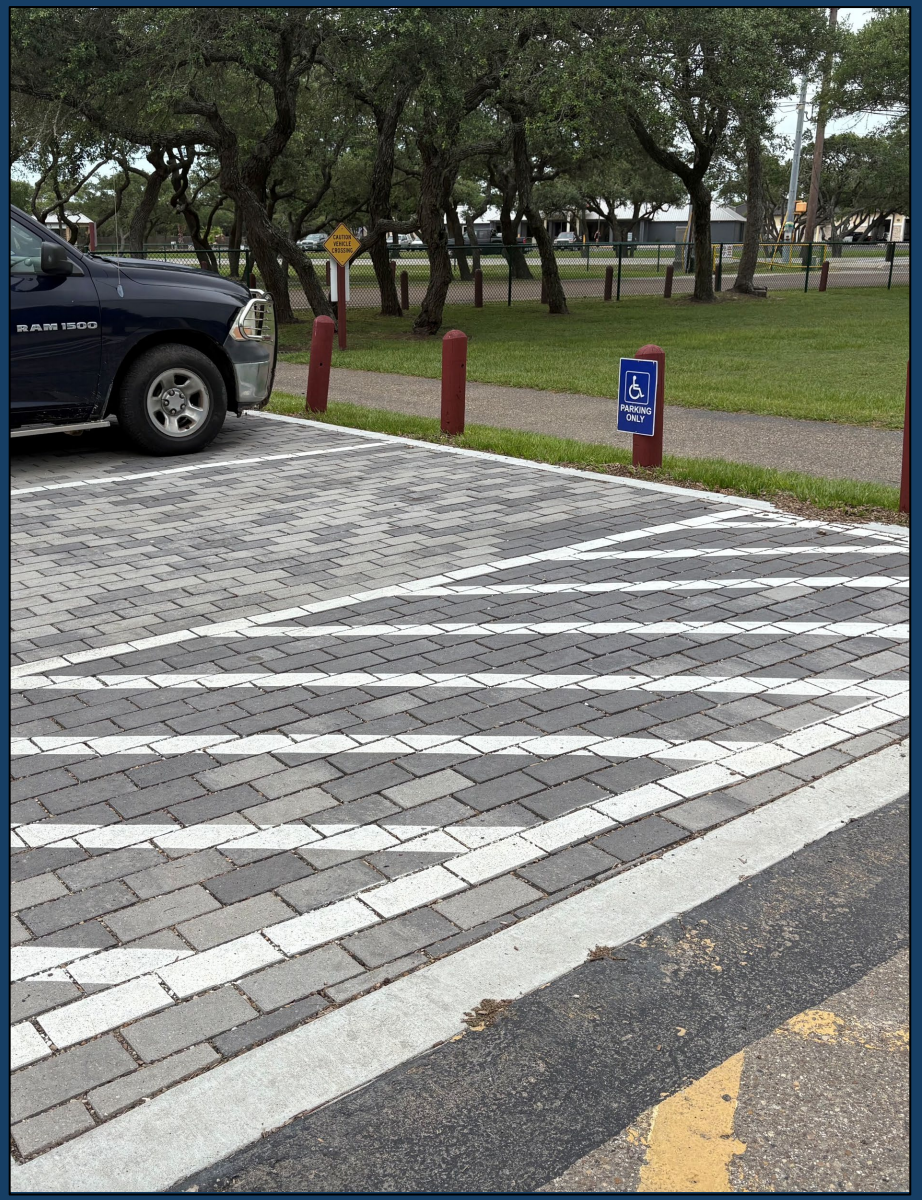


Photo from ephenry.com

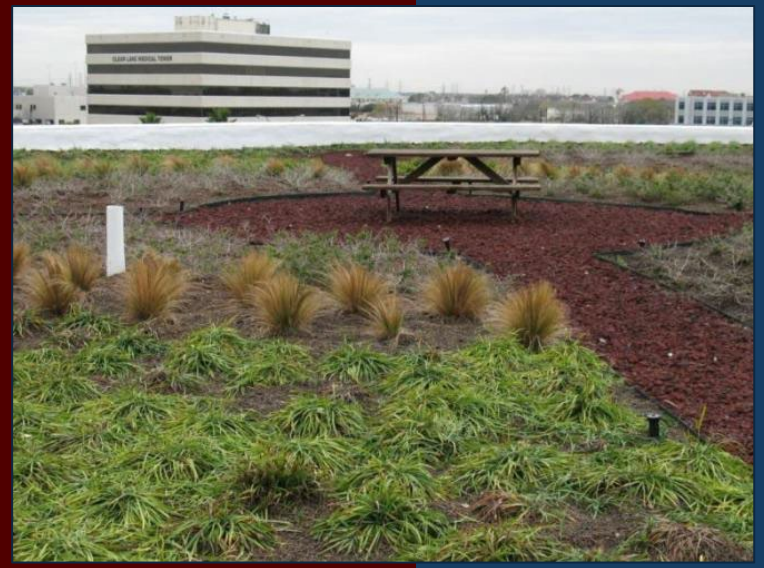


Rockport, TX

Texas A&M AgriLife Extension

Green Roofs

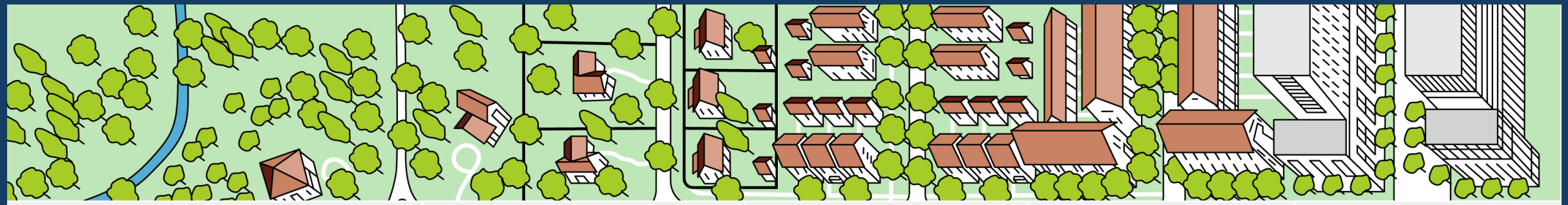
- An extension of a roof which adds water proofing, a drainage system, a lightweight growing medium and plants



Webster, TX

League City, TX

Houston, TX



1. Natural Reserve	2. Natural Preserve	3. Suburban	4. Neighborhood Center	5. Urban Center	6. Urban Core
Good Housekeeping					
Rainwater Harvesting					
WaterSmart Landscaping					
Pervious Pavement					
Rain Gardens/Swales/Bioretention					
Tree-boxes/Sand Filters					
Green Roofs					
Water Quality Inlet Separators					
Green Streets					
Stormwater Wetlands Detention/Retention Ponds				Basins Located Outside Immediate Urban Area	
Conservation Subdivisions/Cluster Development					
Land Preservation Conservation and Restoration					

Selected green infrastructure practices categorized by appropriateness of usage by development type.

The darkest boxes in the diagram indicate the most appropriate location for each type of practice.

Lighter colors indicate potential but less important applications.

GIFT Workshop in La Marque- 2024

CHARM Workshop in Port Lavaca- 2023

GIFT Workshop with a Demonstration of Soil Consistency- 2023

Workshops

GIFT (Green Infrastructure for Texas)

- GIFT is a multi-level approach to Green Infrastructure
- The workshop invites the public, elected officials and municipal staff to learn about GI. It gives an overview of what Green Stormwater Infrastructure is, how it supports natural resource protection, enhances water quality and improves coastal resilience.

CHARM (Community Health And Resource Management mapping application)

- The tool gives local officials, stakeholders, and citizens the power to map and analyze growth with real-time feedback.
- supported with a library of mapping data about urbanization, storm surges, conservation, public facilities, and coastal resources.

Educational Signage

RAIN GARDEN

Is there a way to protect our waterways while also beautifying the landscape?

Not only are rain gardens visually pleasing, but they also benefit our bays and estuaries. A rain garden is a planted shallow depression that collects stormwater runoff from roofs, parking lots, roads, and other hard surfaces. While a rain garden can blend into the landscape and serve as a garden area, its main function is to capture and filter stormwater. Rain gardens can be used in both residential and commercial construction in low-lying areas to capture the most stormwater.

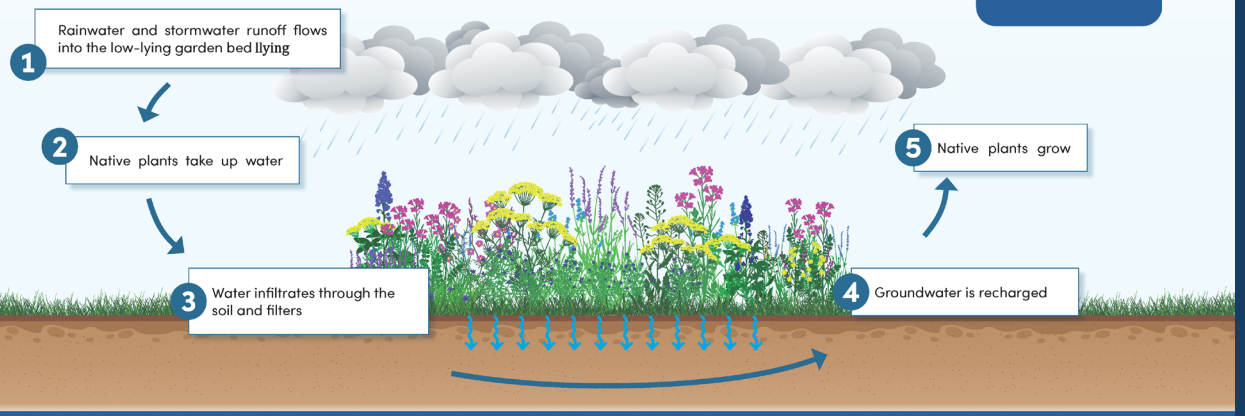
Rain gardens protect the Gulf Coast by:

- Giving stormwater a chance to soak into the ground before it reaches the ocean.
- Reducing the potential for landscape erosion.
- Reducing pollutants such as automotive oils, fertilizers, or pet waste from entering our bays and estuaries via stormwater runoff.

Learn more about the Clean Coast Texas Program at ....

This can all be edited/changed

Qr codes

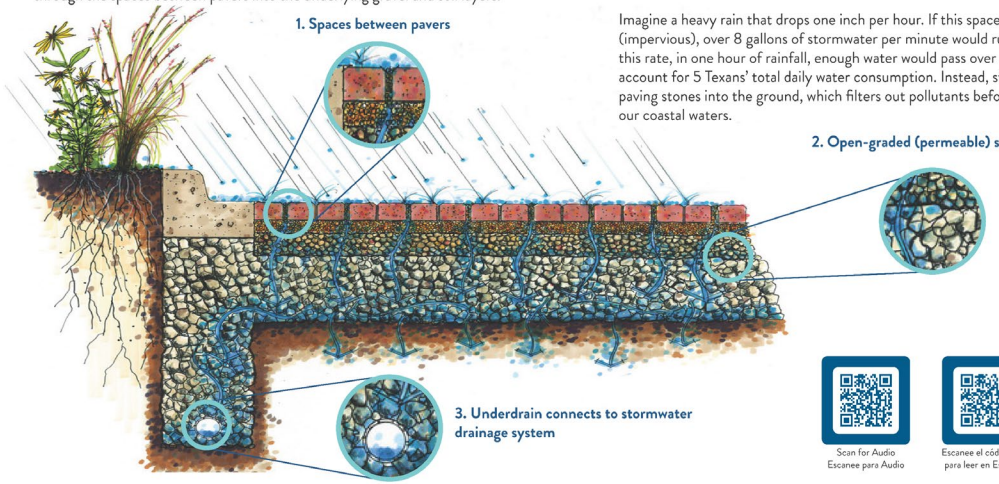


INSERT CCT FOOTING

PARKING WITH A PURPOSE: PERMEABLE PAVERS AT MEMORIAL PARK

When precipitation reaches the ground, where does the water go?

Pervious surfaces are surfaces that allow water to filter through them, unlike impervious surfaces that prevent water absorption, resulting in water collecting or flowing across the surface and contributing to flooding and runoff. Permeable pavers are a pervious alternative to concrete sidewalks, asphalt parking lots, and other impervious surfaces. These pavers are installed with small gaps between the individual paving stones, allowing water to absorb through the spaces between pavers into the underlying gravel and soil layers.



Permeable pavers protect Texas coastal waters by:

- Maintaining healthy groundwater levels through infiltration
- Reducing flooding and standing water through infiltration
- Reducing stormwater runoff, which carries pollutants such as sediment, bacteria, and car oils into local coastal waters

Imagine a heavy rain that drops one inch per hour. If this space were asphalt (impervious), over 8 gallons of stormwater per minute would run off this parking lot. At this rate, in one hour of rainfall, enough water would pass over an impervious surface to account for 5 Texans' total daily water consumption. Instead, stormwater seeps between paving stones into the ground, which filters out pollutants before the stormwater reaches our coastal waters.

Scan for Audio
Escanee para Audio

Escanee el código QR para leer en Español.

Learn more about Clean Coast Texas at www.cleancoast.texas.gov.

TEXAS GENERAL LAND OFFICE
CLEAN COAST TEXAS

The Meadows Center for Water and the Environment
Texas State University

This project was funded in full through a grant from the Texas General Land Office providing Gulf of Mexico Energy Security Act of 2006 funding made available to the State of Texas and awarded under the Texas Coastal Management Program.

HAVE YOU SEEN THESE POLLUTERS?

TOO MUCH BACTERIA AND LITTER CREATE UNSAFE BEACHES

Animal Waste Not only smelly — it contains harmful bacteria. If not picked up, that bacteria ends up in our beaches and bays.

Litter and Trash, especially plastics, hurts wildlife and water quality. Wildlife can mistake trash for food. Trash, like glass, is a safety hazard.

YOU CAN HELP PREVENT THESE COMMON TYPES OF POLLUTION BY:

- Disposing of trash and fishing line, even if it isn't yours
- Picking up after your pet
- Packing food in reusable containers

Learn more at **cleancoast.texas.gov**

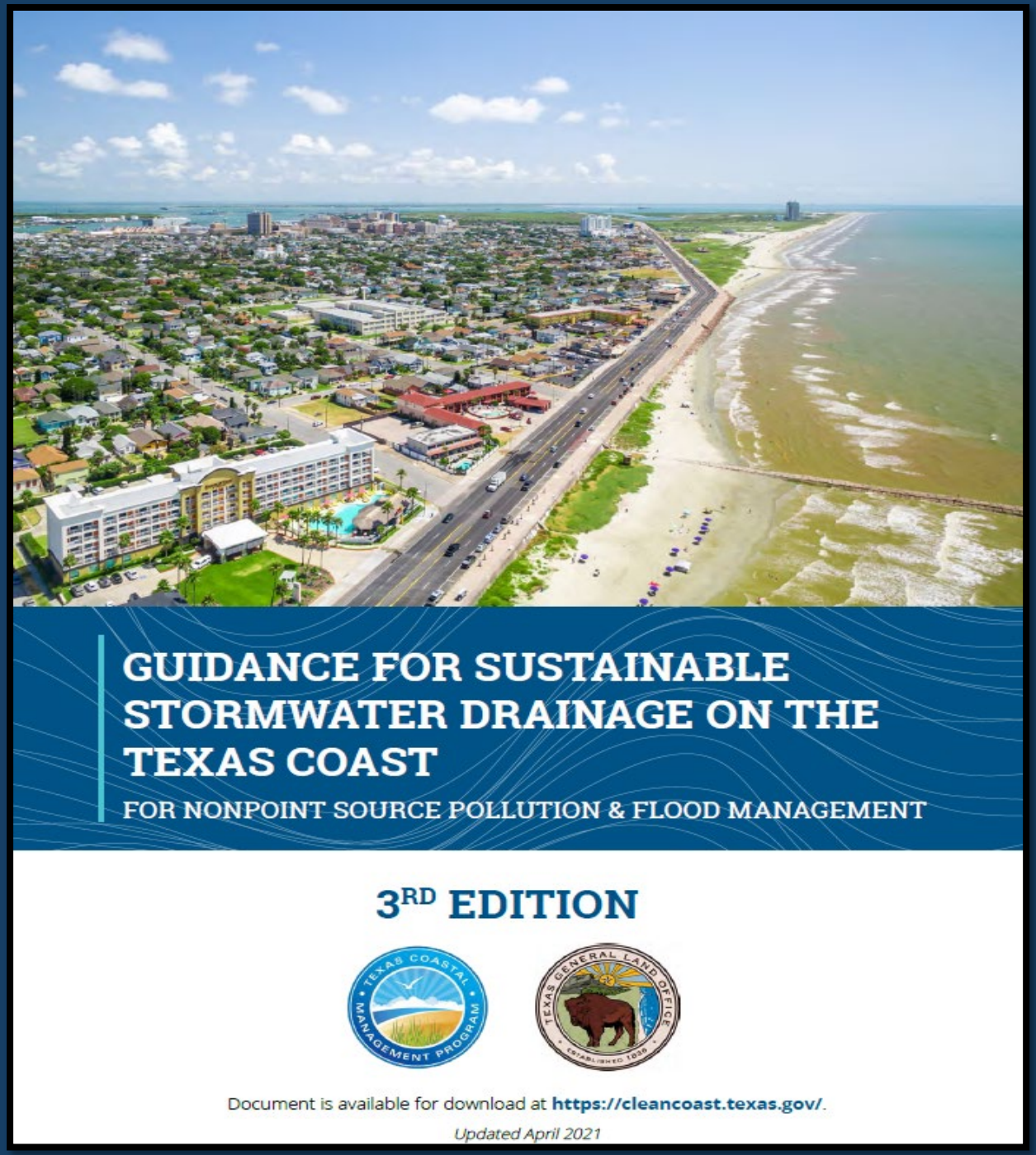
The Meadows Center for Water and the Environment
Texas State University

THIS PROJECT WAS FUNDED BY A TEXAS COASTAL MANAGEMENT PROGRAM GRANT APPROVED BY THE TEXAS LAND COMMISSIONER, PROVIDING FINANCIAL ASSISTANCE UNDER THE COASTAL ZONE MANAGEMENT ACT OF 1972, AS AMENDED, AWARDED BY THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), OFFICE FOR COASTAL MANAGEMENT, PURSUANT TO NOAA AWARD NO. NA19NOS4190106.

Sustainable Stormwater Manual

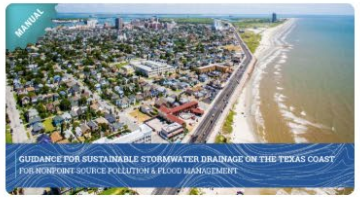
- Technical design guidance
- Construction details
- Maintenance guidance
- Model criteria/ordinance
- Design method incentives
- Retrofits and creek restoration

glo.texas.gov/sites/default/files/2025-01/2022-sustainable-stormwater-drainage-cleancoasttexas.pdf



Clean Coast Texas Resources

Featured Resources



COASTAL

Technical Manual: Guidance for Sustainable Stormwater Drainage

A guidance manual with stormwater management practices for use by government agencies, businesses, and the general public.

COASTAL

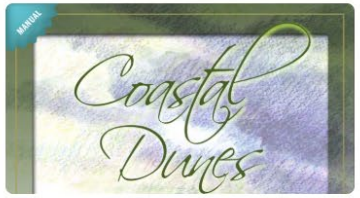
Resident's Handbook: Coastal Water Protection Begins With You

Find practices that local residents can adopt to reduce the impact of stormwater runoff and manage water usage from their own properties.

COASTAL

Technical Manual: Guidance for Roads, Highways, and Bridges

A guidance manual that provides Texas Coastal communities with tools to reduce nonpoint source pollution and manage stormwater runoff from roads, highways, and bridges.



COASTAL

Technical Manual: Dune Protection and Improvement for the Texas Coast

A guidance manual with measures that landowners, city and county planners, developers, and industry can use to preserve sand dunes and promote dune restoration.

COASTAL

Flyer: Clean Coast Texas Menu of Services

Learn how we can work with your coastal community to facilitate non-regulatory, incentive-based programs and projects to protect and restore water quality, habitat, and shorelines.

COASTAL

Community Resource: Clean Coast Texas Funding Guide

A guide for coastal communities detailing state and federal funding opportunities to support projects for protecting and enhancing water quality and stormwater management on the Texas coast.

https://www.glo.texas.gov/coastal/clean-coast-texas

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(site identification, best management practice, design & construction)

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(Assess WWTP, develop action plan and identify funding opportunities)

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https://cleancoast.texas.gov/

Extra Slides

Maintenance

- Gray vs Green
- Involve everyone from the beginning
- Houston-Galveston Area Council
- San Antonio River Authority

APPENDIX G: Operations & Maintenance

Vegetated Swales and Vegetated Filter Strips

Table G-8

Task	Frequency	Indicator maintenance is needed	Maintenance notes
Inlet inspection	Twice annually or after storm event	Ponding occurring at inlet	Check for sediment accumulation and/or uneven flow spreader.
Outlet inspection	Twice annually or after storm event	Ponding occurring in feature	Check for debris or trash accumulation and/or erosion at outlet.
Mowing	2-12 times a year	Overgrown vegetation	Frequency depends on location, desired aesthetic appearance, and type of vegetation. 4" minimum grass height preferred.
Weeding	Monthly as needed	Appearance of undesirable or invasive plant material	Control weeds using Integrated Pest Management strategies. Avoid treatment with herbicides preferred. Some features will be naturally more prone to infestations due to location and the surrounding environment.
Remove and replace dead plants	As needed	Bare space, exposed soil	Plant die-off tends to be highest during the first year. Maintaining complete plantings helps to reduce weed encroachment and is necessary to prevent erosion.
Temporary irrigation	Once every 2-3 days for the first 1-2 months then less frequently, depending on plant material and environmental conditions, until established	Dull leaf color and plant wilting	Watering after plant establishment during periods of drought or for aesthetics may be required.
Inspect check dams	Once before the wet season(s) and monthly during the wet season(s)		Check for sediment accumulation and erosion around or underneath the dam materials.
Miscellaneous	Monthly	Trash collection and erosion and/or rut repairs	

www.sariverauthority.org/services/sustainability/low-impact-development/

Inspection and Maintenance Checklist

RAIN GARDEN

Property Address _____
Property Owner _____
Treatment Measure No. _____ Inspection Date _____
Inspector(s) _____
Type of Inspection:
☐ Monthly ☐ Pre-wet season ☐ Post-wet season ____ ☐ After heavy runoff
☐ Other: _____

Defect	Conditions when maintenance is needed	Maintenance needed?	Comments[a]	Results expected when maintenance is performed
1. Standing water	Water stands in the bioretention area between storms and does not drain within 24 hours after rainfall.			There should be no areas of standing water once inflow has ceased. Any of the following could apply: sediment or trash blockages removed, grade from head to foot of bioretention area improved, media surface scarified, underdrains flushed.
2. Trash and debris	Trash and debris accumulated in the bioretention area and around the inlet and outlet.			Trash and debris removed from the bioretention area and disposed of properly.
3. Sediment	Evidence of accumulated sediment in the bioretention area.			Material removed so that there is no clogging or blockage. Material is disposed of properly.
4. Erosion	Channels have formed around inlets, there are areas of bare soil, or there is other evidence of erosion.			Obstructions and sediment removed so that water flows freely and disperses over a wide area. Obstructions and sediment are disposed of properly.
5. Vegetation	Vegetation is dead, diseased or overgrown.			Vegetation is healthy and attractive. Grass is maintained at least 3 inches in height.
6. Mulch	Mulch is missing or patchy. Areas of bare earth are exposed or mulch layer is less than 3 inches deep.			All bare earth is covered, except mulch is kept 6 inches away from trunks of trees and shrubs. Mulch is even at a depth of 3 inches.
7. Inlet/outlet	Sediment accumulations.			Inlet/outlet is clear of sediment and debris and allows water to flow freely.
8. Miscellaneous	Any condition not covered above that needs attention for the bioretention area to function as designed.			The design specifications are met.

a Describe the maintenance completed; if the needed maintenance was not conducted, note when it will be done.

Prepared by Randle Law Office 2018 www.jgradyrandlepc.com

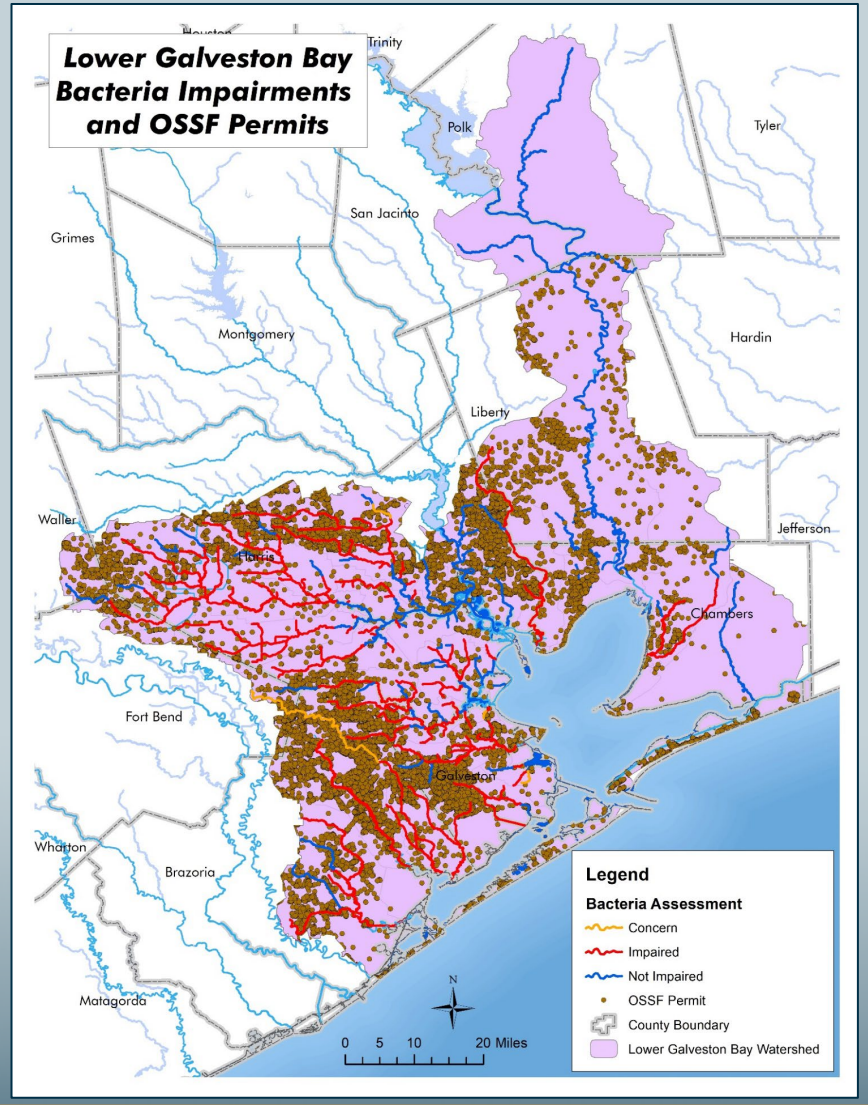
www.h-gac.com/low-impact-development

TEXAS A&M AGRILIFE

Enhancing OSSF Outreach and Assistance on a Community Level with GIS-based Tools and Local Partners

Houston-Galveston Area Council
Kendall Guidroz & Bill Ervin

Failing On-Site Sewage Facilities (OSSFs)

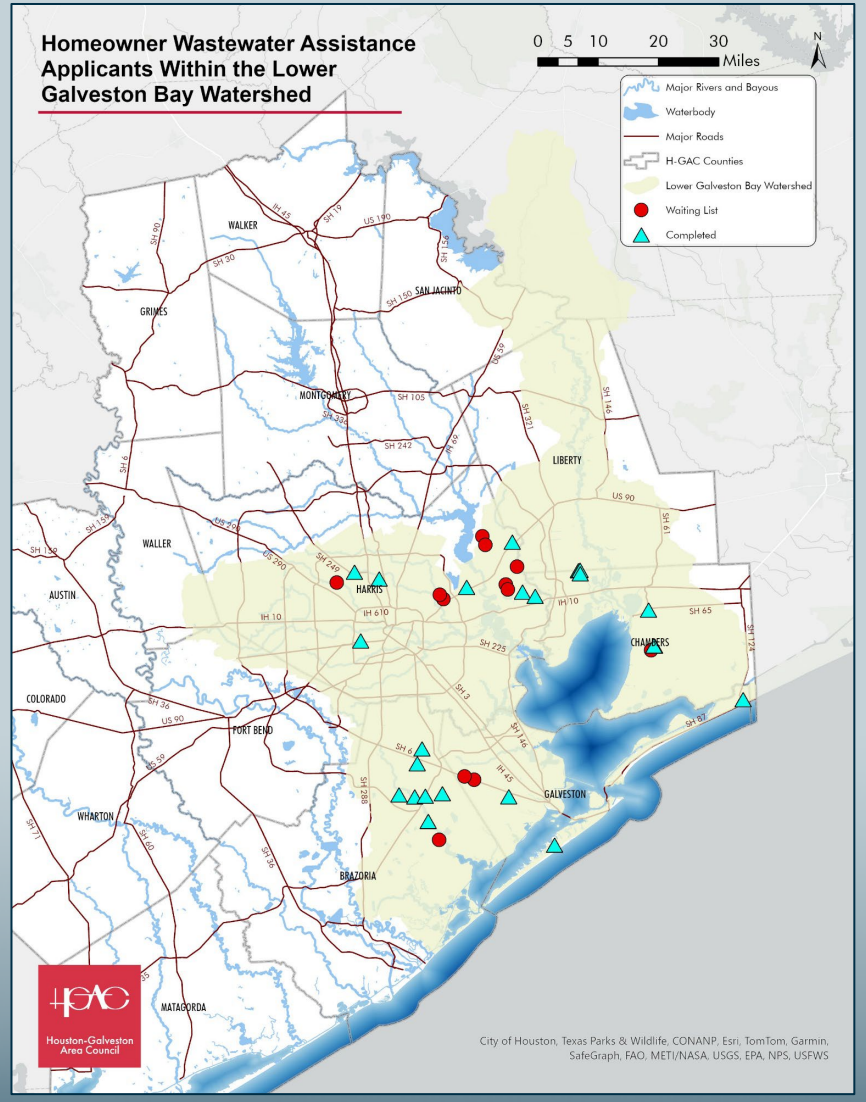


OSSFs in the Lower Galveston Bay Watershed

Permitted OSSFs	Estimated Unpermitted OSSFs	Total Estimated OSSFs	Estimated failure rate for Texas*	Potential Failing OSSFs
42,526	58,851	101,377	12%	12,166

*source: Reed, Stowe & Yanke, LLC. 2001

Homeowner Wastewater Assistance Program



- Covers the cost of repair or replacement of failing OSSFs (includes two years of maintenance)
  - No cost sharing by homeowner
  - Must own and reside in home
  - Make at or below 80% of median household income for the county
  - Eligible even if under enforcement action
- Primary Funding source is a TCEQ Supplemental Environmental Project
  - Funding limited and inconsistent
  - 1-5 OSSFs addressed per year on average depending on funding

Homeowner Wastewater Assistance Program

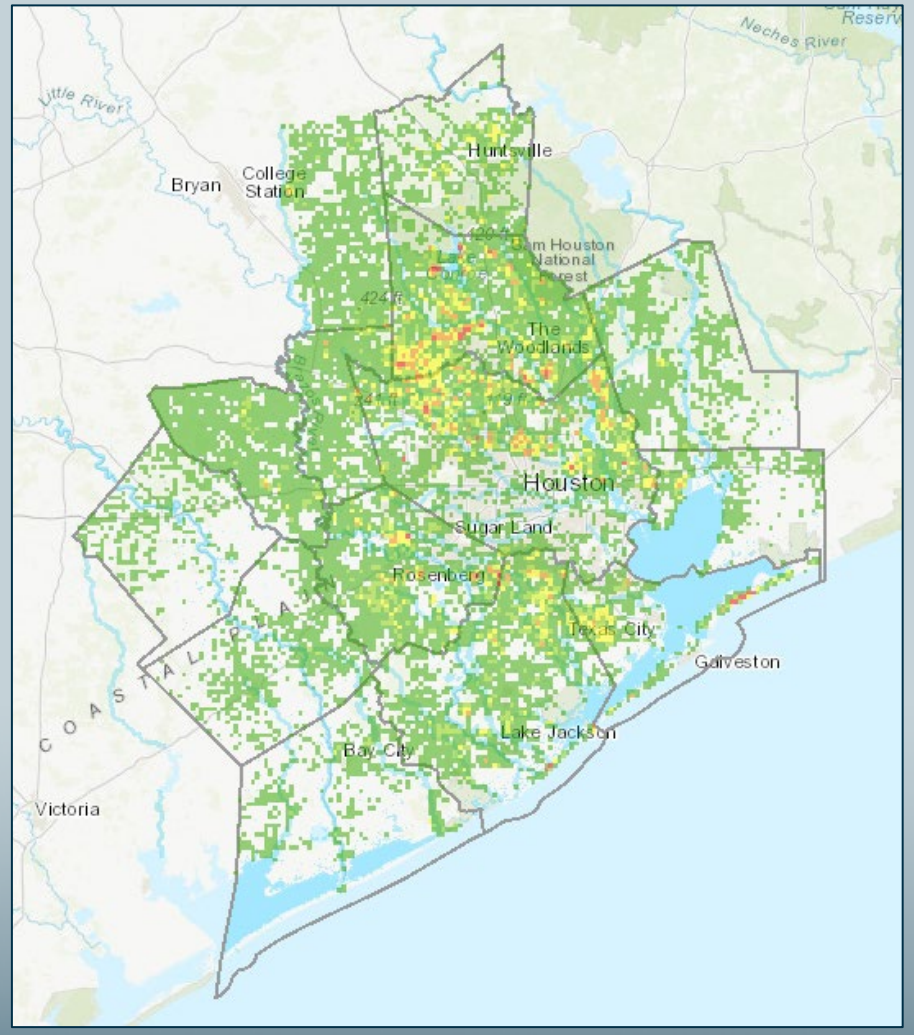
"There are no words to express our gratitude and appreciation for everything that was done to help us… This was no small task, and we recognize all of the effort and financial funding that went into this project… This is something we are beyond grateful for, we are blessed to have crossed paths, we can never repay the financial assistance and kindness."

- Participant testimony 2023

Homeowner Education Workshops

- Free workshop providing homeowners information on:
  - The basics of conventional and aerobic OSSFs
  - Signs of system malfunctions or failures
  - The importance of routine maintenance
  - Important Do's and Don'ts for maintaining an OSSF
- Any community can request a workshop just for education, but workshops are also required for residents who receive assistance from some of our projects
- Does not certify attendees to maintain their own system

Growing Need and Limited Resources



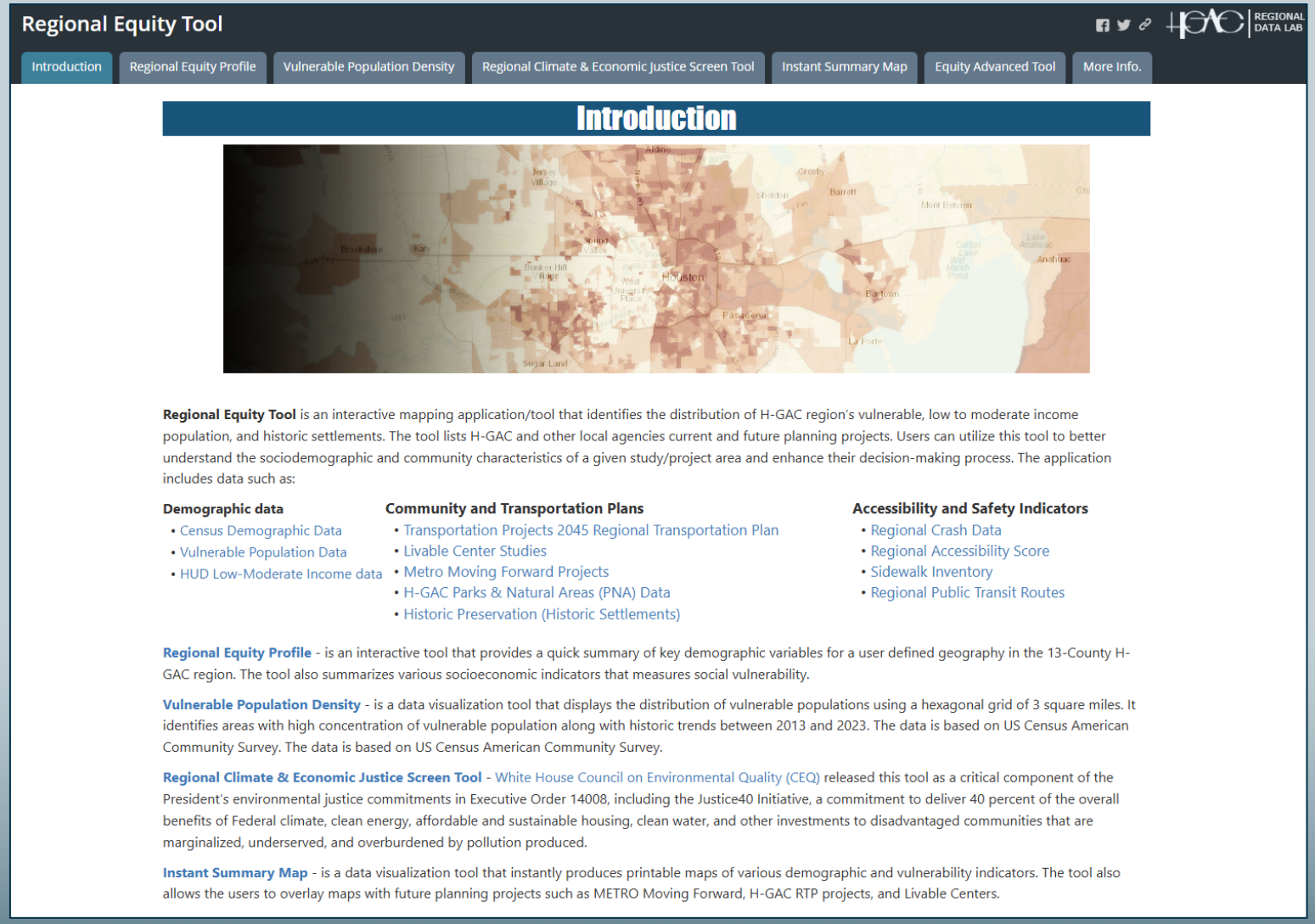
- Age of systems
- New developments and homeowners
- SEP limitations

Addressing OSSFs in Disadvantaged Communities with Vulnerable Populations

Two projects have used similar strategies to:

- Identify Priority Watersheds and Coordinate with Stakeholders
  - Utilize the Regional Equity Tool to identify communities with economic barriers and other potential vulnerabilities.
  - Partner with local officials or organizations trusted by residents
- Host Homeowner OSSF Education Workshop(s) in prioritized watersheds
  - Workshop attendance required to qualify for OSSF repair or replacement
- Address failing or malfunctioning OSSFs in the priority watersheds
  - Community pumpouts or full system repairs and replacements, depending on funding source

H-GAC's Regional Equity Tool



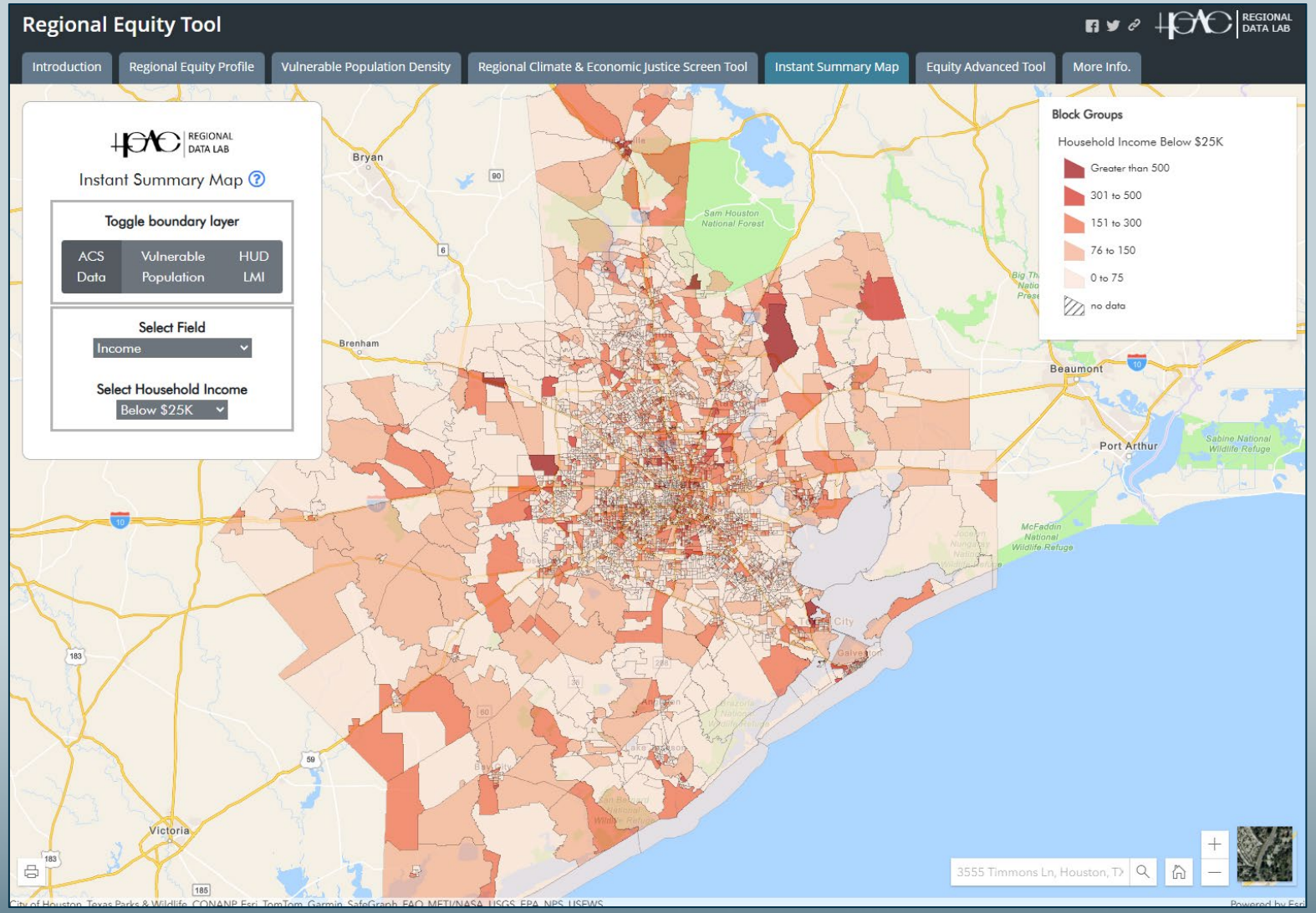
- Online GIS-based interactive tool
  - Utilizes census data and census blocks
  - Identifies 8 population vulnerability factors

H-gac.com/interactive-web-applications

H-GAC's Regional Equity Tool

- Vulnerability factors considered in Regional Equity Tool Analysis
  - Poverty/low-income households (regional basis, not national)
  - Non-Hispanic, non-white populations
  - Hispanic populations
  - Limited English proficiency (not well or not spoken at all)
  - Disabled family members
  - Elderly residents (75+)
  - Car-less residents
  - Households with single mothers and children under 18

H-GAC's Regional Equity Tool



- Online GIS-based interactive tool
  - Can get instant summaries for the different vulnerability factors
  - Advanced features allow for specific queries
  - Ability to add other GIS layers onto the map

The Importance of Local Partnerships

- Trusted partners for residents
- Leverage local resources

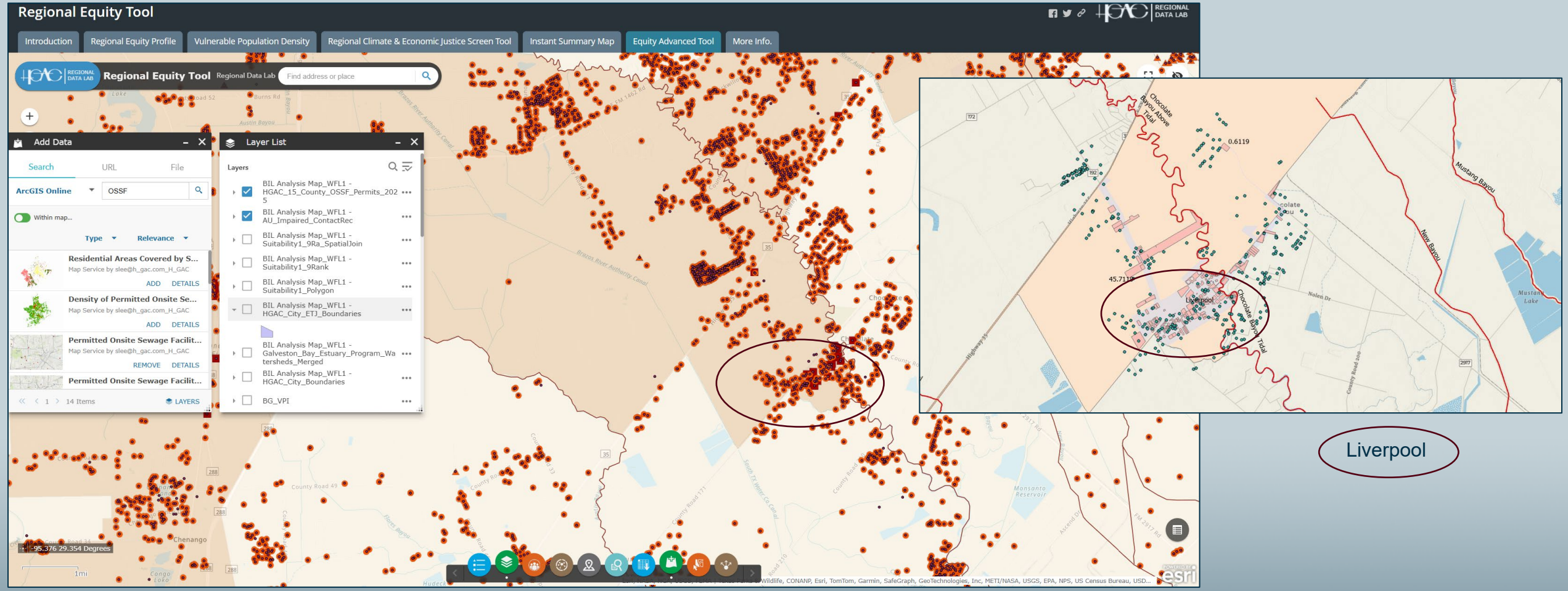
Project 1: Community Pumpouts & Education

- Identify priority communities
  - Areas with high concentrations of OSSFs near impaired waterways
  - Determine vulnerability factors that might prevent maintenance and workshop attendance
  - 1st Priority Community – Liverpool
- Work with local partners to host OSSF Homeowner Education Workshops
  - Identify barriers to resident participation, and work with local partners to overcome
- Additional Funding from Wells Fargo Foundation
  - Allowed for system pumpouts and the addition of Holiday Lakes and Jones Creek communities

This project is funded in part by TCEQ through a grant from the United States Environmental Protection Agency.

Sponsored through a generous grant from the Wells Fargo Foundation

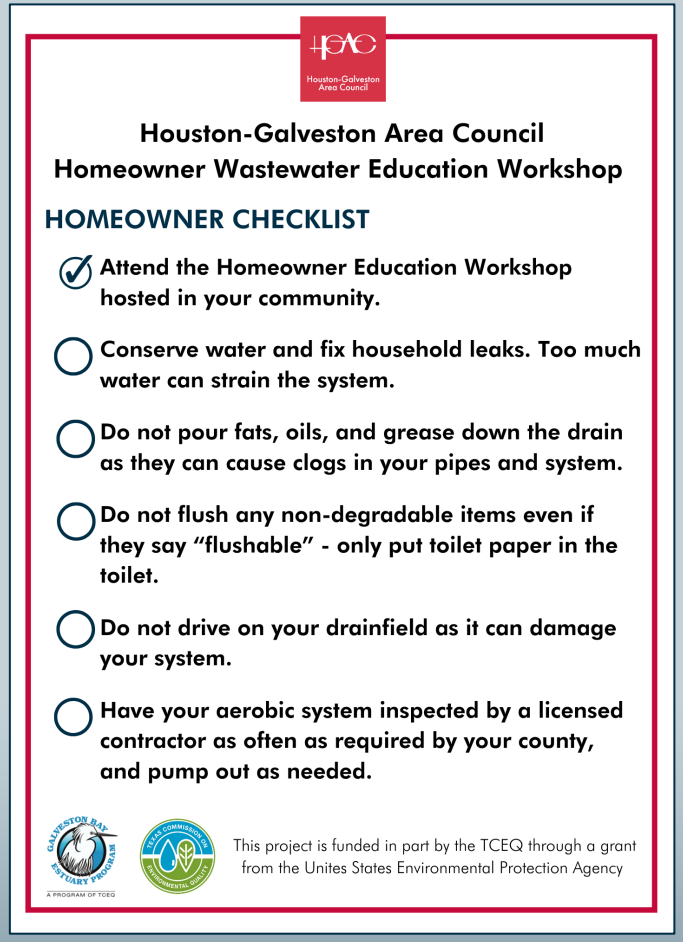
Project 1: Community Pumpouts



Liverpool

Project 1: Community Pumpouts

- Outreach barriers and strategies
  - Elderly population
    - Physical materials and distribution by city or local partners
    - Flyers but also city newsletters and word of mouth
- Key Partners
  - City staff (Liverpool and Holiday Lakes)
  - Nonprofits (Actions, Inc. of Brazoria County and United Way of Brazoria County)



Project 1: Community Pumpouts

- Results and Takeaways
- 3 communities
  - Liverpool's highest vulnerability factors were and elderly population, along with disabled residents, and a small amount of car-less residents.
    - Outreach was provided in physical form and the workshop scheduled close by during early afternoon.

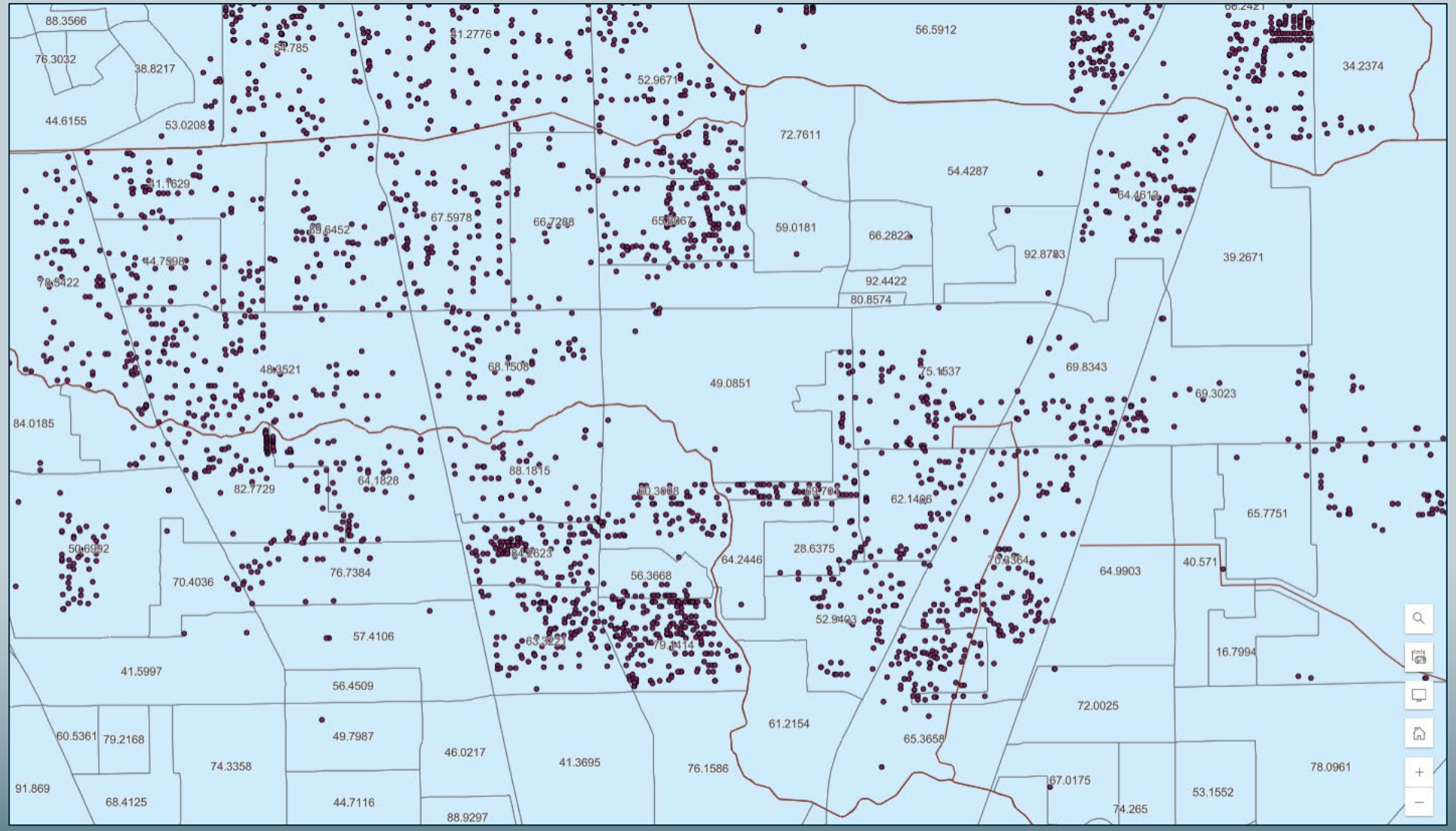
Workshop Location	Workshop Date	Attendees	Resulting Pumpouts
Liverpool, TX	3/8/2024	13	4
Liverpool, TX	3/8/2024	3	2
Angleton, TX	6/19/24	6	6
Angleton, TX	6/19/24	3	1
Holiday Lakes, TX	7/20/24	19	11
Total		44	24

Project 2: Repair & Replacement of OSSFs

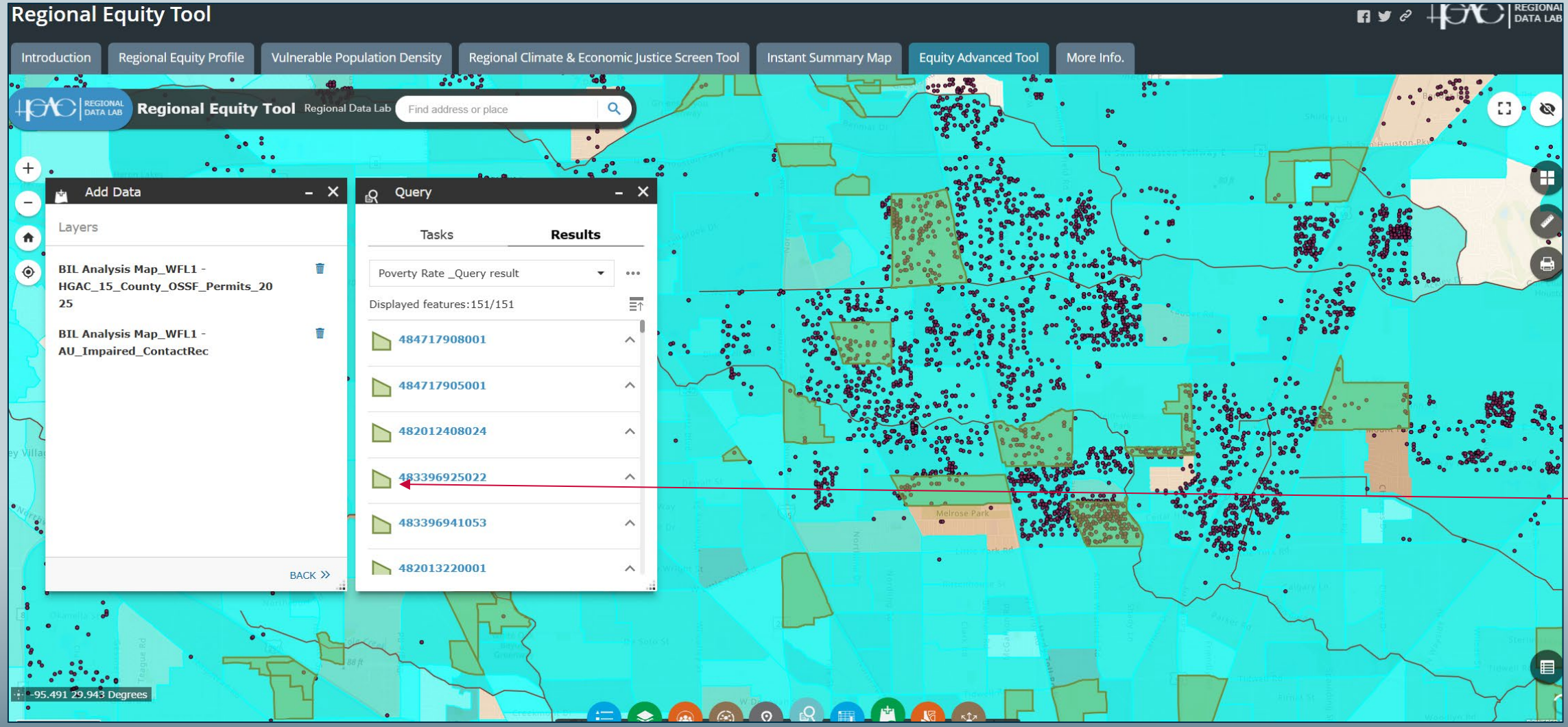
- Identify priority communities
  - Areas with high concentrations of OSSFs near impaired waterways
  - Focus on the income/poverty vulnerability factor
  - 1st Priority Community – East Aldine Management District
- Host OSSF Homeowner Education Workshops
  - At least one per focus community
- Repair or Replace up to 25 failing OSSFs

This project is also funded in part by TCEQ through a grant from the United States Environmental Protection Agency.

Project 2: Repair & Replacement of OSSFs

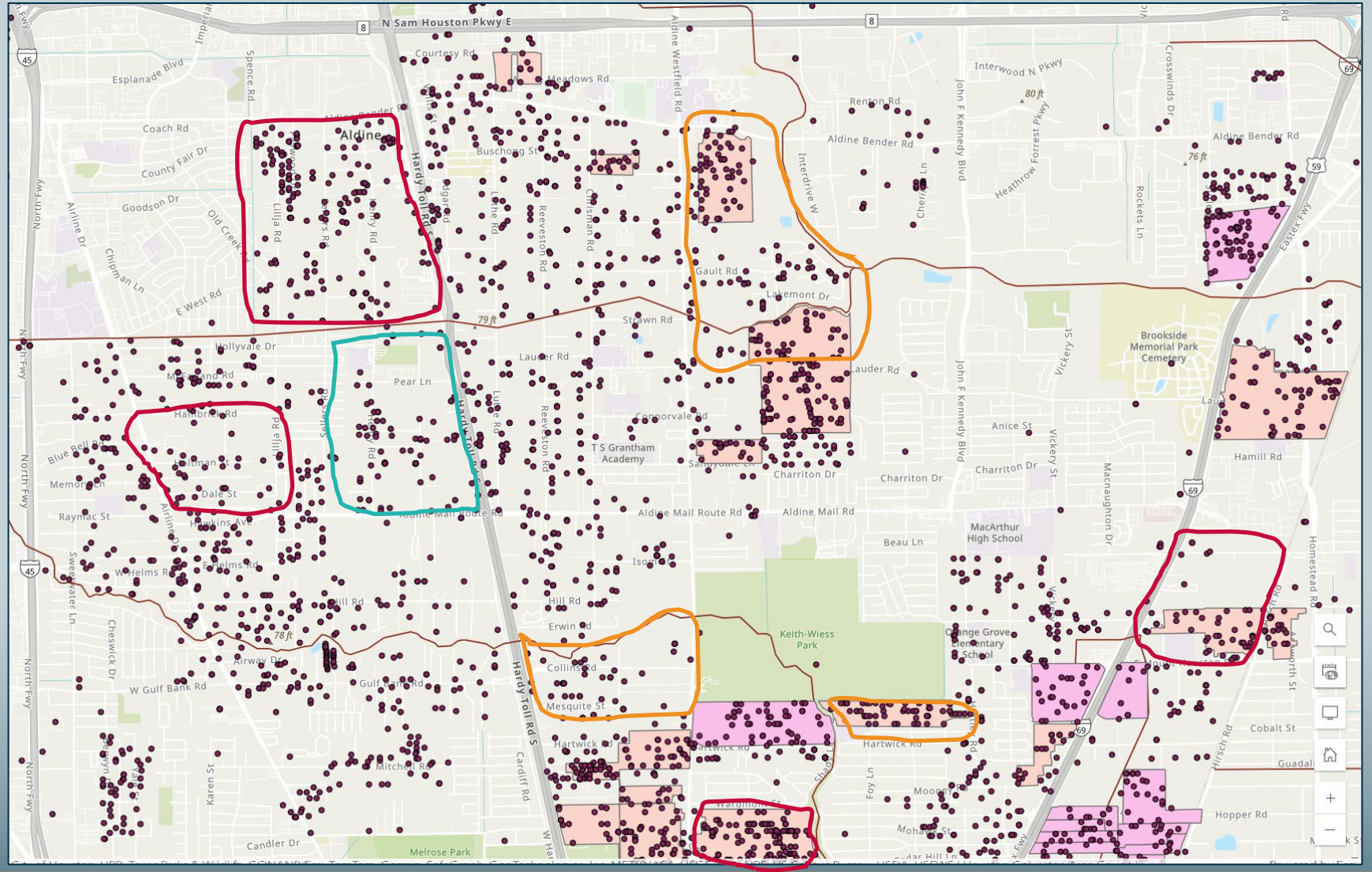


Project 2: Repair & Replacement of OSSFs



Query Results for census blocks with 50% or greater poverty rate level.

Project 2: Repair & Replacement of OSSFs



Project 2: Repair & Replacement of OSSFs

- Key Partners
  - East Aldine District
  - Greens Bayou Coalition
  - Harris County Pct. 2
  - Harris County Authorized Agent and Engineering Department
- East Aldine District
  - Workshop location
  - Local advertisement and community engagement
  - Provided in-person translation services for workshops
  - A trusted resource for residents through the whole process

H-GAC's Homeowner Wastewater Assistance Program can provide no-cost repair or replacement of failing on-site sewage facilities for qualifying applicants.

ELIGIBILITY REQUIREMENTS

- ✓ Attend the Homeowner Education Workshop hosted in your community.
- ✓ Applicant must be the homeowner and reside in the home.
- ✓ Applicant must not earn more than 80 percent of the median household income (80% in Harris County = $58,483.00).
- ✓ Homeowner can be eligible even if under enforcement action for violation of TCEQ rules.

FREQUENTLY ASKED QUESTIONS

Q: *Where does the program funding come from?*
A: This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement (4T-02F61501) to TCEQ. The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the EPA endorse trade names or recommend the use of commercial prducts mentioned in this document.

Q: *What will I learn at the workshop?*
A: The workshop will cover basic components of an on-site sewage facility (conventional septic systems and aerobic systems) and proper maintenance. It does not provide for or allow homeowners to inspect their own systems in place of a maintenance contract.

Q: *What do I need to provide to verify eligibility?*
A: You will need to provide documentation showing that you own the home (ex. deed) and reside in the home (ex. current utility bill). You will also need to provide documentation on the household income (ex. income tax return).

Q: *How will my information be stored/used?*
A: Your information will only be used to validate eligibility and will be stored only until work is completed. No personal information will be shared with any third parties.

Q: *Will I need to provide anything else to complete the installation?*
A: Property owners will need to provide a property survey for system design, and will need to have access to an external 120v, 30amp electrical disconnect near the site for installation. The installation and work area should also be mowed.

Q: *What if I don't meet the no-cost repair or replacement requirements listed?*
A: Everyone is encourage to attend the workshop to learn about their system and proper maintenance. Proper maintenance can extend the life of your system and reduce the risk of failure.

Project 2: Repair & Replacement of OSSFs

- Results and Takeaways
- Aldine area with focus on East Aldine Management District
  - More difficult to define distinct communities in this area of Houston
  - Multiple high ranking census blocks from analysis in and adjacent to East Aldine Management District

Workshop Location	Workshop Date	Attendees	Possible Applicants*	Resulting Repairs/Replacements**
East Aldine	10/21/25	7	4	0
East Aldine	12/6/25	16	11	8
East Aldine	01/10/2026	27	19	11
Total		50	34	19

*This is the number of attendees who took applications and indicated they would be applying.
**At the time of this presentation no repairs/replacements have been completed, but this is the number of attendees who have been approved.

Key Takeaways

- Interactive online tools like H-GAC's Regional Equity Tool can be used to identify priority areas based on impact and funding
- Local partners are key in establishing resident trust and participation
- More/consistent funding is needed to fully address the issue of failing OSSFs in our region

Questions?

Bill Ervin

Senior Planner, Water Resources

Houston-Galveston Area Council

Bill.Ervin@h-gac.com

713-993-2487

Kendall Guidroz

Senior Planner, Water Resources

Houston-Galveston Area Council

Kendall.guidroz@h-gac.com

713-993-2469

Homeowner Wastewater Assistance Program

OSSF@h-gac.com

H-gac.com/on -site-sewage-facilities

Public Awareness of Waterborne Pathogen Risk from Recreational Exposure:

Insights from the Galveston BEACH Survey

Galveston BEACH (**B**eaches, **E**conomic **A**ctivity, and **C**ommunity **H**ealth) **Survey**

Original instrument developed by Dr. Virgie Greb (TAMUG, 2025)

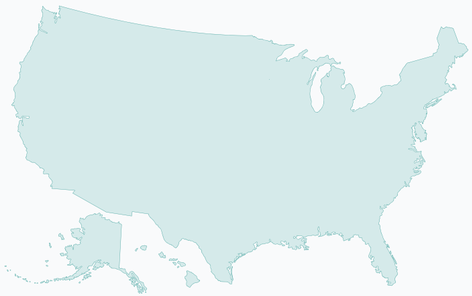
State of the Bay Symposium
February 25, 2026
Galveston, Texas

Dr. Virgie Greb, Texas A&M University at Galveston
Dr. Ashley Ross, Texas A&M University at Galveston
Dr. Cara Pennel, University of Texas Medical Branch

The **Blue Economy** *is the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving ocean ecosystem health.*

National

- **2.4 million jobs** (NOAA, 2023)
- **$397 billion to GDP** (NOAA, 2023)



State

- **25% (7.3 million) of the state's population** (GLO, 2023)
- **$7 billion dollar tourism industry** (GLO, n.d.)
- **$17.3 billion in wages** (NOAA Office for Coastal Management, 2023)
- **$46 billion annually to GDP** (NOAA Office for Coastal Management, 2013)

Local

- **8.9 million visitors, 2023**
- **30.2 million HOT collections**
- **$1.3 billion in visitor spending**
- **$126 million to state & local tax revenues**
- **12,541 jobs (1-in-3)** (Tourism Economics, 2023)

Motivation & Research Questions

There is an urgent need to better understand how the economic activity that supports coastal communities is related to the quality of beaches and waters.

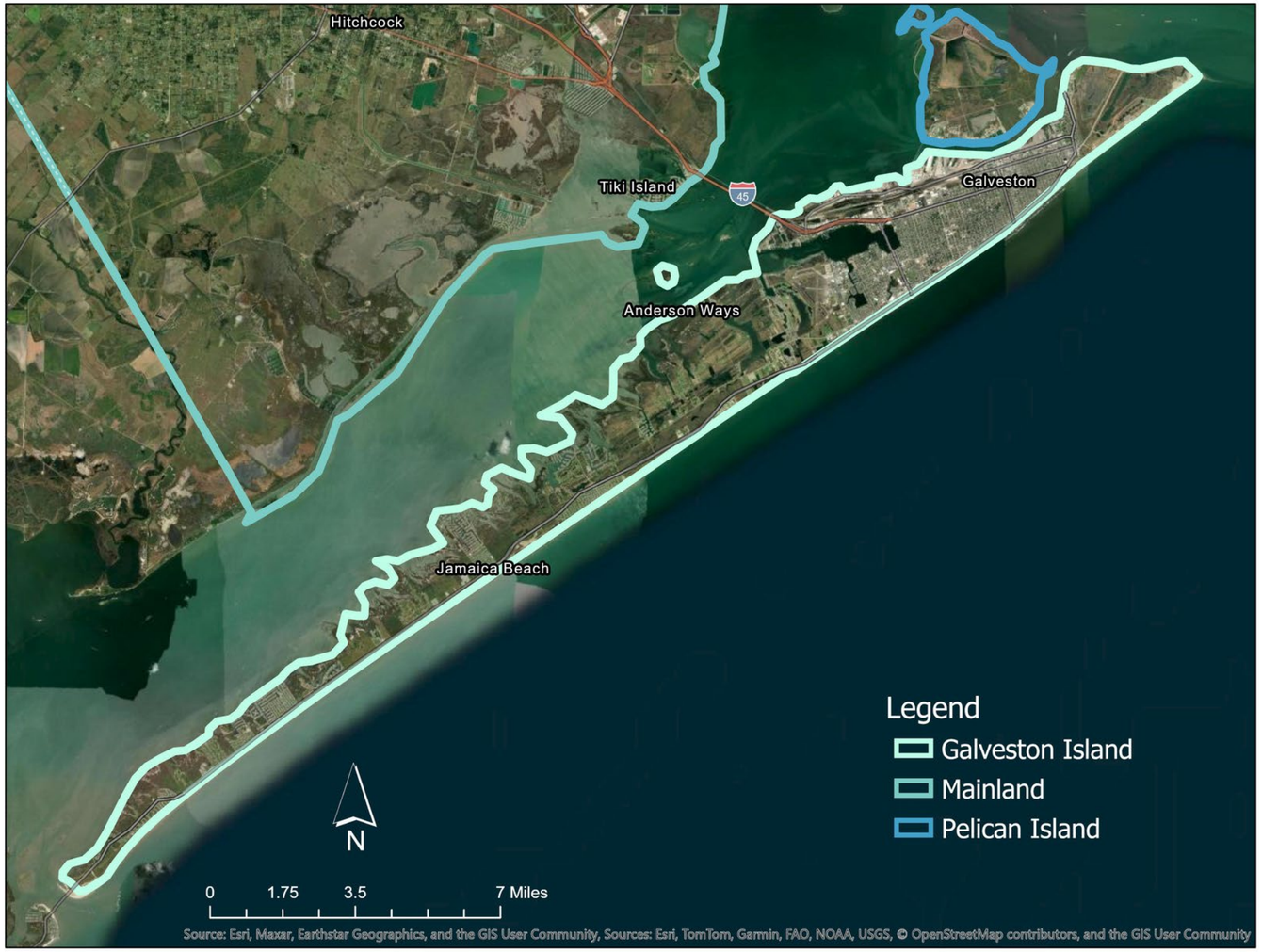
01 How do people perceive Galveston beach quality and cleanliness?

02 What do people understand to be “clean” beach water?

03 How aware are people of available water quality information?

04 When given water quality information, what risks do people associate with polluted water?

Public Awareness of Waterborne Pathogen Risk from Recreational Exposure: Insights from the Galveston Beach Survey



Study Area

Galveston Island, Texas

- **~32 miles** of public beach
- Population of ~53,000
- In 2023:
  - **8.9 million visitors**
  - **$30.2 million dollars** in Hotel Occupancy Tax (HOT) revenue
- Tourism Friendly Certified Community
- 4th most popular homeport in the nation
- At the bottom of the Galveston Bay Watershed

Data Collection

Original Survey | TAMU IRB #2022-1169M

Three Waves of Data Collection:

01 **Online quota-based panel** of Galveston County, Texas residents (match demographics)
February 20–March 10, 2023 (n=327)

02 **In-person convenience sample** on multiple Galveston beaches
June 29–July 28, 2023 (n=209)

03 **Online convenience sample** via City of Galveston water bill distribution
November 1, 2023–December 31, 2023 (n=196)

n = 732

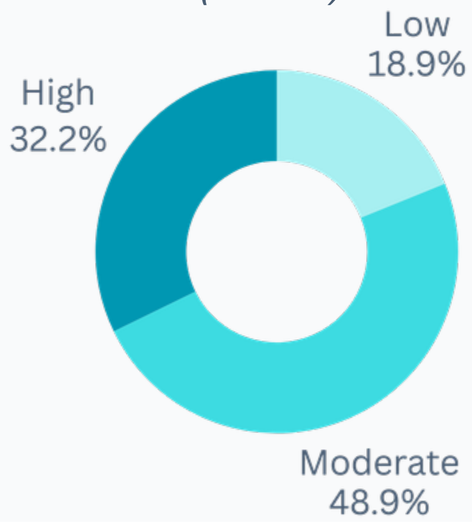
53% residents & 47% visitors

Of residents, 87% have primary home in Galveston

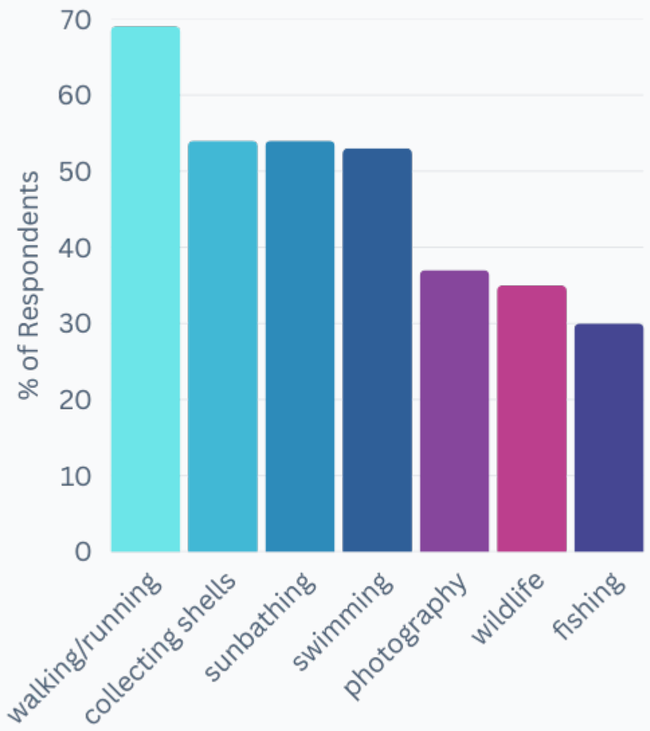
Public Awareness of Waterborne Pathogen Risk from Recreational Exposure: Insights from the Galveston Beach Survey

Recreational Snapshots

Majority of respondents are frequent beachgoers, visiting daily to once a month (resident) or 3-10 times (visitor)



Which of the following recreational activities do you take part in while at the beach?

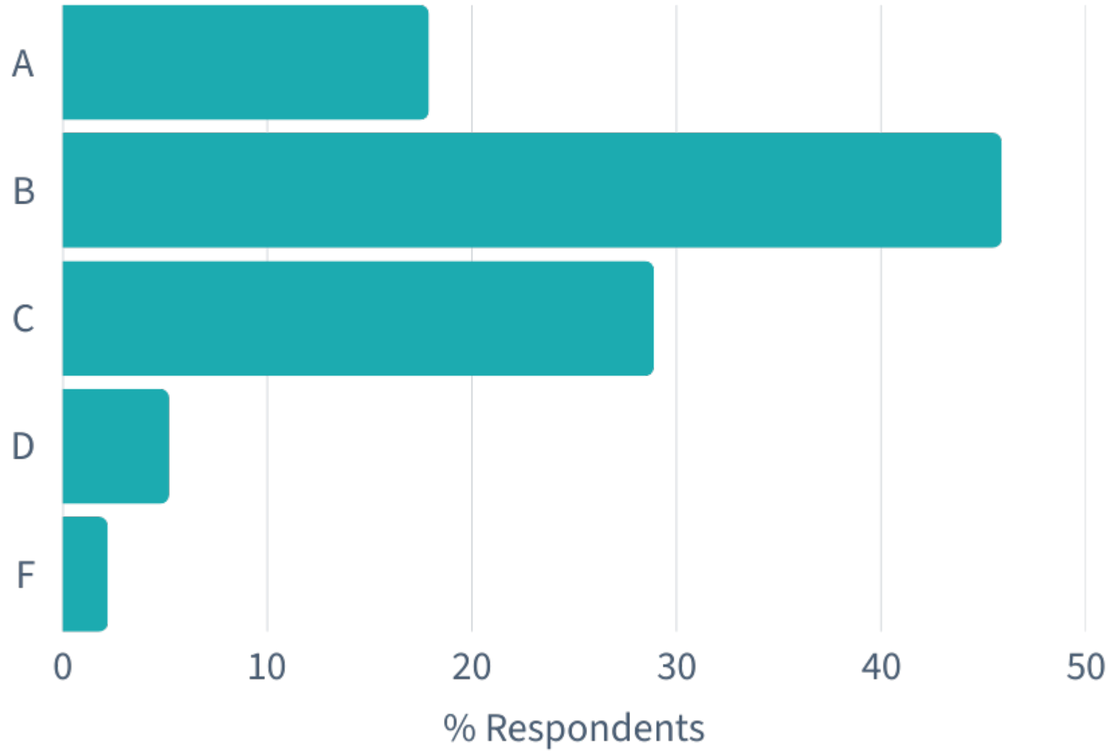


What are the reasons that you visit Galveston beaches?

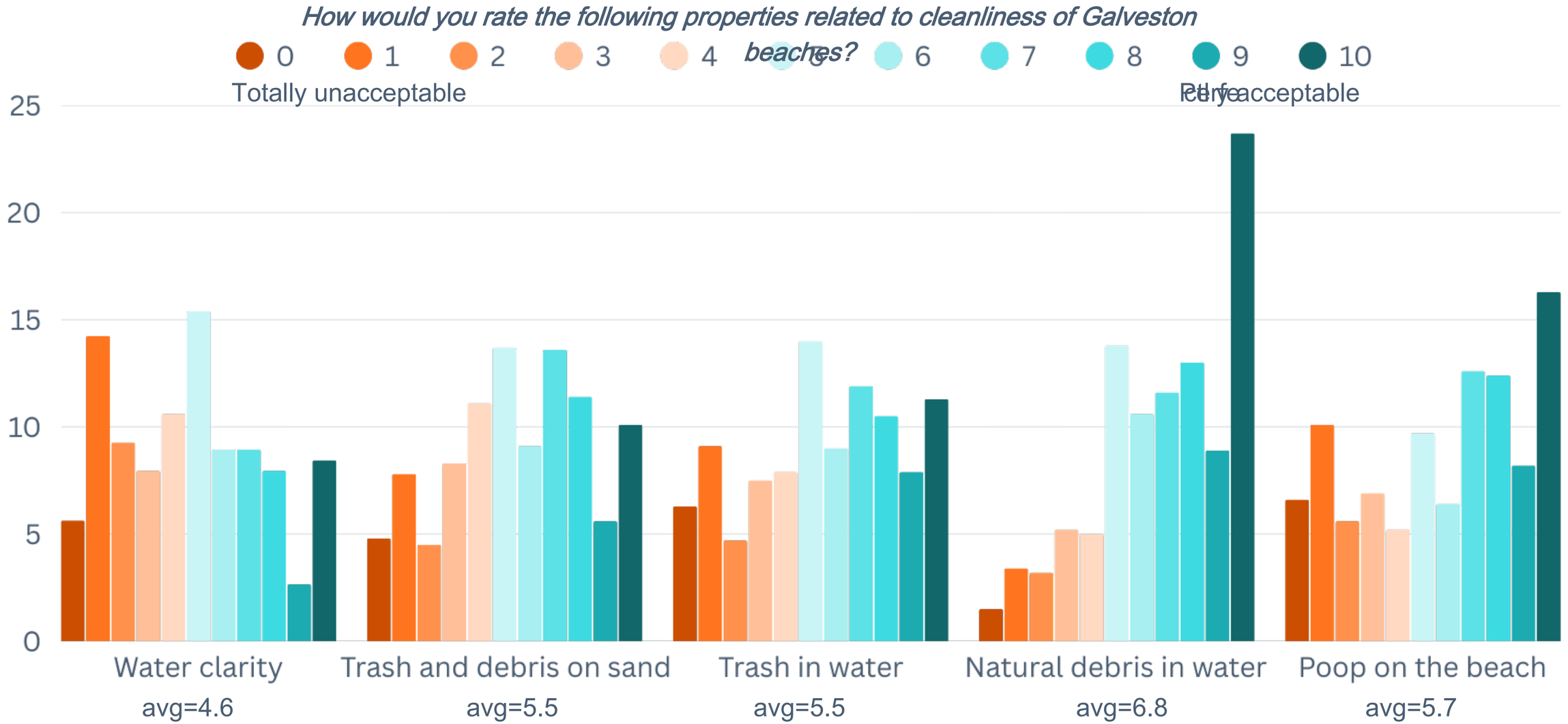
1. To relax
2. To spend time with friends/family
3. To be active
4. Because it's easy to get to
5. Pleasant weather
6. View wildlife/be with nature
7. For the waves
8. Let children play
9. Because it is inexpensive
10. Because it is safe

Galveston Beach Rating

Overall, what grade would you give Galveston beaches?
Please consider A to represent the best possible quality and F the worst possible quality.



Perceptions of Beach Cleanliness



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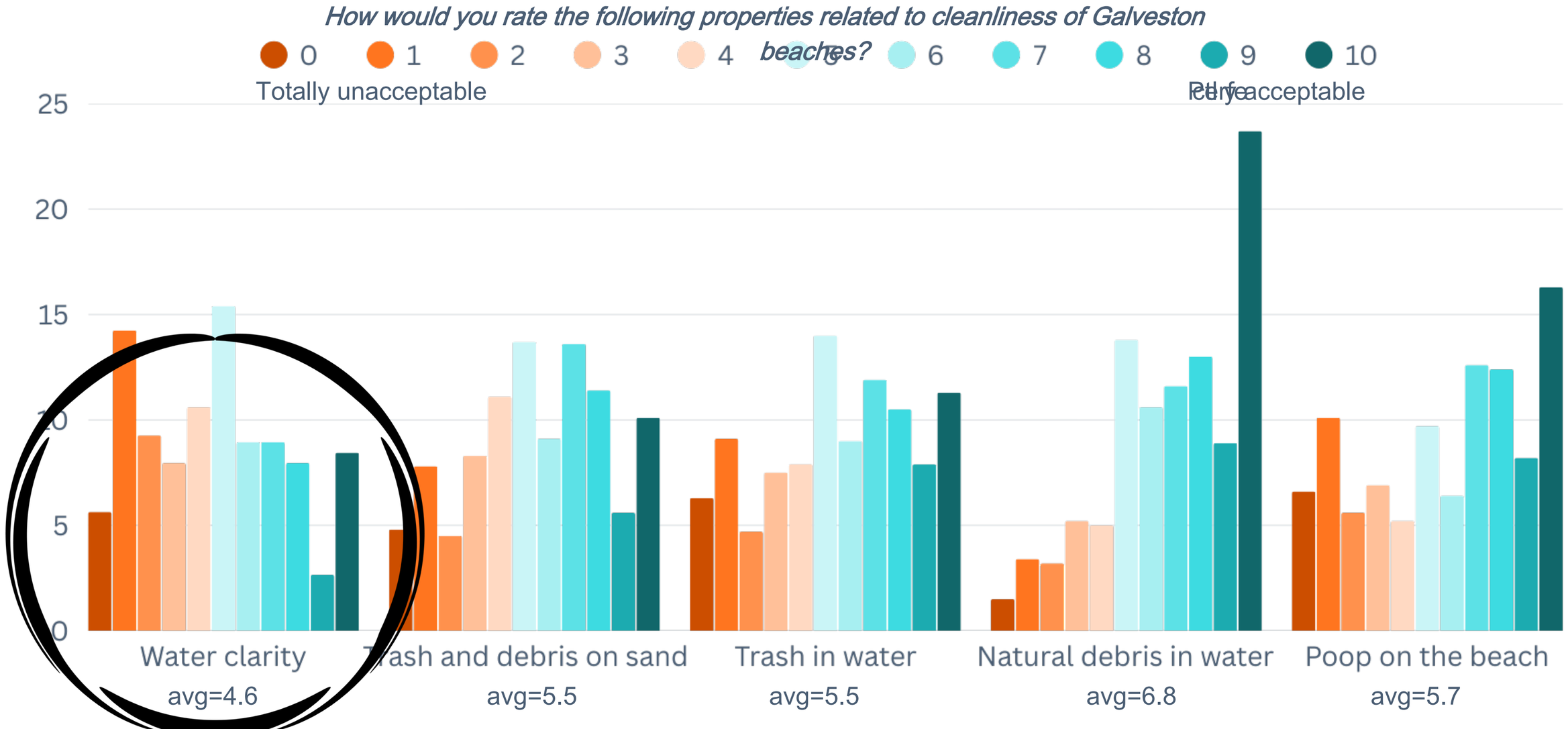
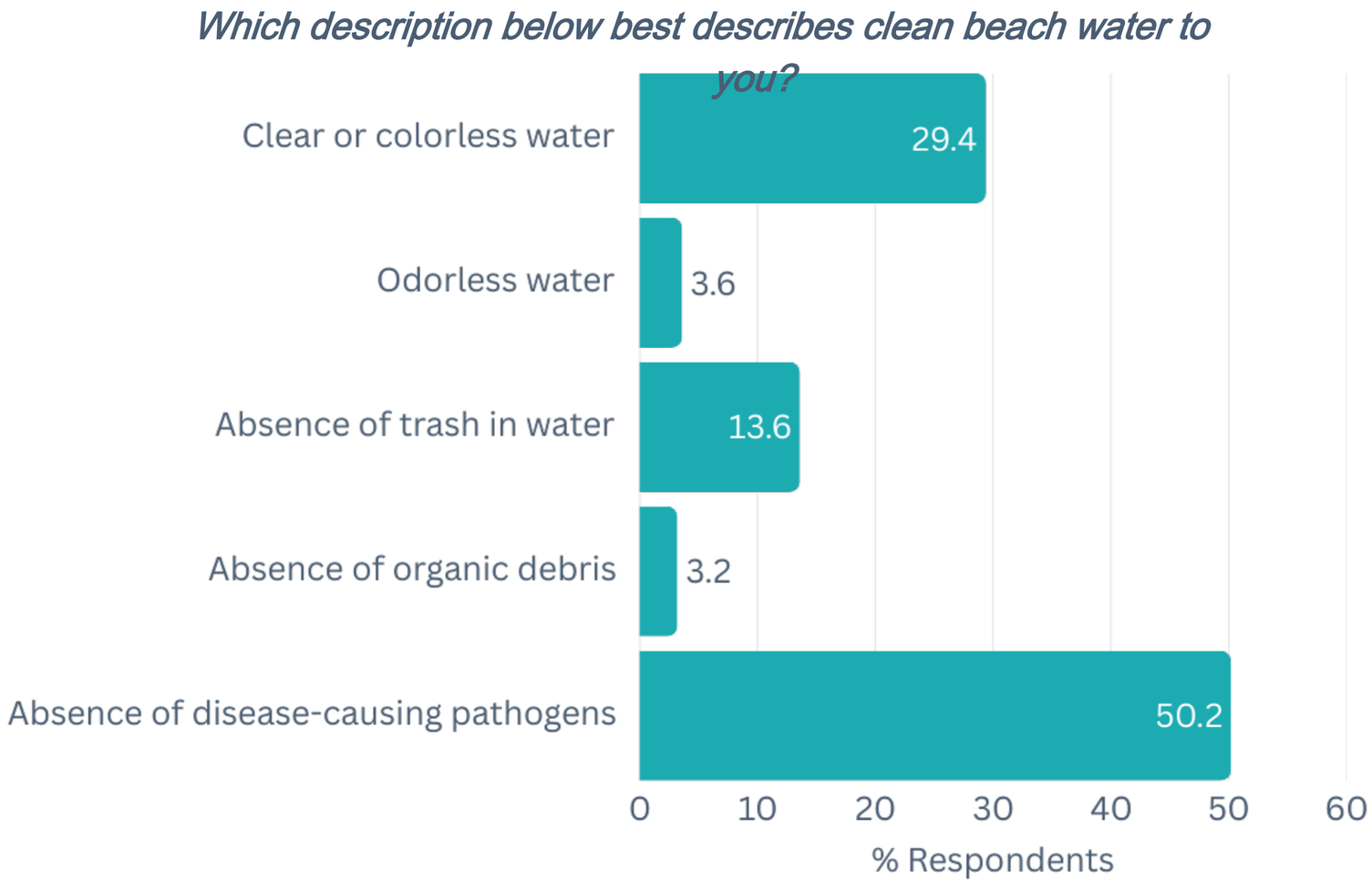
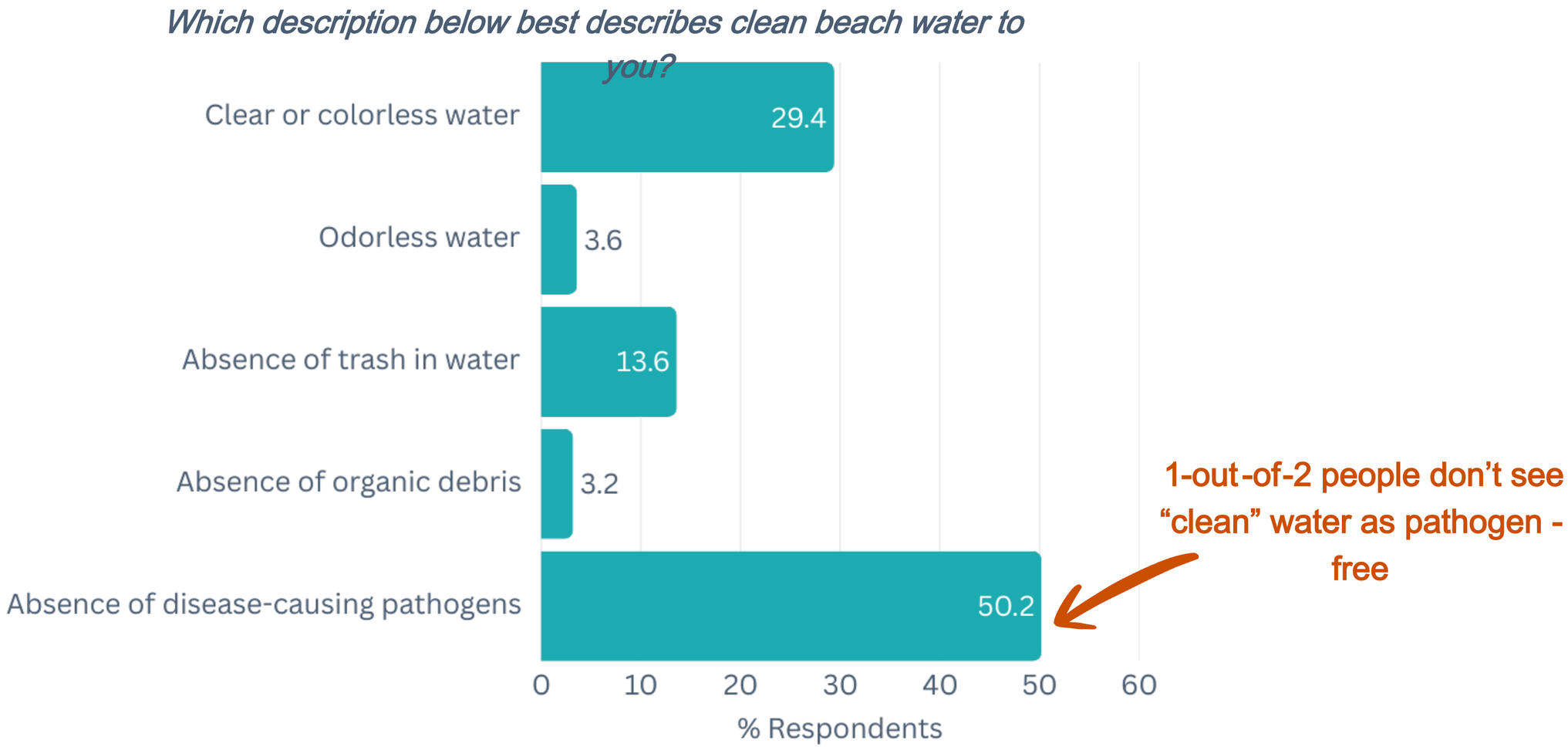


Clean Water Perceptions



Public Awareness of Waterborne Pathogen Risk from Recreational Exposure: Insights from the Galveston Beach Survey

Clean Water Perceptions



Public Awareness of Waterborne Pathogen Risk from Recreational Exposure: Insights from the Galveston Beach Survey

Statistical Analysis

		Test Statistic	p-value
Beach Perceptions	*Grade: A or B*	$X^2 = 0.258$	0.612
	Clarity of the water rating	$F = 11.52$	0.001
Beach habits	*Referent beach*	$X^2 = 9.293$	0.054
	Beach visitation	$X^2 = 5.589$	0.061
Pollution Information	*Pollution monitoring awareness*	$X^2 = 8.952$	0.003
	Consult water quality information	$X^2 = 1.341$	0.247
Resident characteristics	*Residence*	$X^2 = 12.005$	0.002
	Age	$X^2 = 12.332$	0.031
	Income	$X^2 = 12.604$	0.027
	Education	$X^2 = 28.403$	0.000
	Gender	$X^2 = 8.448$	0.004

Notes: Tests for association (Pearson's X^2) were conducted, except clarity of water rating (ANOVA), with the clean water awareness measure (1 = absence of disease-causing pathogens and 0 = clear or colorless water).

Public Awareness of Waterborne Pathogen Risk from Recreational Exposure: Insights from the Galveston Beach Survey

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Individuals who are...

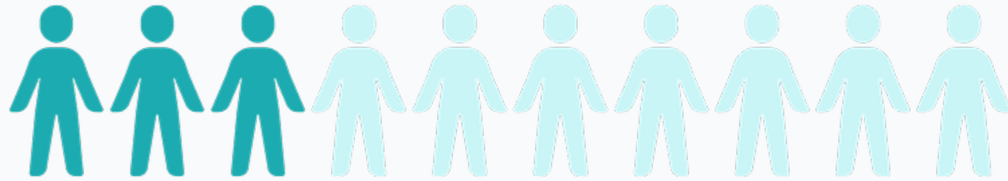
- accepting of Galveston beach water clarity
- aware of pollution monitoring
- live in Galveston as a permanent resident
- older
- higher income
- more educated
- female

...are also more likely to say "clean" beach water is the absence of disease -causing pathogens.

Information Awareness

Are you aware of pollution monitoring for Galveston waters, available from Texas Beach Watch?

Do you typically check water quality information before going to the beach?

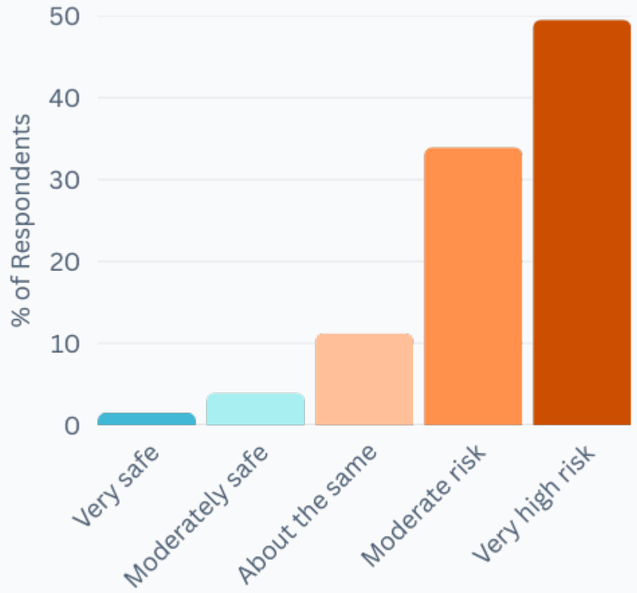


When you visit Galveston beaches, do you typically read the public signage?

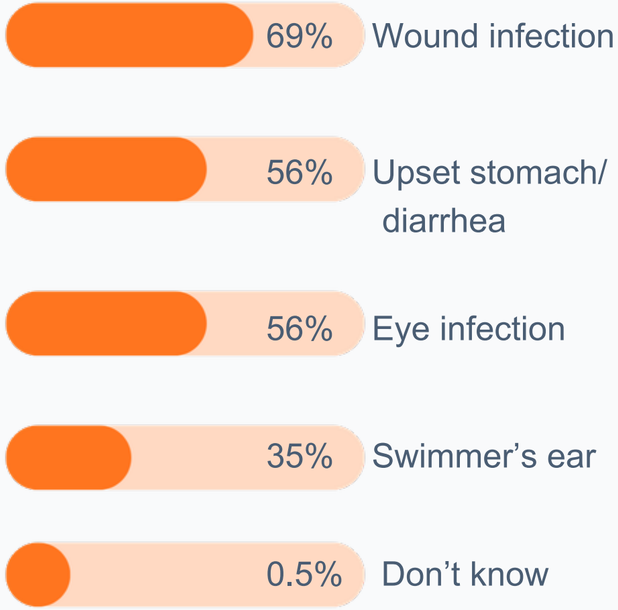
Public Awareness of Waterborne Pathogen Risk from Recreational Exposure: Insights from the Galveston Beach Survey

Perceptions of Health Risks

If you saw a sign warning of unsafe levels of bacteria in the water at a Galveston beach, how would you rate your personal risks if you got into the water?



In your opinion, what are the health risks associated with recreational activities in polluted beach water? Select all that apply.



Key Take -Aways

01 Prevailing misperceptions about clean beach water

Half of the respondents didn't acknowledge that "clean" water is pathogen free, and many rated clarity of water as more unacceptable than other risks (e.g., trash, poop).
But, certain groups (residents, older, higher income/education, female) are more likely to be aware what clean water means --so are those who are aware of pollution monitoring.

02 Moderate lack of awareness and engagement with pollution monitoring data

Most people don't check water quality information before going to the beach, and only 50% of people are aware of pollution monitoring.

03 Strong engagement and responsiveness with beach signage

Majority of people check beach signage and consider a warning of unsafe bacteria levels in beach water as risky.

Implications

Explore leveraging existing beach signage and established organizational campaigns (e.g., Surfrider) to improve knowledge of "clean" water and engagement with water quality monitoring.

More research into perceptions about pollution monitoring (Texas Beach Watch) and how to improve public uptake and understanding.

Build on Galveston Bay Report Card to produce similar "grades" for Galveston beaches across multiple dimensions.

Thank you!

Dr. Virgie Greb, Texas General Land Office (virgie.greb@glo.texas.gov)

Dr. Ashley Ross, Texas A&M University at Galveston (ashleydross@tamug.edu)

Dr. Cara Pennel, University of Texas Medical Branch (clpennel@utmb.edu)

GALVESTON BAY
FOUNDATION

PROTECT TODAY. PRESERVE TOMORROW.

SPLASh
STOPPING PLASTICS AND
LITTER ALONG SHORELINES

Water Quality, Debris, and Citizen Scientists in Galveston Bay

Natasha Zarnstorff, GBF, Water Protection Manager
Liz Virgl, SPLASh, Texas Coastal Program Manager

Our Mission & Vision

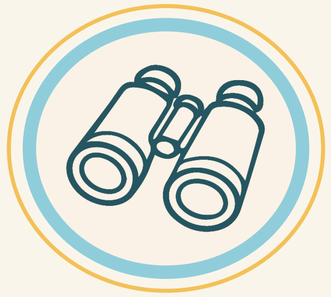
Mission

The mission of Galveston Bay Foundation is to preserve and enhance Galveston Bay as a healthy and productive place for generations to come.

Vision

We envision a future Galveston Bay that is brimming with vitality, connected to people, and contributing to the community in every possible way.

Program Areas



Education

Habitat Restoration

Land Conservation

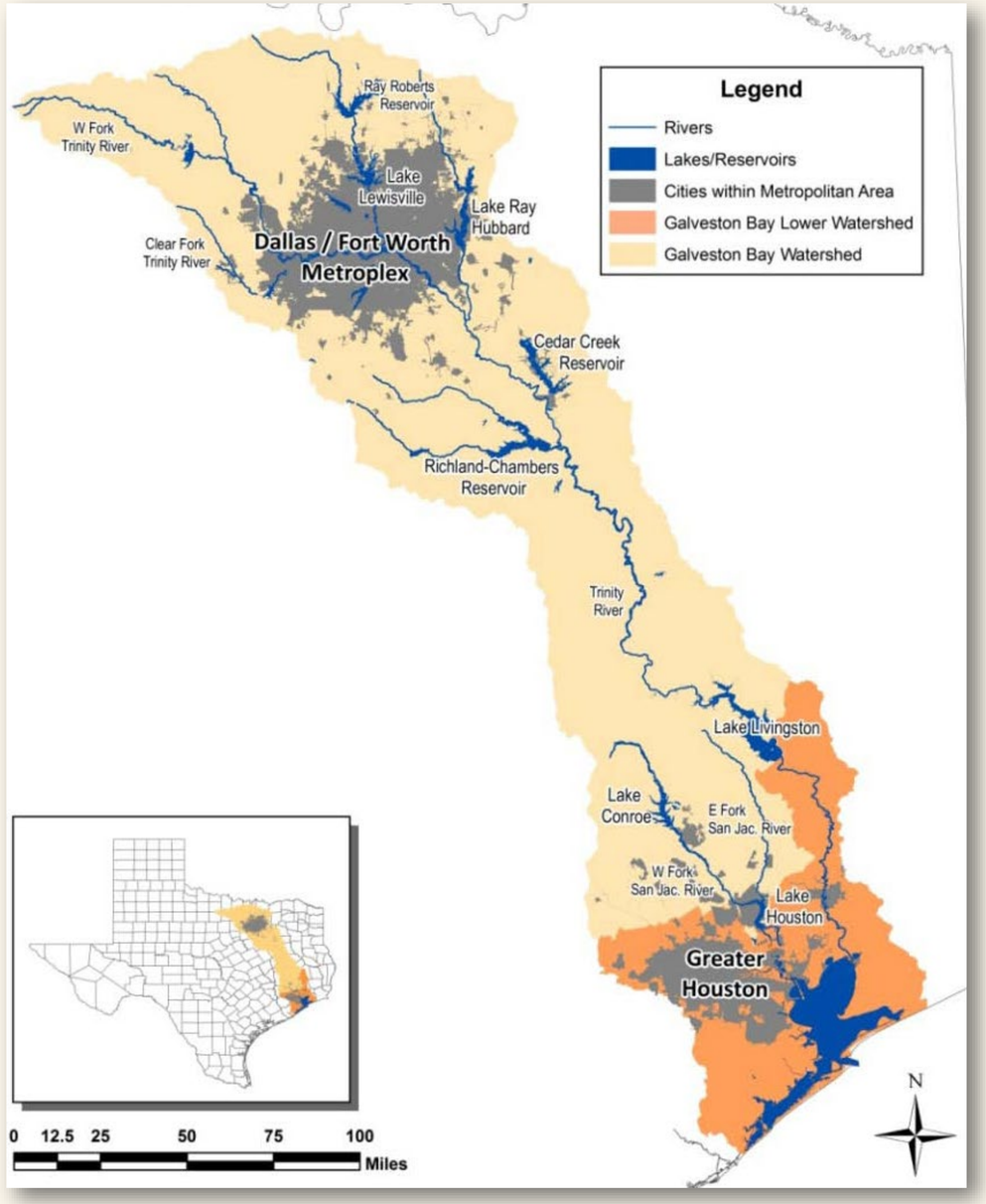
Water Protection

Research

Advocacy

About Our Watershed

- Largest estuary in Texas and 7th largest in United States
- 24,000 square miles - from the Houston metropolitan area, past the Dallas/Fort Worth metroplex
- About half of the population of Texas lives in the Galveston Bay watershed
- Serves the busy ports, commercial and recreational fisheries, tourism, and recreation
- Brackish water = great variety of marine life



galvybay.org

Water Quality

Monitoring, Data Access, Results

Marine Debris

Surveys, Removal, Outreach

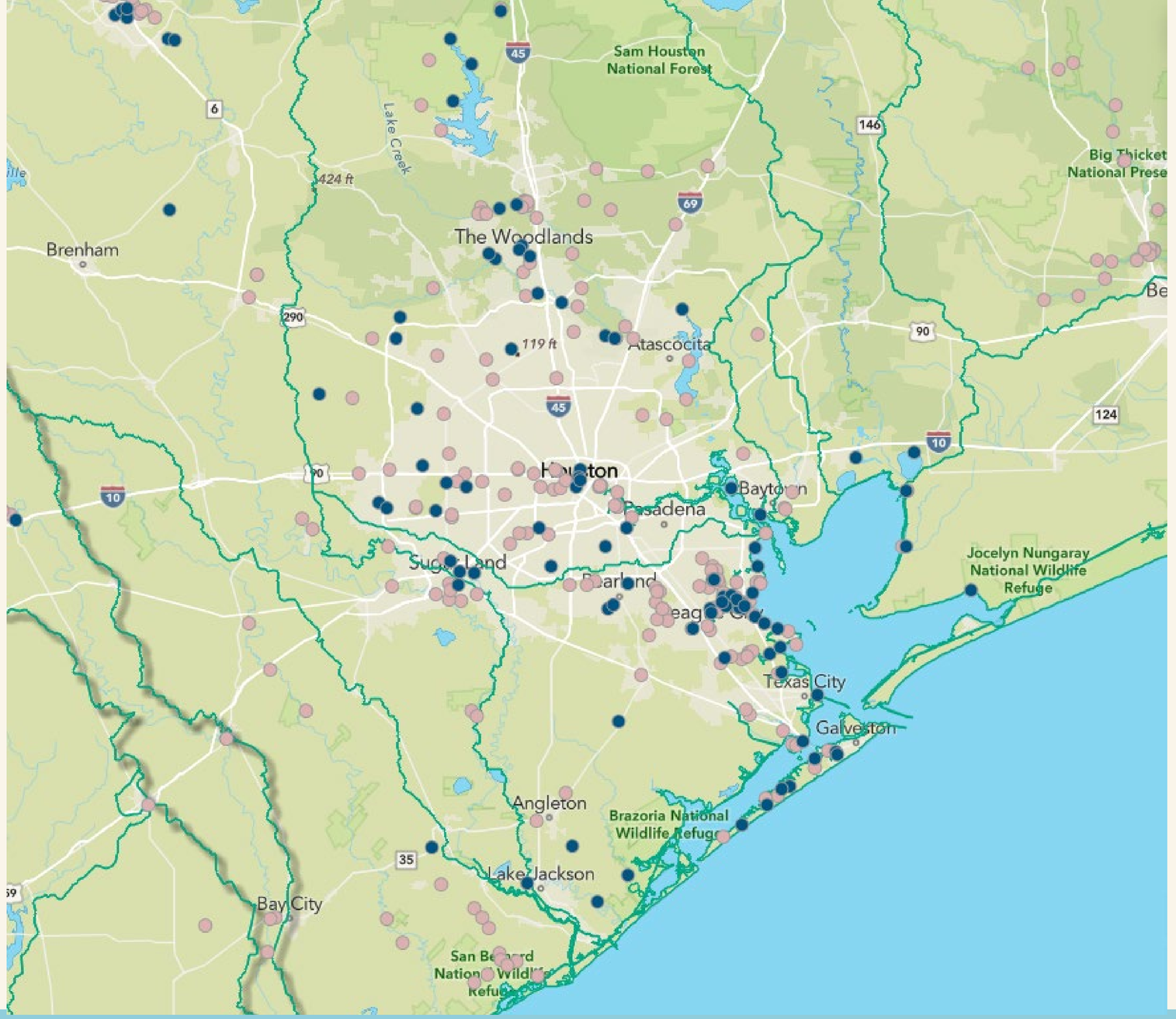
New Projects

Ways to Get Involved

WHY COMMUNITY SCIENCE MONITORING?

- More cost effective than professional monitoring
- More frequent than professional monitoring
- Can trigger alarm bells to alert state officials
- Builds sense of ownership
- Develops advocates for local waterways

The Meadows Center
for Water and the Environment
Texas State University
Texas Stream Team

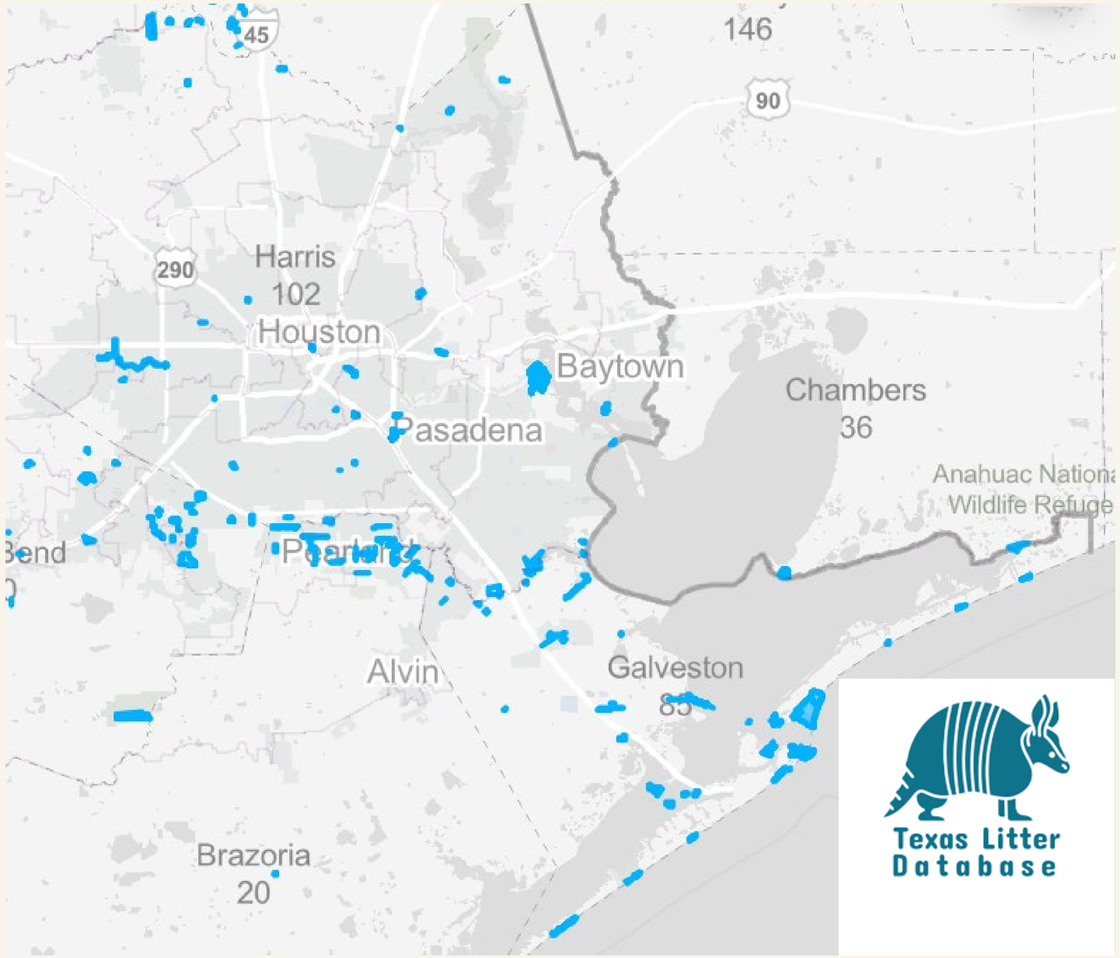


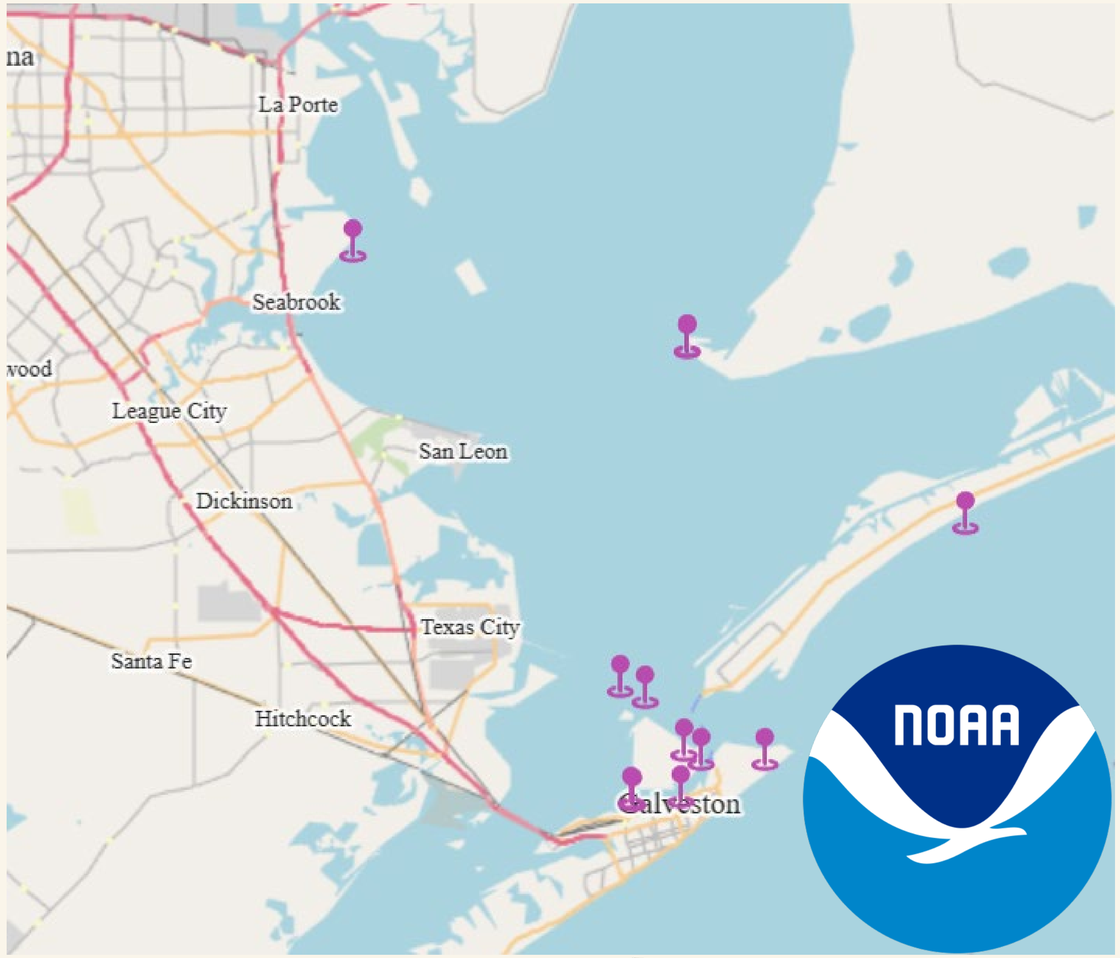
Bayou Preservation Association

Keep Sugar Land Beautiful
KSLB

Houston-Galveston Area Council

City of Sugar Land





TURTLE ISLAND RESTORATION NETWORK
FIGHTING FOR A BLUE-GREEN PLANET

GULF CENTER FOR SEA TURTLE RESEARCH

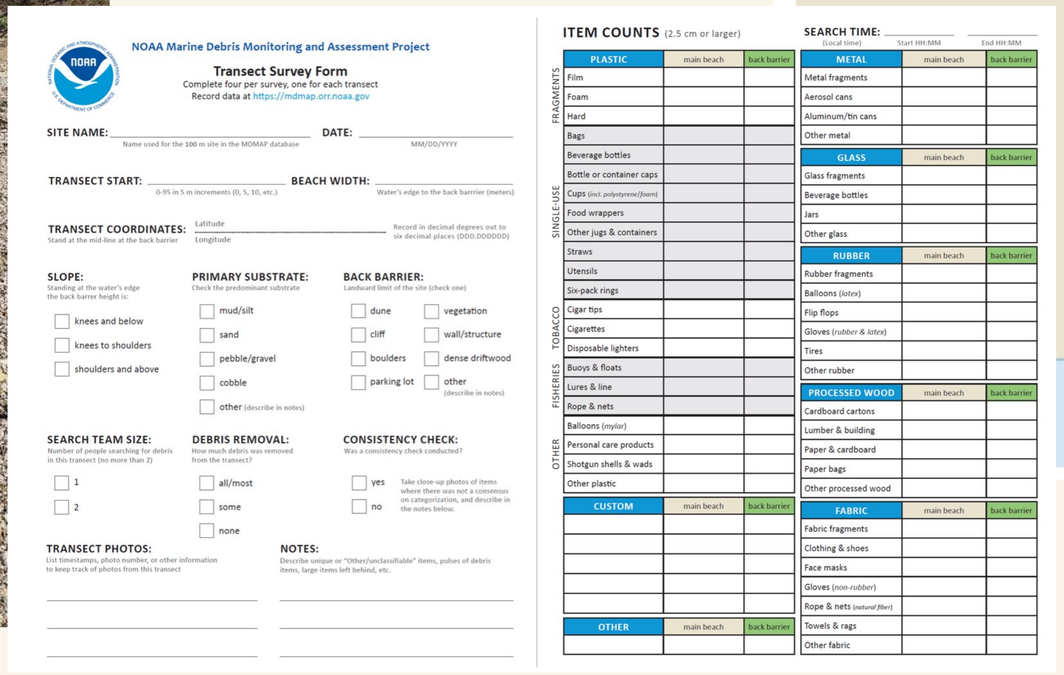
SPLASh
STOPPING PLASTICS AND LITTER ALONG SHORELINES

American Bird Conservancy

Keep Texas Beautiful

Marine Debris Surveys

- NOAA Marine Debris Monitoring and Assessment Project (MDMAP)
- 4 Survey Sites
- Each site visited monthly



NOAA Marine Debris Monitoring and Assessment Project

Transect Survey Form

Complete four per survey, one for each transect
Record data at https://mdmap.orr.noaa.gov

SITE NAME: _____ **DATE:** _____
Name used for the 100 m site in the MDMAP database — MM/DD/YYYY

TRANSECT START: _____ **BEACH WIDTH:** _____
0-95 in 5 m increments (0, 5, 10, etc.) — Water's edge to the back barrier (meters)

TRANSECT COORDINATES: Latitude _____ Longitude _____
Stand at the mid-line at the back barrier — Record in decimal degrees out to six decimal places (DDD.DDDDDD)

SLOPE:
Standing at the water's edge the back barrer height is:
- ☐ knees and below
- ☐ knees to shoulders
- ☐ shoulders and above

PRIMARY SUBSTRATE:
Check the predominant substrate
- ☐ mud/silt
- ☐ sand
- ☐ pebble/gravel
- ☐ cobble
- ☐ other (describe in notes)

BACK BARRIER:
Landward limit of the site (check one)
- ☐ dune
- ☐ vegetation
- ☐ cliff
- ☐ wall/structure
- ☐ boulders
- ☐ dense driftwood
- ☐ parking lot
- ☐ other (describe in notes)

SEARCH TEAM SIZE:
Number of people searching for debris in this transect (no more than 2)
- ☐ 1
- ☐ 2

DEBRIS REMOVAL:
How much debris was removed from the transect?
- ☐ all/most
- ☐ some
- ☐ none

CONSISTENCY CHECK:
Was a consistency check conducted?
- ☐ yes
- ☐ no

Take close-up photos of items where there was not a consensus on categorization, and describe in the notes below.

TRANSECT PHOTOS:
List timestamps, photo number, or other information to keep track of photos from this transect

NOTES:
Describe unique or "Other/unclassifiable" items, pulses of debris items, large items left behind, etc.

ITEM COUNTS (2.5 cm or larger)

SEARCH TIME: (Local time) Start HH:MM _____ End HH:MM _____

	PLASTIC	main beach	back barrier
FRAGMENTS	Film		
	Foam		
	Hard		
	Bags		
SINGLE-USE	Beverage bottles		
	Bottle or container caps		
	Cups (*incl. polystyrene/foam*)		
	Food wrappers		
	Other jugs & containers		
	Straws		
	Utensils		
	Six-pack rings		
TOBACCO	Cigar tips		
	Cigarettes		
	Disposable lighters		
FISHERIES	Buoys & floats		
	Lures & line		
	Rope & nets		
OTHER	Balloons (*mylar*)		
	Personal care products		
	Shotgun shells & wads		
	Other plastic		

CUSTOM	main beach	back barrier

OTHER	main beach	back barrier

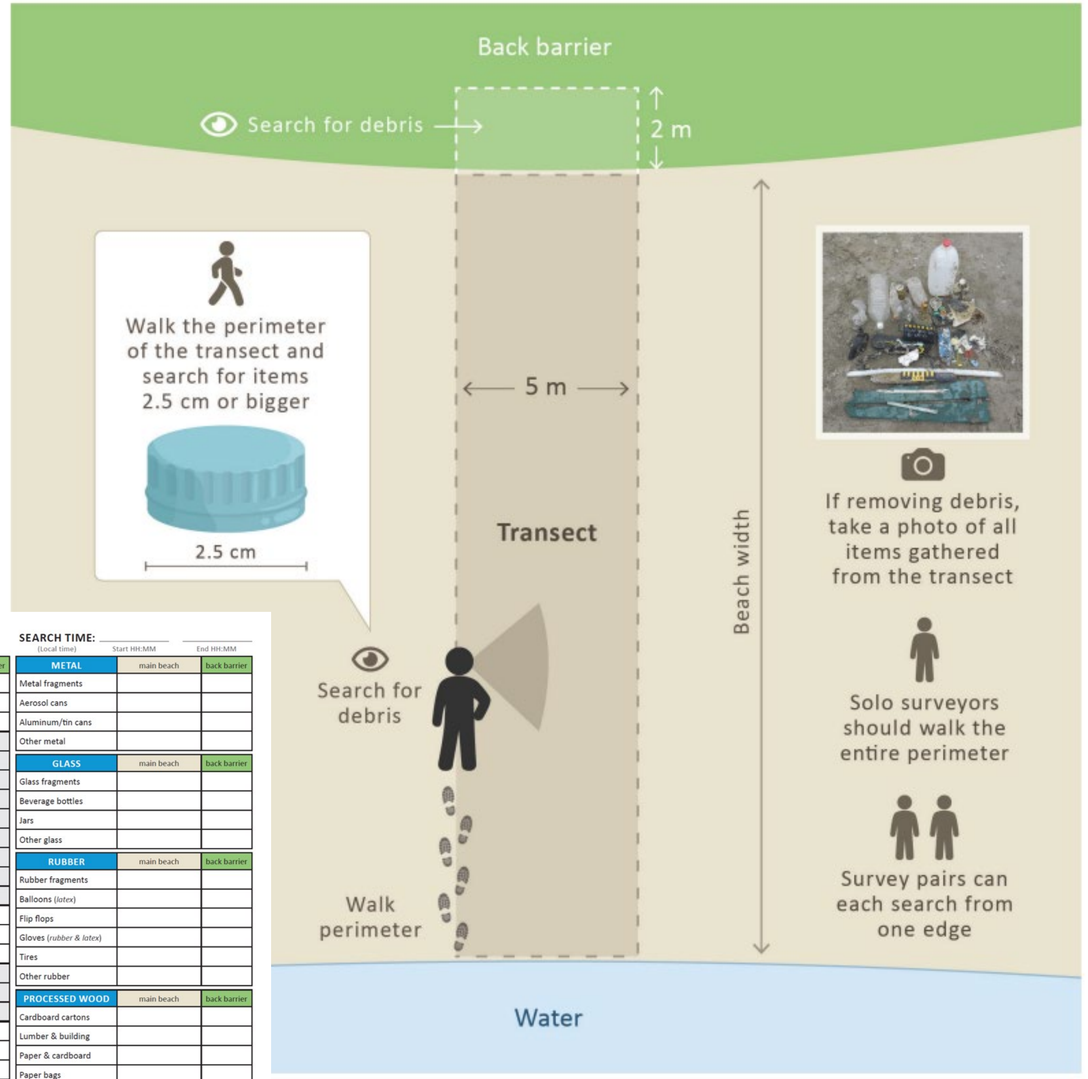
METAL	main beach	back barrier
Metal fragments		
Aerosol cans		
Aluminum/tin cans		
Other metal		

GLASS	main beach	back barrier
Glass fragments		
Beverage bottles		
Jars		
Other glass		

RUBBER	main beach	back barrier
Rubber fragments		
Balloons (*latex*)		
Flip flops		
Gloves (*rubber & latex*)		
Tires		
Other rubber		

PROCESSED WOOD	main beach	back barrier
Cardboard cartons		
Lumber & building		
Paper & cardboard		
Paper bags		
Other processed wood		

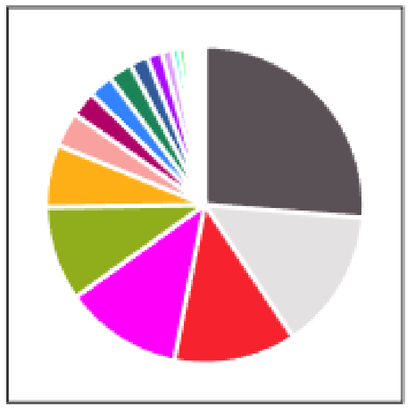
FABRIC	main beach	back barrier
Fabric fragments		
Clothing & shoes		
Face masks		
Gloves (*non-rubber*)		
Rope & nets (*natural fiber*)		
Towels & rags		
Other fabric		



Source: NOAA MDMAP Shoreline Survey Guide | 2021

Marine Debris

Results



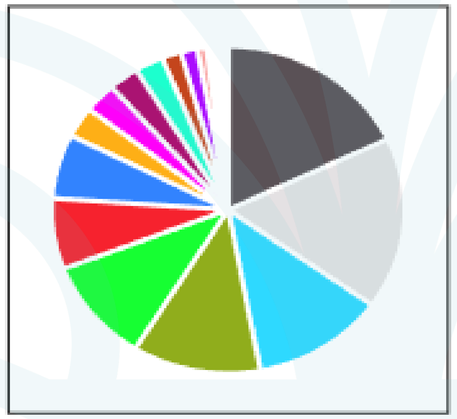
Debris Category

- Plastic Fragments, Hard
- Plastic Bottle/Container Caps
- Fishing Lures and Line
- Plastic Rope/Net Pieces
- Plastic Fragments, Film
- Plastic Fragments, Foamed
- Food Wrappers
- Other Plastic
- Plastic Beverage Bottles
- Straws
- Cigarettes
- Bags
- Shotgun Shells/Wads
- Plastic Jugs/Containers
- Personal Care Products
- Cigar Tips
- Cups
- Utensils
- Buoys and Floats
- Disposable Cigarette Lighters
- 6-Pack Rings
- Plastic Balloons

Seawolf Park: Jan 2021-September 2025

Marine Debris

Results



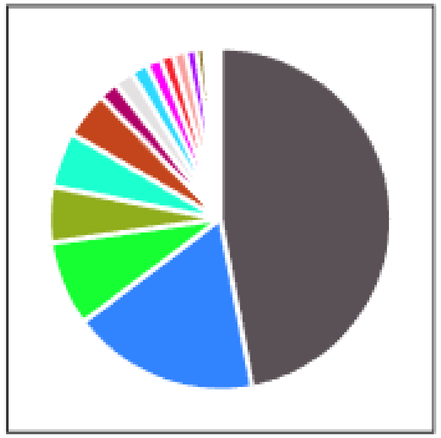
Debris Category

- Plastic Fragments, Hard
- Cigarettes
- Plastic Fragments, Film
- Plastic Bottle/Container Caps
- Plastic Fragments, Foamed
- Fishing Lures and Line
- Food Wrappers
- Straws
- Plastic Rope/Net Pieces
- Other Plastic
- Plastic Beverage Bottles
- Bags
- Utensils
- Personal Care Products
- Cups
- Cigar Tips
- Plastic Jugs/Containers
- Buoys and Floats
- Disposable Cigarette Lighters
- Shotgun Shells/Wads
- Plastic Balloons
- 6-Pack Rings

Texas City Dike: Jan 2021-September 2025

Marine Debris

Results



Debris Category

- Plastic Fragments, Foamed
- Plastic Fragments, Hard
- Plastic Fragments, Film
- Cups
- Food Wrappers
- Plastic Bottle/Container Caps
- Cigarettes
- Plastic Rope/Net Pieces
- Plastic Beverage Bottles
- Straws
- Cigar Tips
- Fishing Lures and Line
- Other Plastic
- Personal Care Products
- Bags
- Buoys and Floats
- Utensils
- Disposable Cigarette Lighters
- Plastic Jugs/Containers
- Shotgun Shells/Wads
- Plastic Balloons

Shell Beach: Jan 2021-September 2025

Get Involved

Volunteer with Us

Get hands-on protecting Galveston Bay by volunteering with GBF and making a real impact right here in our community.

Adopt a Spot

Join us in marine debris monitoring efforts this summer and beyond to help understand the impacts of Mega Sports events on local debris issues

Donate & Support

Your donation to GBF directly supports the programs and people working every day to protect and preserve Galveston Bay for generations to come.

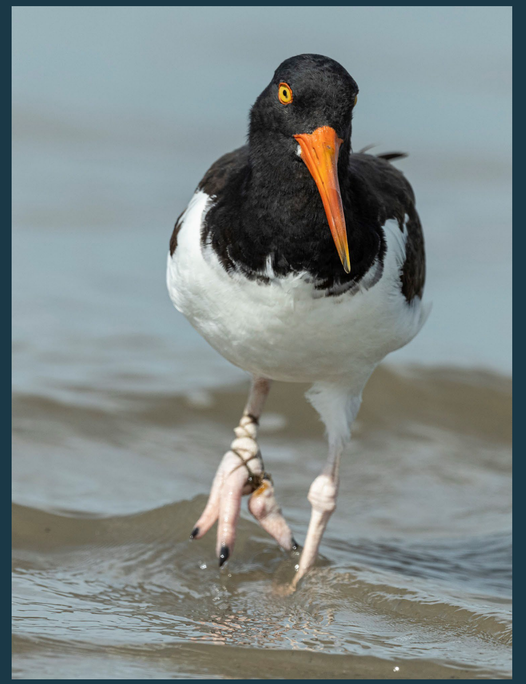
SPLASh

STOPPING PLASTICS AND LITTER ALONG SHORELINES

SPLASh is on a mission to create cleaner environments for birds, people, and other wildlife in the Houston-Galveston region.

Since 2020...

- Removed 70,000 pounds of trash from waterways and coastlines
- Engaged with 32,000 students & community members



FWC26 Houston Sustainability Committee: Sustainability Starts with Hou

- **Purpose:** develop & implement Environmental Sustainability Plan for the 2026 FIFA World Cup events in Houston
- **Vision:** to build a legacy and create a lasting, positive impact that extends well beyond the tournament

Bayou Cleanup Project

1. **Assess Impact**
2. **Coordinate Action**
3. **Standardize Data**

2021

Bayou Cleanup Project

Community Cleanups

Empowering Houstonians to learn, volunteer, and lead the charge in building a sustainable legacy for our city

Details:

- 1 or many community cleanups
- Collect pounds of trash

Transect Cleanups

Conduct trash transects following STOP protocol and entering into Texas Litter Database

Details:

- 3-4 cleanups at 1 location over a period of time
- Trash transect surveys; must be STOP-trained

SPLASh
STOPPING PLASTICS AND LITTER ALONG SHORELINES

GALVESTON BAY FOUNDATION
PROTECT TODAY. PRESERVE TOMORROW.

Buffalo Bayou Partnership

Willow Waterhole
GREENSPACE CONSERVANCY

H-GAC
Houston-Galveston Area Council

tra
Trinity River Authority of Texas

PCT 287
CIVIC ASSOCIATION

Bayou Cleanup Project

Cleanup Timeline

Historic Cleanup

March 1 – April 30

Removing trash that's accumulated over time.

During WC Cleanup

June 11 – July 19

Collect trash data during World Cup events

Pre WC Cleanup

May 1 – May 31

Collect trash data prior to World Cup events

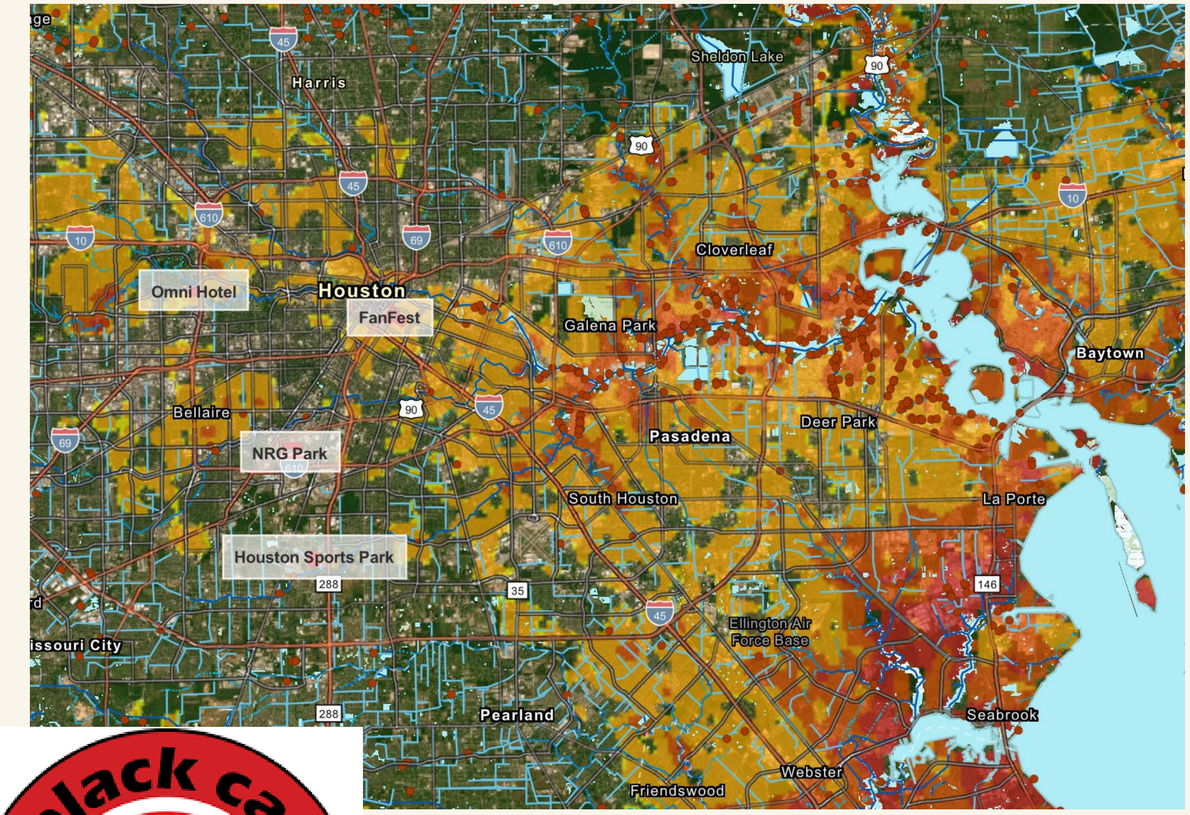
Post WC Cleanup

July 20 – July 26

Collect trash data during World Cup events

Bayou Cleanup Project

Cleanup Resources



Location Map with areas of high concern

Marketing Tool Kit

Limited funding for transect cleanup efforts

Giveaways

Bayou Cleanup Project

For more information and to join the project…

Email: Liz Virgl evirgl@abcbirds.org

Talk to us! Visit the GBF or SPLASh booth!

Learn more about the FWC26 Houston Sustainability Committee

GALVESTON BAY FOUNDATION

Protect Today.

Preserve Tomorrow.

galvbay.org | 1725 Highway 146, Kemah, TX 77565 | 281-332-3381