



Swim at Your Own Risk

Bacteria Pollution in Texas Beaches and Waterways Threatens Public Health



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FRONTIER GROUP

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Executive Summary

Texans love the water – especially in the summertime. From South Padre Island to Galveston Bay, and from the San Marcos River to Lake Lewisville, our rivers, lakes and beaches draw thousands of Texans every time the sun is out and the temperature is up.

But many of the waterways where Texans love to play are sometimes too polluted for people to go swimming, tubing, or wading safely. An analysis of water testing data from the Texas Commission on Environmental Quality (TCEQ) reveals that Texas beaches, rivers and lakes frequently ex-

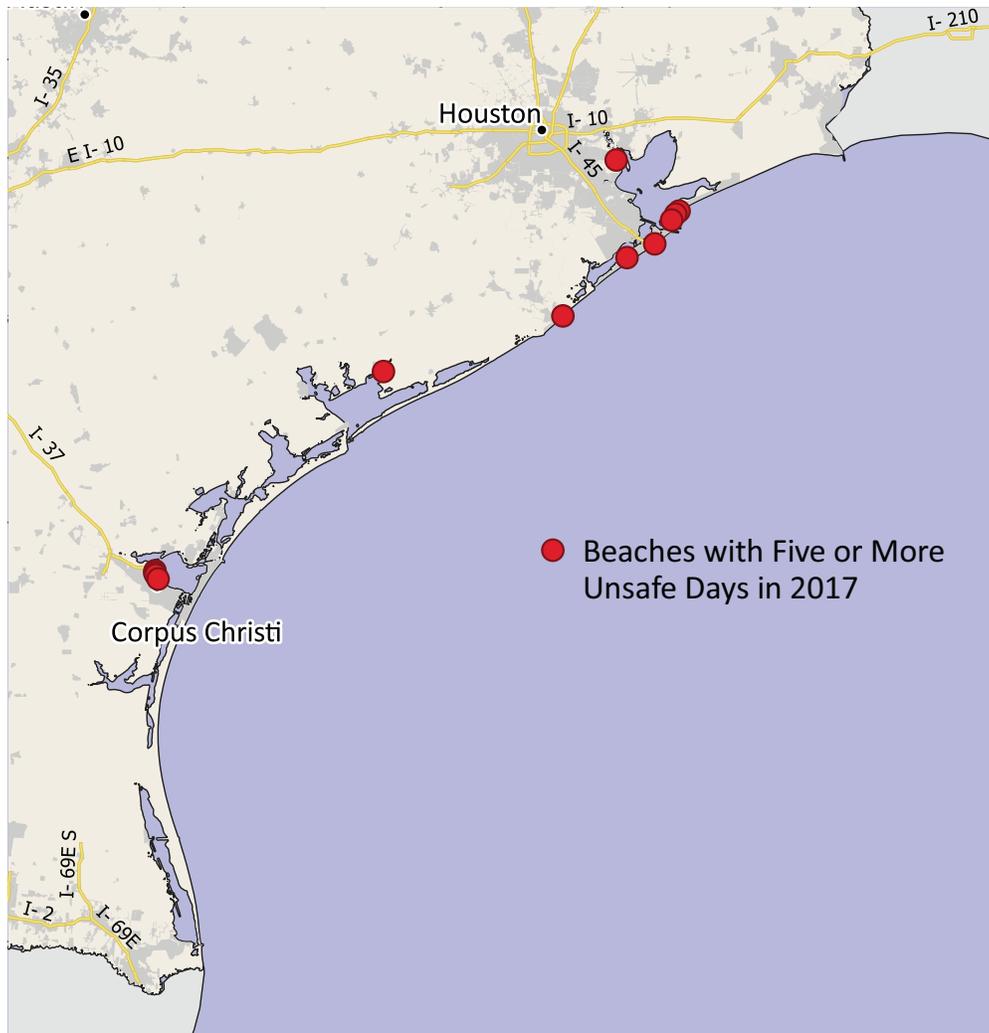
Table ES-1. Beaches with Five or More Days of Unsafe Water Pollution in 2017

Beach Name	Coastal Area	Unsafe Days in 2017	Days with Sampling	Percentage of Testing Days with Unsafe Water
Ropes Park	Corpus Christi Bay	24	57	42%
Cole Park	Corpus Christi Bay	20	53	38%
Emerald Beach	Corpus Christi Bay	14	47	30%
Galveston Island State Park #6 - Bayside	Galveston Bay	8	43	19%
Rettilon Road	Galveston Bay	8	48	17%
Magnolia Lane	Galveston Bay	6	43	14%
Sylvan Beach - South	Galveston Bay	6	41	15%
Beach Drive	Freeport*	5	41	12%
Corpus Christi Marina - South	Corpus Christi Bay	5	41	12%
Fort Crockett Seawall Park	Galveston Bay	5	41	12%
Helen Blvd.	Galveston Bay	5	43	12%
Palacios Pavilion East	Matagorda Bay	5	43	12%

For beaches with multiple testing stations, data from the station with most unsafe days is presented.

* In U.S. Geological Survey watershed maps, this area is referred to as the Austin-Oyster watershed.

Figure ES-1. Beaches with Five or More Days of Unsafe Water Pollution in 2017



ceed bacteria levels deemed safe under state law, indicating unsafe levels of fecal contamination. Swimming in contaminated water can lead to gastrointestinal illness, as well as respiratory disease, ear and eye infections, and skin rashes.¹

To protect Texans' health, and to ensure continued enjoyment of our waterways, Texas policymakers should undertake new efforts to limit water pollution.

More than half of all Texas beaches that were tested for bacterial contamination were unsafe for swimming on at least one day during 2017.

Among 120 beaches in the state, 75 were unsafe for swimming on at least one day when water was sampled.² Over that period, each site was sampled an average of 39 times.

- The three beaches with the most unsafe water days in 2017 – Ropes Park, Cole Park, and Emerald Beach – are all located in Corpus Christi, on the southern shore of the bay. All tested as unsafe on more than 10 days. At Ropes Park, one sample site was unsafe for swimming on 24 days (42 percent of the days on which testing took place). At Cole Park, one sample site was unsafe for swimming on 20 days, and the Emerald Beach sampling site

tested as unsafe for swimming on 14 days. Because each beach was tested fewer than 60 times during the year, there may have been many more days on which swimming was unsafe during the year.

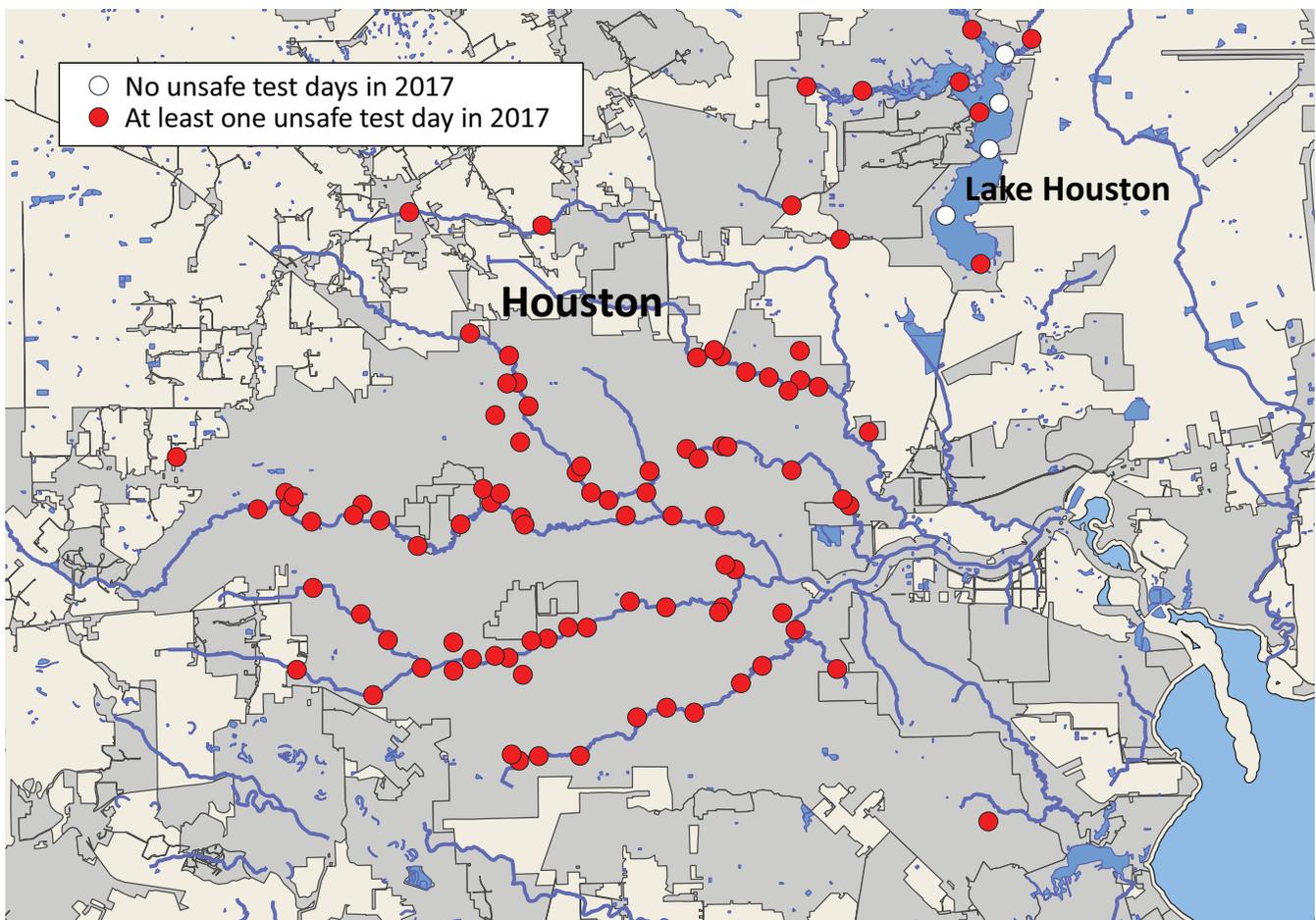
- Three beach sites on the outer shore of the Bolivar Peninsula at Galveston Bay – the beaches at Helen Boulevard, Magnolia Lane and Rettilon Road – all tested as unsafe on five or more days.
- Some areas in Texas did not have any tests that indicated unsafe water in 2017, including beaches in the area of McFaddin National Wildlife Refuge and Sea Rim State Park near Beaumont, and beaches on South Padre Island and Boca Chica

State Park at the southern tip of Texas. These beaches were all tested between 25 and 38 times during 2017.

More than 700 freshwater sites tested as having levels of bacterial contamination that would have made them unsafe for swimming in 2017. Tests at 708 freshwater sites across Texas revealed levels of bacterial contamination that made them unsafe for swimming on at least one day during 2017, out of 1,450 freshwater sites tested.³ Many of these sites are not currently used for swimming, sometimes because of unsafe pollution levels.

- **Austin:** Of 76 test sites within the city limits, 46

Figure ES-2. In Houston Waterways, 96 out of 100 Test Sites Had Unsafe Bacteria Levels at Least Once in 2017



exceeded safe bacteria levels at least once in 2017. Waterways that frequently had unsafe bacteria levels included Waller Creek, Walnut Creek, West Bouldin Creek, East Bouldin Creek, and Blunn Creek.

- **Houston:** In the city's bayous, which sustain parks and provide fishing spots for area residents, all 44 sample sites had at least one day of water that was unsafe for contact recreation in 2017. Of those, 20 sites were unsafe at least 75 percent of the days that they were tested, and 12 sites were unsafe every single time they were tested. In Lake Houston, which is popular for boating and fishing, six out of nine testing sites exceeded safe levels of bacteria for contact recreation at least once in 2017. Three sites exceeded safe bacteria levels more than a third of the dates they were tested.
- **San Antonio:** Along the San Antonio River, 21 sites were unsafe for swimming for at least one day in 2017, and 10 sites were unsafe for at least three days. In downtown San Antonio, where the river is used for boating and fishing and is the centerpiece of the popular River Walk, four neighboring test sites – the river crossings at Houston Street, Presa Street, and Lexington Avenue, and the southeastern corner of the river loop – had levels of bacteria that would have made them unsafe for swimming every time that they were tested.
- **Dallas-Fort Worth:** No lakes in the DFW area showed unsafe levels of bacteria in tests. At 35 test sites in Benbrook Lake, Eagle Mountain Reservoir, Grapevine Lake, Lake Arlington, Lake Lavon, Lake

Ray Hubbard and Lake Worth, no test in 2017 found unsafe levels of bacteria. Many other waterways in the area frequently had high bacteria levels, including Village Creek, the main tributary of Lake Arlington.

- **Killeen-Belton:** Many sites along Long Branch, South Nolan Creek, and the Leon River after its confluence with Nolan Creek tested as having bacteria levels that would make them unsafe for swimming. Among 13 sampling sites in the Killeen-Belton area, 11 sites were unsafe for contact recreation on at least one day in 2017.

Urban and agricultural pollution are often to blame for unsafe water. The fecal contamination indicated by high bacteria levels comes from a range of sources – urban runoff carrying animal waste from pets; sewage overflows and septic leaks carrying human waste; agricultural runoff carrying livestock waste manure from industrial-scale feedlots; and all forms of runoff carrying animal waste from wildlife such as deer, feral hogs and seagulls.⁴

Texans deserve access to clean, swimmable waters. But today, all too often, Texans looking to swim at the beach or tube down a river are deterred by warning signs – or worse, have their health put at risk. To keep Texas' water safe, policymakers must take steps to test water quality at more locations, and test more frequently; post testing results and warnings more publicly; and prevent pollution at the source, whether from urban runoff, sewage systems, or agricultural runoff.

Introduction

All over the state, it's a routine Texans know well: On a hot summer day, load the family in the car, head down to the water, slather on some sunscreen, and jump in for some cool relief.

Texas' nearly 400 miles of coastline contain some of America's best and most fun beaches. There are beaches with quiet, natural splendor at places like Padre Island National Seashore – the world's longest stretch of undeveloped barrier island. Other beach areas, like Galveston Island, attract millions of tourists and spring breakers from across the country. And then there are urban oases dotting the bays near Houston and Corpus Christi, offering residents quick breaks from city life. These beaches are where Texans go to take the edge off of our hot summer days.

For Texans further from the oceans, clean water is just as important. Central Texans go swimming and tubing down the clear waters of the San Marcos River. For Dallas residents, White Rock Lake provides a summer getaway in the heart of the city, and a bit

further away Lake Lewisville offers 29,000 acres of fishing, swimming, and boating.

But in recent years, many Texans have showed up to the beach only to find a bright red advisory that no one wants to see: A warning that the water is unsafe for swimming.

The following analysis of bacteria testing data from the Texas Commission on Environmental Quality (TCEQ) shows that unsafe levels of bacteria are a common occurrence across the state, both at our beaches and in freshwater. This pollution can make people sick and harm wildlife. And it makes it harder for many Texans to simply spend an enjoyable and worry-free day in the water.

Solutions exist that can help make our waterways safe for swimming. By taking measures to limit pollution at its source, and by stepping up enforcement of public health rules, Texas can achieve cleaner and healthier water across the state, and a future of summers where the beach is open to all.

Unsafe levels of bacteria are a common occurrence across the state, both at our beaches and in freshwater. This pollution can make people sick and harm wildlife.

Texas Beaches and Inland Waterways Are Often Too Polluted for Swimming

Texas beaches and waterways are important places for Texans to swim and play. But data provided by the Texas Commission on Environmental Quality indicates that, all too often, the water is not safe for recreation.

How Texas Tests for Contaminated Water

In Texas, beach areas and freshwater areas are monitored on different schedules and with different levels of regularity.

For beaches, the Texas General Land Office (GLO) tests water samples on a set schedule, which varies somewhat by beach. The GLO website www.texas-beachwatch.com explains, "Water samples are collected weekly during the peak beach season, which runs from May through September, and every two weeks during the rest of the year. The one exception occurs in March when weekly sampling is conducted to coincide with spring break at Beach Watch monitored gulf beaches."⁵ Beaches in the below analysis were sampled between 25 and 57 times in 2017.

Most freshwater sites are tested less often, and there is more variability in testing schedules. Testing is performed by a variety of state and regional agen-

cies, including the TCEQ, regional river authorities, and in the case of the Rio Grande, the International Boundary and Water Commission.⁶ These agencies coordinate their efforts and submit their testing data to the TCEQ.⁷ Freshwater sites in the below analysis were sampled between one and 22 times in 2017.

Texas applies different standards for different freshwater and saltwater sites, depending on each site's use designation. Sites designated for "primary contact recreation," which includes activities where ingestion of water is likely (including swimming, wading and tubing) must meet stricter bacteria criteria than sites designated for "secondary contact recreation," which includes activities like fishing and boating. Analysis of all waterways in this report uses Texas' primary contact criteria. (See Methodology for further details.)

The number of days with unsafe water is not necessarily comparable across different parts of Texas, as this statistic reflects not just water contamination, but also the amount of testing that took place in 2017. Austin and Houston, for example, conduct more extensive bacteria testing than many other parts of Texas. The extensive testing in those areas is critical for understanding water quality issues, and should be emulated by other cities and watershed organizations.

Texas Beaches: 63 Percent Tested as Unsafe for Swimming on at Least One Day

Among the 120 beach locations in Texas that were tested in 2017, 75 had levels of bacteria that indicated unsafe levels of pollution for swimming on at least one day.⁸ Over the time period assessed in 2017 (through December 19), sites were sampled an average of 39 times.

Three beaches, all on the south shore of Corpus Christi Bay, were unsafe for more than 10 days in 2017. At Ropes Park, samples from one testing station

showed unsafe water on 24 days, 42 percent of the days that testing took place. At Cole Park, one sample site was unsafe for swimming on 20 days, and the Emerald Beach sampling site was unsafe for swimming on 14 days.

A total of 12 beaches tested as unsafe for swimming on at least five days during 2017. These include three adjacent beaches on the outer shore of Bolivar Peninsula at Galveston Bay – beaches at Helen Boulevard, Magnolia Lane and Rettillon Road.

Many of the beaches with unsafe levels of bacteria in 2017 were also frequently unsafe in past years.

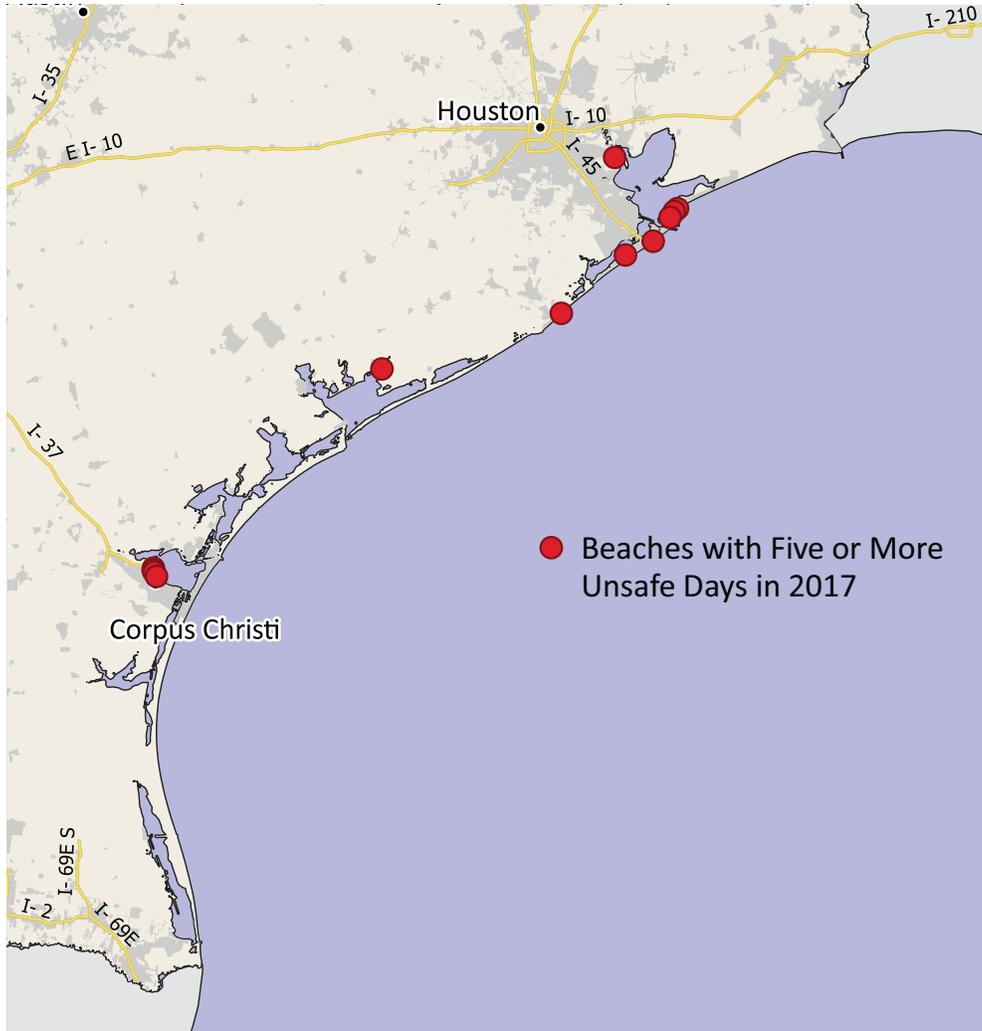
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* In U.S. Geological Survey watershed maps, this area is referred to as the Austin-Oyster watershed.

Figure 1. Beaches with Five or More Days of Unsafe Water Pollution in 2017



In data going back to January 2014:

- Ropes Park in Corpus Christi Bay was unsafe for swimming on 111 days, 44 percent of days that tests took place;
- Cole Park in Corpus Christi Bay was unsafe on 87 days, 38 percent of days that tests took place;
- Emerald Beach in Corpus Christi Bay was unsafe on 45 days, 24 percent of days that tests took place;
- The beach at Rettillon Road on Bolivar Peninsula was unsafe on 48 days, 24 percent of days that tests took place;

- Magnolia Beach on Bolivar Peninsula was unsafe on 32 days, 18 percent of days that tests took place.

Not all coastal areas of Texas had bacteria tests that revealed safety problems in 2017. Beaches in two areas – at the McFaddin National Wildlife Refuge and Sea Rim State Park near Beaumont, and beaches on South Padre Island and Boca Chica State Park in the southern tip of Texas – did not test as unsafe for swimming. These beaches were all tested between 25 and 38 times during 2017.

Freshwater Locations: 49 Percent Tested as Unsafe for Swimming on at Least One Day

In waterways across Texas, 708 freshwater sites had levels of bacterial contamination that made them unsafe for swimming on at least one day during 2017, out of 1,450 freshwater sites tested.⁹ Many of these sites are not currently used for swimming, sometimes because of a legacy of pollution. Urban and highly developed areas such as Austin, Houston, and San Antonio were among those with waterways that most frequently showed excess levels of bacterial contamination. Texans should be able to swim, wade or tube safely in all of our waterways without the risk of falling ill.

In Austin, the Colorado River and its tributaries bring green space and nature to the center of the city. Many of these waterways had high levels of bacteria in 2017.

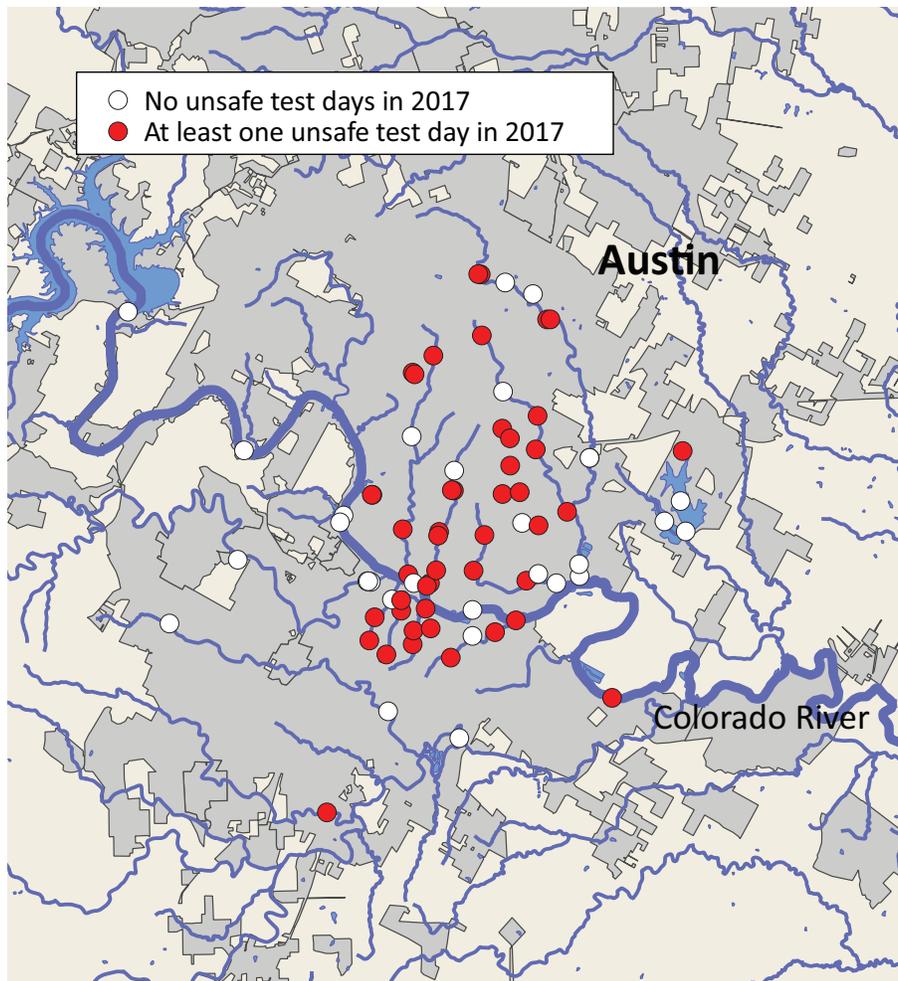
- Of 76 test sites within Austin’s city limits, 46 exceeded bacteria levels safe for recreational contact at least once in 2017.

- Both Colorado River test sites within Austin’s city limits had unsafe levels of bacteria two out of four times they were tested in 2017.
- Waller Creek is the center of a restoration effort that would make it the centerpiece of a new chain of parks.¹⁰ Of eight sites tested in the creek in 2017, seven had unsafe bacteria levels at least once, and two neighboring sites near crossings of 23rd Street and 24th Street were unsafe every time they were tested.
- Walnut Creek is the centerpiece of Walnut Creek Metropolitan Park, and is used for fishing. Of nine sites tested in 2017, four were found to be unsafe for swimming once (no site was tested more than four times during the year).
- Three small creeks – West Bouldin Creek, East Bouldin Creek, and Blunn Creek – run through residential neighborhoods and parkland on the south side of the Colorado River in Austin. Of nine test sites in the three creeks, all but one site were found to have unsafe levels of bacteria for contact recreation at least once in 2017. Four test sites were unsafe 75 percent of the days they were tested.

Table 2. Many Austin Waterways Frequently Had Unsafe Bacteria Levels in 2017¹¹

Waterway	Number of Test Sites in Austin City Limits	Days with Testing	Days with Water Unsafe for Contact Recreation at One Site or More	Percentage of Testing Days with Unsafe Water
Blunn Creek	3	4	4	100%
Colorado River	2	4	2	50%
East Bouldin Creek	3	4	4	100%
Waller Creek	8	8	6	75%
Walnut Creek	9	8	2	25%
West Bouldin Creek	3	4	3	75%

Figure 2. In Austin Waterways, 46 of 76 Test Sites Had Unsafe Bacteria Levels At least Once in 2017



Houston’s bayous are important natural areas in the city’s urban landscape. They sustain parks and wetland areas, and provide fishing spots for city residents.¹² In 2017, many of Houston’s bayous and other freshwater sites frequently exceeded safe levels of bacteria. Hurricane Harvey contributed to some high bacteria readings in the Houston area, as heavy rainfall and flooding led to sewage overflows, and may have washed other sources of fecal contamination into waterways.¹³ But even in non-hurricane years, tests show that Houston’s waterways routinely have poor water quality.¹⁴

- Of the 100 freshwater testing sites in Houston’s city limits, 96 sites had at least one day of unsafe

bacteria levels for contact recreation in 2017. The 100 sites were unsafe, on average, 56 percent of the days that they were tested.

- Along the city’s major bayous – Sims Bayou, Brays Bayou, White Oak Bayou, Halls Bayou, Greens Bayou, and Buffalo Bayou – all 44 sample sites had at least one day of water that was unsafe for contact recreation in 2017. Of those, 20 sites were unsafe at least 75 percent of the days that they were tested, and 12 sites were unsafe every single time they were tested. Every single day that a test took place at some point along Brays Bayou, at least one test exceeded bacteria levels safe for contact recreation.

- In Lake Houston, which is popular for boating and fishing, six out of nine testing sites exceeded safe levels of bacteria for contact recreation at least once in 2017. Three sites exceeded safe bacteria levels more than a third of the dates they were tested.
- Dickinson Bayou, south of Houston, was unsafe for swimming two out of three days it was tested in 2017. Dickinson Bayou is used for swimming and other recreation.¹⁵
- Within San Antonio’s city limits, 12 of 14 testing sites on the San Antonio River showed levels of bacteria that would be unsafe for contact recreation at least once in 2017.
- Four adjacent sites in downtown San Antonio – the river’s crossings of Houston Street, Presa Street, Lexington Ave., and the southeastern corner of the river loop – showed excessive levels of bacteria for contact recreation every time that they were tested.
- The San Antonio River also had unsafe levels of bacteria downstream. One site next to Goliad State Park, about 90 miles south of San Antonio, tested as having unsafe levels of bacteria for eight days in 2017, out of 22 days tested. Along

The San Antonio River is an important feature of downtown San Antonio. The River Walk is billed as the city’s most popular attraction, and elsewhere in the city, the river is used for fishing and recreational boating.¹⁷

Figure 3. In Houston Waterways, 96 out of 100 Test Sites Had Unsafe Bacteria Levels At least Once in 2017

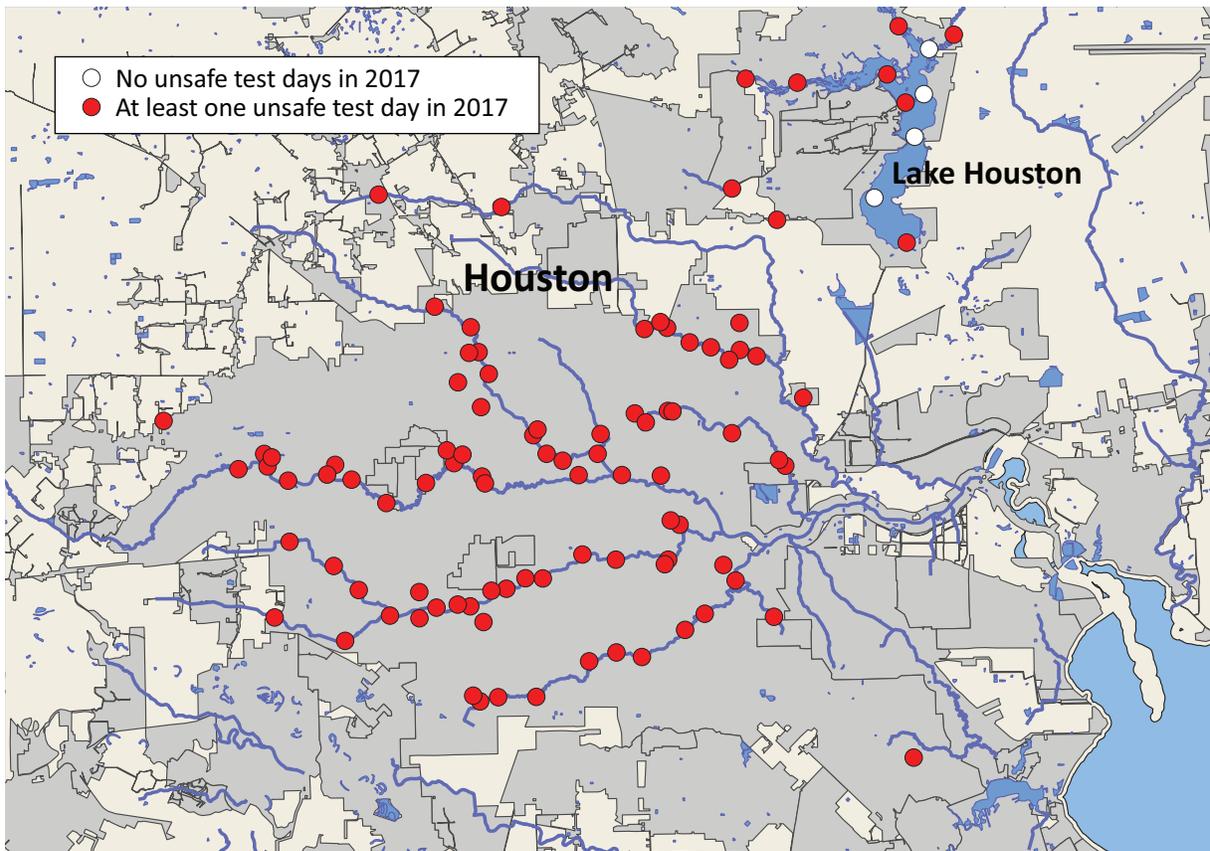


Table 3. Houston Bayous Frequently Exceeded Safe Bacteria Levels in 2017¹⁶

Waterway	Number of Test Sites in Houston City Limits	Days with Testing	Days with Water Unsafe for Contact Recreation	Percentage of Testing Days with Unsafe Water
Brays Bayou	12	34	34	100%
Buffalo Bayou	11	23	20	87%
Greens Bayou	2	9	5	56%
Halls Bayou	5	18	9	50%
Sims Bayou	8	18	13	72%
White Oak Bayou	6	21	15	71%

the entire length of the river, 21 sites had unsafe bacteria levels for at least one day in 2017, and 10 sites were unsafe for at least three days.

Lakes in the Dallas-Fort Worth area are popular for boating, swimming and fishing, and tests in 2017 did not find bacteria levels unsafe for contact recreation. Other waterways in the area, however, were frequently found to have high levels of bacteria.

- At 35 test sites in major lakes in the Dallas-Fort Worth area – Benbrook Lake, Eagle Mountain Reservoir, Grapevine Lake, Lake Arlington, Lake Lavon, Lake Ray Hubbard and Lake Worth – no test in 2017 found unsafe levels of bacteria.
- Along other waterways in the area, water frequently exceeded bacteria levels safe for swimming. For example, at eight test sites on Village Creek, all but one showed levels of bacteria unsafe for contact recreation at least once in 2017.

In the Killeen-Belton area, Nolan Creek and South Nolan Creek are popular for boating and fishing.¹⁸ Due to unsafe levels of bacteria, however, the city of Belton warns residents not to swim in Nolan Creek itself.¹⁹ In 2017, sites along South Nolan Creek, and the nearby Long Branch and Leon River, frequently exceeded safe bacteria levels. Among 13 sampling sites, 11 were unsafe at least one day in 2017, and eight sites were unsafe on at least one third of the days they were tested.

The Rio Grande winds through dense urban areas as it flows by El Paso along the border. In the El Paso area, all six Rio Grande testing sites had unsafe days in 2017. Four of the sites, while tested just once or twice during 2017, had bacteria levels that indicated water unsafe for swimming every time they were tested.

Urban and Agricultural Pollution Are Often to Blame for Unsafe Water

As the above analysis shows, many Texas waterways are frequently unsafe for swimming. Fecal contamination of waterways – which is indicated by high levels of bacteria – has a number of causes, including:

- **Urban runoff:** When rain runoff flows over yards and parks, it can pick up fecal waste from pets. When it flows over parks and natural areas, it can pick up fecal waste from wildlife. This bacteria-laden runoff can then flow into streams, lakes and the ocean, either directly or indirectly through storm drains. Animal waste in runoff is the primary cause of unsafe bacteria levels in many urban waterways.
- **Sewage overflows:** Sanitary sewer systems can overflow, spilling human fecal waste into the environment.²⁰ In 2017, the TCEQ recorded 6,667 sanitary sewer overflows, which spilled 72 million gallons of sewage.²¹ According to the agency, sewer overflows have increased as a result of aging systems.²² Sewage can also leak from inadequate septic tanks. Domestic sewage is particularly dangerous for human contact, because it contains high levels of bacteria capable of causing disease in humans.²³
- **Livestock manure:** Most livestock is now raised in industrial-scale feedlot operations that generate large amounts of manure, which can contaminate

water and make it unsafe for human contact. When runoff flows over improperly managed manure, or when waste sites leak or spill, bacteria pollution can flow into waterways. Nationally, industrial-scale livestock operations generate hundreds of millions of tons of manure each year.²⁴ In Texas, concentrated animal feeding operations must maintain a permit that tracks the management of animal waste and any violations.²⁵

- **Wildlife waste:** All forms of runoff can pick up animal fecal waste from wildlife such as deer, feral hogs and seagulls.²⁶

Flooding after major storms can exacerbate the spread of fecal pollution. For example, one study conducted following Hurricane Harvey found significant sewage contamination at flooded locations, “indicating that a large number of sewage overflows and stormwater runoff occurred during Harvey flooding.”²⁷

Urban and agricultural pollution have been identified as causing problems for specific beach areas and waterways in Texas:

- The San Antonio River Authority highlights urban and agricultural runoff pollution as leading causes for elevated bacteria levels in the river.²⁸
- In June of this year, the San Pedro Creek Culture Park in San Antonio was forced to temporarily close in order to undergo a redesign to stop people from

swimming in the creek, which has unsafe bacteria levels. According to the park, contaminated water in the creek is a result of “pollutants getting into the creek from non-treated stormwater runoff when it rains.”²⁹

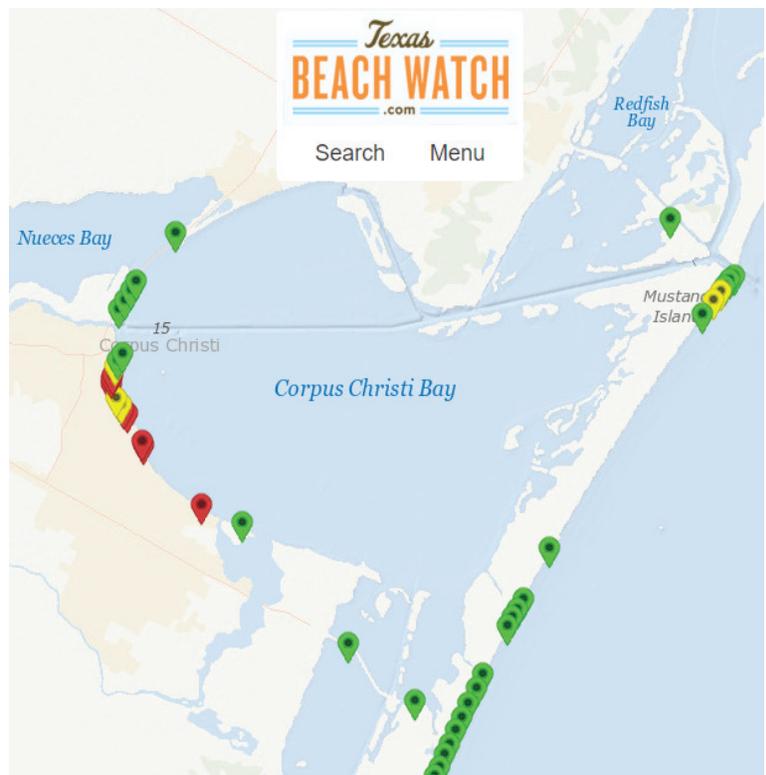
- In 2015, the director of environmental health programs for the Galveston County Health District told the *Houston Chronicle* that high bacteria readings in the area tend to occur after rainfall, because rain washes fecal matter from farm animals, pets and sewers into the bay.³⁰
- Ropes Park and Cole Park in Corpus Christi each contain pipes that discharge stormwater, and one study found elevated bacteria concentrations at the beaches following rainfall.³¹ These were the two most frequently unsafe beaches in 2017, based on bacteria testing data.
- According to Texas data compiled by the U.S. Environmental Protection Agency, runoff pollution from agriculture is a probable source of pollution that impairs the ability of 1,888 miles of rivers and streams, and 20,122 acres of lakes and reservoirs in Texas to support designated uses such as fishing swimming, and drinking.³² Urban runoff and stormwater is a probable source of impairment for 786 miles of rivers and streams, 5,134 acres of lakes and reservoirs, and 60,251 acres of bays, estuaries, and ocean.³³

Fecal contamination can have dangerous consequences for humans and the environment. People who come into contact with contaminated water can become seriously ill. Contact most commonly causes gastrointestinal illness, but can also cause respiratory disease, ear and eye infections, and skin rash.³⁴ In a single 2011 incident listed on the website for the Centers for Disease Control and Prevention (CDC), 56 people fell ill and one person was hospitalized after coming into contact with *E. coli* and other bacteria in a Texas lake (the lake was not named by the CDC).³⁵ Consuming oysters and other seafood harvested from contaminated water can also pose a health threat.³⁶

Oyster harvesting is an important economic activity in some Texas coastal areas.

Fecal contamination also threatens plants and wildlife. According to the TCEQ, it “may overstimulate the growth of algae and aquatic plants, creating conditions that interfere with ... the health and diversity of native fish, plant, and animal populations.”³⁷

Because of the danger posed by fecal contamination, the GLO provides a website and physical advisories to warn beachgoers. When bacteria samples indicate unsafe water, the GLO “works with local governments to issue advisories warning the public not to swim in affected waters.”³⁸ In Galveston, for example, advisories are issued at the affected beach, although beaches are not closed.³⁹



The Texas Beach Watch site operated by the Texas General Land Office warns beachgoers of potentially unsafe water.⁴⁰

Conclusion and Policy Recommendations: Keep Texas Water Safe

In every corner of the state, Texans should be able to enjoy beaches and waterways that are clean and safe for swimming.

At popular swimming areas, bacterial pollution can mean vacation days ruined by warning advisories, or the threat of illness for those who do go in the water. At waterways that are generally avoided for recreation – often precisely because they are known to be unsafe – bacterial pollution can also threaten public health. Sometimes people swim where they are not supposed to, and sometimes they can't stop their kids or pets from jumping in.

All the waterways described in this report – from beaches that attract millions of visitors every summer, to urban waterways that are considered too polluted for swimming – deserve protection. Protecting popular swimming areas can help ensure Texans' continued enjoyment of the places they love. Restoring polluted waterways to health can create new opportunities for swimming and provide healthier natural environments for our communities.

Cleaning up polluted waterways is also the law. When the Clean Water Act was passed in 1972, Congress explicitly stated that all major waters in the

U.S. should be safe for swimming and fishing by 1983. Thirty-five years later, the U.S. is still very far from achieving that goal.

Across Texas, many efforts to address bacteria pollution have already resulted in cleaner water and have made it possible for Texans to safely swim. But at far too many waterways and beaches, people will be putting their health at risk if they try to go swimming. To keep Texas water safe, policymakers must take the following steps:

Test more frequently, post more publicly.

- Water quality testing should be conducted much more frequently at popular swimming sites, both at coastal beaches and at freshwater streams and lakes.
- Water quality testing should be conducted in more locations, especially in major metropolitan areas, and not limited to only locations already used for swimming.
- Water testing data, including historical data, should be made more accessible to the public.
- An online tool for freshwater safety advisories should be created, similar to the existing Texas Beach Watch.

- Public warning signs should be posted more conspicuously at both freshwater and beach locations that frequently have poor water quality testing results.
- More locations should participate in the Texas Bacterial Source Tracking Program, which can identify the primary causes of bacterial pollution at a specific location.

Prevent urban runoff pollution.

- Cities should require new developments to use green stormwater infrastructure features such as rain gardens, permeable pavement, and green roofs to reduce bacteria pollution in runoff.
- Environmentally sensitive spaces in urban areas should be protected from development, especially riparian areas and wetlands that can filter bacteria, sediment, and nutrients.
- Riparian areas that have already been developed, such as streams that have been lined with concrete or even buried, should be restored to their natural state whenever possible.
- Cities should educate residents on the harms that pet waste can cause, and enact and enforce policies to limit this source of bacteria pollution.

Prevent sewage pollution.

- Municipal wastewater treatment standards should be enforced more strongly.
- Discharges of treated wastewater into environmentally sensitive waterways should be curtailed.

- Communities should upgrade or relocate wastewater facilities that are in danger of overflowing during storms and floods.
- Texas should increase public investment in wastewater infrastructure. According to the American Society of Civil Engineers, our state must invest nearly \$12 billion over the next 20 years to upgrade its wastewater treatment facilities.⁴¹
- Residential sewage systems, particularly septic tanks, should be inspected more frequently.

Prevent manure pollution.

Texas should enact a moratorium on new or expanded industrial-scale livestock operations, especially in watersheds already overburdened by manure pollution.

- Local communities should have the right to reject industrial-scale livestock operations in order to protect water, health, and quality of life.
- Big agribusiness companies (such as Tyson Foods, which has extensive operations in Texas) should commit that all new contracts for livestock production will be with pasture-based producers using sustainable methods, not factory farms.
- Grocery chains (such as Austin-based Whole Foods), food service companies (such as Houston-based Sysco) and fast-food chains should use their leverage as important customers to insist on zero water pollution from their meat suppliers.

City-Specific Recommendations for Green Infrastructure

One Water: All Texas cities should look for ways to incorporate the One Water approach into their policy planning. Most cities follow the traditional approach of assigning responsibility for a particular aspect of water to a particular department. The One Water approach (also known as Integrated Water Management) looks at all forms of water – drinking water, wastewater, stormwater, reclaimed water, natural water – as being different aspects of a single resource that should be managed in a comprehensive way.

For example, capturing rainwater in green stormwater infrastructure (GSI) features can improve natural water quality by reducing runoff pollution, but the water retained by these features can also be used for on-site uses such as irrigating landscapes or flushing toilets, thus reducing the need to use drinking water for those uses. To implement the One Water approach, cities must look for ways to develop policies and programs that transcend traditional departmental lines of responsibility.

Austin: The city's Watershed Protection Department has proposed that all new commercial and multifamily new developments and redevelopments be required to use green stormwater infrastructure (GSI) features to meet their water quality requirements. This proposal was made as part of the CodeNext revision of the city's Land Development Code. At present it appears that the CodeNext process will be replaced with a new process devised by Austin's city manager, who should make sure that the GSI requirement is carried over into the new revision.

In addition, the Austin City Council should adopt an Integrated Water Resource Plan which promotes rain harvesting citywide. Rain harvesting can not only help the city meet its water needs but can also reduce runoff pollution.

Dallas-Fort Worth: As called for in the state plan to clean up bacteria pollution in the Trinity River, cities in the Dallas Fort Worth area should eliminate barriers to green infrastructure (such as restrictions on rainwater harvesting or permeable pavement) and incorporate green infrastructure into their capital spending plans.⁴²

Houston: The city's chief resilience officer (also known as the "flood czar") has commissioned a team of outside consultants to conduct a study on developer incentives for GSI. Houston should immediately follow up on this study by adopting new incentives, such as allowing developments to use GSI features to meet part of their detention requirements or giving stormwater fee discounts for GSI use.

Houston experiences approximately 840 sewage overflows every year, with raw sewage flowing into city bayous and streets.⁴³ To avoid future overflows, Houston should invest in upgraded pipes, increased maintenance, and public education on steps to avoid clogging sewers.

San Antonio: The City Council is currently reviewing San Antonio's stormwater policies. The city should adopt a water quality regulation that requires developments to use green infrastructure.

Methodology

Water samples were listed as unsafe for swimming if they exceeded levels of bacteria deemed safe for swimming by Texas regulation. Texas Administrative Code establishes separate criteria for saltwater and freshwater, both based on bacteria counts. For saltwater, safety is determined by counts of the bacteria enterococcus. For freshwater, safety is determined by counts of the bacteria *E. coli*. These bacteria, while they are not typically dangerous for humans, are used as indicators of fecal contamination, which can contain bacteria that make people sick.

For saltwater, the Texas single sample criterion for contact recreation is no more than 130 enterococci bacteria per 100 ml sample.⁴⁴ For freshwater, the single sample criterion is 399 *E. coli* per sample. According to the EPA, the enterococci bacteria level is associated with approximately 32 illnesses per 1,000 primary contacts with the water, and the *E. coli* level is associated with slightly below 32 illnesses per 1,000 primary contacts.⁴⁵ Primary contact is any activity where some ingestion of water is likely, such as swimming, wading or tubing.⁴⁶ These illness rates are for the general population, and vulnerable populations including pregnant women or individuals with weakened immune systems may be at higher risk from exposure to pathogens.⁴⁷

Beach sampling data was provided by the Texas Commission on Environmental Quality (TCEQ). Data from more than 28,000 beach samples were provided through 19 December 2017. Freshwater sampling data is from two sources. Statewide data was downloaded from the TCEQ's "CRP Data Tool," available on the TCEQ website.⁴⁸ Data on additional sites in the city of Austin was provided by the City of Austin Watershed Protection Department. Location information for statewide sampling sites was downloaded from the TCEQ website.⁴⁹ Sampling data provided by the City of Austin Watershed Protection Department included location information.

This analysis determined the safety of beach and freshwater sites based on the number of days that at least one sample indicated unsafe water. Areas with the highest percentage of unsafe sample days were determined by dividing the number of days that sample sites exceeded bacteria criteria at least once by the sum of total days that tests took place across all sample sites. The number of days on which samples were taken, and on which safe levels of bacteria were exceeded at least once, were grouped and counted using Microsoft Access and Excel.

Notes

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