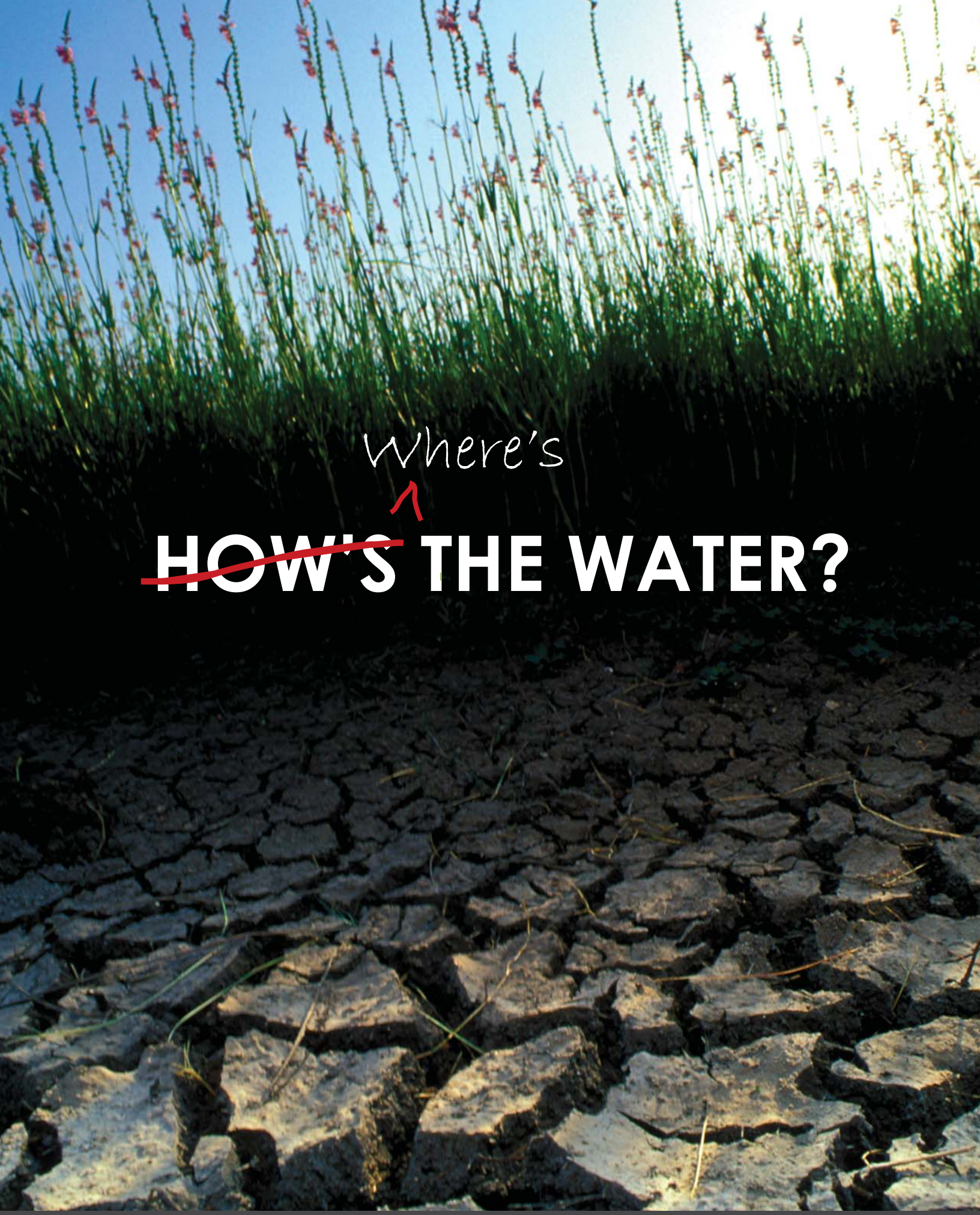


~~HOW'S~~ Where's THE WATER?

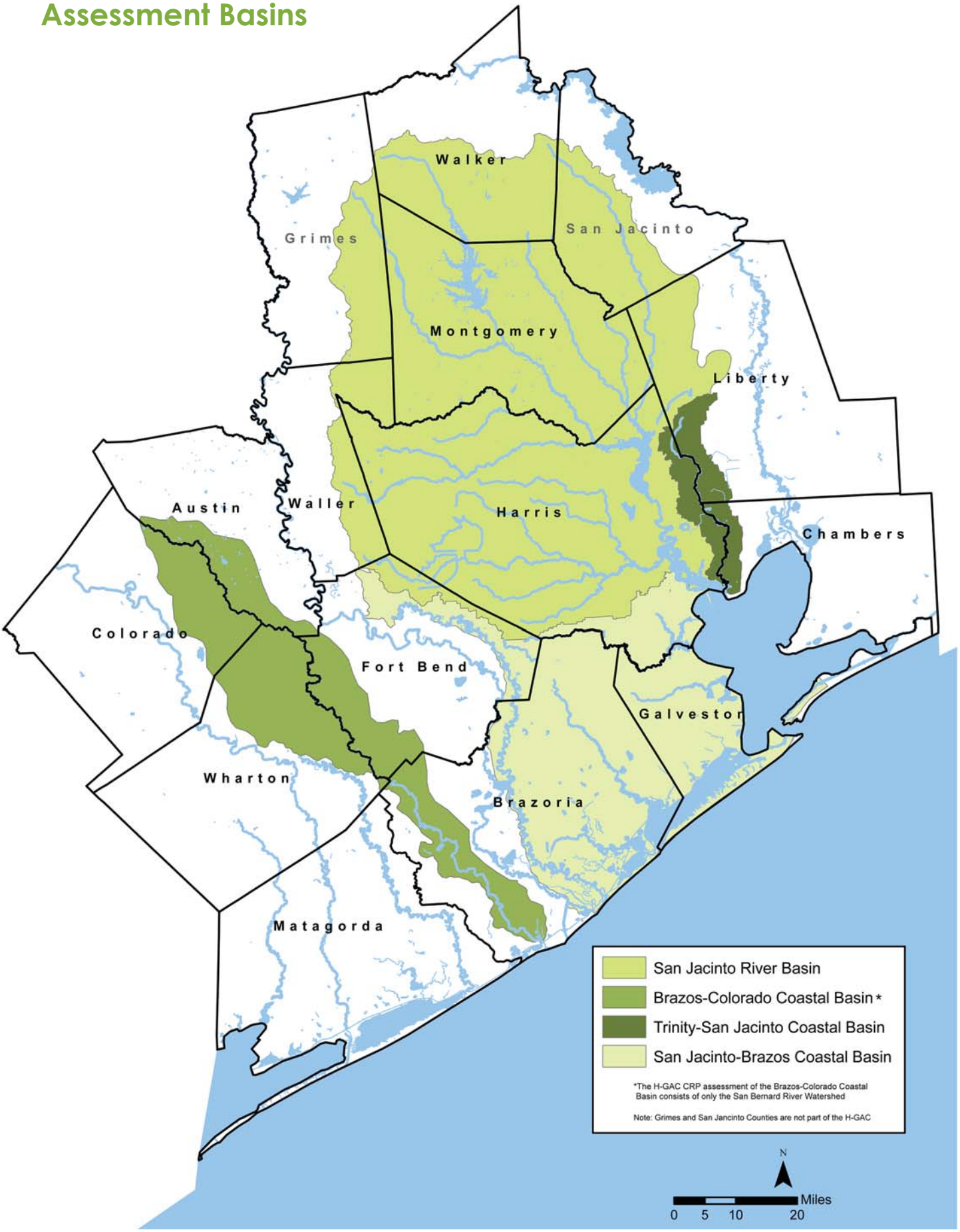
2012 Houston-Galveston Area Council Basin Highlights Report

Photo by Sara Robertson

The Houston-Galveston Area Council's Clean Rivers Program produces "How's the Water?" highlighting the region's water quality and various programs and plans that were implemented in the past year. This year, we turn our focus to "Where's the Water?" as we consider what happens when our region faces unprecedented drought.

Beginning in October 2010, the Houston-Galveston region has been suffering from one of the worst droughts on record. Though the rains in late 2011 and early 2012 made significant steps toward overcoming the rain deficit, as of February 21, 2012, most of the region is still classified as under drought conditions by the U.S. Drought Monitor. For a region that historically spends its time and resources developing plans to address too much water (floods, tropical storms, hurricanes), the challenge of solving the problems that arise when there is not enough water has been eye-opening. No longer can we consider water quality and water quantity in isolation from each other. This drought has been an excellent reminder that water is not an infinite resource, and a drought contingency plan must be a part of any resiliency or sustainability plan. This renewed awareness will be essential to protecting our most precious resource.

Clean Rivers Program Assessment Basins



The Effects of the Drought

The drought had an immediate cost impact on not only water quality monitoring but also on other end users of surface water.

Partner Monitoring

Although very limited amounts of data were collected at many monitoring sites during the drought, partners still incurred travel costs. Local Clean Rivers Program partners did, however, realize savings by not sending as many water samples from these sites to labs for analysis.

Water Lines

Water lines are more prone to breakage during a drought. As the soil dries out it shrinks or moves, causing buried pipes to break. In June 2011, the City of Pasadena responded to 558 calls for water leaks and line bursts, compared to 99 service requests at the same time in 2010. By the end of 2011, the City of Houston had responded to and repaired 17,756 water line breaks, an increase from 10,821 in 2010. In September 2011, Houston City Council approved spending more than $7 million for emergency water line repairs and continued to appropriate funds to repair lines through January 2012. Street repairs on top of water line breaks added time and expense.

Fishing and Oyster Harvesting

The drought had significant impact on commercial and recreational fishing in the region. Galveston Bay closed to all oyster harvesting on October 5, 2011, due to red tide. Other bay systems closed effective November 1, 2011, the beginning of the 2011-2012 commercial oyster harvesting season. According to the Galveston Bay Foundation, Galveston Bay's oyster fisheries produce more oysters than any other water body in the United States, and the Texas Parks and Wildlife Department indicates the oyster business in Texas lost an estimated $7.5 million.

Trees

Thousands of trees throughout the region died as a result of the drought. In October 2011, the City of Houston contracted to spend $4.5 million to remove dead trees in rights-of-way, public parks and forested park lands. As of February 15, 2012, the City of Houston has removed 17,900 of the dead trees. According to the Harris County Flood Control District, Centerpoint Energy has also removed 19,000 trees on their rights-of-way at a cost of $5.1 million. The loss of tree canopy around area streams can be detrimental to water quality. Increased light can trigger nuisance algal blooms and cause daily water temperatures to increase, affecting the water's ability to hold dissolved oxygen (DO) and support aquatic life.

Silver Lining

When Lake Houston's water levels sank to historic lows, members of the Houston Police Department's Lake Patrol Department removed debris that was not visible or accessible when the lake was at full capacity. The debris removal ranged from navigational hazards, such as pilings, to large debris, including tires and vehicles.

Overall awareness of the importance of water has increased. As more people are seeking information about the drought, they are also learning about water conservation, water quality, watershed protection plans and other water related issues they may not have considered in the past.

Photo by Houston Council Member Mike Sullivan

Were We Ready?

The H-GAC Clean Rivers Program and our partners have never experienced a drought of this extent. Monitoring parameters, such as flow, DO and bacteria could not be measured at many sites due to the lack of water. While data was captured in some cases, it represents unusual conditions for a short period of time and is unlikely to cause a change in a streams assessment. H-GAC staff and local partners were unable to collect water quality data during 37 visits to monitoring stations from October 2010 through December 2011 because the sites were inaccessible due to low water levels, were completely dry, or had only small, isolated pools. In the 10 years prior to the drought, staff encountered low- or no-water circumstances only 11 times. Monitors at these dry sites could only report field observations, including the date, time, and weather but could not take field measurements or collect samples for lab analysis.

As a result, the TCEQ worked with monitoring partners across the state to develop drought-condition monitoring procedures so all partners will be more prepared to characterize the next drought. The new procedures, released in November 2011, direct the monitors to survey the stream bed at a site with no or low flow conditions to note pool coverage (length and depth of visible pools). Samples taken from appropriate pools (1 foot deep and 10 feet wide) may be used as a baseline for low flow conditions in the future.

Approximately 90% of Houston's Memorial Park's canopy cover has died as a result of the drought.(photo by Jim Olive)

11.18 inches

Average rainfall from October 2010 to September 2011 -- 16 inches below normal (Office of the Texas State Climatologist, October 31, 2011)

100 percent

Percent of the state under drought conditions (U.S. Drought Monitor, September 27, 2011)

4 million

Approximate acres of land damaged or destroyed by wildfires (Texas Forest Service, November 2010 to February 2012)

500 million

Number of trees killed (Texas Forest Service, December 19, 2011)

$5.2 billion

Agricultural losses (Texas AgriLife Extension Service at Texas A&M, August 17, 2011)

Where's the Water?

According to the TCEQ, at the height of the drought (September 2011) 916 water systems in the state were enforcing voluntary or mandatory water rationing in an effort to help conserve a rapidly depleting supply of water.

Though the region was not faced with the prospect of running out of water, like the community of Spicewood* in central Texas, all three of the City of Houston's water sources (Lake Houston, Lake Conroe and Lake Livingston) dropped to an average of 73% capacity by fall 2011. In February 2012, following above average rainfalls, Lake Livingston and Lake Houston had returned to 100% capacity, according to the Texas Water Development Board. Lake Conroe remained at 80.62% capacity, but that number continues to rise.

Lake Conroe reached much lower levels than Lake Houston and Lake Livingston as a result of the additional water being released from the Lake to the City of Houston. In August 2011, the City of Houston ordered a measured release of its share of the water rights in Lake Conroe because the city needed additional water to maintain operation of its Northeast Water Purification Plant. The City of Houston owns 70% of the water rights of Lake Conroe and Lake Livingston and 100% of the water rights of Lake Houston. In December 2011, Lake Conroe reached its lowest water level when it fell to 8 feet below normal or 65.92% capacity. The City of Houston stopped calling for water to be released from Lake Conroe in November 2011.

*Spicewood's water supply was almost completely depleted by January 2012. The Lower Colorado River Authority brought water to the community from other LCRA water systems by tanker trucks.

Photo by Bill Hoffman

What's the Difference?

During routine monitoring of Persimmon Bayou in November 2011, professional monitors from the Environmental Institute of Houston (EIH) noted specific conductance, or the measure of salinity, was 20,000 micro Siemens/cm , which is significantly higher than it should have been for this fresh water or slightly brackish water site. (Sea water ranges from 48,000 to 58,000 micro Siemens/cm). In response to the EIH data, H-GAC submitted and TCEQ approved a request to reclassify the station as tidal instead of freshwater. In January, 2012, following a significant rainfall, conductance was once again measured at 200 microsiemens/cm. This site also saw a significant difference in bacteria levels – Escherichia coli (E.coli) levels of 200 MPN/100 mL in November, followed by an increase to 10,000 MPN/100 mL after the rain. Lower bacteria densities might suggest enhanced support for recreational uses, but higher salinity levels that accompanied them adversely affect aquatic life and reduce support for aquatic life uses.

This illustrates the potential for extreme swings in data during drought conditions. This site had historically produced conductance measurements of a freshwater site, but the lack of rain led to increases in measured conductance. The surge of freshwater from the rains significantly reduced the conductance. This occurrence also allows us to determine that bacteria levels at this site increased after a rainfall and therefore are significantly affected by runoff pollution.

How's the Water?

The drought, although unwelcome, provided an opportunity for H-GAC and local partners to take a closer look at data collected to determine the impacts of drought on bacteria levels and other parameters. H-GAC staff analyzed water quality data collected during routine monitoring at stations on freshwater streams to investigate the effects of the drought on water quality by comparing the levels of *E.coli* bacteria, DO, and nutrients (phosphorus and nitrogen compounds) before and after the official start of the drought.

Bacteria

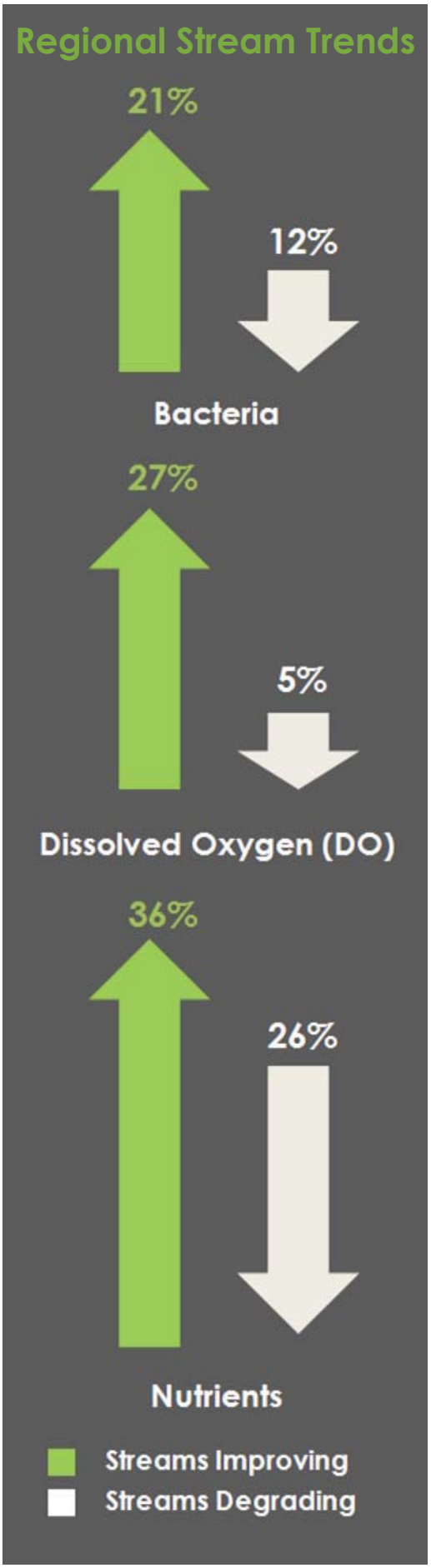
In the assessment units where *E. coli* is the indicator bacteria, 73% of the monitoring sites exhibited lower average bacteria levels than the seven-year period before the drought. Conversely, only 15% of the monitoring sites showed higher average bacteria levels. *E. coli* is the indicator bacteria for freshwater sites, while enterococci is the indicator bacteria for saltwater sites.

This supports the idea that runoff pollution is likely a significant source of *E.coli* in most streams. Several factors may also have contributed to the higher bacteria levels observed at several stations, including pollution from sources other than runoff. Poor quality effluent from waste water treatment plants, undetected broken sewer lines in the collection system, wildlife, and bird droppings could create areas of concentrated bacteria that would ordinarily be diluted during conditions of normal flow.

In addition to less runoff, lower bacteria levels could also be attributed to broken drinking water lines. In some instances broken water lines have leaked into waterways that normally have elevated bacteria levels. The disinfecting properties of chlorinated drinking water, coupled with dilution, may have temporarily decreased bacteria levels at the time of sampling. However, the reductions in bacteria levels did not mean that the stream was meeting the recreational water quality standard. Bacteria levels in most cases were still quite high but were less than previous levels.

Dissolved Oxygen and Nutrients

DO is vital to the health of aquatic ecosystems. Our analysis shows moderate, but significant, decreases in DO in the bays and estuaries in our region during the drought. DO problems are often caused by elevated nutrient levels, including total phosphorus. Prior to the drought, 36% of samples exceeded screening levels for total phosphorus. During the drought, 45% of samples exceeded these limits, and 74% of samples showed at least a 10% increase in median concentration of total phosphorus. Possible explanations for higher nutrient concentrations include higher evaporation rates and a higher proportion of phosphate-rich wastewater treatment plant effluent in area waterways.



Nature's Contributions

According to the Texas Parks and Wildlife Department Spills and Kills Team, tidal tributaries in the Galveston Bay area experienced more frequent and more widespread fish kills during the drought than in previous years. The primary species killed was gulf menhaden. Low DO is the leading contributor to fish kills. During the drought, the region experienced higher water temperatures generally associated with low DO. Algal blooms also contributed to low DO.

As a result of little or no rainfall, water bodies are subject to lower than normal flows and can become stagnant. Nutrients in this stagnant water lead to flourishing algal blooms. This algae then consumes the oxygen overnight, drastically reducing the oxygen supply in the water and causing fish and other aquatic life to die.

High salinity also created problems for aquatic life in Galveston Bay. Texas Parks and Wildlife reports that Galveston Bay recorded the highest salinity (42 parts per thousand in West Bay in late summer 2011) since the department's routine monitoring was initiated more than 30 years ago. Oysters need just the right balance of freshwater and saltwater to survive and thrive in Galveston Bay. According to Texas A&M University-Galveston, too much freshwater is devastating to the oyster population. However, too much saltwater, high temperatures, low wind and decreased fresh water inflows from rainfall contribute to ideal conditions for the influx of oyster predators and parasites (e.g. oyster drill and Dermo disease) or blooms of harmful algae such as red tide. Texas saw one of the longest occurrences of red tide in the state's history during the drought.

The Texas Department of State Health Services closed all Texas coastal waters to commercial and recreational harvesting of mussels, clams and oysters because of the red tide in October 2011. By early February 2012, some waterways, including portions of Galveston Bay, North and Central provisional areas and East Bay) and San Antonio Bay were re-opened. This was good news for the $30-billion oyster industry.

Photo byJustin Bower

Photo by Justin Bower

Impact on Wildlife

- Migrating birds rely on forage, like rice fields. Lack of water decreases rice production and decreases forage and habitat for the birds.
- Wetland species, including the American Alligator, must relocate or face increasingly stressful conditions to survive as shallow wetlands dry up from lack of rainfall.
- Many wild animals, including feral hogs, are driven into populated areas to seek food and water. Other wild animals, including fish, were forced from their indigenous areas to populated areas, disrupting the delicate balance of that area's ecosystem.
- Reproduction rates of many species may be negatively impacted.
- Dry streams have led to a decrease in fish communities.

From the Texas Parks and Wildlife Department:

Red tide is a marine species and prefers higher salinities which are linked to periods of drought. Red tide is a single celled microscopic algae (Karenia brevis) that produces a neurotoxin that affects a fish's ability to respire causing fish kills. Striped mullet was the primary species killed during the 2011-2012 red tide. However, oysters and clams accumulate the neurotoxin while filter feeding. The toxin is heat resistant and can't be neutralized by cooking. People who eat fish or shellfish contaminated during red tide may become ill. Red tide can also cause respiratory problems for people who inhale the airborne toxin.

Photo by Jim Olive

Other Highlights

Even in the face of the drought, the Clean Rivers Program and programs that rely on CRP data continued to make strides in 2011.

TCEQ Watershed Action Planning

The TCEQ has implemented Watershed Action Planning. This process helps the TCEQ coordinate, document and track activities and strategies for protecting and improving water quality. The TCEQ worked with the Texas State Soil and Water Conservation Board and CRP partners from across the state to develop the Watershed Action Planning strategy table which lists impaired and special-interest water bodies, the recommended strategies for addressing the problems or issues, the status of each strategy and the lead agency or program for tracking.

Water bodies of special interest are those that are not considered "impaired" by state standards, but are of concern to local agencies. This list will be used by TCEQ to help focus funding and other resources. Two water bodies in our region – Lake Creek and Lake Conroe – while not impaired, show deteriorating conditions, and at H-GAC's request, TCEQ added them to the list. H-GAC plans to start a watershed protection plan (WPP) project on Lake Creek when funds are available. The San Jacinto River Authority – Lake Conroe Division has started a WPP for Lake Conroe and can also use funds that may become available now that these two water bodies have been added to the list.

Bacteria Implementation Plan

In August 2011, the Bacteria Implementation Group approved the Bacteria Reduction Implementation Plan (I-Plan) for the Houston-Galveston Region to submit to the TCEQ for consideration and possible approval and support. More than 90 local governments, professional organizations, and environmental groups have passed formal resolutions of support or otherwise indicated support for the I-Plan.

The I-Plan, developed over three years, includes 34 implementation activities and four research priorities to address eleven strategies to reduce the amount bacteria entering impaired waterways in the project area. The project area is roughly 2,204 square miles, has a population of about four million people, and encompasses all or part of ten counties and 56 cities.

H-GAC calculated the seven-year averages for E. coli levels at 345 monitoring stations in the project area and determined that 63% had levels higher than the state standard for contact recreation. Data suggests bacteria levels are increasing at 13 of the sites and decreasing at 29 of the sites. Among the ten stations with the highest bacteria, concentrations at three sites are decreasing.

H-GAC is working with local governments to share information about the stations that have the highest bacteria levels in the region. Local governments are examining water quality data as well as complaint and violation data. The local governments are also conducting visual investigations and additional sampling to try to identify the source(s) of bacteria at each of the sites. For the sites that are at the most upstream portion of the waterway, preliminary investigations suggest that grease blockages may be contributing to sanitary sewer system overflows into the storm drains. It may take several months or more to determine the primary sources of bacteria, and longer in other sites with upstream contributions.

WRIM, How's the Water App.

In 2011, H-GAC's CRP updated the Water Resources Information Map to make it easier to query, provide more information, including data summaries, current assessments and more data points. In January 2011, 84 unique users visited the mapping resource. Typical users for this interactive tool are water quality professionals, students working on research or class projects, instructors and professors, and water quality volunteers. (www.h-gac.com/go/wrim)
This year, we also released our How's the Water iPhone app to give users on the go a snapshot of water quality, as well as the locations of water quality monitoring sites in their vicinity. Visit http://www.h-gac.com/go/cemobilegis or logon to the iTunes store and search for "How's the Water?"

Photo by Kristi Corse

Bibliography

Office of the Texas State Climatologist, "The 2011 Texas Drought: A Briefing Packet for the Texas Legislature," (October 31, 2011), p.38, http://atmo.tamu.edu/osc/library/osc_pubs/2011_drought.pdf (last visited February 12, 2012.)

U.S. Drought Monitor, "Drought Conditions (Percent Area): Texas," (September 27, 2011), http://droughtmonitor.unl.edu/DM_tables.htm?TX. (Last visited February 12, 2012)

Texas Forest Service, "Current Texas Wildfire Situation," (February 9, 2012), http://tfsweb.tamu.edu/main/article.aspx?id=12888. (Last visited February 12, 2012.)
Texas Forest Service, "Preliminary Estimates Show Hundreds of Millions of Trees Killed by 2011 Drought," (December 19, 2011), http://txforestservice.tamu.edu/main/popup.aspx?id=14954. (Last visited February 12, 2012.

Texas A&M Agrilife Extension, "Texas agricultural drought losses reach record $5.2 billion," (August 17, 2011), http://agrilife.org/today/2011/08/17/texas-agricultural-drought-losses-reach-record-5-2-billion. (Last visited February 15, 2012.)

Office of the Texas State Climatologist, "The 2011 Texas Drought: A Briefing Packet for the Texas Legislature," (October 31, 2011), p. 9, http://atmo.tamu.edu/osc/library/osc_pubs/2011_drought.pdf (last visited February 12, 2012.)

U.S. Drought Monitor, "U.S. Drought Monitor Texas," (February 21, 2012), http://droughtmonitor.unl.edu/DM_state.htm?TX,S. (Last visited February 27, 2012)

E-mail correspondence with Alvin Wright, Public Information Officer with the City of Houston Public Works and Engineering Department, February 27, 2012; and e-mail correspondence with Robin Green, City of Pasadena Public Works Director, Rickey Helton, City of Pasadena Utilities Superintendent; and Wayne Holt, City of Pasadena Publications Director, February 23, 2012.

Galveston Bay Foundation, "Upper Gulf Coast Oyster Waters Total Maximum Daily Load (TMDL) Implementation Plan," http://galvbay.org/advocacy_tmdl.html. (Last visited February 12, 2012); and e-mail correspondence with Lance Robinson, Coastal Fisheries Division, Texas Parks and Wildlife, Dickinson Marine Laboratory, February 23, 2012.

E-mail correspondence with Victor Cordova, City of Houston Forester, February 15, 2012.

E-mail correspondence with Heather Saucier, Harris County Flood Control District, February 22, 2012.

E-mail correspondence with Winston Denton, Spills and Kills Team, Texas Parks and Wildlife, February 27, 2012.

E-mail correspondence with Lance Robinson, Coastal Fisheries Division, Texas Parks and Wildlife, Dickinson Marine Laboratory, February 23, 2012.

E-mail correspondence with Dr. Sammy Ray, Texas A&M University-Galveston, February XX, 2012.

Texas Parks and Wildlife Department, "Red Tide Confirmed along Upper, Lower Texas Coast," (September 23, 2011), http://www.tpwd.state.tx.us/newsmedia/releases/?req=20110923b&nrtype=all&nrspan=2011&nrsearch=red+tide. (Last visited February 12, 2012.)

Texas Department of State Health Services, "Oyster Harvesting Closed Along Texas Coast," dshs.state.tx.us (October 26, 2011), http://www.dshs.state.tx.us/news/releases/20111026.aspx. (Last visited February 12, 2012.)

Texas Parks and Wildlife Department, "Current Status," .tpwd.state.tx.us (February 9, 2012), www.tpwd.state.tx.us/landwater/water/environconcerns/hab/redtide/status.phtml. (Last visited February 12, 2012

Texas Commission on Environmental Quality, "Public Drinking Water Report," TCEQ.gov (September 28, 2011) http://www.tceq.texas.gov/drinkingwater/trot/droughtw.html. (Last visited February 27, 2012.)

About the Cover

The cover photo of dry, cracked earth on the Texas Coast was taken by Jim Olive. Jim is the creator of Stockyard Photos, a stock and assignment photography company providing exceptional quality images in both digital and print media. Jim is a native Houstonian whose work has been featured in publications and corporate boardrooms throughout the world.

Photo by Kristi Corse

When considering water quality, rainfall can be a double-edged sword. The region needs rain to fill reservoirs and waterways, and to support aquatic life. A slow, moderate rainfall is ideal, allowing water to soak into the ground. Torrential downpours and isolated thunderstorms cause many waterways to overflow their banks while carrying high concentrations of bacteria, heavy sediment, and other unknown pollutants to downstream waterways and, eventually, Galveston Bay.

Only time will tell if the 2011 Drought will have a significant long-term effect on water quality in the Houston-Galveston Region or if it will simply be an outlier of information like other extreme weather events. The H-GAC Clean Rivers Program will continue to work with partners to monitor water quality in the region, report those findings to area residents, and work to help develop solutions for the problems we find.

This report was prepared in cooperation with the Texas Commission on Envinromental Quality under the authorization of the Texas Clean Rivers Act.

HOUSTON-GALVESTON AREA COUNCIL 3555 TIMMONS LANE, SUITE 120 HOUSTON, TEXAS 77027
WWW.H-GAC.COM

CE0512