

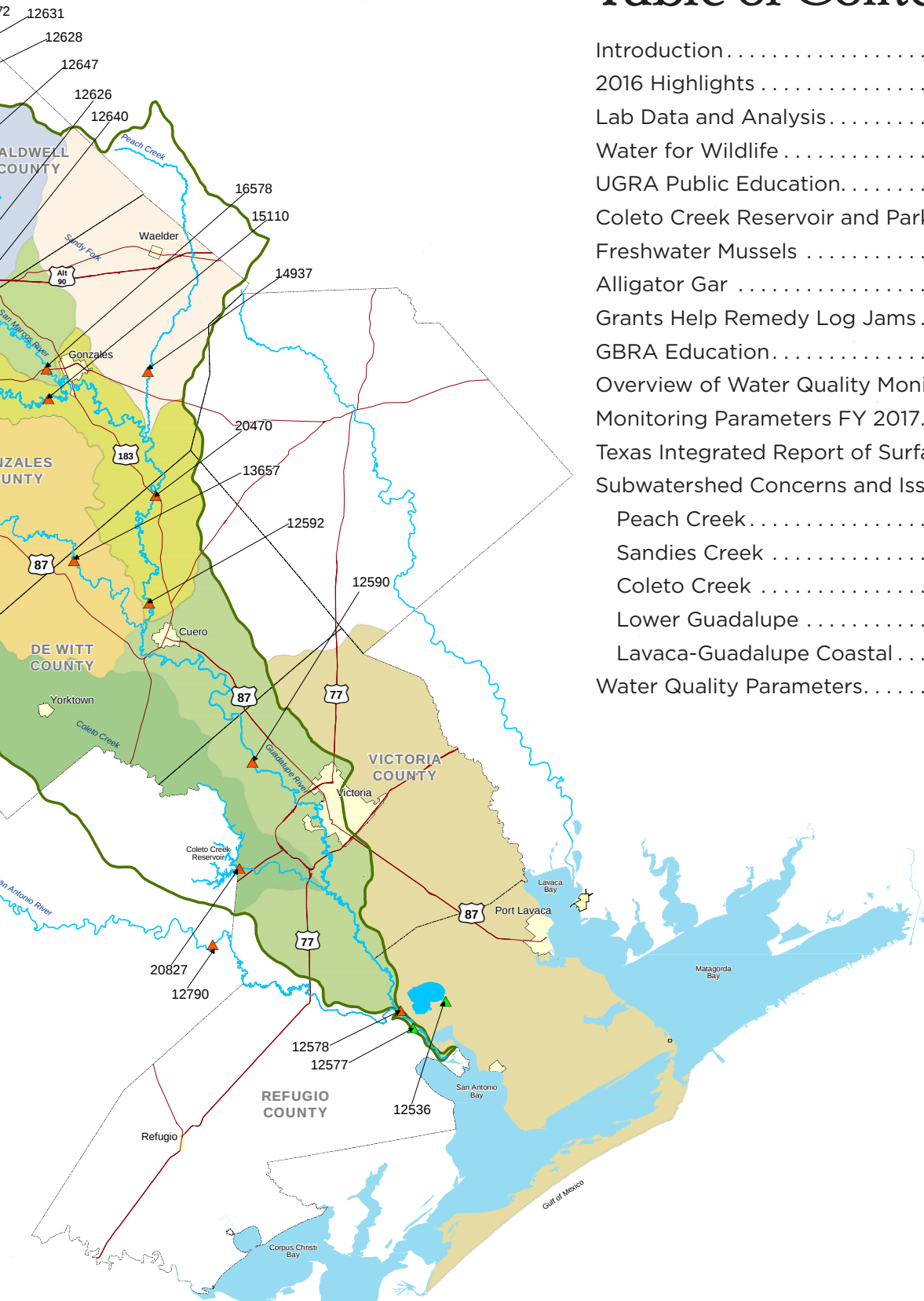
2017 Clean Rivers Program Basin Highlights Report

Guadalupe River and Lavaca-Guadalupe Coastal Basins
Featuring the Lower Basin



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Featuring the Lower Basin

Introduction

By Lee Gudgell

This report highlights the activities in the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin under the Clean Rivers Program (CRP) in 2016. The CRP is managed by the Texas Commission on Environmental Quality (TCEQ). The state-wide program is funded by the fees assessed to water rights and wastewater discharge permit holders. The Guadalupe-Blanco River Authority (GBRA), together with the Upper Guadalupe River Authority (UGRA), carry out the water quality management efforts in the Guadalupe Basin under contract with TCEQ. This report includes watershed characterizations of the waterbodies in the Lower Guadalupe Watershed. Watershed characterizations include descriptions of segments, hydrologic characteristics, water quality issues, land uses, potential stakeholder issues,

major events, ongoing projects and maps. The specific waterbodies that are described in this report are Elm Creek (1803A), Sandies Creek (1803B), Peach Creek (1803C), Coletto Creek (1807), the Guadalupe River below the San Marcos River (1803), the Guadalupe River below the San Antonio River (1802), the Guadalupe River Tidal (1801) and the Victoria Barge Canal (1701). This *2017 Basin Highlights Report* also includes descriptions of activities and projects

related to water quality monitoring, a review of the 2014 Texas Integrated Report, public outreach, education and stewardship activities. Articles included in this report were chosen to highlight ongoing projects and activities in the lower basin of the Guadalupe River.



Highlights

The Guadalupe and San Antonio rivers experienced several large flood pulses in the spring of 2016. The United States Geological Survey (USGS) gauge in Victoria (08176500) monitored a 12,000 cubic ft per second (cfs) average daily flow event in April of 2016 and a larger 17,800 cfs event in May of 2016. The 2016 flood pulses followed the historic rainfalls of 2015. The same gauge registered an average daily flow of 45,700 cfs in May of 2015. The USGS gauge on the San Antonio River in Goliad (08188500) monitored a 10,200 cfs average daily flood flow in May of 2015 and another 13,100 cfs flood event in June of 2016. These periodic flood events bring fresh water to the Guadalupe Bay system and are a necessary part of a healthy aquatic ecosystem. Flood conditions are particularly important to the life cycles of Alligator Gars and other aquatic life. More information about current Texas Parks and Wildlife (TPWD) Alligator Gar monitoring activities in the Guadalupe River basin can be found on page 10. Information about TPWD freshwater mussel studies in the Guadalupe River basin can be found on page 8.

Unfortunately, these flood waters have also caused large tree trunks and debris to form log jams that inhibit navigation in the waterways of the Lower San Antonio and Lower Guadalupe rivers. GBRA has partnered with the San Antonio River Authority (SARA) to clear these log jams in the rivers. More information about the GBRA logjam removal activities can be found on page 13.

Minimizing damage from flooding is one of the goals of riparian education efforts in the watershed. The UGRA has been tailoring education efforts towards promoting healthy riparian zones. More information about UGRA riparian education efforts can be found on page 5. GBRA education efforts also teach the public about healthy riparian zones in schools, the Irma Lewis Seguin Outdoor Learning Center (ILSOLC) and at the Coletto Creek Park and Reservoir. Information about GBRA education activities can be found on page 14 and more details about the GBRA Coletto Creek Park can be found on page 6.

Photos by Janet Thome



Lab Data and Analysis



By Jennifer Blinder

All this data makes one wonder how does it get here? It is a large scale, well-coordinated team effort between Texas Commission on Environmental Quality (TCEQ), Texas State Soil and Water Conservation Board, Guadalupe-Blanco River Authority (GBRA), Upper Guadalupe River Authority and Wimberley Valley Watershed Association.

At GBRA, the water quality and laboratory staffs work closely to collect and analyze the

samples from which the data is derived. Water quality technicians are apt to start their journey early in the day, typically loaded with a variety of sampling equipment that includes ice-chests, bottles, flow meters and water quality monitoring probes. Along the way they encounter all manners of squirmy, slithery and slippery organisms while capturing surface water samples in the rivers and creeks of the 10 county Guadalupe-Blanco river basin. These sampling trips range from short distances to the nearby Geronimo Creek or further distances down to San Antonio Bay where freshwater of the Guadalupe River blends with saltwater in an estuarine environment. Each sampling site includes recording immediate field parameters such as temperature, pH, dissolved oxygen and conductivity. Water samples are also collected in preserved or unpreserved bottles to be taken back to the lab for analysis.

Upon return to the lab in the sample receipt department, each bottle is accounted for and samples are channeled through the lab to the proper area for analysis. Some parameters require immediate attention such as *E. coli*, which must be set up and placed in an incubator within eight hours of collection. Other tests, such as ammonia, hardness and anions are run on a regular rotation within the GBRA lab. Although there is a flurry of urgent activity with each sample event, final results may take up to three weeks before data can be validated and approved, as the information goes through several hands to ensure complete accuracy.

The numbers produced seem dry when facing a large report, but the data is used for a wide variety of reasons by an even wider variety of people. Residents may access the water quality data online at <http://www.gbra.org/lab/> to check the bacteria levels in the creek or lake by their home. River outfitters check historical turbidity to determine if the cloudiness of the water is caused by a particularly raucous weekend or examine the data for natural trends that occur during the year or weather events. Wastewater permit writers from TCEQ look at historical and current data when determining how a new wastewater effluent permit will impact a stream. Because of programs like these, researchers have historical data from the previous 25 years that help with establishing trends. Monitoring the quality of the water that flows through our creeks, lakes and rivers ensures protection not only for the water, but also the flora and fauna that depend upon it.

Water for Wildlife

By Dan Alonso

The San Antonio Bay Foundation's, Water for Wildlife Project, seeks funding and strategic locations for drilling water wells to be used by wildlife. During periods of drought, water for wildlife can be difficult to find on sandy barrier islands. In partnership with the Aransas National Wildlife Refuge and Friends of the Aransas and Matagorda Island, two wells were drilled and outfitted with solar power panels. The funding was made possible with funds from the Texas Commission of Environmental Quality Supplemental Environmental Project (SEP). These grant funds replaced two windmills that once functioned for watering cattle. Jetting the old wells and placing solar panels and pumps allows the wells to be easily maintained and utilized by a large diversity of wildlife, including whooping cranes.

Wells were drilled to an estimated depth of 200 feet. Earthen ponds were dug to allow ground level access. Well drillers had no difficulty drilling through the sandy soil to find good quality water.

Additional wells are needed and the San Antonio Bay Foundation continues to seek additional funding.



UGRA Public Education

Raises Awareness of the Importance of Riparian Areas

By Tara Brushone

As the lead water resource planning agency for the Upper Guadalupe River Basin, UGRA partners with municipal and county governments, communities, civic groups, schools, and citizens to preserve and protect all Kerr County surface waterbodies.

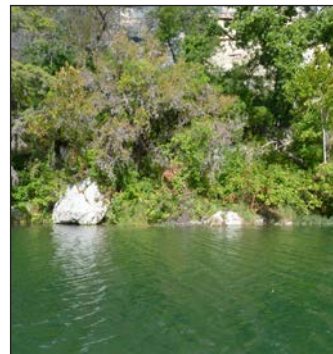
Part of UGRA's mission is to actively facilitate the understanding of water issues and engage the community in maintaining and promoting the health and enjoyment of the Upper Guadalupe River Basin. UGRA has an active education program designed to give Kerr County residents a better understanding of the Upper Guadalupe River and its watershed. UGRA staff prepares presentations for area schools, clubs, organizations, and summer camps to teach about water quality, conservation, the water cycle, and the importance of the Guadalupe River to the community. In recent years, UGRA has increased the amount of information regarding the structure and function of riparian areas in the education programs.

The riparian area is a band of dense, native vegetation along a body of water. This zone is identified by high soil moisture, frequent flooding, and the unique collection of plants and animals found there. Riparian areas provide a variety of functions from filtering and reducing pollution into streams, to reducing erosion, to providing wildlife habitat and shade to control water temperature. The distinct soil and vegetation form a network of roots and ground cover that intercepts runoff from upland areas and stabilizes the river bank. Riparian areas also provide essential flood control by slowing rushing flood waters and providing a place for swollen rivers to expand outside of their banks. These areas also act like a sponge and have the capacity to store water for sustained release back into

the river. As a result, riparian areas improve both water quality and quantity.

Since riparian areas impact the health of rivers and creeks in numerous ways, UGRA has been including the topic in nearly all outreach and education activities. From discussions of habitats with elementary age students to presentations on urban runoff with civic groups, increasing awareness of the value of riparian areas has been a constant theme in UGRA programs. UGRA also works to reach streamside landowners specifically with information about practices they can implement to support healthy riparian areas. Since more than 95 percent of Texas is privately owned, streamside landowners have enormous potential to improve and protect riparian areas. A properly functioning riparian area will not only serve to preserve your land from erosion and flood damage, it also will help maintain water quality by buffering the waterway from activities throughout the watershed.

If you are interested in learning more about riparian areas and the function of the vegetation they support, please contact UGRA at (830) 896-5445.



Photos By Travis Linscomb

Coletto Creek Reservoir and Park

More Than a Great Fishing Hole!



By Wilfred Korth

The Guadalupe-Blanco River Authority (GBRA) - Coletto Creek Park and Reservoir, located in the Texas Coastal Bend between Victoria and Goliad, is celebrating its 36th birthday in 2017. This joint venture between GBRA and Central Power and Light Company started back in the late 1970's and has become a very popular South Texas get-a-

way and fishing hole. The reservoir was created by damming off the Coletto, Turkey, Sulphur, and Perdido Creeks. Its drainage area covers 507 square miles of ranch and farm lands in Goliad and Victoria counties. The reservoir waters cover approximately 3,100 surface acres with an average depth of 12 feet. Being a power plant reservoir, versus a water supply or flood control, the water level tends to be fairly consistent. During the hot, dry South Texas summers, evaporation may take over. Also,

because the surrounding land use is mostly ranching, and soils are sandy, the water clarity is very good with sunlight penetration to over 30 feet occurring during times of low flow into the reservoir. The power plant with its hot water discharge into the reservoir,

provides quality fishing year round. Water temperatures vary from a high in the mid-90s during the summer to a low in the mid-60s during the winter. So on any given day, one may find a reservoir that is full, with clear, blue water, and loaded with freshwater opportunities.

Since its creation the Coletto Creek Reservoir has been monitored by GBRA, TCEQ, and TPWD staff to ensure its water quality meets the standards for water contact recreation and provides a healthy system for the diverse aquatic species calling Coletto their home. Part of this

monitoring has included work to control invasive aquatic plant species that migrate into the reservoir. To date, GBRA has worked to control hydrilla, Eurasian watermilfoil, and water hyacinth. The coordinated efforts between these agencies have led to a quality fishery and freshwater recreation site.

Today the number one activity at Coletto is fishing and the most sought after fish are largemouth bass, and catfish. Coletto Creek has yet to produce any huge Largemouth Bass, but the catch rate per hour fished and numbers of bass being caught keeps Coletto in the top ranks of Texas bass lakes. Some bass fishermen have been known to catch and release more than 100 bass in a day. This has brought many bass clubs to Coletto, which hosts more than 65 bass tournaments annually. The current "Water Body Largemouth Bass Record" for Coletto is 12 pounds, 13 ounces with the "Top 10" bass weighed in at the Coletto Park Office—all exceeding 10 pounds. Many of the largest bass brought out of Coletto have been caught in February.



Photo by Janet Thome



Photo by Wilfred Korth



Photo by Mark Oberle

Coletto also has an outstanding population of blue, yellow, and channel catfish. The "Certified Water Body Record Catfish" for Coletto are a 41 pound Yellowcat, a 9.73 pound Channel cat, and a 51 pound Bluecat. Crappie are the next most sought after gamefish at Coletto. They can be hard to find but once located can lead to some excellent catches. The "Certified Coletto Water Body Crappie Records" are a 1 pound, 14 ounce White Crappie, and a 1 pound, 6 ounce Black Crappie.

Basin Highlights Report

Even though fishing is the main activity at Coletto, it is more than just a great fishing hole! Families from throughout the state enjoy a wonderful variety of outdoor recreation opportunities at Coletto's 190-acre park, which provides the only public access to the reservoir. The park offers a wide range of facilities for picnicking, camping and boating. Park users also utilize the reservoir for a variety of different water activities. The park is frequented by pleasure boaters just out for a relaxing ride around the reservoir, jet skiers, water skiers, and those who sailboat. Kayakers also enjoy Coletto due to the many quiet coves that allow them to escape the regular boat traffic out on the reservoir. From end to end the reservoir is over 17 miles long.

Coletto sees many Wintering Texans each year but not all are out-of-state campers. Many fly in because Coletto is a prime migratory winter site for a wide variety of waterfowl



Photo by Mark Oberle

and birds. The quality and diversity of Coletto's terrestrial and aquatic habitat attracts a wide variety of birds. Avian species include nesting Bald Eagles, Osprey, Green Jays, Hummingbirds, Roseate Spoonbills, and White Pelicans. At last count, Coletto has recorded over 165 different bird species that have visited the reservoir.

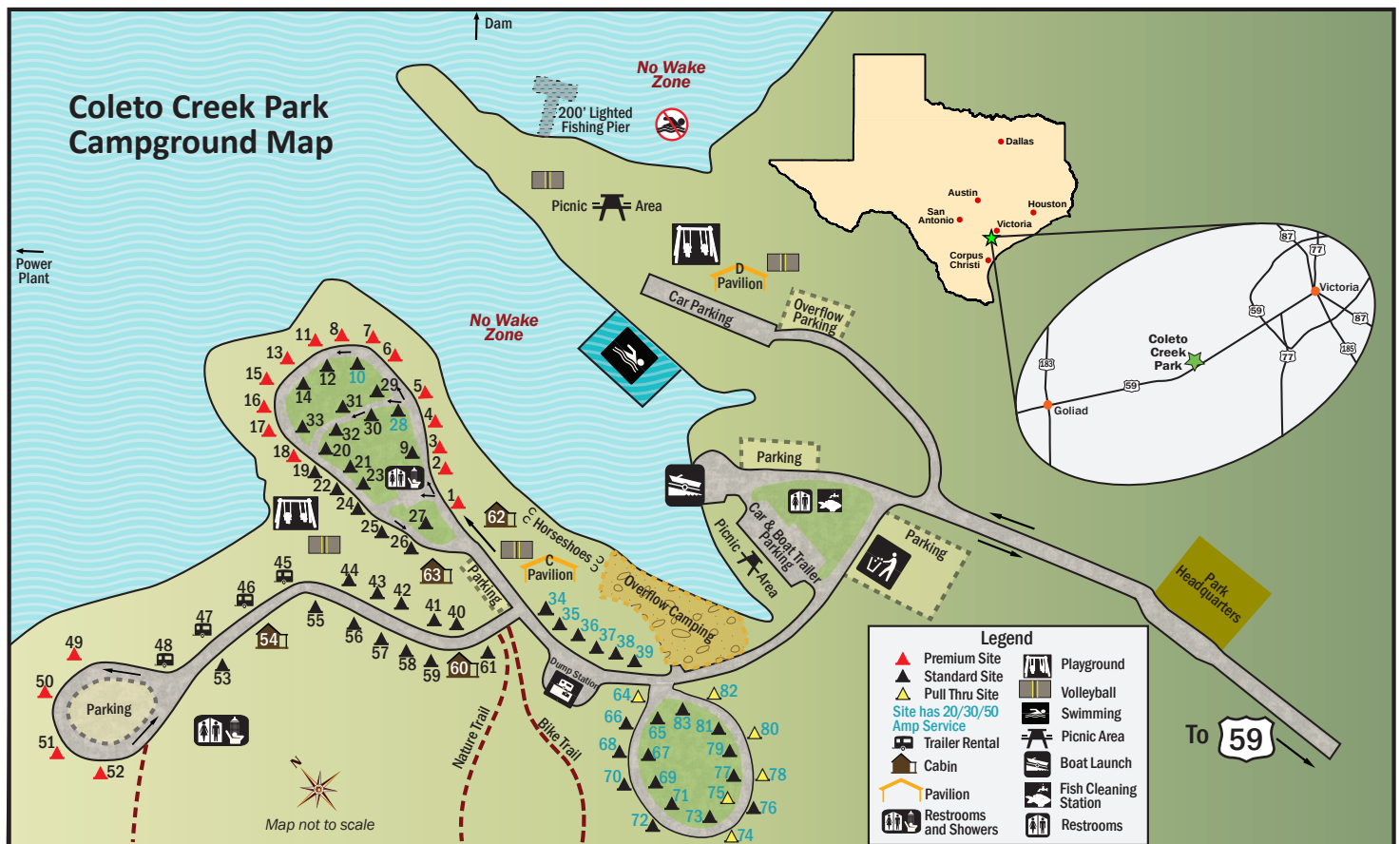
In addition to bird life, recreationalists will find an abundance of wildlife that reside within the park and along the shores of the reservoir. Park users may see deer, squirrels, turkey, foxes, bobcats, raccoons, and a variety of other wild

creatures during their visits.

GBRA's continued partnerships with Coletto Creek Power and other agencies will help to ensure the continued high quality aquatic system for future park users.



Photo by Janet Thome



Freshwater Mussel Research Projects in the Lower Guadalupe River

By Clint Robertson
Aquatic Biologist, TPWD - River Studies Program

Over the past several years, mussels have received a lot of attention in Texas. This recent attention has nothing to do with their distinctive names such as the Rio Grande Monkeyface, Creeper, Texas Pimpleback, Texas Pigtoe, or the Wartyback, but instead due to recent state listings and petitions for federal listing. In January 2010, the Texas Parks and Wildlife Department (TPWD) added 15 mussel species to the state threatened species list. Subsequently in October 2011, the United States Fish and Wildlife Service (USFWS) listed five of these as candidate species under the Endangered Species Act, had 6 additional species proposed for federal listing, and proposed one species (Texas Hornshell) be listed as Federally Endangered. Three of these species occur within the lower Guadalupe River Basin (Table 1): Texas Pimpleback, Golden Orb, and False Spike. Due to a poor understanding of basic mussel life history requirements (reproduction, feeding, habitat preferences, etc.) for most Texas and North American mussel species, TPWD has invested in funding research that will provide information to help us better understand these needs for the conservation of these species. An area of emphasis for TPWD funded mussel research has been the lower Guadalupe River.

The lower Guadalupe River is a priority river basin for the Senate Bill 2 Texas Instream Flow Program (TIFP), and as such, filling in information gaps associated with mussels will provide a more complete understanding of the instream flow needs of the river. Working with our study partner, the Guadalupe-Blanco River Authority (GBRA), the TIFP agencies collected baseline fish and mussel assemblage information from Gonzales to Victoria. During these baseline assessments, completed in 2015, ten species of mussels were collected, including the three species proposed



TAMU - IRNR researchers with a large sample of mussels from the lower Guadalupe River.
Photo Credit Charles Randklev

for federal listing (Table 1). Because this sampling effort was designed as a rapid assessment of current conditions in the lower Guadalupe River at limited sites, a more thorough assessment was needed.

In 2015, TPWD funded Texas A&M University - Institute of Renewable Natural Resources (TAMU-IRNR) to conduct a quantitative mussel distribution and abundance study from Gonzales to Victoria (study completed in 2016). During this effort, 70 sites were sampled with over 21,000 live mussels collected representing 13 species (Table 1). This research showed the lower

Guadalupe River supported a high diversity and abundance of mussels, and contained one of the largest mussel beds known to occur in the state. Also encouraging is that the three species of interest (Golden Orb, Texas Pimpleback, and False Spike) ranked as the second, fourth and fifth most abundant species respectively.

Table 1. Common and scientific names for mussel species recently collected in the lower Guadalupe River during TIFP (2015) baseline surveys and TAMU-IRNR quantitative surveys (2016).

Species	Common Name	TIFP	TAMU-IRNR
<i>Amblema plicata</i>	Threeridge	X	X
<i>Arcidens confragosa</i>	Rock Pocketbook		X
<i>Cyrtonaias tampicoensis</i>	Tampico Pearlymussel	X	X
<i>Fusconaia mitchelli</i> ^{1,2}	False Spike	X	X
<i>Lampsilis hydiana</i>	Louisiana Fatmucket	X	X
<i>Lampsilis teres</i>	Yellow Sandshell	X	X
<i>Megaloniaias nervosa</i>	Washboard	X	X
<i>Pyganodon grandis</i>	Giant Floater		X
<i>Quadrula aurea</i> ^{1,3}	Golden Orb	X	X
<i>Quadrula petrina</i> ^{1,3}	Texas Pimpleback	X	X
<i>Quadrula verrucosa</i>	Pistolgrip	X	X
<i>Toxolasma parva</i>	Lilliput	X	X
<i>Toxolasma texasense</i>	Texas Lilliput		X

¹-State listed, ²-Proposed for federal listing, ³-Federal candidate.

In addition to understanding the current distribution and abundance of mussels in the lower Guadalupe River, understanding basic mussel life history requirements of these species (reproduction, habitat preferences, environmental stressors, etc...) is also important. To better understand these requirements, TPWD is funding multiple universities to fill in these critical information gaps with USFWS State Wildlife Grant and Section 6 research funds.

TAMU-IRNR is being funded to assess the fish host requirements for the Golden Orb, Texas Pimpleback, and False Spike (study to be completed in 2019). Freshwater mussels require a fish host to complete their life cycle, and some mussel species will only use a particular species of fish as a host. Research on declines and extinctions of other mussel species in the United States has found that one of the major causes of declines or extinction has been the removal of the fish host for those species. Understanding the host fish requirements for these Texas mussel species is just as important as understanding the habitat needs. Mussels can have the best habitat available but still vanish from the river if they cannot successfully reproduce.

Determining the growth rates and age structure of mussel populations is another important conservation tool for these species. Understanding growth rates allows researchers to make connections between environmental conditions and optimal growth, as well as, to better understand conditions (stressors) that lead to poor growth. These studies are conducted by slicing the mussel shell and counting growth rings, similar to aging trees. University of Texas Marine Science Institute and Texas A&M Corpus Christi are being funded to assess the age and growth of Golden Orb and Texas Pimpleback from the Guadalupe River and the environmental conditions associated with different growth rates in individuals (study to be completed in 2017).

Water temperature is an important environmental stressor for mussels. As water temperatures decrease, mussels are known to burrow into the sediment to avoid the cold. Also, being cold-blooded, mussel activity/movement tends to

decrease as temperatures decrease. Understanding the effects of temperature on the movement behavior of mussels is important so that we know when it is appropriate to sample for mussels. Doing visual searches for mussels in the winter months may underestimate mussel abundances and disturbing the mussels during these cold months may lead to increased mortalities due to the inability of the mussels to re-anchor themselves in the substrate. Texas State University (TSU) is being funded to assess the seasonal movements of Golden Orb and Texas Pimpleback to better understand the movement patterns of these focal species (study to be completed in 2017).

In addition to affecting movement of mussel species, high water temperatures can be lethal for mussels. High water temperatures typically occur during the hottest summer months and during very low flows in rivers. Understanding the upper-thermal maximums for mussel species can help ensure that subsistence flows (low flows) are set at an appropriate level as to not be detrimental to listed mussel species. TAMU-IRNR is being funded to assess the temperature tolerance limits of Golden Orb, Texas Pimpleback, and False Spike from the lower Guadalupe River to fill in this critical information gap (study to be completed in 2020).

Lastly, contaminants (pollutants) have been shown to be numerous in aquatic environments and can have negative effects on aquatic species by inhibiting reproduction or even causing death. Because information on contaminants in freshwater mussels is lacking, the first step is understanding the extent of this issue and if there is cause for concern. TSU is being funded to assess if contaminants in mussels in the lower Guadalupe River from Luling to Victoria (study to be completed in 2018) is an issue.

Filling these critical information gaps for mussels in the lower Guadalupe River and throughout the state will take some time, but we are confident that these first steps will provide critical information to support conservation of these species and the lower Guadalupe River into the future.



False Spike



Texas Pimpleback



Golden Orb



Golden Orb

ALLIGATOR GAR

in the Lower Guadalupe River

By Dave Buckmeier, Nate Smith, and Dan Daugherty (TPWD)

Alligator Gar are the largest member of the gar family and the biggest freshwater fish found in Texas. While this species is declining across much of its native range, strongholds remain in Texas coastal rivers and estuaries including the Guadalupe River below Gonzales. Most Texans don't realize that fish over 8 feet long and weighing more than 200 pounds can still be found in many Texas rivers. Alligator Gar can live more than 50 years, but it typically takes about 20 years for fish

to reach 6 feet or 100 pounds. Although these prehistoric fish look intimidating, they are quite docile and a key contributor to river ecosystem health, feeding mostly on non-game fish and scavenging whatever is available.

The Texas Parks and Wildlife Department (TPWD) began intensively studying Alligator Gar in 2008 due to increasing popularity of the fish among both bow and rod-and-reel anglers. At that time there were no harvest regulations for Alligator Gar, but in 2009, TPWD





Development of young-of-year Alligator Gar (Time since spawning clockwise from top left: eggs, 2 days, 12 days, 3 weeks, 6 weeks)

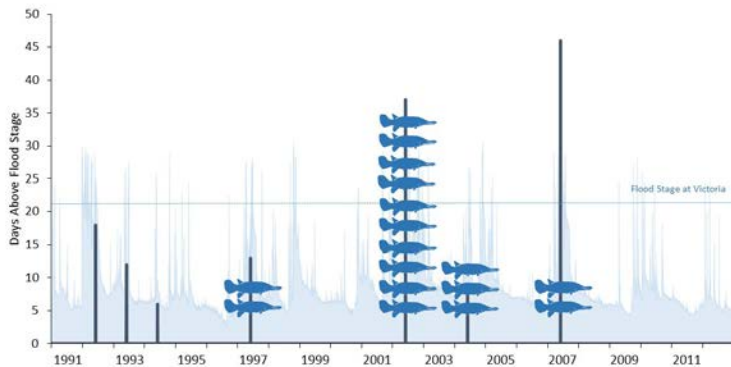
enacted a statewide one fish per day limit to prevent overharvest. Today, as many as 100,000 Texans pursue this species each year. With the increasing popularity of recreational fisheries for this species, it is important to learn more about Texas' gar populations in order to develop strategies for sustainable management of this unique trophy fish.

Understanding the Alligator Gar life cycle has been an important area of research over the past decade. Female Alligator Gar generally mature at 7-10 years and do not successfully spawn every year. In Texas, good

reproduction of Alligator Gar only occurs every 5-10 years and corresponds with the availability of floodplain spawning habitats. Alligator Gar spawn from April through July when water temperatures are between 70 and 85 degrees. Large flood pulses trigger spawning congregations of 5-20 adults to seek out shallow areas on the floodplain where terrestrial grasses are flooded. Spawning happens near the peak of the flood pulse, and after about 48 hours the eggs hatch. The newly hatched gar remain attached to the flooded vegetation for another 2-4 days. If flood waters recede too quickly the eggs and larvae die. Once the yolk-sac is absorbed, Alligator Gar young detach from the vegetation, and can drift in the receding flood waters where they immediately begin feeding on invertebrates and other young fish. The young Alligator Gar grow very quickly and can be over 5 inches after one month and up to 30 inches by the fall.

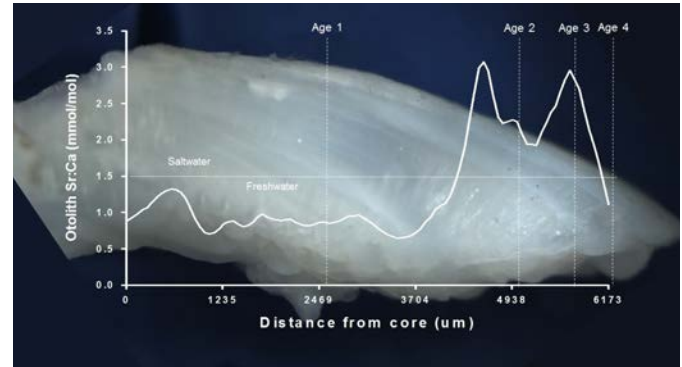
ALLIGATOR GAR

in the Lower Guadalupe River



The best years for Alligator Gar reproduction (fish symbols) in the lower Guadalupe River compared to the number of days the river was above flood stage during spring and summer (bars). The background shows river elevation at Victoria for reference.

Much like tree rings can be used to describe the age and past growing conditions of trees, fish biologists can use otoliths (ear bones) to get similar information about fish. Otoliths can provide an accurate and complete chronology of an individual fish's life. Using otoliths, TPWD estimated ages of Alligator Gar from the lower Guadalupe River to evaluate past reproduction patterns. Fish up to 38-years-old were found and the population was mostly made up of fish from only a few spawning years. Reproduction in 2002 was particularly good, and fish hatched that year made up about 40 percent of the population in 2014. Other



Cross section of an otolith from a 4-year-old Alligator Gar with an overlay of the Sr:Ca ratio showing that this fish transitioned from freshwater to saltwater at about 1.5 years and back to freshwater at about 3.5 years.

good reproduction years were 1997, 2004, and 2007. As expected, good reproduction coincided with years where flooding occurred during the spawning season. In fact, the 4 best years for Alligator Gar reproduction since 1991 (when hydrologic data are available) all occurred in years where June and July floods inundated spawning habitats. A detailed model is currently being developed that links floodplain inundation and availability of suitable spawning habitats to improve predictions of reproductive success for Alligator Gar.



TPWD biologists with an Alligator Gar collected from the Guadalupe River below Victoria, TX.

Alligator Gar otoliths also record chemical signatures from their environment, which can be used to interpret past use of different habitats by an individual fish. For instance, the ratio between Strontium (Sr) and Calcium (Ca) can show whether a fish was in freshwater or saltwater at any given time. Using this technology, the TPWD examined the movements of Alligator Gar between the lower Guadalupe River and San Antonio Bay. Most of the Alligator Gar found above Cuero lived only in the river, but many of the fish collected downstream of Victoria moved back and forth between the river and the bay. In addition, a few fish spent their entire lives in the saltwater habitat of the bay. Fish in these two reaches also had different genetics which indicates the "river fish" and "bay fish" don't typically spawn together. These data suggest there may be two distinct populations of Alligator Gar in the Guadalupe River that could be managed on a more local scale in the future.

Photos by TPWD Heart of the Hills Fisheries Science Center Staff

Grants Help to Remedy Basin Log Jams



Photo by Janet Thome

It is no secret that log jams have plagued the basins of the lower Guadalupe and San Antonio rivers for years. With the help of grants totaling more than \$2.6 million, the Guadalupe-Blanco River Authority (GBRA) was able to conduct three significant cleanup operations in both the upper and lower ends of the basin.

The Natural Resource Conservation Service (NRCS) provided the funding to conduct log jam operations in areas along the San Antonio, Guadalupe, San Marcos and Blanco rivers at the end of 2016 and early part of 2017.

GBRA officials applied for the NRCS matching grants in June 2015 to assist Caldwell and Hays counties, which would provide assistance to remove debris that accumulated due to the massive flooding on the Blanco and San Marcos rivers in May 2015, and in August 2015 to assist Calhoun, Refugio and Victoria counties and with disaster relief efforts using the Emergency Watershed Protection (EWP) program.

The NRCS, which organizationally is part of the U.S. Department of Agriculture, approved matching grants for these projects. Matching fund contributions came from the San Antonio River Authority with \$109,000, Hays County with \$364,000 and GBRA with \$279,000 plus in-kind technical assistance.

After the grants were approved, GBRA and local officials obtained rights of entry with the respective property owners whose land was adjacent to the river in the designated work areas where necessary.

“One project concentrated on log and debris cleanup on a three-mile stretch of the San Antonio River between river mile 6.5 and 9.5,” GBRA’s Chief Engineer Tommy Hill said. “The second project concentrated on cleanup in the floodplain for about 800 feet on both sides of the San Marcos River along FM 1979 and a third project, which was managed by Hays County, was carried out on the Blanco River upstream of Wimberley down to its confluence with the San Marcos River,” he explained. Contracts were awarded on all projects to clear obstruction material from the rivers with work to be completed by June 2017.

Work conducted on the San Marcos River near the city of Martindale is complete and yielded about 5,000 cubic yards of material. To put that in perspective, Hill said, that would amount to about 120 dump trucks with beds that hold about 40 cubic yards each. Those logs and debris were either burned or mulched.

Officials had not estimated and finalized the amount of logs and debris cleaned up at the other sites by the time of this printing.

GBRA Education in the Basin

By Cinde Thomas-Jimenez



GBRA staff remains active in schools throughout the river basin. In school year 2015-16, GBRA presented to over 100 different school-age groups, totaling almost 11,000 students. Water quality education and monitoring are introduced to fourth and fifth grade students at outdoor nature education sites, such as the Seguin Outdoor Learning Center, Lockhart State Park, Jacob's Well Natural Area, Meadows Center and Coletto Creek Park. In addition, GBRA leads an intensive water quality education effort in Plum Creek schools in Hays, Lockhart and Luling Independent School Districts (ISD's) and in Hays and Caldwell counties ISD's.

School year 2016-2017 is the thirteenth consecutive year GBRA has offered fourth grade students an opportunity to participate in the annual Composition Challenge. This contest is a wonderful opportunity for fourth grade students to practice STAAR writing skills for the test in late March, and can be implemented through language arts, science or social studies curriculum. Teachers are sent notices about the contest in January and register students in February. Compositions are due in March. GBRA staff has about six weeks to score the compositions and then schedule awarding prizes in the schools during the first week of May, which is National Drinking Water Week. During the first 10 years this contest focused on water conservation, which matched up well when the region was in a drought. However, once the drought came to an end, the focus of the contest switched to water quality. This topic is a bit more challenging for both students and teachers, but the schools have adjusted well. Schools that would like a presentation ahead of students writing the compositions are welcome to



schedule these during the month of February. Many of the participating schools have found that utilizing GBRA's award-winning fourth grade program, "Journey through the Guadalupe River Basin" during this period of time beneficial to the students. Specific to the Guadalupe River Basin, this TEKS-correlated program uses an interdisciplinary approach to introduce the topic of water, placing an emphasis on watersheds and water quality. In addition, the curriculum touches on the water cycle, water uses in the basin, population growth, and water conservation.

The writing prompt that students are given for the expository writing exercise include:

Water is a critical resource that we depend on for many things.

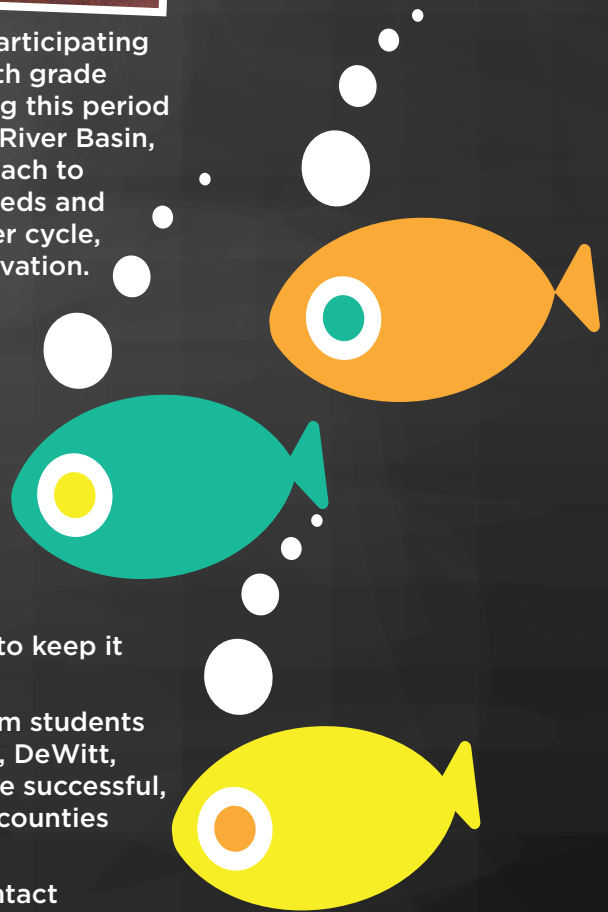
Water is so important that we all need to work together to keep it free from pollution, so that there will be clean water for the future.

THINK about the importance of water and the many ways that we use water.

WRITE about why water is important, and what we can do to keep it clean and free of pollution.

In school year 2016, GBRA received 1,650 compositions from students in eight counties: Kendall, Comal, Hays, Caldwell, Guadalupe, DeWitt, Victoria and Calhoun. The year 2017 appears to be even more successful, as registrations from twelve different school districts in nine counties have registered over 2,300 students.

For more information on the GBRA education program, contact Environmental Education Administrator Cinde Thomas-Jimenez at cthomas-jimenez@gbra.org.



Overview of Water Quality Monitoring



Lee Gudgell
Water Quality Project Manager

A successful Water Quality Monitoring program involves the integration of several key components:

- ♦ *A coordinated monitoring strategy designed to collect a well distributed and representative set of samples,*
- ♦ *A NELAC (TNI) accredited environmental laboratory that analyzes the samples for parameters of interest, and*
- ♦ *A governing body that uses the quality assured data to perform assessments against water quality standards.*

The following section outlines the coordinated monitoring schedule, laboratory analyses, and the results of the last TCEQ assessment in the Guadalupe River Basin.

One of the key roles of the Clean Rivers Program (CRP) is fostering coordination and cooperation in monitoring efforts. Coordinated monitoring meetings are held annually and are attended by the entities collecting water quality data on the Guadalupe River and its tributaries. By coordinating these efforts and discussing the areas in need of additional monitoring, more data will be collected, maximizing the limited resources available to these entities. Table 1 outlines the types and amounts of water quality monitoring conducted in the Guadalupe River Basin and Lavaca-Guadalupe Coastal Basin under a Texas Commission on Environmental Quality (TCEQ) approved Quality Assurance Project Plan for September 2016 through August 2017.

In addition to the monitoring programs conducted by the Guadalupe-Blanco River Authority (GBRA), the Upper

Guadalupe River Authority (UGRA), and the Wimberley Valley Watershed Association (WVWA), conduct water quality monitoring in the Lower Blanco and Cypress Creek watersheds. The goals of these programs include establishing baseline water quality data; identifying potential pollution problems; documenting spatial and temporal changes; determining impacts of point and nonpoint source pollution; and assessing compliance with water quality standards. These programs will also provide recommendations for local planning efforts to protect water quality. In addition to laboratory analyses, GBRA provides technical assistance and oversight of the quality assurance aspects of each program. The complete monitoring schedule is available at <http://cms.lcra.org>.

Table 2. Monitoring parameter and frequencies conducted by monitoring partners in the Guadalupe River Basin in 2017.

Sampling Entity	Field Parameters	Conventional Parameters	Bacteria	Biological and Habitat	24 hr. Dissolved Oxygen
GBRA	19 sites monthly; 12 sites, quarterly	19 sites monthly; 12 sites, quarterly	19 sites monthly 12 sites, quarterly	2 sites, twice yearly	1 site, twice yearly
UGRA	6 sites, monthly; 11 sites, quarterly	11 sites, quarterly	6 sites, monthly 11 sites, quarterly		1 site, twice yearly
TCEQ	9 sites, quarterly	9 sites, quarterly	9 sites, quarterly		
WVWA	9 sites, quarterly	9 sites, quarterly	9 sites, quarterly		2 sites, twice yearly

Texas Integrated Report of Surface Water Quality

Table 3. Summary of Findings from the 2014 Texas Integrated Report of Surface Water Quality in the Guadalupe River Basin. (Assessed using data inclusive of December 1, 2005 through November 30, 2012)

Segment Number	Water Body	Impairment or Concern	Impairment or Concern Removed 2014	Category (if assigned)	Year Listed
1701	Victoria Barge Canal	Nitrate-Nitrogen and Chlorophyll-a		Note 1	2000
1801	Guadalupe River Tidal	Nitrate-Nitrogen		Note 1	2002
1802	Guadalupe River below San Antonio	Nitrate-Nitrogen		Note 1	2002
1803	Guadalupe River below San Marcos River	Nitrate-Nitrogen	Bacteria	Note 1	2014
1803A	Elm Creek	Depressed Dissolved Oxygen ; Chlorophyll-a		5b ; Note 1	1999
1803B	Sandies Creek	Depressed Dissolved Oxygen; Impaired Fish and Macroinvertebrate Communities; Bacteria ; Impaired Biological Habitat; Chlorophyll-a		5b ; Note 1	1999
1803C	Peach Creek	Depressed Dissolved Oxygen; Bacteria ; Impaired Fish Community; Total Phosphorous and Chlorophyll-a		5b ;	2002
1803D	Salty Creek	Not Assessed			
1803E	Little Elm Creek	Not Assessed			
1803F	Denton Creek	Not Assessed	Bacteria		
1803G	Sandy Fork	Not Assessed	Bacteria		
1804	Guadalupe River below Comal River	No Impairments or Concerns			
1804A	Geronimo Creek	Bacteria ; Nitrate-Nitrogen		5c ; Note 1	2006
1804C	Alligator Creek	No Impairments or Concerns			
1804D	Bear Creek	Bacteria		Note 1	2014
1805	Canyon Lake	Mercury in Edible Fish Tissue ; Ammonia-Nitrogen		5c ; Note 1	2006
1806	Guadalupe River above Canyon Reservoir	Impaired Biological Habitat	Bacteria	Note 1	1999
1806A	Camp Meeting Creek	Depressed Dissolved Oxygen		Note 1	2004
1806D	Quinlan Creek	Bacteria ; Depressed Dissolved Oxygen		5a ; Note 1	2010
1806E	Town Creek	Bacteria ; Depressed Dissolved Oxygen		5a ; Note 1	2010
1807	Coleto Creek	No Impairments or Concerns			
1807A	Perdido Creek	No Impairments or Concerns			
1808	Lower San Marcos River	No Impairments or Concerns			
1809	Lower Blanco River	No Impairments or Concerns			
1810	Plum Creek	Bacteria ; Depressed Dissolved Oxygen; Impaired Biological Habitat; Nitrate-Nitrogen; Total Phosphorus		4b ; Note 1	2004
1810A	Town Branch	Bacteria; Depressed Dissolved Oxygen and Nitrate-Nitrogen		Note 1	2014
1811	Comal River	No Impairments or Concerns			
1811A	Dry Comal Creek	Bacteria		5c	2010
1812	Guadalupe River below Canyon Dam	No Impairments or Concerns			
1813	Upper Blanco River	No Impairments or Concerns	Depressed Dissolved Oxygen		
1814	Upper San Marcos River	No Impairments or Concerns	Total Dissolved Solids		
1815	Cypress Creek	Depressed Dissolved Oxygen and Impaired Biological Habitat		Note 1	2006
1816	Johnson Creek	No Impairments or Concerns			
1817	North Fork Guadalupe River	No Impairments or Concerns			
1818	South Fork Guadalupe River	Depressed Dissolved Oxygen		Note 1	2014

Bolded text indicate an impairment of the water quality standard.

Note 1: A water quality concern was identified rather than an impairment of a designated use. Concerns are identified for bodies of water near-nonattainment of water quality standards (CN) or not meeting numerical screening levels (CS).

Category 4: Standard is not attained or nonattainment is predicted in the near future due to one or more parameters, but no TMDLs are required.

4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future.

Category 5: Standard is not attained or nonattainment is predicted in the near future for one or more parameters.

5a: TMDLs are underway, scheduled, or may be scheduled for one or more parameters.

5b: Review standards for one or more parameters will be conducted before a management strategy is selected, including a possible revision to the water quality standards.

5c: Additional data or information will be collected and/or evaluated for one or more parameters before a management strategy is selected.

Peach Creek Watershed

River Segments, Descriptions and Concerns

Segment 1803C: (Peach Creek, unclassified water body) Peach Creek is a tributary of the Guadalupe River that flows for 64 miles through the gently rolling hills of Bastrop and Fayette counties northeast of Waelder, before reaching the confluence with the Guadalupe River in eastern Gonzales County. The watershed falls entirely within the Post Oak Savannah ecoregion and land use largely consists of undeveloped ranch land. The sandy loam soils of the watershed are dominated by forests of Post Oak, Blackjack Oak, and other hardwoods. Peach Creek receives discharges from multiple tributaries including Rocky Creek, Elm Creek, Pin Oak Creek, Copperas Creek, Big Fivemile Creek, Obar Creek, Sulphur Branch, Baldrige Creek, Valley Branch, Sandy Fork (1803G), Vanham Creek, Denton Creek (1803F), Live Oak Branch, Mitchell Creek, Elm Slough and Gelhorn Creek. A routine monitoring station (14937) is collected monthly by the GBRA at the CR 353 bridge crossing. The stream has USGS gauge located downstream of alternate highway 90 (8174600) with a harmonic mean of 3.2 cfs and a 7Q2 (7-day minimum flow with a 2-year recurrence interval) of 1 cfs.

Segment Concerns: Peach Creek was included on the 303(d) list of Impaired Water Bodies in 2002 because of average bacteria concentrations that exceeded the contact recreation standard. In 2014, the assessed bacterial concentration mean was 148.61 MPN/100 mL in the assessment unit (AU) comprising the lower 25 miles of the segment (AU 1803C_01), which was well above the standard criteria of 126 MPN/100 mL. Peach Creek was also found to have impaired dissolved oxygen levels for aquatic life use in 2006. In the latest 2014 assessment, the minimum dissolved oxygen concentration in the creek was found to be below the acceptable criteria on three occasions AU 1803_01. Peach Creek was also found to have a general use nutrient screening level concern for chlorophyll-a in 2010 in the assessment unit that included the stream reach from 1.2 miles downstream of farm to market road 1680 in Gonzales county up to the confluence with Elm Creek in Fayette County (1803C_03). In the 2014 Texas Integrated Report concerns were also identified for total phosphorus concentrations and impaired fish community in the 1803C_03 AU. A Total Maximum Daily Load (TMDL) has been adopted for Peach Creek, but to date no implementation of best management practices (BMPs) have been initiated to help remove the pollutant loads that were identified in the TMDL. The TMDL determined that bacterial loading was most likely due to non-point source pollution sources such as failing septic tanks, livestock and wildlife. The TMDL recommended a 47 to 100 percent reduction in loading of bacterial sources. Bacteria limits were also included in the permits for the five wastewater treatment plant discharges into Peach Creek. Additional monitoring conducted under the TMDL study also found that the Denton Creek (1803F) and Sandy Fork (1803G) tributaries of Peach Creek had bacteria concentrations that exceeded the contact recreation standard. These tributaries were added to the 303(d) list of impaired water bodies in 2010 using data collected during the TMDL study. The tributaries were subsequently removed from the list in 2012, because TCEQ staff discovered that the data used to determine the listing was collected during storm conditions and was not representative of ambient conditions in these water bodies.



Photo by Lee Gudgell

Drainage Area: 480 square miles

Streams and Rivers: Guadalupe River, Peach Creek, Copperas Creek

Aquifers: Carrizo-Wilcox

River Segments: 1803C

Cities: Waelder, Flatonia

Counties: Caldwell, Bastrop, Fayette, Gonzales

EcoRegions: Texas Blackland Prairies, Post Oak Savannah

Vegetation Cover: Shrublands 13.9%, Grass/Herbaceous 23.4%, Deciduous Forest 34.1%, Pasture/Hay 21.1%

Climate: Average annual rainfall 31 inches, Average annual temperature January 39°, July 94°

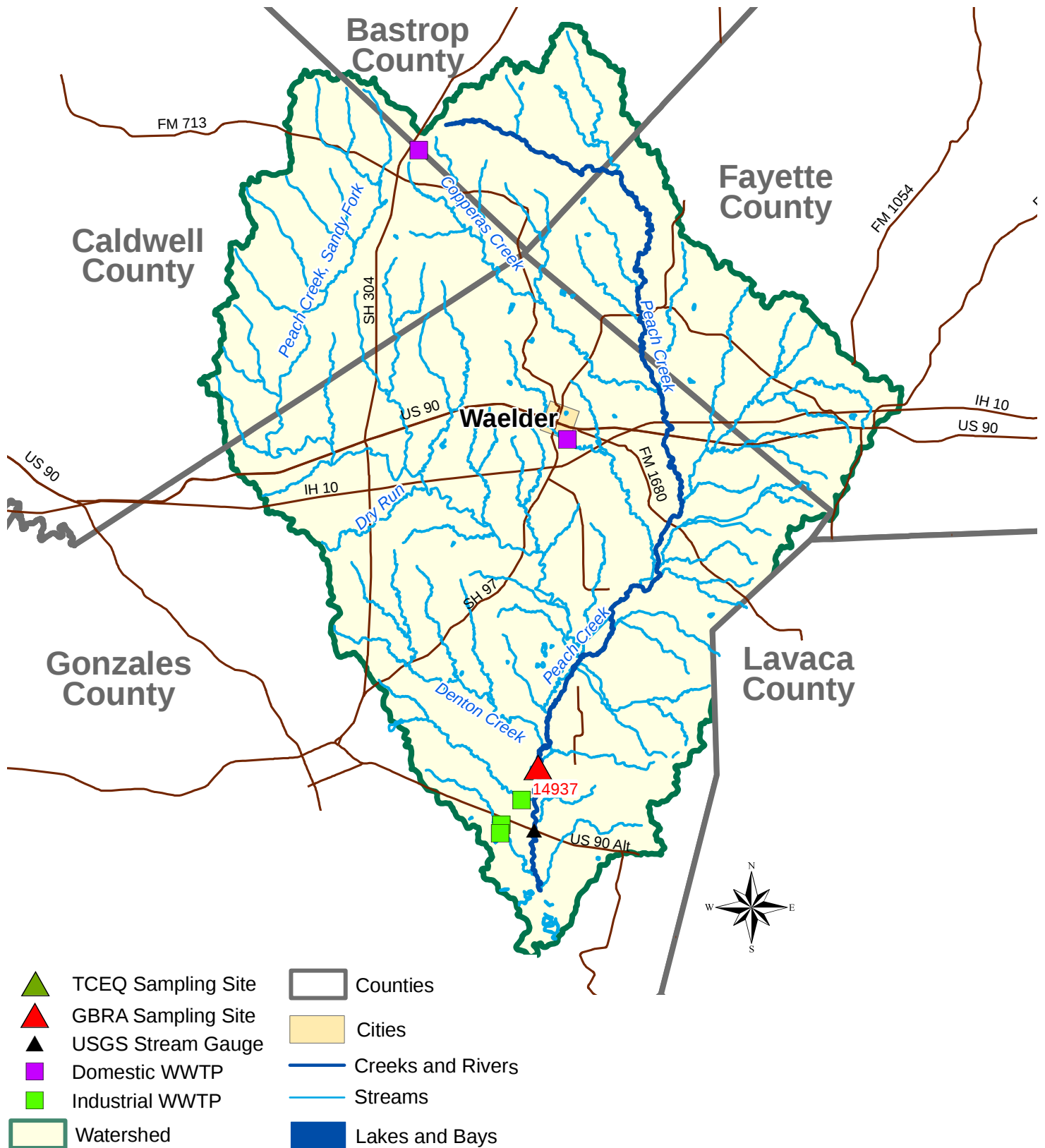
Land Uses: Recreation, extensive cattle and poultry productions, light industry and agricultural crops

Water Body Uses: Aquatic life, contact recreation, and fish consumption

Soils: Dark red sandstone and tan and grey sandstone

Permitted Wastewater Treatment Facilities: Domestic 2, Land Application 0, Industrial 3

Peach Creek Watershed



Sandies Creek Watershed

River Segments, Descriptions and Concerns



Photo by Janet Thome

Drainage Area: 711 square miles

Streams and Rivers: Guadalupe River, Elm Creek, Sandies Creek, Five Mile Creek, Salty Creek, Clear Creek, and O'Neil Creek

Aquifers: Carrizo-Wilcox, Gulf Coast

River Segments: 1803A, 1803B

Cities: Smiley, Nixon

Counties: Guadalupe, Karnes, Wilson, Gonzales, DeWitt

EcoRegions: Texas Blackland Prairies, Post Oak Savannah

Vegetation Cover: Pasture/Hay 24.9%, Deciduous Forest 19.6%, Row Crops 3.4%, Grass/Herbaceous 24.3%, Evergreen Forest 5.3%, Shrublands 21.1%

Climate: Average annual rainfall 31 inches, Average annual temperature January 39°, July 94°

Land Uses: Light manufacturing, extensive cattle and poultry production, agricultural crops (hay, sorghum, etc.)

Water Body Uses: Aquatic life, contact recreation and fish consumption

Soils: Dark red sandstone, light tan and gray sandstone

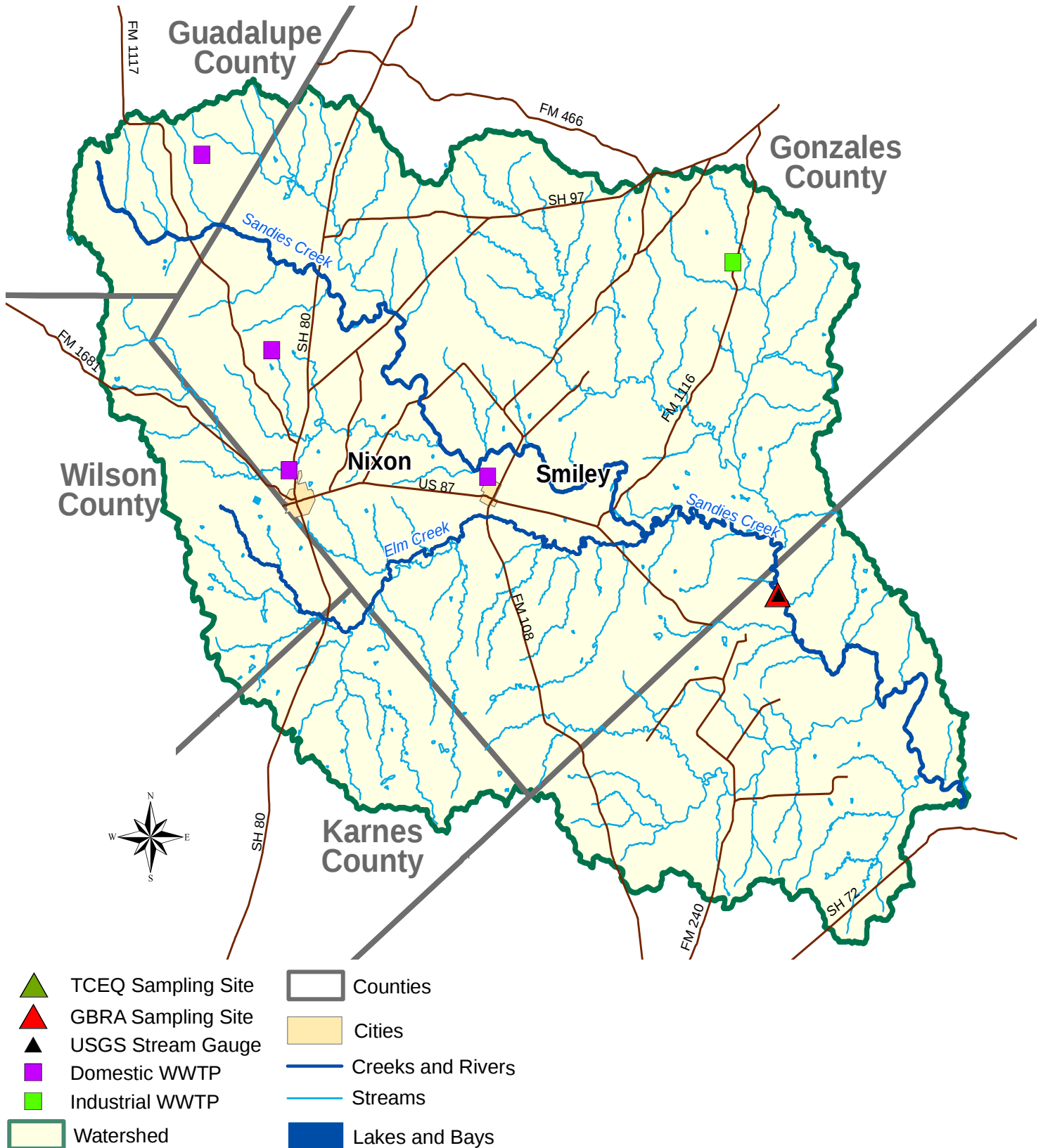
Permitted Wastewater Treatment Facilities: Domestic 4, Land Application 0, Industrial 1

Segment 1803A: (Elm Creek, unclassified water body) Elm Creek is a fourth order stream that arises west of Nixon, in Wilson County. Elm Creek flows through Karnes and Gonzales Counties for 30.8 miles before it confluences with the Sandies Creek, east of Smiley. The Elm Creek watershed has a total drainage area of 135 square miles and receives water from at least 15 different tributaries, including Shockley Creek, Mustang Creek, Willow Creek, Racetrack Creek, Wickey Branch, Mound Creek, Panther Branch, Cottonwood Creek, Dykes Creek and Rocky Creek. The creek flows past the cities of Pandora, Nixon, Gillett and Smiley. The watershed falls entirely within the Southern Post Oak Savannah ecoregion, which is characterized by sand and sandy loam soils that transition to dense clay pan soils that retain water in low lying areas. The majority of the land use in the watershed is dominated by scrub shrub rangeland, improved pasture for hay production and deciduous post oak forest. There is no current water quality station located within this segment. There are no USGS stream gaging stations in this segment, but the stream has historically gone dry on several occasions and the flow is best described as intermittent during dry weather conditions.

Segment Concerns and Impairments: Elm Creek is comprised of a single assessment unit (AU) 1803A_01, which includes the length of the entire stream. Elm Creek was listed on the 303(d) list of impaired water bodies in 1999 for impaired aquatic life use due to depressed dissolved oxygen and a concern for chlorophyll-a. The 1999 impairments and concerns remained in the most recent 2014 Texas Integrated Report. Elm Creek was included in a Total Maximum Daily Load (TMDL) study,

Continued on page 22

Sandies Creek Watershed



Sandies Creek Watershed

River Segments, Descriptions and Concerns Cont.



Photo by Janet Thome

but as of 2017 the TMDL has not been adopted. The results of the TMDL indicated that a review of the water quality standards for this segment may be necessary. The TCEQ Water Quality Standards Division has evaluated recent use attainability analysis studies (UAA) performed in the watershed and plans to propose a change in designated aquatic life use for this stream from the current high level of aquatic life use to an intermediate use at the end of 2017. If this change is accepted, then the average 24-hour dissolved oxygen standard will change from 5mg/L to 3 mg/L. The 24-hour minimum dissolved oxygen level standard will also change from a 3 mg/L minimum to a 2 mg/L minimum. Intermediate aquatic life use is the common standard applied to streams with intermittent flows. If a reclassification of the aquatic life use standard occurs on this water body, it is possible that the current impairments may no longer apply.

Segment 1803B: (Sandies Creek, unclassified water body) Sandies Creek originates in Guadalupe County northwest of Nixon, although the perennial portion of the creek begins in Gonzales County northwest of Smiley. This fifth order stream travels 79 miles to the confluence of the Guadalupe River west of Cuero, in DeWitt County. The name of this water body is aptly applied, as much of the stream bed consists of sandy substrate. The sandy soil is largely typical of the surrounding Southern Post Oak Savannah ecoregion that surrounds much of the creek before it flows into the southern Blackland Prairie ecoregion near the confluence with the Guadalupe River. The Blackland Prairie has more clay in the soil than the upland Post oak Savannah. Shrub forage and range land remains the dominant land use in both ecoregions, but larger portions of the watershed are used for improved pasture hay and deciduous forest near the mouth of the stream. Sandies Creek has at least 14 named tributaries including Cordell Creek, Tidwell Creek, Salt Branch, O'Neal Creek, Yow Branch, Clear Fork Creek, Little Elm Creek (1803E), Elm Creek (1803A), White Oak Branch, Five Mile Creek, Birds Creek, Boggie Creek, Clear Creek, and Deer Creek. One monitoring station (13657) is monitored monthly by the GBRA at the Cheapside road bridge crossing near the USGS gauging station (08175000).

Segment Concerns: Sandies Creek consists of two assessment units (AUs). 1803B_01 consists of the section of Sandies Creek from the Elm Creek confluence down to the confluence with the Guadalupe River. Assessment unit 1803B_02 consists of the section of the creek from the Elm Creek confluence upstream to the headwaters.

Sandies Creek Watershed

River Segments, Descriptions and Concerns Cont.

Both assessment units of Sandies Creek have been listed on the 303(d) list of impaired water bodies for aquatic life since 1999 due to depressed dissolved oxygen. In 2002, both assessment units were also listed for impaired contact recreation use because of elevated bacteria concentrations. Additional aquatic life use impairments were assessed on unit 1803_01 in 2010 for impaired fish community and impaired macrobenthic community. These additional aquatic life use impairments were most likely a direct result of the depressed dissolved oxygen levels in the creek. Most recently, the 2014 Texas Integrated Report found that assessment unit 1803B_01 had a nutrient screening concern for excessive concentrations of chlorophyll-a. Sandies Creek and Elm Creek were both included in a TMDL study to address the known impairments. The TMDL has indicated that a review of the water quality standards for this segment and Elm Creek (1803A) may be necessary. The United States Geological Survey (USGS) has maintained one stream flow gaging station (08175000) two miles northeast of Westhoff, Texas since 1930. This gaging station has recorded a minimum daily average stream flow

of 0.00 cfs many times throughout its history including the summers of 2009, 2015 and 2016. The stream gauge experienced its historic peak of 92,700 cfs in July of 1936. The current harmonic mean of this gauge is 3.9 cfs and the 7Q2 (7-day minimum flow with a 2-year recurrence interval) is 1.2 cfs.

The Eagle Ford Shale Play is one of the richest oil and gas deposits in Texas and uses the hydraulic fracturing process that has raised concerns on potential impacts it may have on groundwater and surface water. Potential stakeholder concerns are future water availability due to the quantity of water used in this water-limited area and the potential for spills and lack of containment of chemicals.

The proposed reclassification of the aquatic life use standards will very likely remove the current dissolved oxygen impairments from the next assessment, but the bacteria loading addressed by the TMDL will likely require future management efforts to reduce non-point source pollution in order to meet the contact recreation standard.



Coletto Creek Watershed

River Segments, Descriptions and Concerns

Segment 1807: (Coletto Creek) Coletto Creek extends 27 miles beginning in Dewitt County, through Goliad and Victoria counties, to the confluence with the Guadalupe River in Victoria county. This segment includes the 3100-acre Coletto Creek Reservoir. The size of Coletto Creek's drainage basin can turn this normally slow moving creek into a fast flowing river during a typical South Texas rainstorm. Several tributaries contribute drainage to the creek, including Turkey Creek, Sulphur Creek, and Perdido Creek (1807A). Much of the creek bottom is sandy, with typical vegetation ranging from brush trees such as mesquite and huisache to large live oaks and anacua trees. Due to the rural setting and limited development of this watershed you can still find a wide range of Texas wildlife along its shores ranging from turkey and deer, to red fox and bobcats. The completion of the Coletto Creek Reservoir provided habitat to support over 100 different species of birds, such as the Southern Bald Eagle, Osprey, and Roseate Spoonbills. This segment has one routine station (20827), which is monitored monthly by the GBRA at the midpoint of the dam on the Coletto Creek Reservoir. The water at this monitoring station is over 10 meters deep and depth profiles at the station have shown that the Coletto Reservoir undergoes typical large lake seasonal stratification patterns for temperature and dissolved oxygen. Stratification occurs during the summer months as waters near the surface become less dense due warmer temperatures while the water near the bottom remain more dense and cool. Mixing occurs during the fall as the cooler temperatures of the waters at the surface begin to match the temperatures of the waters at the bottom.

Segment Concerns: The 2014 *Texas Integrated Report of Water Quality* did not identify any impairments or concerns in either of the assessment units that are evaluated for this segment. Coletto Creek Reservoir is used as cooling water by a coal-fired power plant. The influence of the power plant can cause temperature levels in the reservoir to be several degrees warmer than other water bodies during the same time of year. These slightly altered ambient conditions do not appear to have affected the aquatic life of the reservoir, which is meeting all of its designated uses. Stakeholders remain concerned about the possible impacts of in-situ groundwater uranium mining activities located in the northwest portion of Goliad County. The area of concern is located in the recharge zone of the Evangeline component of the Gulf Coast Aquifer. Other activities that may impact water quality in the area include increased oil field mining, new subdivision development and the introduction of invasive aquatic plants.

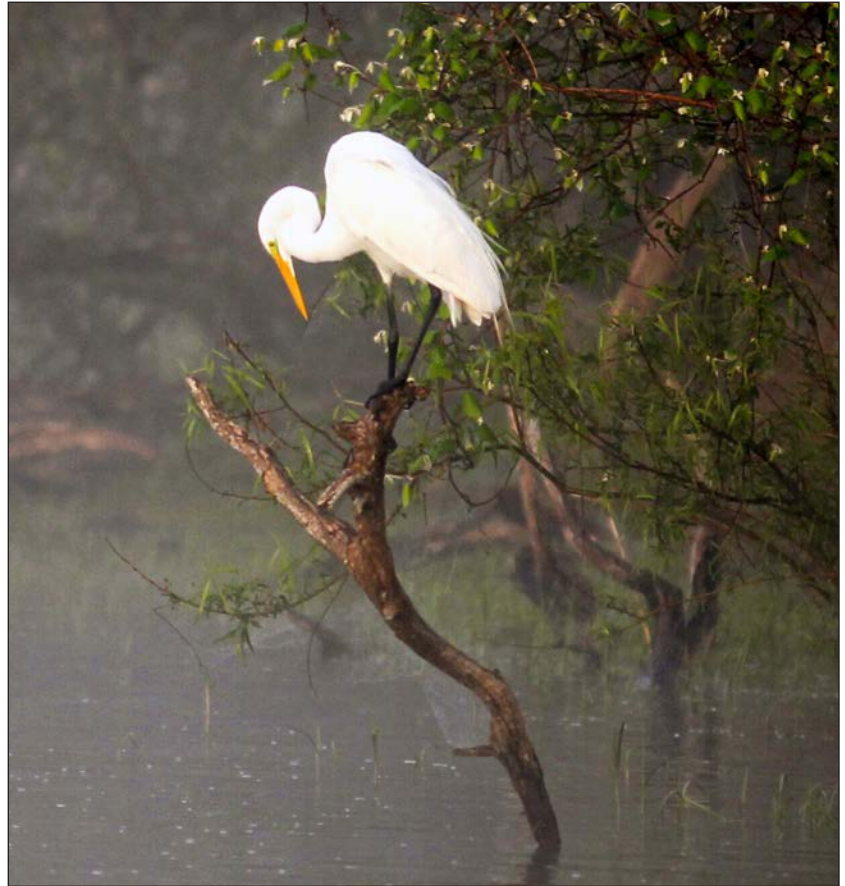


Photo by David Sikes

Drainage Area: 558 square miles

Streams and Rivers: Guadalupe River, Coletto Creek, Perdido Creek, Twelve Mile Creek, Thomas Creek

Aquifer: Gulf Coast

River Segments: 1807

Cities: Yorktown

Counties: DeWitt, Goliad, Victoria

EcoRegion: Texas Blackland Prairies, Gulf Coastal Plains

Vegetation Cover: Pasture/Hay 15.3%, Shrublands 9.7%, Grass/Herbaceous 33.2%, Deciduous Forest 18.7%, Row Crops 5.0%

Climate: Average annual rainfall 30 inches, Average annual temperature January 41°, July 95°

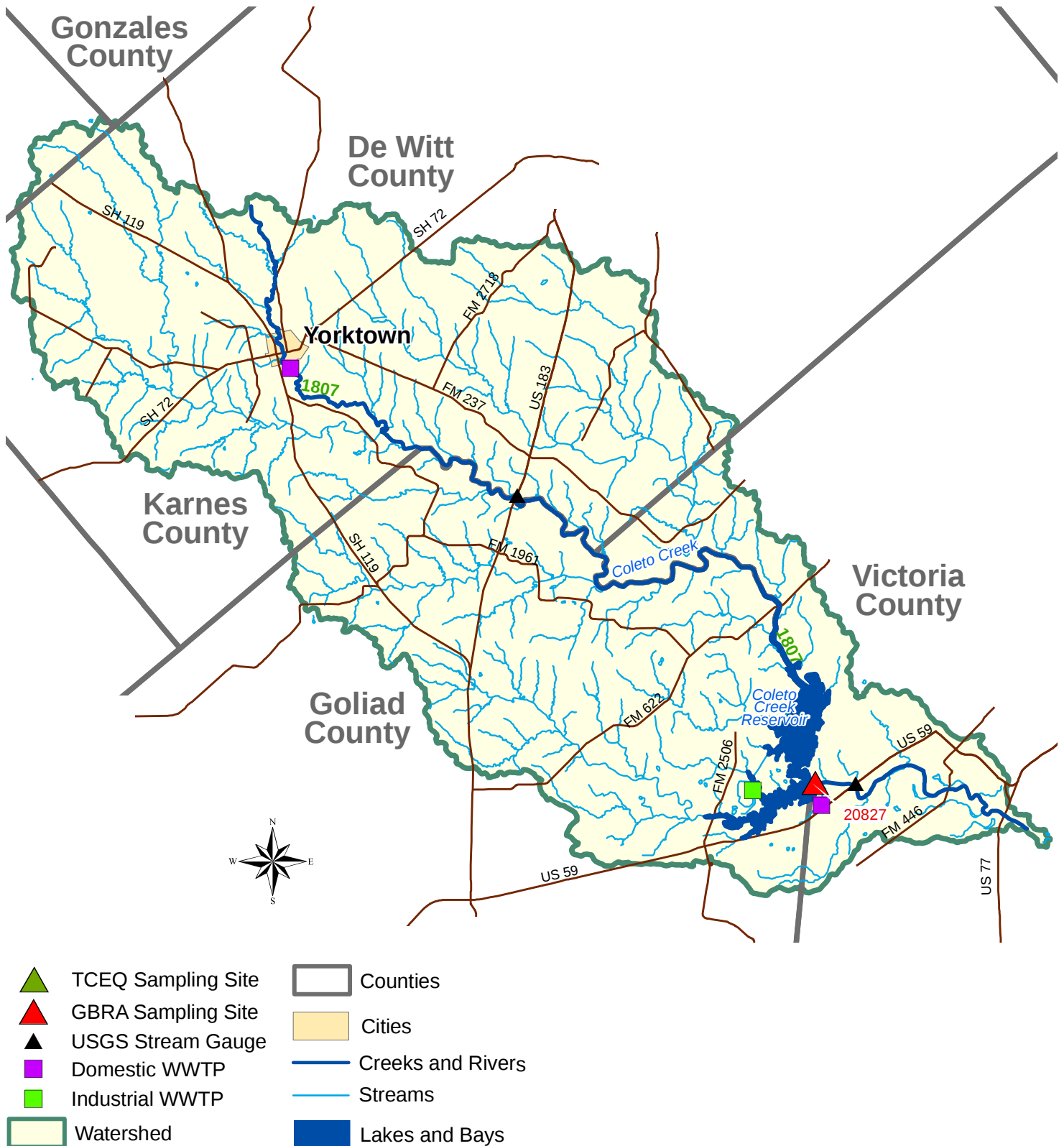
Land Uses: Agricultural crops (sorghum, rice, cotton and corn), beef, hogs and poultry productions and oil and gas production

Water Body Uses: Aquatic life, contact recreation, fish consumption, public water supply and power plant cooling

Soils: Sandy, sandy loam and clay loam

Permitted Wastewater Treatment Facilities: Domestic 2, Land Application 0, Industrial 1

Coleto Creek Watershed



Lower Guadalupe River Watershed

River Segments, Descriptions and Concerns



Photo by Fain Zimmerman

Drainage Area: 488 square miles

Streams and Rivers: Guadalupe River Tidal, Guadalupe River below San Antonio River, Guadalupe River below San Marcos River, Sandies Creek, Elm Creek, Coletto Creek, Spring Creek, McDonald Bayou

Aquifers: Carrizo-Wilcox, Gulf Coast

River Segments: part of 1803, 1802, 1801, 1701

Cities: Cuero, Victoria, Tivoli

Counties: Calhoun, Refugio, Victoria, DeWitt

EcoRegion: Gulf Coastal Plains, East Central Texas Plains

Vegetation Cover: Pasture/Hay 14.8%, Shrublands 21.1%, Row Crops 4.2%, Grass/Herbaceous 22.6%, Evergreen Forest 5.7%, Wetlands 10.2%, Deciduous Forest 14.8%

Climate: Average annual rainfall 37.4 inches, Average annual temperature January 53°, July 84°

Land Uses: Urban, agricultural crops (cotton, corn, wheat, rice, hay, grain sorghum), cattle and hog productions, industrial (plastics, chemicals, petrochemicals)

Water Body Uses: Aquatic life, contact recreation, general, fish consumption, heavy industrial and public water supply

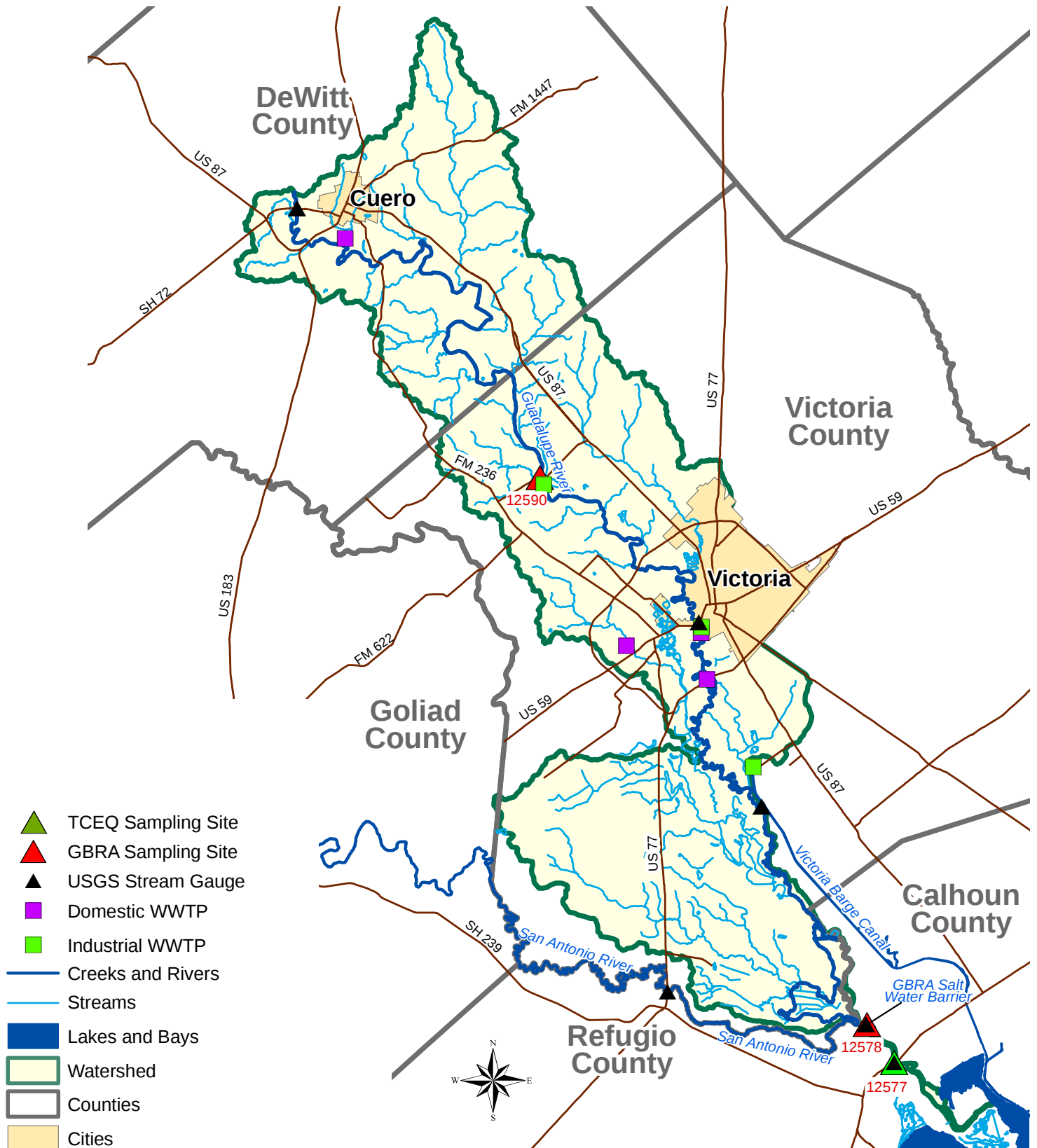
Soils: Cracking clay subsoil, sandy, sandy and clay loam

Permitted Wastewater Treatment Facilities: Domestic 4, Land Application 0, Industrial 3

Segment 1803: (Guadalupe River below San Marcos River) Segment 1803 begins at the confluence of the San Marcos River west of Gonzales, and travels 161.5 miles to the confluence with the San Antonio River. This portion of the Guadalupe River is a large, slow moving river with minimal elevation changes and a low-stream gradient. Frequent twists and bends are common and rapids are greatly reduced from the upstream portions of the river. Segment 1803 flows south past the cities of Cuero in DeWitt County and Victoria in Victoria County, to immediately upstream of the confluence with the San Antonio River in Calhoun County. Numerous minor tributaries combine with the Guadalupe River in this portion of the watershed including Kerr Creek, Cross Timber Creek, Cottle Creek, Black Creek, Peach Creek (1803C), Freeman Creek, Kokernot Creek, Rocky Creek, Boggy Creek, Fulcher Creek, Willow Branch, McCoy Creek, Cuero Creek, Sandies Creek (1803B), Lost Creek, Gohlke Creek, Oaxley Branch, Cattail Creek, Irish Creek, Reeds Branch, Carlisle Creek, Price Creek, Rocky Creek, Mission Creek, Wright Creek, Spring Bayou, Blue Bayou, New River, Coletto Creek (1807), Black Bayou and Kuy Creek. The segment transitions from a fifth order stream to a sixth order stream when it combines with Sandies Creek in Dewitt County. The river segment begins in the sandy soils of the Southern Post Oak savannah ecoregion and flows through the moisture retaining clays of the southern Blackland Prairie before it transitions to the sandy clay of the humid Gulf Coastal Plains ecoregion. Land use consists of cropland, hay pasture, rangeland and poultry farming with deciduous forests of live oak, elm and ash. Native grasses such as big bluestem, little bluestem and switchgrass are abundant in the rangeland prairies. Invasive tree species such as the Chinese Tallow and Chinese Privet have been found in many areas of the watershed. This stream segment has three current routine monitoring stations that are sampled by the GBRA at FM 447 west of Nursery (12590), FM 766 west of Cuero (12592), and US 183 in Hochheim (20470).

Continued on page 28

Lower Guadalupe River Watershed



Lower Guadalupe River Watershed

River Segments, Descriptions and Concerns Cont.

Segment Concerns: The Texas Instream Flow Program (TIFP) was enacted by the legislature under Texas Senate Bill 2. In 2012, preliminary study design began an in-depth scientific study of the flows necessary to support a sound ecosystem on the lower Guadalupe River. This segment is not currently impaired for any of its designated uses, although several of its contributing subwatersheds have been listed as impaired (1803A Elm Creek, 1803B Sandies Creek, 1803C Peach Creek). Segment 1803 consists of five TCEQ assessment units (AUs) between the confluence with the San Marcos River to the confluence with the San Antonio River.

Water quality monitoring parameters are analyzed against water quality standards for each of the streams designated uses in each of these AUs. A general use nitrate-nitrogen concern was identified in the *2014 Texas Integrated Report* on assessment unit 1803_01, which includes the lower 25 miles of the segment. The average nitrate-nitrogen value was assessed at 8.47 mg/L, which was more than four times the General Use nutrient screening level of 1.95 mg/L. The

elevated nitrate concentrations were not identified in any of the four other assessment units of the segment, which were all located upstream of the confluence with Coletto Creek. This concern was most likely due to contributions of data from a historical monitoring station (16579). Monitoring at the historical station was discontinued in 2006 because it was found to be located within the mixing zone of an industrial wastewater discharge and therefore not representative of ambient conditions in this portion of the stream. An alternative station has never been monitored in this assessment unit due to site access concerns in this portion of the river. The *2014 Texas Integrated Report of Water Quality* also removed a contact recreation concern for bacteria in assessment unit 1803_04, which included the portion of the segment 25 miles downstream of the Sandies Creek confluence. This concern was eliminated because the assessed mean of bacteria concentrations for this AU dropped below the 126 MPN/ 100 mL assessment criteria. The Eagle Ford Shale Play, located in Dewitt and Gonzales

counties, has become one of the richest oil and gas deposits in Texas because of the exploration technology called hydraulic fracturing or “fracking.” Fracking is the process to stimulate wells and recover natural gas and oil by creating fractures that extend from a well bore into formations and allow the product to travel more easily. The fracking solution can be made up of a proprietary mixture of organic chemicals, acids and bases. Concerns have been raised about the impacts that these activities will have on groundwater quality, surface water quality, the quantity of

water needed in a water-limited area and the potential for spills and lack of containment of chemicals.



Segment 1802: (Guadalupe River below San Antonio River) This 0.4 mile long stretch between the confluence of the San Antonio and Guadalupe rivers to the GBRA Salt Water Barrier is a typical slow moving coastal river. Following the confluence with the San Antonio River the watershed drainage expands

from 5,979 square miles to 10,172 square miles and the average yearly flow of the Guadalupe River below this point increases by approximately 40 percent. This is the most downstream stream segment of the Guadalupe River that is not influenced by tidal waters. This portion of the western Gulf Coastal Plain ecoregion is characterized by floodplains and low terraces comprised of alluvial sediments. Land cover typically includes lowland forests of elms, water oak and ash trees as well as grazed pasture and cropland. A routine monitoring station (12578) is sampled monthly by the GBRA upstream of the salt water barrier on Shultz road.

Segment Concerns: Segment 1802 consists of one assessment unit that encompasses its entire length. The Texas Integrated Report assessed a mean concentration of 3.13 mg/L of nitrate-nitrogen for this segment, which exceeded the general use nutrient screening level of 1.95 mg/L. Other nutrient assessment parameters such as total phosphorus, ammonia nitrogen, and chlorophyll-a were also evaluated with no concerns.

Lower Guadalupe River Watershed

River Segments, Descriptions and Concerns Cont.

Segment 1801: (Guadalupe River Tidal) This stream segment comprises the 10 mile portion of the Guadalupe River from the GBRA Salt Water Barrier to the confluence with the San Antonio Bay. This tidally influenced portion of the river is prone to frequent log jams. The logs that travel downstream catch on bridges, railroad crossings and other obstructions creating restrictions to water flow, changes in the river channel, and producing new ecosystems. The floodplain can often extend several miles outside of the stream banks. The Senate Bill 3 stakeholder process has recommended instream flows for the Guadalupe and San Antonio rivers and inflows into the bays and estuaries in the lower basin. TCEQ has since established environmental flow requirements for the Guadalupe and San Antonio

rivers using stakeholder recommendations. The ongoing Senate Bill 2 TIFP will provide additional scientific data to the TCEQ in order to further refine the environmental flow requirements for the future and facilitate adaptive management strategies. A routine station (12577) is monitored quarterly at the state highway 35 tidal bridge by TCEQ region 14 staff.

Segment Concerns: Segment 1801 is assessed as a single assessment unit, which includes the length of the entire segment. The *2014 Texas Integrated Report* assessed a mean concentration of 2.47 mg/L of nitrate-nitrogen for this segment, which exceeded the general use nutrient screening level of 1.10 mg/L for tidal waterbodies. A total of 18 of the 25 measurements that were analyzed for

the assessment exceeded these screening levels. High nitrate-nitrogen levels may contribute to eutrophic conditions in the waterbody that can lead to low dissolved oxygen concentrations for the aquatic ecosystem. Although nitrate nitrogen levels appeared to be elevated in the last assessment, other nutrients such as ammonia nitrogen, and total phosphorus were not concerns. Chlorophyll-*a* is a common response indicator for excessive algae and nutrient enrichment, but these concentrations were also below the assessed screening level. TCEQ is currently evaluating possible ways to incorporate numerical nutrient levels into water quality standards for freshwater and tidal streams.



Photos by Bryan Serold

Lavaca-Guadalupe Coastal Basin

River Segments, Descriptions and Concerns



Photo by Janet Thome

Drainage Area: 998 square miles

Streams and Rivers: Guadalupe River, Garcitas Creek, Victoria Barge Canal, Marcado Creek, Arenosa Creek

Aquifer: Gulf Coast

River Segments: 1701

Cities: Victoria, Seadrift, Bloomington, Inez, Port O'Connor, Port Lavaca

Counties: Calhoun, Victoria, Jackson

EcoRegion: Gulf Coastal Plains

Vegetation Cover: Pasture/Hay 15.1%, Row Crops 21.4%, Shrublands 16.9%, Grass/Herbaceous 13.7%, Deciduous Forest 8.4%, Wetlands 17.2%

Climate: Average annual rainfall 42 inches, Average annual temperature January 44°, July 93°

Land Uses: Agriculture row crops (cotton, corn, rice and grain sorghum), urban, recreation, oil and gas production, cattle, hog and poultry production and industry (plastics, chemicals, petrochemicals)

Water Body Uses: Aquatic life, non-contact recreation, fish consumption and industrial cooling

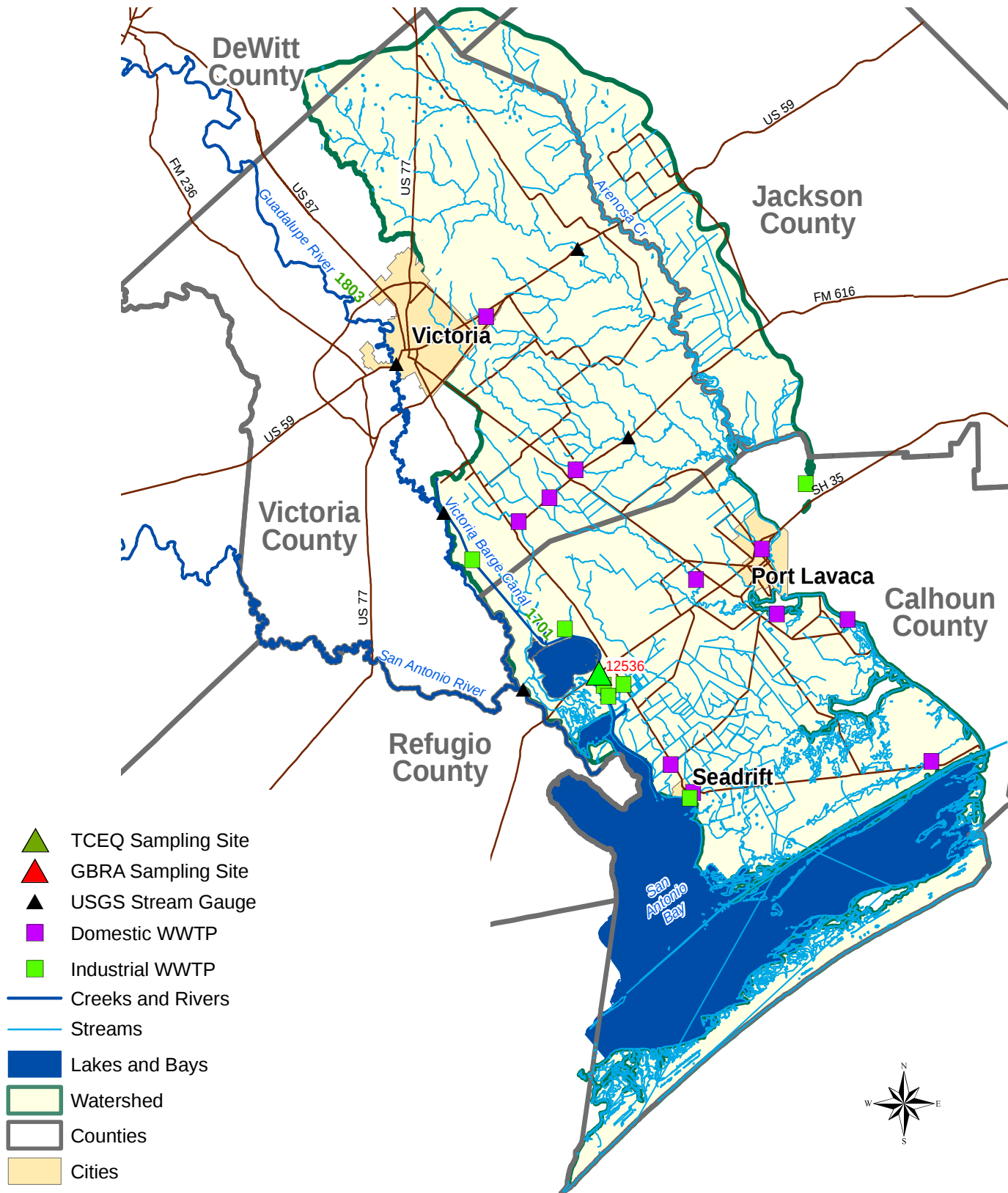
Soils: Clay subsoils, deep black soil, sandy clay, dark clay loam, clay

Permitted Wastewater Treatment Facilities: Domestic 11, Land Application 1, Industrial 7

Segment 1701: (Victoria Barge Canal) The Victoria Barge Canal is a 35-mile-long, man-made stream segment that was completed in 1968. The barge canal was constructed to provide a navigable waterway from the Victoria Turning Basin in Victoria County to the Gulf Intracoastal Waterway (GIWW) located at the confluence with the San Antonio Bay in Calhoun County. This waterway provides a route for barge traffic to reach the Port of Victoria without the need to deal with the frequent log jams and course changes in the lower Guadalupe River. The canal was originally constructed 9 feet in depth and 100 feet in width, but was expanded between 1995 and 2002 to a depth of 12 feet and a width of 125 feet. The canal sees large amounts of shipping traffic to accommodate the needs of several industrial manufacturing plants located along its length. TCEQ region 14 staff monitors Station 12536 quarterly where the State Highway 35 bridge crosses the canal.

Segment Concerns: The 2014 *Texas Integrated Report* identified general use concerns for chlorophyll-*a* and nitrate-nitrogen. Chlorophyll-*a* concentrations were assessed at a mean value of 39.34 mg/L, which exceeded the nutrient screening level of 11.60 mg/L by more than three times. Elevated chlorophyll-*a* values are usually linked to excessive algal growth in the water body. Algae biomass is dependent upon available nutrients and may be affected by the nitrate-nitrogen concern for this segment. The average nitrate-nitrogen concentration was assessed at 0.72 mg/L, which was four times greater than the nutrient screening level of 0.17 mg/L. Nutrient screening levels are more restrictive on the tidally influenced barge canal than in most freshwater waterways. This waterway is unique among tidally influenced segments in that it does not receive any direct freshwater influences from any perennial rivers or streams. Most of the water in the canal originates in the San Antonio Bay system, although it does receive some freshwater from industrial wastewater effluent and stormwater runoff.

Lavaca-Guadalupe Coastal Basin Sampling Location



Water Quality Parameters

Field Parameters are water quality constituents that can be obtained on-site and generally include: dissolved oxygen (DO), conductivity, pH, temperature, stream flow (not in reservoirs), and secchi disc depth (reservoirs only).

Dissolved Oxygen indicates the amount of oxygen available in the stream to support aquatic life. DO can be reduced by the decomposition of organic matter.

Conductivity is a measure of the water body's ability to conduct electricity and indicates the approximate levels of dissolved salts, such as chloride, sulfate and sodium. Elevated concentrations of dissolved salts can impact water as a drinking water source and aquatic habitat.

pH is a measure of the hydrogen ion concentration in an aqueous solution. It is a measure of the acidity or basic property of the water. Chemical and biological processes can be affected by the pH. The pH can be influenced by dissolved constituents, such as carbon dioxide and by point and nonpoint source contributions to the stream.

Temperature of the water affects the ability of the water to hold dissolved oxygen. It also has an impact on the biological functions of aquatic organisms.

Stream Flow is an important parameter affecting water quality. Low flow conditions common in the warm summer months create critical conditions for aquatic organisms. Under these conditions, the stream has a lower assimilative capacity for waste inputs from point and nonpoint sources.

Secchi Disc transparency is a measure of the depth to which light is transmitted through the water column, and thus the depth at which aquatic plants can grow.

Conventional Parameters are typical water quality constituents that require laboratory analysis and generally include: nutrients, chlorophyll a, total suspended solids, turbidity, hardness, chloride, and sulfate.

Nutrients include the various forms of nitrogen and phosphorus. Elevated nutrient concentrations may result in excessive aquatic plant growth and can make a water body unfit for its intended use(s).

Chlorophyll a is a plant pigment whose concentration is an indicator of the amount of algal biomass and growth in the water.

Turbidity is a measure of water clarity or light transmitting properties. Increases in turbidity are caused by suspended and colloidal matter such as clay, silt, fine organic and inorganic matter, plankton and other microscopic organisms.

Total Suspended Solids indicate the amount of particulate matter suspended in the water column.

Hardness is a composite measure of certain ions in water, primarily calcium and magnesium. The hardness of the water is critical due to its effect on the toxicity of certain metals. Typically, higher hardness concentrations in the receiving stream can result in reduced toxicity of heavy metals.

Chloride and Sulfate are major inorganic anions in water and wastewater. Numeric stream standards for chloride and sulfate have been set on all of the classified stream segments in the basin. Both of these inorganic constituents can impact the designated uses and can come from point and nonpoint sources, such as wastewater discharges, oil field activities, and abandoned flowing wells from groundwater with elevated concentrations of dissolved solids.

Other Parameters

Bacteria, specifically *E. coli*, is used as an indicator of the possible presence of disease-causing organisms.

Biological and Habitat assessment includes collection of fish community data, benthic macroinvertebrate (insects) data, and measurement of physical habitat parameters. This information is used to determine whether the stream adequately supports a diverse and desirable biological community. The physical, chemical and biological data are used together to provide an integrated assessment of aquatic life support.

24-Hour DO studies perform measurements of DO in frequent intervals (e.g., one hour) in a 24-hour period. The average and minimum concentrations in the 24-hour period are compared to corresponding criteria. This type of monitoring takes into account the diurnal variation of DO and avoids the bias in samples taken only at certain times of the day.

Metals in Water, such as mercury or lead, typically exist in low concentrations, but can be toxic to aquatic life or human health when certain levels are exceeded. To obtain accurate data at low concentrations, the GBRA uses special clean methods that minimize the chance for sample contamination and provide high quality data.

Organics and Metals in Sediment could be a source of toxicants for the overlying water, though currently there are no numeric sediment standards.

Organics in Water, such as pesticides or fuels, can be toxic to aquatic life or human health when certain levels are exceeded.

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