

San Marcos River Watershed

River Segments, Descriptions and Concerns

Segment 1814 (Upper San Marcos River): Beginning at the San Marcos Springs that are fed by the Edwards Aquifer in Hays County, the five mile stretch of river continues through to the confluence with the Blanco River east of San Marcos. The headwaters of the San Marcos River are clear flowing and a constant temperature year long.

Segment 1808 (Lower San Marcos River): From the confluence of the San Marcos River with the Blanco River continuing about 75 miles until the point of confluence with the Guadalupe River outside the City of Gonzales. Includes the confluence with Plum Creek. The lower San Marcos River is a lazy, smooth flowing river during normal flow.

Drainage Area: 522 square miles

Streams and Rivers: Lower San Marcos River, Upper San Marcos River, Sink Creek, York Creek, Purgatory Creek, Sessom Creek

Aquifers: Edwards-Balcones Fault Zone, Carrizo-Wilcox

River Segments: 1814, 1808

Cities: San Marcos, Maxwell, Martindale, Fentress, Prairie Lea, Luling, Ottine, Gonzales

Counties: Hays, Guadalupe, Caldwell, Gonzales

EcoRegions: Edwards Plateau, Post Oak Savannah, Texas Blackland Prairies

Vegetation Cover: Pasture/Hay 27.0%, Evergreen Forest 12.8%, Shrublands 12.2%, Grass/Herbaceous 16.3%, Deciduous Forest 19.0%, Row Crops 8.6%

Climate: Average annual rainfall 33 inches
Average annual temperature January 40°, July 96°

Land Uses: Urban, industry, agricultural crops (corn, sorghum, hay, cotton, wheat, pecans), cattle and hog production, poultry production, oil production, and recreation

Water Body Uses: aquatic life, contact recreation, general use, fish consumption, and public water supply

Soils: Varies from thin limestone to black, waxy, chocolate, and grey loam

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



Photo by Glenn Longley

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San Marcos River Watershed - Upper San Marcos River

The **San Marcos River** is divided into two classified stream segments. Segment 1814, the **upper San Marcos River**, extends from the confluence of the San Marcos and Blanco Rivers, just outside the City of San Marcos, to the headwaters of the river in and around Spring Lake within the city. The segment is 4.5 miles long and is separated into four assessment units: the lower 1.5 miles; from that point to IH 35; from IH 35 to Spring Lake; and, the remaining portion of the segment to the headwaters. The lower San Marcos, Segment 1808, is described in the following section. GBRA has been monitoring the San Marcos River at IH 35 (station no. 12672) quarterly since 1998. The GBRA station is located in the upper half of the segment, above the discharge of the city's wastewater treatment plant but below the city's downtown and business district. TCEQ has one historical station less than one mile

downstream of the GBRA station that has data from 1991 to 1997. TCEQ monitored this station two to four times per year. There are other TCEQ stations in this segment but with very limited data sets. Beginning in 2012, TCEQ assumed the quarterly monitoring at the IH 35 station but GBRA continues to go to the station monthly to collect samples for total dissolved solids and conductivity.

The City of San Marcos operates a wastewater treatment plant that discharges to the upper San Marcos River (Segment 1814). The facility is permitted to discharge 9.0 million gallons per day, with permit limitations of 5 milligram per liter (mg/L) carbonaceous biochemical oxygen demand, 5 mg/L total suspended solids, 2 mg/L ammonia nitrogen and 1 mg/L total phosphorus. The facility also has a permit limit for bacteria. In addition to the City of San Marcos's Wastewater Treatment Plant, there is one other wastewater discharge to the segment. The Texas Parks and Wildlife Department's A.E. Wood Fish Hatchery is complying with a concentrated aquatic animal production general permit. The General Permit (TXG130005) requires measuring and reporting flow once daily; daily maximum total suspended solids of 90 mg/L monitored once per month; dissolved oxygen of 5.0 mg/L monitored once per week; carbonaceous oxygen demand of 250 pounds per day maximum reported once per month and an ammonia daily maximum of 2.0 mg/L.

The San Marcos River is home to the Texas Wild Rice and fountain darter, both endangered species. The constant temperature and consistent flow make the conditions conducive to these unique species as well as other native

and non-native, aquatic flora and fauna. The Texas Wild Rice was in danger of being eliminated by an invasive plant called *Cryptocoryne*, also known as water trumpet. Water trumpet is a fast-growing rooted aquatic plant. Not only did it pose a threat to the Texas Wild Rice, it was replacing the habitat that the fountain darter relies on. Several years ago, the US Fish and Wildlife Service, along with area volunteers, meticulously removed the plant

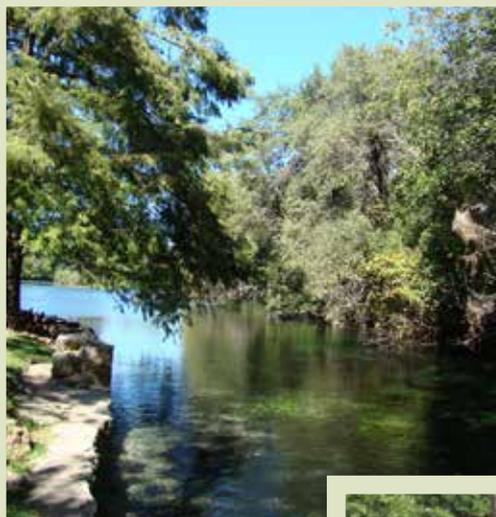


Photo by Elizabeth Aguilar



Stock Photo



Photo by LaMarriol Smith

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by hand. The plant is no longer out-competing the Wild Rice. In fact it is close to being removed entirely. The area where it was removed is checked a few times per year. It is quite a success story.

However, there are still quite a number of other exotic invasive plants introduced to the San Marcos River, like elephant ears, water hyacinth and alligator weed, that grow along the banks in San Marcos, and in the stream. There are very large colonies of alligator weed found upstream and downstream of Martindale, and hyacinth and elephant ears are found all the way to the coast. Volunteers from the San Marcos River Foundation have had great success after eight years of hyacinth removal from Spring Lake at Aquarena. They are now seeing open water on the slough, where there was once 100% coverage of the water by the floating hyacinth.

The cryptocoryne is an example of the damage that can come from introduction of non-native species, in this case, most likely introduced by people disposing of the contents of their aquariums. Other species that are associated with the improper disposal of aquarium populations include loricarids (algae eaters), hydrilla and the giant ram's horn snail.

The stream segment is heavily influenced by springs from the Edwards Aquifer, located in the hills above the city and in Spring Lake. The springs discharge a median flow of 169 cubic feet per second. The flow from these springs keeps the temperature in the upper San Marcos River stable, at a median temperature of 22.8°C, ranging from 19.2°C to 25.2°C. The small range of temperature change shows how stable the temperature of the upper San Marcos River is. However, Figure 1 shows that there has been a



Photo by Janet Thome

downward trend in flow over the last 10 years.

The 2012 Texas Water Quality Inventory lists Segment 1814 as impaired for **dissolved solids** (TDS). The TDS concentration used in the assessments were estimates based on the conductivity measured at the station. TDS is estimated by multiplying the conductivity by a factor of 0.65. The mean TDS

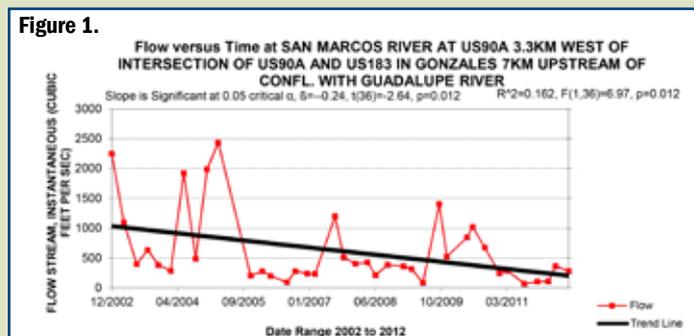
estimated by this method is 402 mg/L at the IH35 monitoring location, exceeding the stream standard of 400 mg/L established for this river segment. GBRA has collected both TDS and conductivity at this station for two years. The average concentration of TDS measured since GBRA began collecting samples (22 samples) for this parameter is 337 mg/L, which is below the stream standard.

The median concentration for **dissolved oxygen** is 10.4 mg/L, ranging from a minimum of 8.1 mg/L to a maximum of 13.0 mg/L. At no time in the period of record did the dissolved oxygen drop below the minimum dissolved oxygen standard (4.0 mg/L). The **specific conductance** ranged between 579 micromhos per centimeter (umhos/cm), and 833 umhos/cm with a median conductivity of 625 umhos/cm. The median **pH** was 7.7, ranging from 7.4 to 7.9 standard units, never falling outside the stream standard range of 6.5 to 9 standard pH units. The median concentrations for **chloride** and **sulfate** were 19.1 mg/L and 26.9 mg/L respectively. At no time did the concentration of these dissolved constituents exceed the stream standard of 50 mg/L.

Nutrients, nitrate nitrogen, ammonia nitrogen and total phosphorus, were analyzed at the GBRA. The median concentration for **nitrate nitrogen** was 1.18 mg/L, ranging from 0.29 mg/L to 1.69 mg/L. Statistical analysis of the data collected over the last 10 years shows a rising trend in nitrate nitrogen over time as seen in Figure 2.

The median **ammonia nitrogen** concentration was 0.05 mg/L, ranging from less than the Limit of Quantification (LOQ of 0.02 mg/L to 0.51 mg/L; exceeding the screening concentration of 0.33 mg/L one time. The median **total phosphorus** concentration was below the LOQ for the

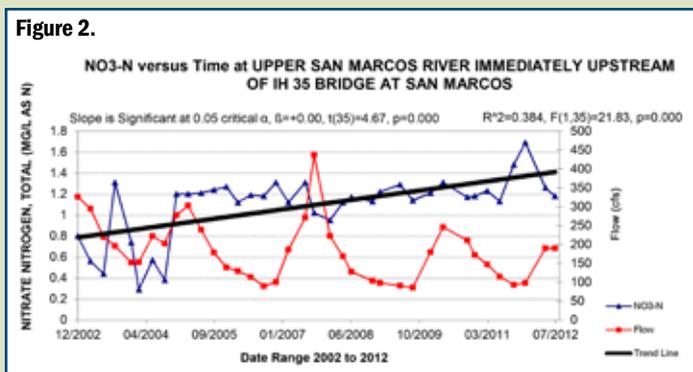
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Figure 2.



method and when total phosphorus was detected in a sample it did not exceed the screening concentration of 0.69 mg/L. The median **chlorophyll a** concentration was less than the LOQ and there was never a measured value above the screening concentration of 14.1 microgram per liter.

Segment 1814 is known for its contact recreational opportunities. The clear, cool spring water attracts recreationists. Flows from the springs create excellent conditions for snorkeling, tubing and canoeing. The San Marcos River is home to the Texas Water Safari, one of the world's largest canoe races. The race attracts over 200 canoeing teams each June. The stream standard for contact recreation is a geometric mean of 126 colonies per 100 milliliters. The geometric mean for **E. coli** at the GBRA IH 35 station is 51 MPN/100mL.

The **suspended solids** ranged from less than method detection (1.0 mg/L) to 6.3 mg/L, with a median of 2.8 mg/L. The sediment at the GBRA monitoring location in this segment was analyzed for organics analysis three times over the period of record, specifically looking for the constituents associated with urban environments, such as total petroleum hydrocarbons (TPHs). No TPHs were detected in any sample.

The historical data from the monitoring station was reviewed for trends, comparing constituents over time and flow regimes. Any statistically significant trends not yet noted in this section, either positive or negative, were not indicative of degrading water quality conditions.

San Marcos River Watershed - Lower San Marcos River

Segment 1808, the **lower San Marcos River**, extends from the confluence of the San Marcos and Guadalupe Rivers, just outside the City of Gonzales, upstream to the

confluence with the lower Blanco River near the City of San Marcos in Hays County. The segment is 75 miles long and is separated into four assessment units: the lower 18 miles; from the confluence with Mile Creek to the confluence with Plum Creek; from the confluence with Plum Creek to the Guadalupe County Road 239; and, the remaining portion of the segment to the confluence with the Blanco River. GBRA has been monitoring the San Marcos River at Luling (station no. 12626) monthly since 1987 and at the San Marcos at SH 90A (station no. 16578) quarterly since 1999. The GBRA Luling station is located in the upper half of the segment, in the third assessment unit. The GBRA 90A station is in the most downstream assessment unit, just upstream of the confluence with the Guadalupe River. TCEQ has one historical station located just downstream of the confluence with the Blanco River in Hays County (station no. 12628).

The City of San Marcos operates a wastewater treatment plant that discharges to the upper San Marcos River (Segment 1814). The facility is permitted to discharge 9.0 million gallons per day, with permit limitations of 5 mg/L carbonaceous biochemical oxygen demand, 5 mg/L total suspended solids, 2 mg/L ammonia nitrogen and 1 mg/L total phosphorus. The facility also has a permit limit for bacteria. In addition to the City of San Marcos's Wastewater Treatment Plant (WWTP) located in the upper segment, there is one other wastewater discharge to the segment. The City of Luling's south plant discharges to the San Marcos River and is permitted to discharge up to 500,000 gallons per day. The facility is permitted to discharge total suspended solids of 20 milligrams per liter (mg/L), 20 mg/L carbonaceous biochemical oxygen demand, and ammonia-nitrogen of 2.0 mg/L.

The lower San Marcos River has two major tributaries that contribute flow and loading to the stream, the Blanco River and Plum Creek. The lower segment does not have the endangered species that are found in the upper segment. The median instantaneous **flow** of the uppermost station in Segment 1808 was 272 cubic feet per second (cfs) which is made up of the combined flow of the San Marcos River and the Blanco River. As evidence of the severe drought that has plagued the area for 4 of the last 5 years, Figure 3 shows the decline in average instantaneous flow at

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the TCEQ station. The same trend persists downstream at the station at the end of the San Marcos River (Hwy 90A) as seen in Figure 4.

There are very little contributions of flow downstream of the Blanco River to Luling so the concentrations of dissolved constituents remain relatively unchanged. The median concentrations for **conductivity**, **chloride** and **sulfate** are 596 umhos/cm, 20 mg/L and 26 mg/L respectively at the TCEQ station just downstream of the Blanco River. The GBRA Luling station had median concentrations of conductivity, chloride and sulfate of 551 umhos/cm, 25.2 mg/L and 30.8 mg/L respectively.

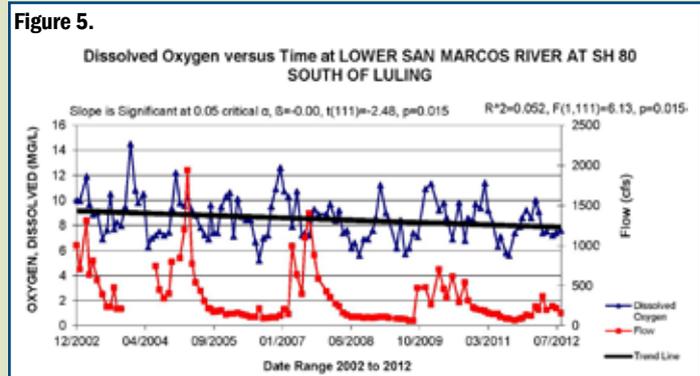
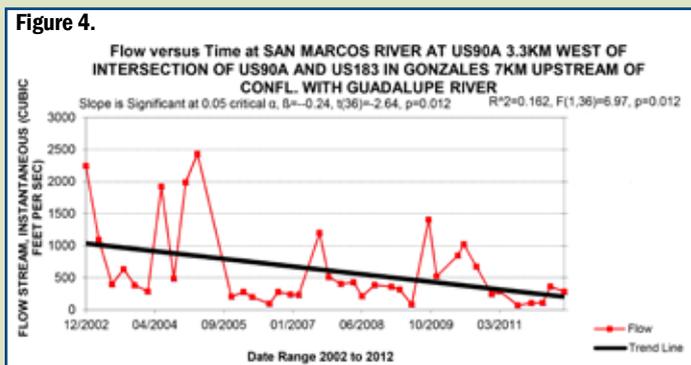
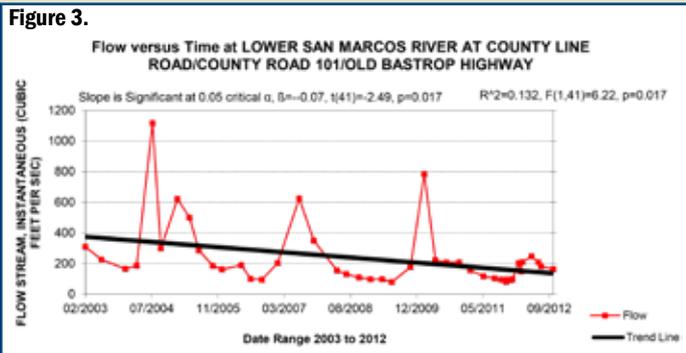
Plum Creek enters the lower San Marcos River just downstream of the City of Luling. The median instantaneous flow at the GBRA station at SH 90A was 608 cfs. Plum Creek's impacts on the water quality of the San Marcos River can be seen in the rise in dissolved constituents. The GBRA station at SH 90A had median concentrations of 611 umhos/cm conductivity, 39.6 mg/L chloride, and 35.5 mg/L sulfate. At the GBRA SH 90A station downstream of the confluence with Plum Creek, the stream standard for chlorides of 50 mg/L was exceeded 15% of

the time, ranging from 11.6 to 115 mg/L which is lower by 5% as compared to the trend analyses done in 2008. The stream exceeded the standard for sulfate which is also 50 mg/L twice in the period of record. Plum Creek contributes nutrients and bacteria to the San Marcos River as well. A more detailed discussion of the water quality of the Plum Creek can be found in the section on that creek.

The 2012 Texas Water Quality Inventory has no impairments or concerns listed for Segment 1808. The median concentration for **dissolved oxygen** is 9.2 mg/L, ranging from a minimum of 7.4 mg/L to a maximum of 12.1 mg/L at the TCEQ station below the confluence with the Blanco River. At the GBRA Luling station, the median concentration for dissolved oxygen was slightly lower at 8.5 mg/L, ranging from a minimum of 5.2 mg/L to a maximum of 14.5 mg/L. Statistical analyses of the dissolved oxygen collected over the last 10 years (2003 – 2012) shows a slight downward trend in dissolved oxygen at the Luling station (Figure 5).

The median concentration for dissolved oxygen was 8.5 mg/L, ranging from a minimum of 5.6 mg/L to a maximum of 11.3 mg/L at the GBRA 90A station. At no time in the data sets of all three monitoring locations did the dissolved oxygen drop below the minimum dissolved oxygen standard (3.0 mg/L). The median pH values at the three stations were 7.9, 7.9 and 8.0, upstream to downstream, and ranged from a low of 7.3 to a high of 8.6.

The moderating effect of the San Marcos Springs on water temperature in the upper segment is lost as the stream flows downstream through the watershed. The median **temperature** of the TCEQ station on the San Marcos River, downstream of the Blanco River was 22.8°C,



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ranging from 13.3°C to 26.4°C. The median temperature at the GBRA Luling station was 24°C, ranging from 10.3°C to 31.2°C, and the median temperature at the GBRA 90A station was 23.3°C, ranging from 11.7°C to 30.7°C.

Nitrate nitrogen, ammonia nitrogen and total phosphorus, were analyzed at the GBRA and TCEQ locations. At the TCEQ station in the upper part of the segment, the median concentrations for **nitrate nitrogen** was 1.61 mg/L, ranging from 0.66 mg/L to 2.2 mg/L, falling outside of the screening concentration of 1.95 mg/L three times. Moving downstream to the GBRA Luling station, the median concentration was 1.03 mg/L, ranging from 0.08 mg/L to 1.84 mg/L. In the lower portion of the segment, median concentrations for nitrate nitrogen was 0.9 mg/L, ranging from 0.38 mg/L to 1.58 mg/L. There is an upward trend in nitrate concentration over the last 10 years at the TCEQ station at Old Bastrop Road as seen in Figure 6. The flow from the Blanco River has dropped due to the severe drought. This flow had slightly diluted the nitrates contributed from the San Marcos Springs.

The median **ammonia nitrogen** concentration, at both GBRA stations, was 0.1 mg/L, ranging from the LOQ to 0.28 mg/L; never exceeding the screening concentration of 0.33 mg/L. The LOQ used for analyses was raised from 0.02 mg/L to 0.1 mg/L in 2010 which accounts for any upward trend in ammonia concentrations. Median **total phosphorus** concentrations were 0.06 mg/L, 0.05 mg/L and 0.08 mg/L, from upstream to downstream respectively, and ranged from below the LOQ for the method to 0.83 mg/L. Concentration of total phosphorus exceeded the screening concentration of 0.69 mg/L one time at the SH 90A station which can be attributed to the flood flows at that time.

Segment 1808 is known for its contact recreational opportunities. Flows in the river create excellent conditions for snorkeling, tubing and canoeing. The San Marcos River is home to the Texas Water Safari, one of the world's largest canoe races, attracting over 200 canoeing teams each June. Additionally, it was in this segment that the Texas Parks and Wildlife Department opened their first Paddling Trail. The Luling Paddling Trail begins at the river crossing at SH 90 west of Luling and ends at the Zedler Mill in the city. The stream standard for contact recreation is a geometric mean of 126 colonies/100 mL. Over the last ten years, the geometric mean for **E. coli** is 107 MPN/100 mL at the TCEQ station at Old Bastrop Road, 72 MPN/100 mL at the station at Luling and 73 MPN/100 mL at SH 90A.

A review of the data for **suspended solids** at each location shows no significant trend over time. Looking at the segment as a whole, the median concentration of

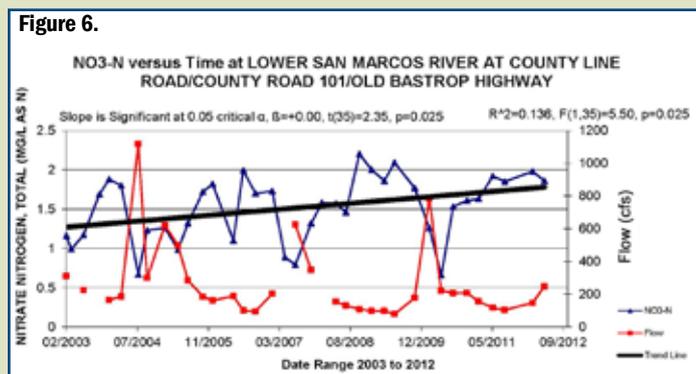


Photo by Janet Thome

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suspended solids increases as you move downstream, beginning at 7 mg/L at the uppermost station, going to 16 mg/L at the GBRA Luling station and then to 28.7 mg/L at the downstream station at SH 90A. The land use in the watershed that drains to the segment consists of mostly large farms and ranch land. These family farms are being sold and subdivided, so the region will likely begin to see more roof tops in the watershed than cattle, and those cattle in much more concentrated areas. With urban sprawl comes more impervious cover, more runoff and more pollutant loading.

The median **chlorophyll a** concentration is less than the LOQ and there was never a measured value above the screening concentration of 14.1 microgram per liter. 🌿

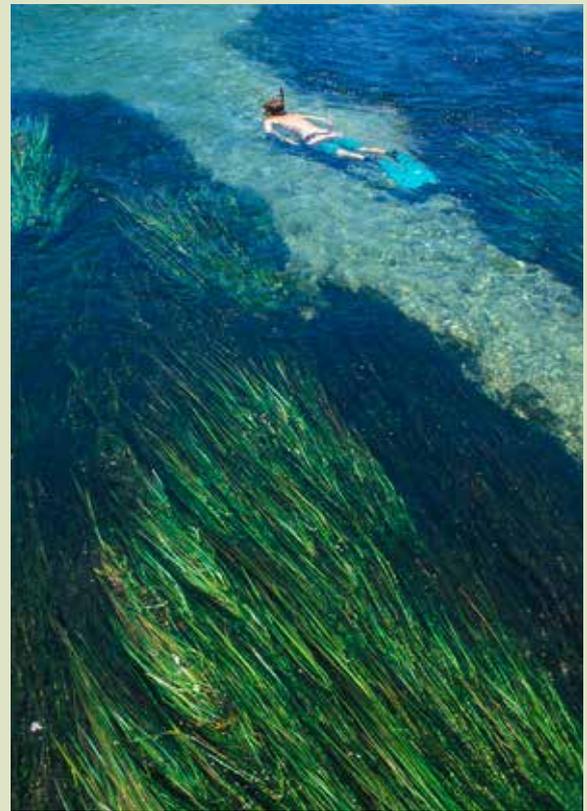


Photo by Earl Nottingham, TPWD

San Marcos River Issues and Concerns			
Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Reduction in Spring Flow	Upper San Marcos River	Impacts to habitat for endangered species	Minimization and mitigation measures recommended in the Habitat Conservation Plan developed as a result of the Edwards Aquifer Recovery Implementation Program
Exceedence of Total Dissolved Solids Water Quality Standard	Upper San Marcos River		Watershed protection plan underway; GBRA collecting TDS data to confirm impairment