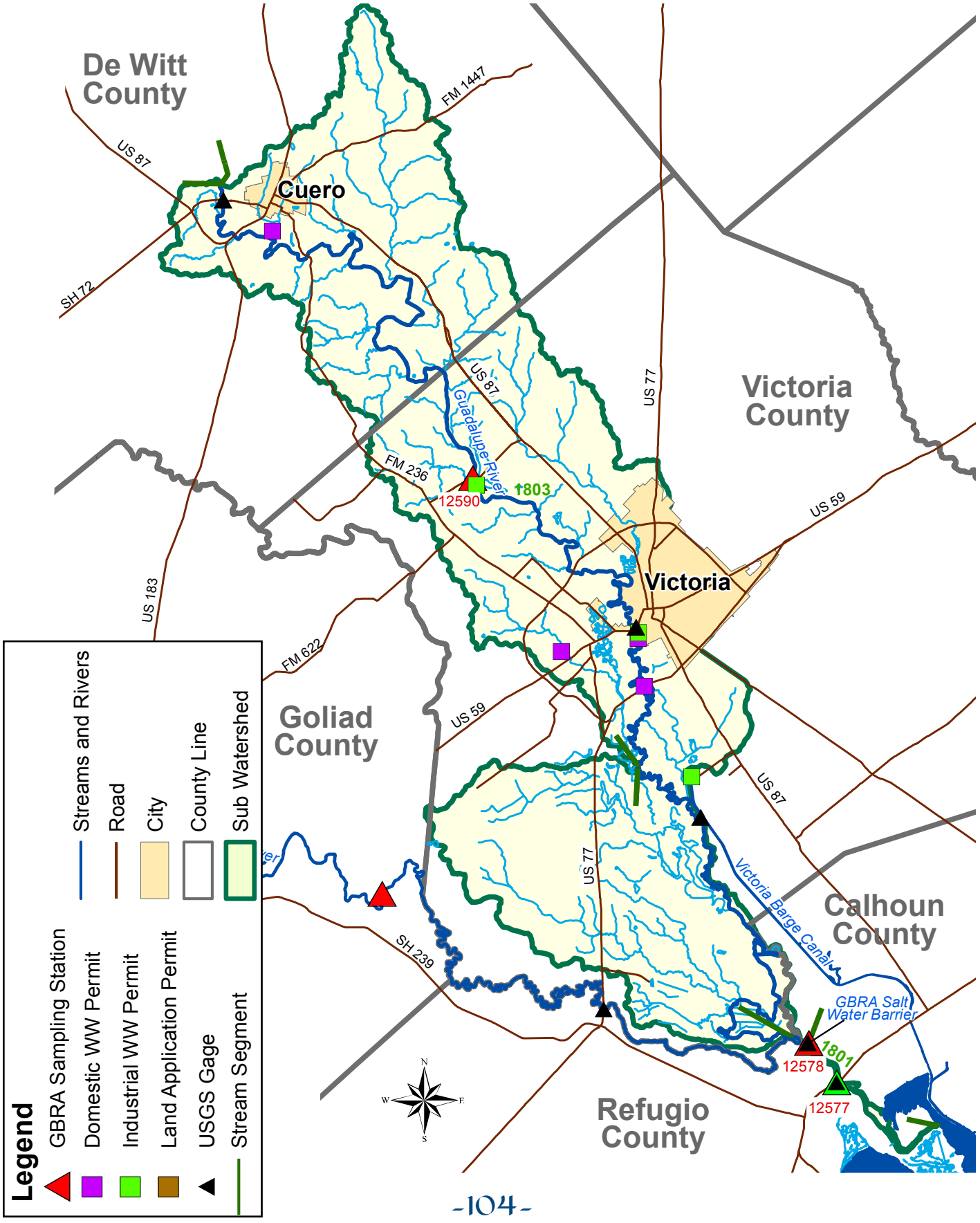
Lower Guadalupe River Watershed



Lower Guadalupe River Watershed
River Segments, Descriptions and Concerns

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, Coleto 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

EcoRegions: 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): From the point where the San Marcos River confluences with the Guadalupe River in Gonzales, Segment 1803 becomes a twisting, slow-moving coastal river, lined with pecan bottoms, with no rapids of any consequence. This portion of Segment 1803 begins to the west of the City of Cuero, flowing south to the west of the City of Victoria, to immediately upstream of the confluence with the San Antonio River.

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.

Segment 1801 (Guadalupe River tidal): From the confluence with Guadalupe Bay in Calhoun and Refugio counties to the GBRA Salt Water Barrier (0.4 miles) downstream of the confluence of the San Antonio River in Calhoun and Refugio counties.

Photo by John Snyder

Lower Guadalupe River Watershed

River Segments, Descriptions and Concerns

Lower Guadalupe River

The Lower Guadalupe River is made up of three river segments. Segment 1801, **Guadalupe Tidal**; Segment 1802, **Guadalupe River below the San Antonio River**; and, Segment 1803, the **Guadalupe River below the confluence with the San Marcos River**.

Guadalupe Tidal

Segment 1801, **Guadalupe Tidal**, extends from one-half mile downstream of the GBRA Salt Water Dam to where the river enters Guadalupe Bay in Calhoun County. This eleven-mile stretch is a typical marshy, tidal river. The Salt Water Dam is a set of two inflatable fabridams, used during times of low river flow to prevent salt water intrusion by tides. The TCEQ Region 14 office has monitored at the tidal bridge over the Guadalupe River two to four times per year since 1990. Unfortunately, the data set did not include flow data with each constituent, so it is difficult to correlate extremes in water quality to extremes in flow.

Segment 1801 is made up of one assessment unit. The segment was listed with concerns on the 2012 Texas Water Quality Inventory for depressed dissolved oxygen and nitrate nitrogen. The Inventory cites that the segment exceeded the **dissolved oxygen** grab criteria of 5.0 milligrams per liter (mg/L) 8 times out of the 35 data points assessed. The median concentration for dissolved oxygen was 6.5 mg/L, ranging from 3.9 mg/L to 12.3 mg/L.

Nitrate nitrogen exceeded the screening concentration of 1.10 mg/L 20 out of 25 sampling events. The median concentration was 2.02 mg/L, ranging from 0.06 mg/L to 4.72 mg/L. The exceedence of the nitrate screening criteria is due to the concentration of nitrate nitrogen coming from the San Antonio River. GBRA established a monitoring station on the lower San Antonio River at Fannin in 1987, in part, to help explain impacts of high flows coming from this "tributary" of the Guadalupe River. The GBRA San Antonio River station had a median concentration of 5.42 mg/L over the period of historical monitoring performed by GBRA from 1987 to 2012. The San Antonio River is effluent-dominated with the City of San Antonio and other smaller cities downstream discharging to the stream. Prior to major upgrades to the wastewater plants that serve the City of San Antonio, the stream routinely violated the drinking water standard of 10 mg/L nitrate nitrogen. Since the upgrade of the City of San Antonio's Dos Rios Wastewater plant and the installation of a major water reuse program that diverts a large portion of the city's wastewater effluent to industrial users, concentration of nitrate nitrogen in the San Antonio River has been reduced. However, the San Antonio River routinely discharges into the Guadalupe River with nitrate nitrogen levels above the screening criteria (1.1 mg/L). The nitrate nitrogen concentration upstream, in Segment 1803, ranged from 0.85 mg/L at the Guadalupe River at FM 766 in DeWitt County to 0.7 mg/L at the Hwy 59 Bridge in downstream of Victoria (very limited data set collected by USGS.)

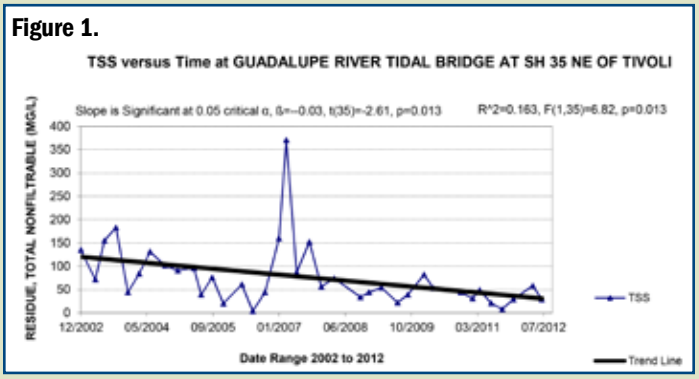
Despite the **total phosphorus** contributions from the San Antonio River, Segment 1801 never exceeded the screening concentration of 0.66 mg/L for total phosphorus in the 2012 Texas Water Quality Inventory. Improvements to the City of San Antonio's Dos Rios Wastewater plant and the installation of a major water reuse program that diverts the majority of the city's wastewater effluent to industrial users is no longer resulting in a significant decline in total phosphorus concentrations. The San Antonio River at Fannin has contributed a median of 0.92 mg/L of phosphorus over the period of record.

The median concentration of the **specific conductance** from 2003 through 2012 was 690 micromhos per centimeter (umhos/cm), ranging from 400 umhos/cm to 3550 umhos/cm. The largest conductance was recorded in Sepember of 2011 during extreme drought conditions. Higher conductivity results at this station during 2011 are most likely due to tidal influences, because the specific conductance contribution from the San Antonio River never exceeded 1690 umhos/cm.

The median **pH** was 7.9, ranging from 7.5 to 8.4. The temperature ranged from 8.9°C to 31.9°C, with a median **temperature** of 26.9°C. The **total suspended solids** ranged from 4 mg/L to 371 mg/L, with a median

concentration of 56 mg/L. TSS was the only parameter to show any significant trend within the last 10 years (Figure 1). **Ammonia nitrogen** did not exceed the screening concentration during the period of record. **Chloride** concentrations ranged from 29 mg/L to 908 mg/L, with a median concentration of 64 mg/L. **Sulfate** concentrations ranged from 25 mg/L to 191 mg/L, with a median concentration of 55 mg/L. Since 2001 this station has been monitored for Enterococcus bacteria. The concentration of Enterococcus only exceeded the stream standard one time.

Figure 1.



An environmental flows analysis as required by Senate Bill 3 was completed in 2012 in order to give the state a better idea of how to manage water rights and allocate adequate freshwater for endemic species habitat. The nationally endangered whooping crane spends the winter near the San Antonio Bay and the long term reduction in fresh water inflows due to upstream demands and wastewater reuse could impact the tidal stretches of the Guadalupe River and may result in a change to the habitat of these species. Log jams on the Guadalupe River tidal segment create impedances that force the rivers and streams in the segment to leave their channels and flow across property.

Guadalupe River Below the San Antonio River

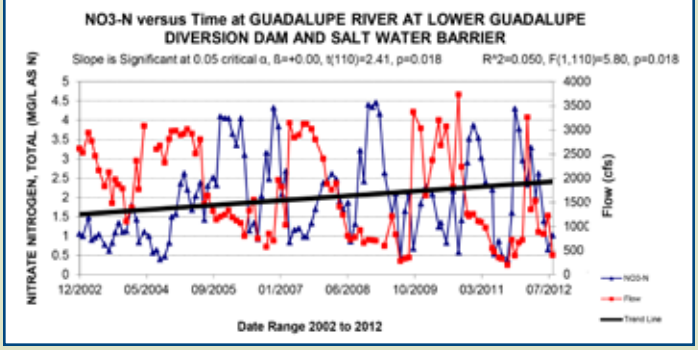
Segment 1802, **Guadalupe River below the San Antonio River**, is a 0.4 mile section of river that extends from the confluence of the Guadalupe River and the San Antonio River in Refugio County to 0.5 mile downstream of the Salt Water Barrier. In this stretch, the Guadalupe River is a slow moving coastal river that is characterized by log jams and fractured flow patterns. Currently, the flow from the San Antonio River is still entering the Guadalupe River through the old river channel, however, the majority of the flow appears to be passing through Elms Bayou, due to the log jams that have built up and created a diversion of the main flow. GBRA, along with other entities in the area, including the Refugio and Calhoun counties, the US Corp of Engineers, and NRCS, have been investigating this area to determine the extent of the changes in these flow patterns.

Segment 1802 is made up of one assessment unit. GBRA has one historical monitoring station in Segment 1802. The "Salt Water Barrier" site (GBRA SWB), station no. 12578, has been sampled monthly since 1987. The flow was recorded as gage height until the year 2000, where mean daily flow or instantaneous flow in cubic feet per second is now being recorded for each sampling event.

The segment was listed with concerns on the 2012 Texas Water Quality Inventory for **nitrate nitrogen**, with 39 out of 79 measurements exceeding the screening concentration of 1.95 mg/L. In the GBRA data set, the median concentration for nitrate nitrogen from 2003 through 2012 was 1.75 mg/L, ranging from 0.40 mg/L to 4.46 mg/L. As described in the summary for Segment 1801, Segment 1802 is also highly influenced by the contributions of the effluent-dominated San Antonio River during low flows. There is a significant increasing trend in nitrate nitrogen at the Guadalupe River at Salt Water Barrier station from 2003 to 2012 (Figure 2).

Figure 3 shows a decreasing trend in **total suspended solids**, similar to the downward trend seen in Segment 1801. The decreasing concentrations of TSS may be associated with an improvement in wastewater treatment in both watersheds over time, but this is most likely due to a

Figure 2.



significant increasing correlation with flow (Figure 4) and a significant decrease in overall flows in this segment during the past 10 years (Figure 5), resulting in less solids contributed from runoff. The median concentration of TSS was 61 mg/L, ranging from 16 to 398 mg/L.

The water quality at the GBRA SWB station was very similar to the TCEQ monitoring location at the Tidal Bridge in Segment 1801, since both are downstream of the San Antonio River, the largest influence to the water quality

Figure 3.

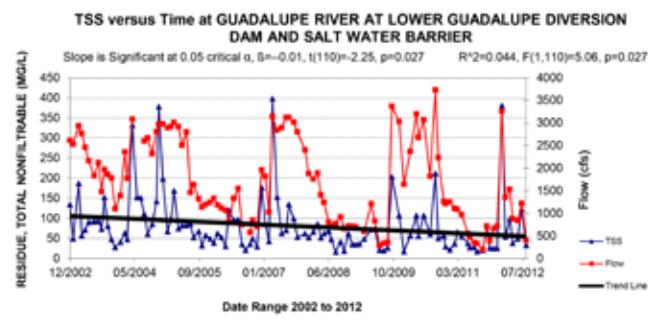


Figure 4.

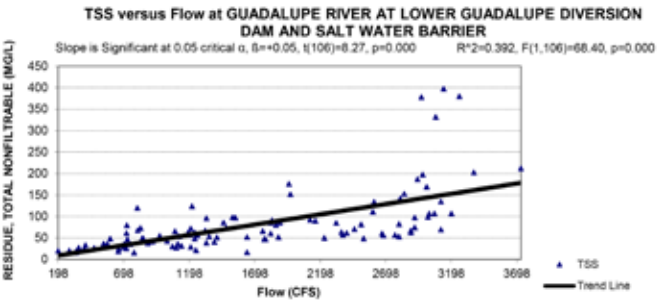
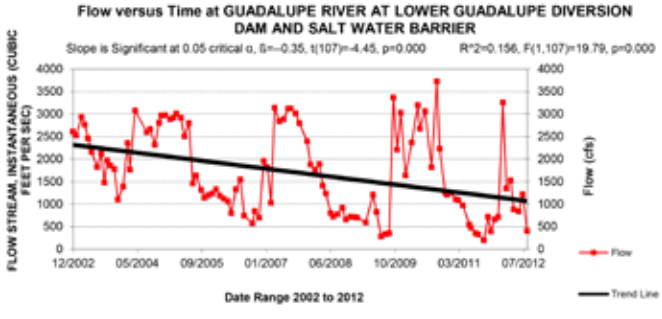


Figure 5.



in this portion of the river. The **temperature** ranged from 9.5°C to 32.2°C, with a median temperature of 24.4°C. The **pH** ranged from 7.5 to 8.9, with a median pH of 7.99. The **total phosphorus** had a median concentration of 0.28 mg/L, ranging from 0.05 mg/L to 0.71 mg/L. The **chloride** and **sulfate** concentrations had median concentrations of 62.3 mg/L and 55.4 mg/L, ranging from 19.1mg/L to 163 mg/L and 17.2 mg/L to 139 mg/L respectively.

The bacterial analysis of Segment 1802 utilized ***E. coli,*** but not enterococcus. The *E. coli* concentrations ranged from 4 MPN/100 ml to 3300 MPN org/100 mL, with higher concentrations correlated with higher flow events and a geometric mean of 80 MPN/100 mL from 2003 to 2012. The **chlorophyll *a*** ranged from less than method detection to 38.3 micrograms per liter (ug/L) exceeding the screening concentration of 14.1 ug/L 19 times out of 135 sampling events. There was no statistical correlation with flow.

No specific stakeholders concerns have been voiced at Clean Rivers Program meetings for Segment 1802 but issues that have been raised over the years include reduction in fresh water flows due to upstream demands and wastewater reuse, impacting the bay and estuary and threatening the habitat of the whooping crane, an endangered species that winters near San Antonio Bay, and log jams that create dams that force the rivers and streams in the segment to leave their channels and flow across property.

Guadalupe River below the confluence with the San Marcos River

The **Guadalupe River below the confluence with the San Marcos River**, Segment 1803, begins in Gonzales County, flowing downstream to the confluence with the San Antonio River in Refugio County. The river flows through Gonzales, DeWitt, Victoria, Refugio and Calhoun counties. This portion of the Guadalupe River is a slow-moving, coastal river with a silty substrate, and lined with pecan bottoms. Because of the change in elevation, the upper reaches of the Guadalupe River located in the hill country are shallow and turbulent. Conversely, the lower Guadalupe River flows through low hills and flat plains, with very little turbulence. Segment 1803 is subject to flooding during which the river often leaves its

Photo by Alvin Schuerg

banks and inundates the riparian areas along the river. While high flows during flooding events scour the inundated areas in the upper segments of the river, the flood waters in the lower basin, spread out over the land that is along the river, deposits silt and carries material such as logs downriver.

Segment 1803 is divided into five assessment units: the lower 25 miles (1803_01); from the confluence with the Coleto Creek 25 miles upstream (1803_02); from the confluence with the Sandies Creek upstream 25 miles (1803_03); from 25 miles upstream of the confluence with Coleto Creek to the confluence with Sandies Creek (1803_4); from 25 miles upstream of the confluence with Sandies Creek to the upper end of the segment (confluence with the San Marcos River) (1803_05).

GBRA has an historical station near Cuero ("FM 766"; station no. 12595) in Segment 1803. GBRA has monitored this station monthly since 1990. The FM 766 station is located in the assessment unit 1803_03, approximately at the halfway point down the segment. Also in Segment 1803, in assessment unit 1803_02, GBRA maintains a quarterly monitoring station upstream of the City of Victoria, near the community of Nursery. The station at Nursery (station no. 12590) has been monitored since late 1999. GBRA discontinued monitoring at a quarterly station on the Guadalupe located near the Invista (formerly I.E. Dupont deNemours, Inc.) in 2006. After reviewing the flow, it was determined that the sampling location was in the mixing zone of the industrial discharge and not representative of the flow and water quality of the segment. The station has not been replaced because of the lack of public access locations in the area. A station was added to the Guadalupe River at US 183 near Hochheim (station no. 20470) in September of 2008. The area downstream of the industrial plant is in large tracts of private land with no public access points. The next closest monitoring station was a station maintained in the early 1990s by the US Geological Survey located downstream of the City of Victoria at Hwy 59.

The land use in the upper portion of Segment 1803 is primarily agricultural, with row crops, pastures, hog, chicken and cattle operations. The cities of Gonzales and Cuero are located in the upper portion, both of which have wastewater plants that discharge into the segment. The City of Gonzales operates a wastewater facility that is permitted to discharge 1.5 million gallons per day (MGD), with limitations of 10 mg/L biochemical oxygen demand, 15 mg/L total suspended solids and utilizes ultraviolet light for disinfection of the effluent. The City of Cuero wastewater treatment plant is designed and permitted to treat 1.5 MGD. The facility has permit limitations of 20 mg/L biochemical oxygen demand and 20 mg/L total suspended solids. The City of Victoria is located further

downstream and is the largest city in the watershed, with a population of greater than 60,000. The city is served by two wastewater treatment plants. The Victoria Willow Street plant is designed and permitted to treat 2.5 MGD. The facility is a combination trickling filter/activated sludge facility, with permit limitations of 20 mg/L biochemical oxygen demand and 20 mg/L total suspended solids. The Victoria Regional plant is designed and permitted to treat 9.6 MGD. Its effluent limitations include 20 mg/L carbonaceous biochemical oxygen demand and 20 mg/L total suspended solids.

In addition to the municipal wastewater systems, there are industrial discharge permits issued in the segment. There are two power plants that serve the City of Victoria and surrounding area that use flow from the Guadalupe River as once-through cooling, discharging warm water back to the mainstem. The power plant located in the City of Victoria must monitor and record the daily maximum flow, temperature and rise in river temperature, along with river stage. The second facility is located upstream of the city and near the community of Nursery. Invista has discharge permits, in addition to injection wells and a wetlands area, that treat and dispose of different waste streams on their plant site.

There are two stations on Segment 1803 with sufficient historical data for trends analyses and review, the GBRA's monthly station near Cuero ("FM 766") and the GBRA station upstream of the City of Victoria near Nursery ("Nursery"). The Nursery station is only monitored quarterly and was established in late 1999. The USGS monitoring location at Hwy 59 downstream of Victoria has a very limited data set from the early to mid-90s. The data can be used for comparison to the upstream locations but not for trend analysis.

The median **flow** that was recorded during the historical monitoring from 2003 to 2012 at the FM 766 station in the upper portion of the segment was 952 cubic feet per second (cfs) and at Nursery, the median flow during sampling was 809 cfs. This difference in flow is not due to a loss in water but mostly due to difference in the size of the data sets. The **temperature** ranged from 9.4°C to 33.4°C, with a median temperature of 24.6 °C at the FM 766 station. The range of temperature measured at the Nursery station was similar, 11.1°C to 31.3°C, with a median temperature of 22.4°C. The median **pH** for the FM766 station was 8.1, and 8.0 at Nursery. Neither stations exceeded the stream standard range of 6.5 to 9.0. The **conductivity** at the FM766 station ranged from 266 umhos/cm to 691 umhos/cm, and ranged from 302 umhos/cm up to 688 umhos/cm, at the Nursery station, with medians of 540 umhos/cm and 569 umhos/cm respectively. Both stations show a significant decline in stream flow over the past 10 years (Figure 6 & Figure 7). The entire watershed was impacted by extreme drought conditions in 2011 and 2012. The pH at both stations appears to be increasing along with the changes in stream flow (Figure 8 & Figure 9).

There is very little change in nutrient concentrations between the two stations. The Nursery station never exceeded the screening concentration for **ammonia nitrogen** of 0.33 mg/L, and the FM 766 only exceeded the screening criteria one time in May of 2012 (0.36 mg/L). Overall ammonia nitrogen levels appear to be increasing at both stations, but this is most likely due to a change in

Figure 6.

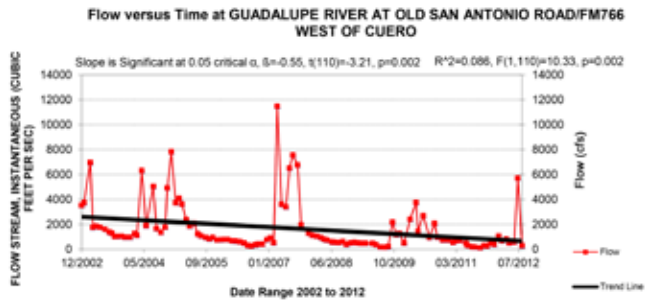
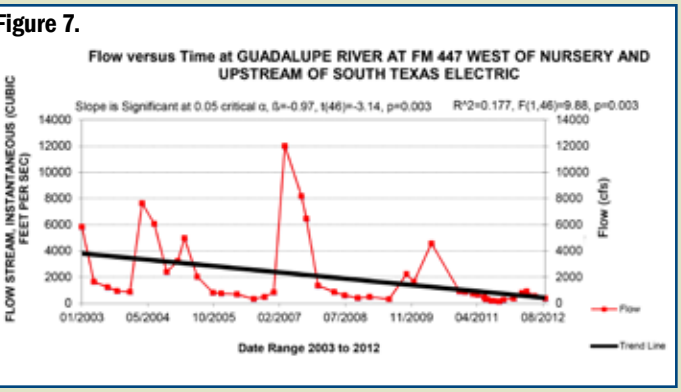


Figure 7.



the Limit of Quantification (LOQ) of the analysis from 0.02 mg/L to 0.10 mg/L in September of 2007. The median concentration for **nitrate nitrogen** was 0.78 mg/L at the FM 766 station and 0.73 mg/L at the Nursery station. Neither station exceeded the nitrate screening criteria of 1.95 mg/L during the assessment period. There is very little correlation of nitrate concentration with flow.

Total phosphorus has a positive correlation with higher flows at the FM 766 station as seen in Figure 10. The source of the total phosphorus is most likely the suspended material that is carried in during high runoff events. To support this likelihood, Figure 10 shows the statistical correlation between Total Phosphorus and flow at the FM 766 station and Figure 11 shows the correlation between TSS and flow at the FM 766 station. The suspended material is made up of sediment and organic material which contains phosphorus, in the form of inorganic phosphates that are added to the fields as fertilizer and organic phosphorus, bound in plant material and soil. The same relationships are seen at the Nursery station as well.

The median total phosphorus is 0.08 mg/L at both the FM 766 and the Nursery monitoring station. The median **total suspended solids** concentration at the FM 766 station was 29.1 mg/L, ranging from 6.0 mg/L to 2010 mg/L. The Nursery station had a median concentration of 35.4 mg/L, ranging from 8.3 mg/L to 948 mg/L.

An increase in stream flow has the opposite effect on dissolved constituents, diluting the natural background concentrations of chloride and sulfate. The median concentrations of **chloride** at the FM 766 station was 28.7 mg/L, ranging from 7.2 mg/L to 45.1 mg/L, and never exceeded the stream standard of 100 mg/L. The median concentration for **sulfate** at the FM 766 station was 31.8 mg/L, ranging from 12.6 mg/L to 45.8 mg/L and never exceeded the stream standard of 50 mg/L. The concentrations for these dissolved constituents were similar at the Nursery station.

The ***E. coli*** geometric mean at the FM766 station was 54 MPN/100 mL. The *E. coli* geometric mean at the Nursery station was slightly higher, at 115 MPN/100 mL.

Figure 8.

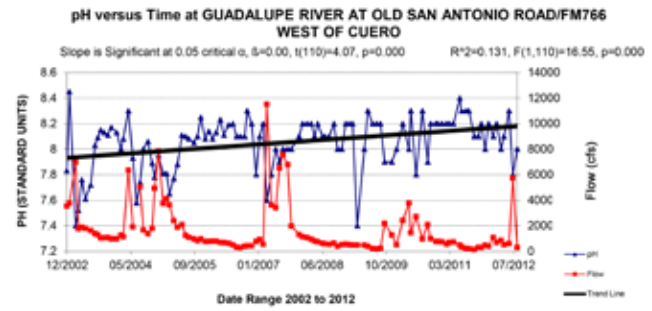


Figure 9.

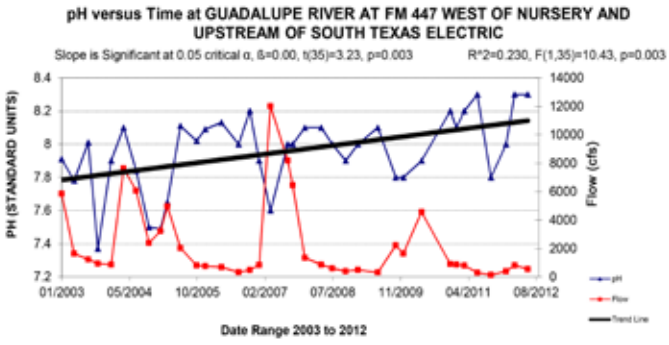


Figure 10.

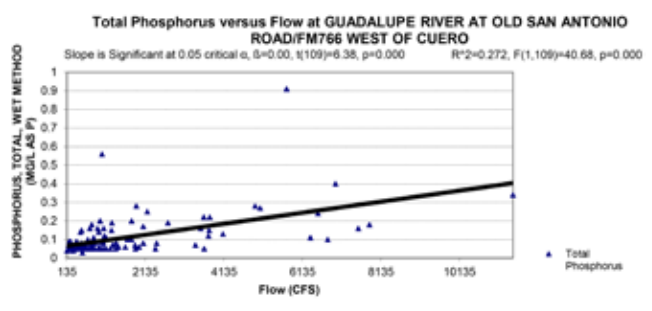
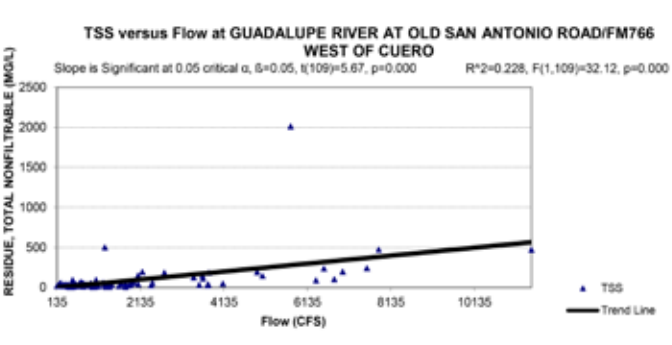


Figure 11.



Lower Guadalupe River Watershed

River Segments, Descriptions and Concerns

The difference between stations is most likely due to the differences in the size of the two data sets and the larger drainage area of the Nursery station and not due to a consistent source of bacteria. Median **chlorophyll *a*** concentrations at the FM 766 and Nursery monitoring stations were 2.9 ug/L and 3.1 ug/L respectively. The ranges differed slightly, with higher concentrations occurring at the FM 766 station. The station exceeded the 14.1 ug/L screening concentration for chlorophyll *a* 3 out of 111 measurements. The Nursery station did not exceed the screening concentration in the period of assessment. As with other constituents monitored the differences between stations are most likely due to the smaller size of the data set.

Stakeholder concerns in this segment include impacts of poultry operations, primarily in the Sandies and Elm Creek watersheds; impacts from bacterial and nutrient contributions from nonpoint source runoff, ranging from small cow/calf operations to confined animal feed lots; potential for spills and leaks from the many chemical pipelines that cross the river; impacts from in-situ uranium mining; long-term drought effects and, impacts of endocrine disrupting chemicals associated with agricultural

operations, such as synthetic growth hormones and antibiotics, as well as those that fall in the group of chemicals referred to as "personal care products", such as lotions, pain relievers and insect repellents. This area of the watershed has also seen the greatest development of oil and natural gas extraction from the Eagle Ford shale deposits in the area through hydraulic fracturing technology. Some stakeholders have expressed concern about potential impacts to ground and surface water due to the development of these resources. Hydraulic fracturing activities on the Eagle Ford shale began in 2010 and more data will need to be collected in order to assess any long term impacts. The bacterial impairments on Sandies and Elm Creeks were being investigated in the total maximum daily load project that finished data collection in 2008. This TMDL was never finalized due to stakeholder concerns about appropriate contact recreational use designation.

The potential for spills and leaks is difficult to address. TCEQ regional offices are responsible for responding to spills, as well as the Texas Parks and Wildlife Department's Spills and Kills Team. Specific to the Guadalupe Basin, GBRA sends letters each year to the fire and emergency management offices of each county, requesting that GBRA be notified if there is spill or leak response required in their county. Our field crew will respond in order to offer assistance in monitoring the stream, to provide historical water quality information as well as gather current information that can be relayed to operations and water users downstream of the spill and to keep the events inventory up to date for future reference. In-situ uranium mining is discussed in the section on the Coleto Creek watershed, Segment 1807.

Investigation into the potential for endocrine disrupting chemicals in the watershed is very costly and there are very few laboratories available to analyze for that large suite of compounds. As technology improves, the compounds are more easily detected, but there is little known as to what concentrations in surface water should raise a red flag. In the future, CRP and GBRA will discuss the need for these analyses and whether the funding for those analyses is available.

Photo by Connie Rothe

Lower Guadalupe River Issues and Concerns

Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Exceedence of Chlorophyll *a* screening criteria	Victoria Barge Canal	Wastewater discharges	Continued monitoring
Exceedence of nitrate nitrogen screening criteria			