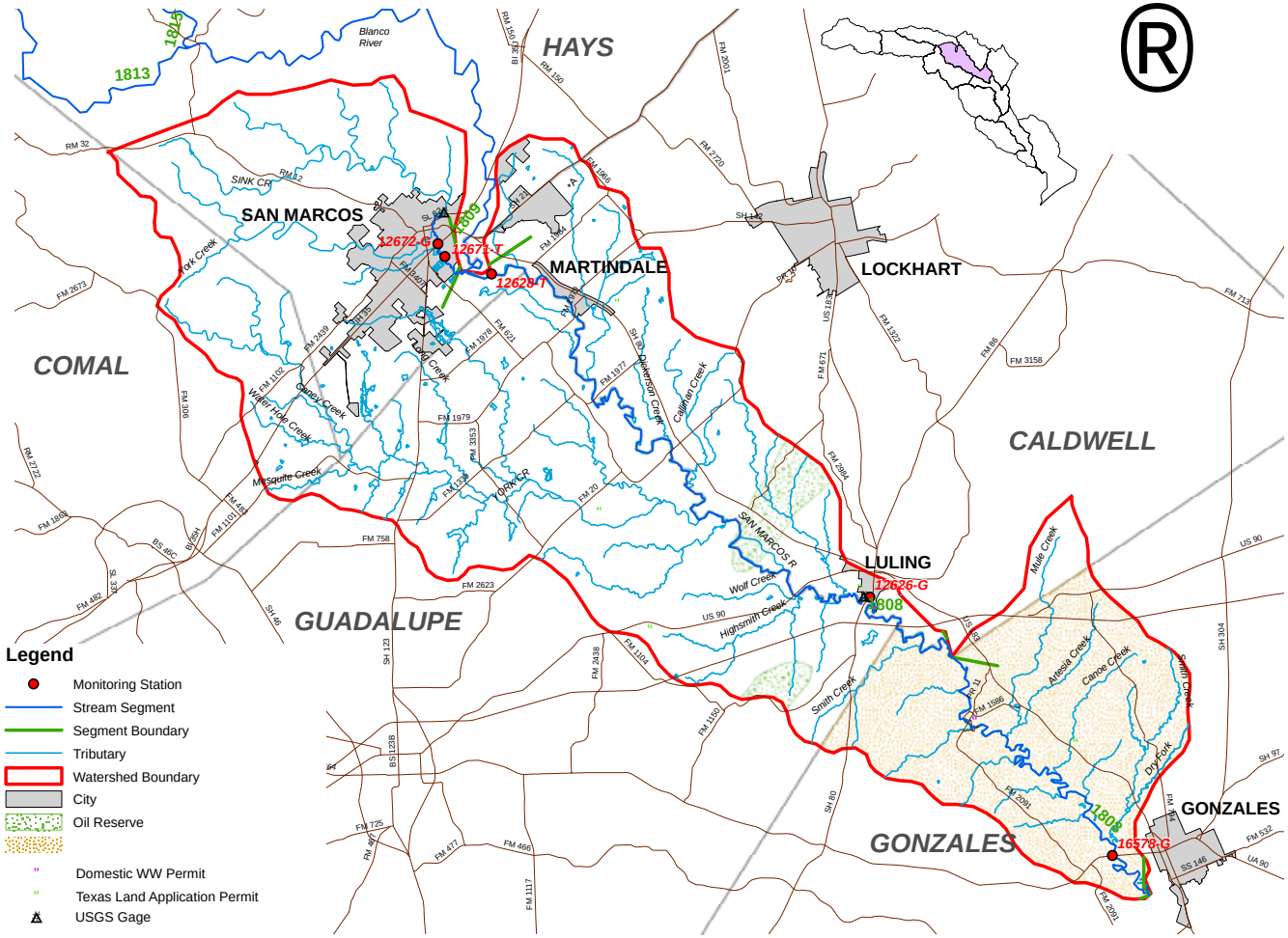
San Marcos River Watershed



Monitoring Stations – San Marcos River

12672-G	San Marcos River at IH 35 in San Marcos
12671-T	San Marcos River 0.7 m downstream of IH 35 in San Marcos
12628-T	San Marcos River downstream of confluence with Blanco River
12626-G	San Marcos River at Luling
16578-G	San Marcos River at SH 90A, near Gonzales

Sampling sites are labeled in red followed by the letter G (GBRA), T (TCEQ), U (UGRA) or W (Wimberley) indicating who is the monitoring entity.

San Marcos River Watershed

Drainage Area: 522 square miles

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

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

Vegetation Cover:

Pasture/Hay- 27.0%	Evergreen Forest - 12.8%
Grass/Herbaceous - 16.3%	Shrublands - 12.2%
Deciduous Forest - 19.0%	Row Crops - 8.6%

Climate:

Average annual rainfall: 33 inches

Average annual temperature: January 40° July 96°

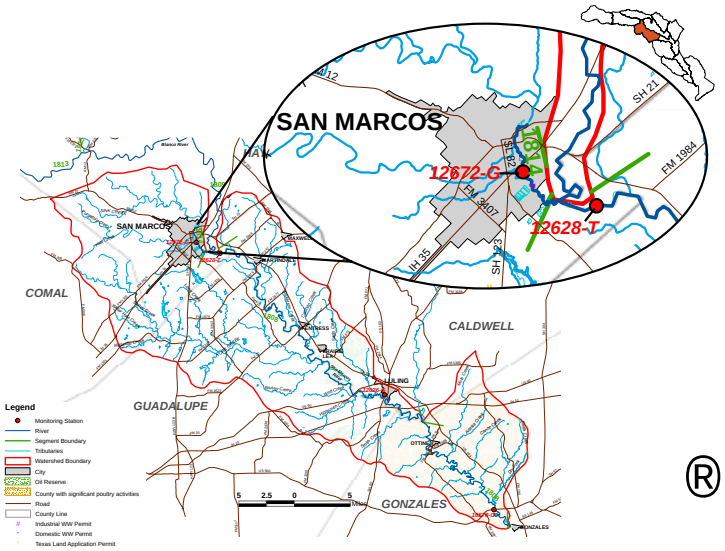
Land Uses: Urban, Industry, Agricultural Crops (corn, sorghum, hay, cotton, wheat, pecans), Cattle & Hog Production, Poultry Production, Oil Production, and Recreation

Water Body Uses: Aquatic Life Use, Contact Recreation Use, General Use, Fish Consumption Use, and Public Water Supply Use

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

Permitted Wastewater Treatment Facilities:

Domestic: 4, Land Application: 2, Industrial: 0



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 (site no. 12672) quarterly since 1998. The GBRA site 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 site less than one mile downstream of the GBRA site that has data from 1991 to 1997. TCEQ monitored this site two to four times per year. There are other TCEQ sites in this segment but with very limited data sets.

Stakeholder Concerns

The stakeholders, primarily the San Marcos River Foundation, have asked that TCEQ locate a monitoring site downstream of the city's discharge. The closest monitoring station downstream of the discharge is at site no. 12629 (approximately 0.5 miles) but only four sampling events were conducted in 1999-2000. When asked at a basin steering committee meeting, representatives of the TCEQ Region 11 office explained the difficulty of getting public access for a monitoring site in close proximity and downstream of the wastewater treatment plant. The San Marcos River Foundation offered to assist in locating a landowner that could grant public access to the regional Surface Water Quality Monitoring team. TCEQ has a quarterly monitoring site that is 3 miles downstream of the city's discharge. The 44 data points span 1990 to 2007. Data from this site will be discussed in the next section on segment 1808.

Wastewater Contributions

In addition to the city of San Marcos's Wastewater Treatment Plant (WWTP), there is one other wastewater discharge to the segment. The Texas Parks and Wildlife Department's A.E. Wood Fish Hatchery manages 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 milligrams per liter (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 city of San Marcos wastewater plant is permitted to discharge 9 million gallons per day. After a lengthy court battle, the San Marcos River Foundation was successful in getting the city's effluent treated to a higher quality. The effluent must meet high quality standards of 5 mg/L biochemical oxygen demand, 5 mg/L total suspended solids, 2 mg/L ammonia-nitrogen and 1 mg/L total phosphorus. The wastewater plant utilizes ultraviolet light for disinfection and is allowed to discharge up to 200 organisms per 100 milliliter of fecal coliform bacteria. The wastewater plant has received authorization from the TCEQ to reuse the effluent for irrigation on golf courses and dust control, when possible. The Gary Job Corps Center (GJCC), located along this segment, no longer discharges treated wastewater to the San Marcos River. The GJCC discontinued its treatment of wastewater in 2000 and sends its raw wastewater to the San Marcos WWTP.

Endangered Species

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 is in danger of being out-competed by an invasive non-native aquatic plant, cryptocoryne, also known as water trumpet. Water trumpet is a fast-growing rooted aquatic plant with no natural predators. In addition to the damage it poses to Texas Wild Rice, water trumpet is replacing the habitat that the fountain darter relies on. Removal or control of this invasive plant is difficult because it is found commingled with the wild rice. Gentle removal techniques, that are very labor intensive, have been employed so as to not uproot or damage the wild rice. 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 loriicarids (algae eaters), hydrilla and the giant ram's horn snail.

Water Quality

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 164 cubic feet per second. The flow from these springs keeps the temperature in the upper San Marcos River stable, at a median temperature of 22.8ºC, ranging from 19.2 ºC to 25.2ºC. Figure 1 shows how stable the temperature of the upper San Marcos River is. The exception is during times of

prolonged drought as seen in 2006 where, in the data set collected by GBRA, the site experienced its historical maximum temperature and minimum flow. The inverse relationship between temperature and flow would not be unusual or alarming at most sites, but with the existence of the endangered species that live in this segment and rely on the consistency of temperature and flow, maintaining the flow from San Marcos Springs is critical to maintaining their habitat.

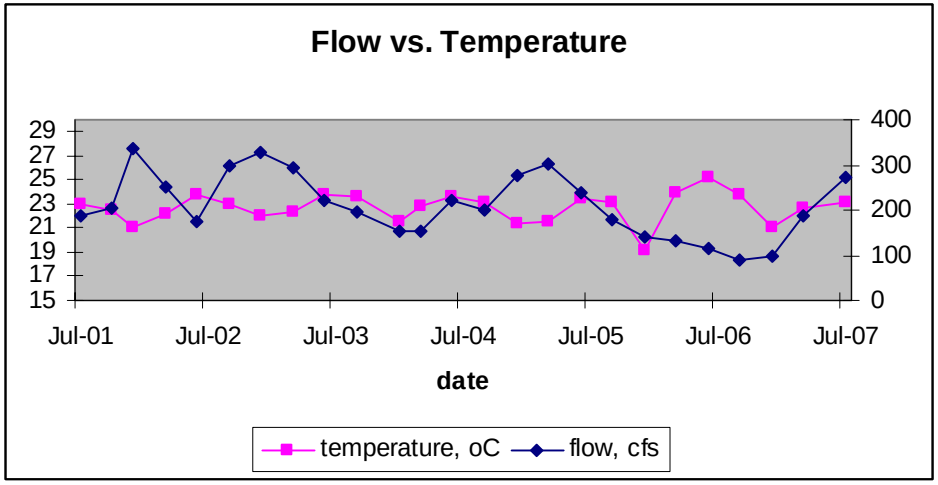


Figure 1. Flow and temperature collected by GBRA at the IH 35 site on the upper San Marcos River (12672).

The 2008 draft Texas Water Quality Inventory has no impairments or concerns listed for Segment 1814. The water quality at the GBRA and TCEQ monitoring sites is very good. The median concentration for dissolved oxygen is 9.35 mg/L, ranging from a minimum of 7.0 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 263 and 569 micromhos per centimeter, with a median conductivity of 425 micromhos per centimeter. The median pH was 7.67, ranging from 6.9 to 8.06 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 19.2 and 25.3 mg/L respectively. At no time did the concentration of these dissolved constituents exceed the stream standard of 50 mg/L.

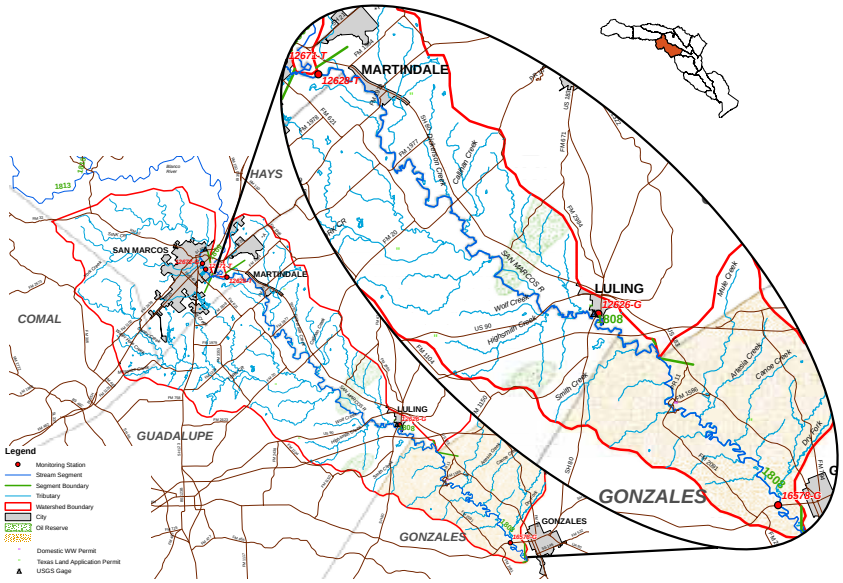
Nitrate nitrogen, ammonia nitrogen and total phosphorus were analyzed at the GBRA and TCEQ locations. Over the period of record, nitrate nitrogen was reported under three storet codes, as nitrate nitrogen and in combination with nitrite nitrogen. The median concentrations for all three methods were 1.18, 1.13, and 1.23 mg/L, ranging from 0.29 to 2.26 mg/L. Regardless of storet code citing, only two samples exceeded the nitrate nitrogen screening criteria of 1.95 mg/L. The median ammonia nitrogen concentration, combining the GBRA and TCEQ sites, was 0.03 mg/L, ranging from 0.03 to 0.14 mg/L; never exceeding the screening concentration of 0.33 mg/L. The median total phosphorus concentration was below the limit of quantification for the 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 is less than detection and there was never a measured value above the screening concentration of 14.1 microgram per liter.

Water and Land Uses

Segment 1814 is known for its contact recreational opportunities. The clear, cool spring water attracts recreationists. The 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 150 canoeing teams each June. The stream standard for contact recreation is a geometric mean of 126 organisms per 100 milliliters, and a single sample concentration of 394 organisms per 100 milliliters. The geometric mean for ***E. coli*** at the GBRA IH 35 site is 34 organisms per 100 milliliters. In the period of record no sample collected exceeded the single sample *E. coli* standard of 394 organisms per 100 milliliters. The TCEQ monitored their site for fecal coliform bacteria before a contact recreation standard was established for *E. coli*. The geometric mean for fecal coliform bacteria at the TCEQ site was 39 organisms per 100 milliliter (contact recreation standard for fecal coliform is a geometric mean of 200 organisms per 100 milliliters), with only one sample exceeding the single sample standard of 400 organisms per 100 milliliters.

The land use in the segment consists of a highly urbanized area above the two monitoring locations and urban area to large tracts of farmland below the two monitoring sites. Many of these family farms are being sold and subdivided, so you are beginning to see more roof tops in the watershed than cows. The impervious cover created by these urbanized areas and subdivisions, i.e. streets, rooftops and parking lots, can be a source of nonpoint source pollution. Because of the impervious cover, the pollutants that might be captured and bio-degraded by soils, are instead readily washed over cement and pavement, directly into the surface water bodies. The suspended solids at the two monitoring sites ranged from 1 to 32 mg/L, with a median of 3 mg/L. The sediment at the GBRA monitoring location in this segment is slated for organics analysis in 2008-09, specifically looking for the constituents associated with urban environments, such as polyaromatic hydrocarbons.

The historical data from the two monitoring sites was reviewed for trends, comparing constituents over time and flow regimes. Statistically significant trends that were noted, either positive or negative, were not indicative of degrading water quality conditions.



The San Marcos River is divided into two classified stream segments. 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. The upper San Marcos, segment 1814, is described in the preceding section. GBRA has been monitoring the San Marcos River at Luling (site no. 12626) monthly since 1987 and at the San Marcos at SH 90A (site no. 16578) quarterly since 1999. The GBRA Luling site is located in the upper half of the segment, in the third assessment unit. The GBRA 90A site is in the lowest most assessment unit, just upstream of the confluence with the Guadalupe River. TCEQ has one historical site located just downstream of the confluence with the Blanco River in Hays County (site no. 12628). TCEQ monitors this site two to four times per year. There are other TCEQ sites in this segment but with very limited data sets. The statistical review of the data covered the three historical sites described above.

Stakeholder Concerns

At a Guadalupe River Basin Steering Committee meeting the stakeholders, primarily the San Marcos River Foundation, asked that TCEQ locate a monitoring site downstream of the city of San Marcos' discharge. Representatives from the TCEQ Region 11 office explained the difficulty of getting public access for a monitoring site in close proximity and downstream of the wastewater treatment plant. The San Marcos River Foundation offered to assist in locating a landowner that could grant public access to the regional Surface Water Quality Monitoring team. The TCEQ's monitoring site in segment 1808 is 3 miles downstream of the city's discharge.

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 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 226 cubic feet per second (cfs) which is made up of the combined flow of the San Marcos River and the Blanco River as measured at the USGS gages. There are very little contributions of flow downstream of the Blanco to Luling so the concentrations of dissolved constituents remain relatively unchanged. The median concentrations for conductivity, chloride and sulfate are 553 micromhos per centimeter, 18.5 milligrams per liter and 26 milligrams per liter respectively at the TCEQ site just downstream of the Blanco River. The GBRA Luling site had median concentrations of conductivity, chloride and sulfate of 552 micromhos per centimeter, 24.6 milligrams per liter and 28.7 milligrams per liter respectively.

Moving downstream, comparing the GBRA site at 90A to the GBRA Luling site, there is evidence of impacts to water quality by Plum Creek. The median instantaneous flow at the GBRA site at SH 90A was 415 cfs, made up of the combined flows of the San Marcos River and Plum Creek, increasing the median flow upstream at the Luling site. The city of Luling's wastewater treatment plant contributes less than 1.5 cfs to the San Marcos River. The GBRA 90A site had median concentrations of conductivity, chloride and sulfate of 610 micromhos per centimeter, 43.4 milligrams per liter and 35.1 milligrams per liter respectively. The GBRA Luling site exceeded the stream standards for both dissolved constituents only once as well (Cl - 56.5 mg/L and SO4 - 63.8 mg/L). But, at the GBRA 90A site downstream of the confluence with Plum Creek, the standard for chlorides was exceeded 20% of the time, ranging from 18.4 to 135 mg/L. The stream exceeded the standard for sulfate two times 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 can be found in the section on Plum Creek.

Looking at each site individually and reviewing the data for trends, the conductivity shows a positive trend over time at the uppermost site as well as the GBRA Luling site (figures 1 and 2). Although there was statistically significant data for more than one dissolved constituent that explained the slight rise over time in the conductivity at the uppermost site, the rise in conductivity at the Luling site is most likely due to a rise in sulfate (figure 3).

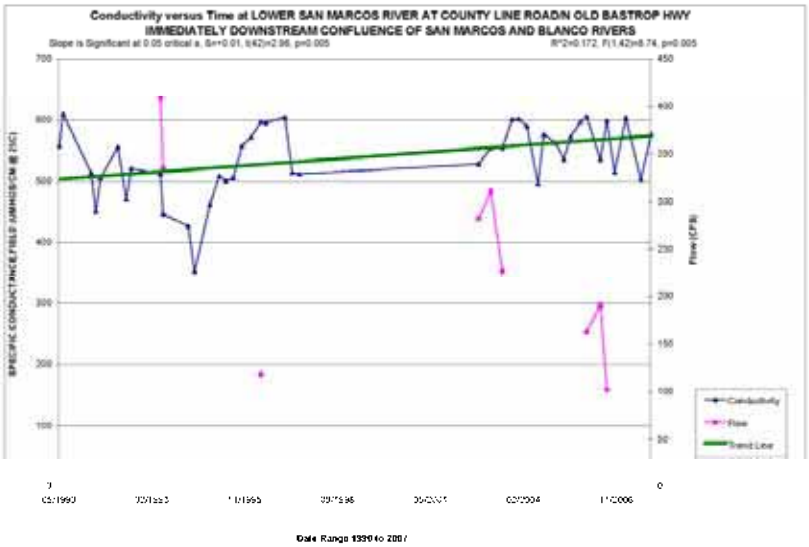


Figure 1. Rise in conductivity at the uppermost monitoring location on the lower San Marcos River (12628).

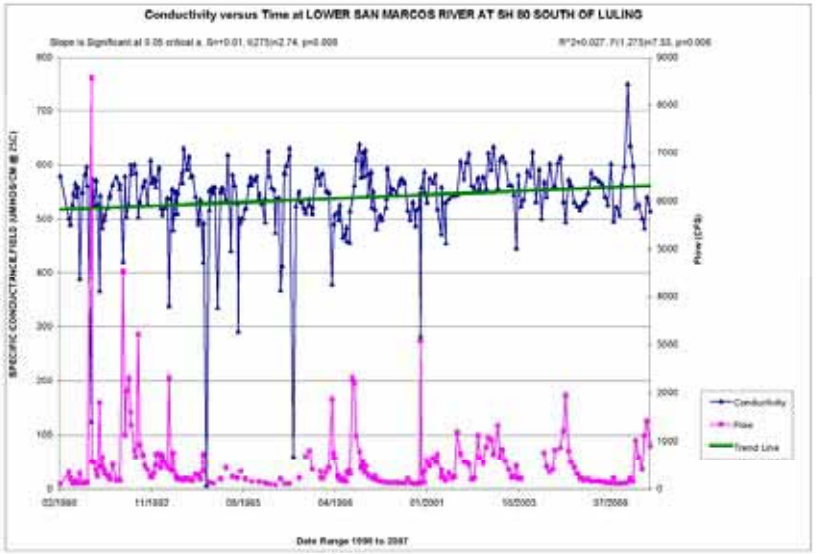


Figure 2. Rise in conductivity over time at the GBRA Luling site on the San Marcos River (12626).

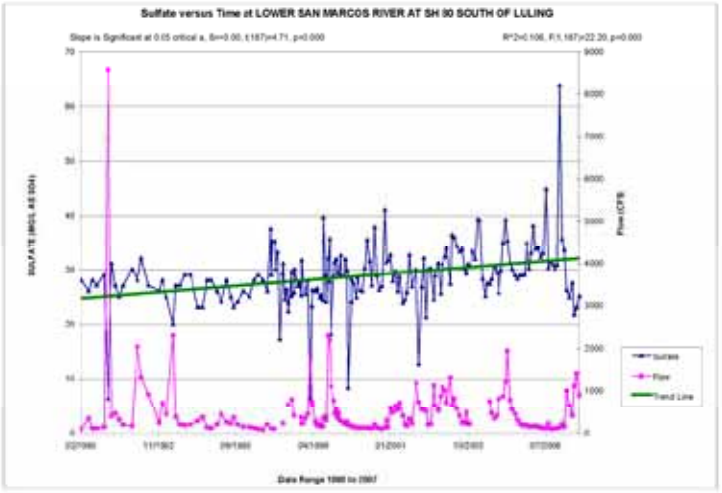


Figure 3. Rise in sulfate concentration over time at the San Marcos River at Luling (12626).

The 2008 draft Texas Water Quality Inventory has no impairments or concerns listed for Segment 1808. The median concentration for dissolved oxygen is 9.0 mg/L, ranging from a minimum of 7.4 mg/L to a maximum of 10.8 mg/L at the TCEQ site below the confluence with the Blanco River. At the GBRA Luling site, the median concentration for dissolved oxygen was slightly lower at 7.99 mg/L, ranging from a minimum of 5.2 mg/L to a maximum of 21.0 mg/L. The median concentration for dissolved oxygen was 8.81 mg/L, ranging from a minimum of 5.8 mg/L to a maximum of 11.7 mg/L at the GBRA 90A site. 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 sites were 7.8, 7.8 and 7.99, upstream to downstream, and ranged from a low of 7.13 to a high of 9.34, falling outside the stream standard range of 6.5 to 9 standard pH units one time at the GBRA Luling site.

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 site downstream of the Blanco was 23°C, ranging from 17.6 °C to 27.7°C. The median temperature at the GBRA Luling site was 22.8°C, ranging from 8.4 °C to 31.5°C, and the median temperature at the GBRA 90A site was 22.2°C, ranging from 12.1 °C to 30.3°C.

Nitrate nitrogen, ammonia nitrogen and total phosphorus, were analyzed at the GBRA and TCEQ locations. Over the period of record, nitrate nitrogen was reported under three storet codes, as nitrate nitrogen and in combination with nitrite nitrogen. At the TCEQ site in the upper part of the segment, the median concentrations for all three methods were 0.9, 1.1, and 1.28 mg/L, ranging from 0.42 to 1.88 mg/L. Moving downstream to the GBRA Luling site, the median concentrations for all three methods were 0.71, 1.06, and 1.25 mg/L, ranging from 0.18 to 8.51 mg/L, falling outside of the screening concentration of 1.95 mg/L three times. In the lower portion of the segment, the median concentrations for all three methods were 0.66, 1.02, and 1.03 mg/L, ranging from 0.38 to 1.83 mg/L. The median ammonia nitrogen concentration, at both GBRA sites, was 0.04 mg/L,

ranging from less than detection to 0.30 mg/L; never exceeding the screening concentration of 0.33 mg/L. The median concentration for ammonia nitrogen of 0.07 mg/L at the TCEQ site was slightly higher than the downstream stations, and exceeded the screening concentration of 0.33 mg/L one time. The difference in the median concentrations may be from contributions from the wastewater treatment plant discharge 3 miles upstream, though the impact is not significant enough to cause the stream to exceed the screening concentration of 0.33 mg/L more than one time. The median total phosphorus concentrations were 0.06, 0.09 and 0.10 mg/L, from upstream to downstream respectively, and ranged from below the limit of quantification for the method to 1.38 mg/L. The concentration of total phosphorus exceeded the screening concentration of 0.69 mg/L five times at the TCEQ site. Again, the source of the nutrient may be coming from the wastewater discharge that is within 3 miles of the sampling site. Other possible sources of the nutrients can be from nonpoint sources such as stormwater off of fertilized fields.

A review of the nutrient data for trends over time at the TCEQ site show statistically significant downward trends in total kjeldahl nitrogen (TKN) and total phosphorus (figures 4 and 5). TKN is a combination of organic nitrogen and ammonia nitrogen. TKN and total phosphorus are both nutrients that are constituents of wastewater effluent. The downward trend in these nutrients could be a result of the improved level of wastewater treatment by the city of San Marcos plant or it could just be the result of a change in detection level for each method in 1997.

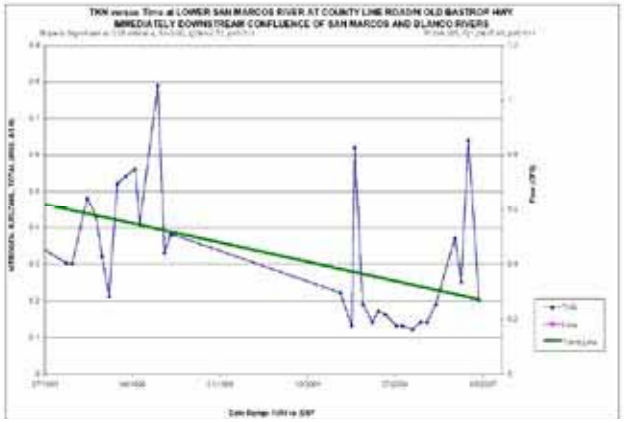


Figure 4. Total Kjeldahl Nitrogen versus time at the San Marcos River at Old Bastrop Highway (12628) (No flow data was available for this data set).

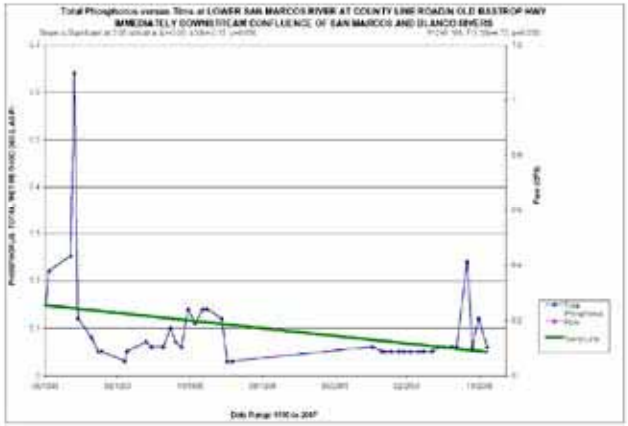


Figure 5. Total Phosphorus versus time at the San Marcos River at Old Bastrop Highway (12628) (No flow data was available for this data set).

Segment 1808 is known for its contact recreational opportunities. The 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. The race attracts over 150 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 organisms per 100 milliliters, and a single sample concentration of 394 organisms per 100 milliliters. The TCEQ monitored for fecal coliform bacteria at their site before a contact recreation standard was established for ***E. coli***. The geometric mean for fecal coliform in the small data set was 89 organisms per 100 milliliters (contact recreation standard for fecal coliform is a geometric mean of 200 organisms per 100 milliliters), and the geometric mean for *E. coli* was 101 organisms per 100 milliliter after the parameter was changed. Two samples exceeded the single sample standard of 400 organisms per 100 milliliters for fecal coliforms and exceeded the single sample standard for *E. coli* three times. At the GBRA Luling site, the geometric mean for *E. coli* was 55 organisms per 100 milliliters, exceeding the single sample standard 8 times. At the lower portion of the segment, the geometric mean for *E. coli* was 98 organisms per 100 milliliters, exceeding the single sample standard four times, all of which were during high flow events. The higher concentration of bacteria at high flows is not unusual because storm water brings in bacteria and for a period of time after the storm event, the high flows keep solids in suspension and shade ultraviolet light from the sun from penetrating the water and killing the bacteria.

The land use in watershed that drains to the segment consists of mostly large farms and ranch land. The contributions of bacteria from agricultural activities that have been recognized in other parts of the state as being a significant source of the load in impaired streams are not seen in segment 1808 but this may be because the median flow in the San Marcos River can assimilate those contributions. But, as with other areas in the basin as well as the state, these family farms are being sold and subdivided, so you will 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.

A review of the data for suspended solids at each location shows no significant trend over time, or, if there was a slight trend, it was negative, i.e. a reduction in total suspended solids, over time. Looking at the segment as a whole, the median concentration of suspended solids increases as you move downstream, beginning at 8 mg/L at the uppermost site, going to 17.2 mg/L at the GBRA Luling site and then to 31.6 mg/L at the downstream site at SH 90A.

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