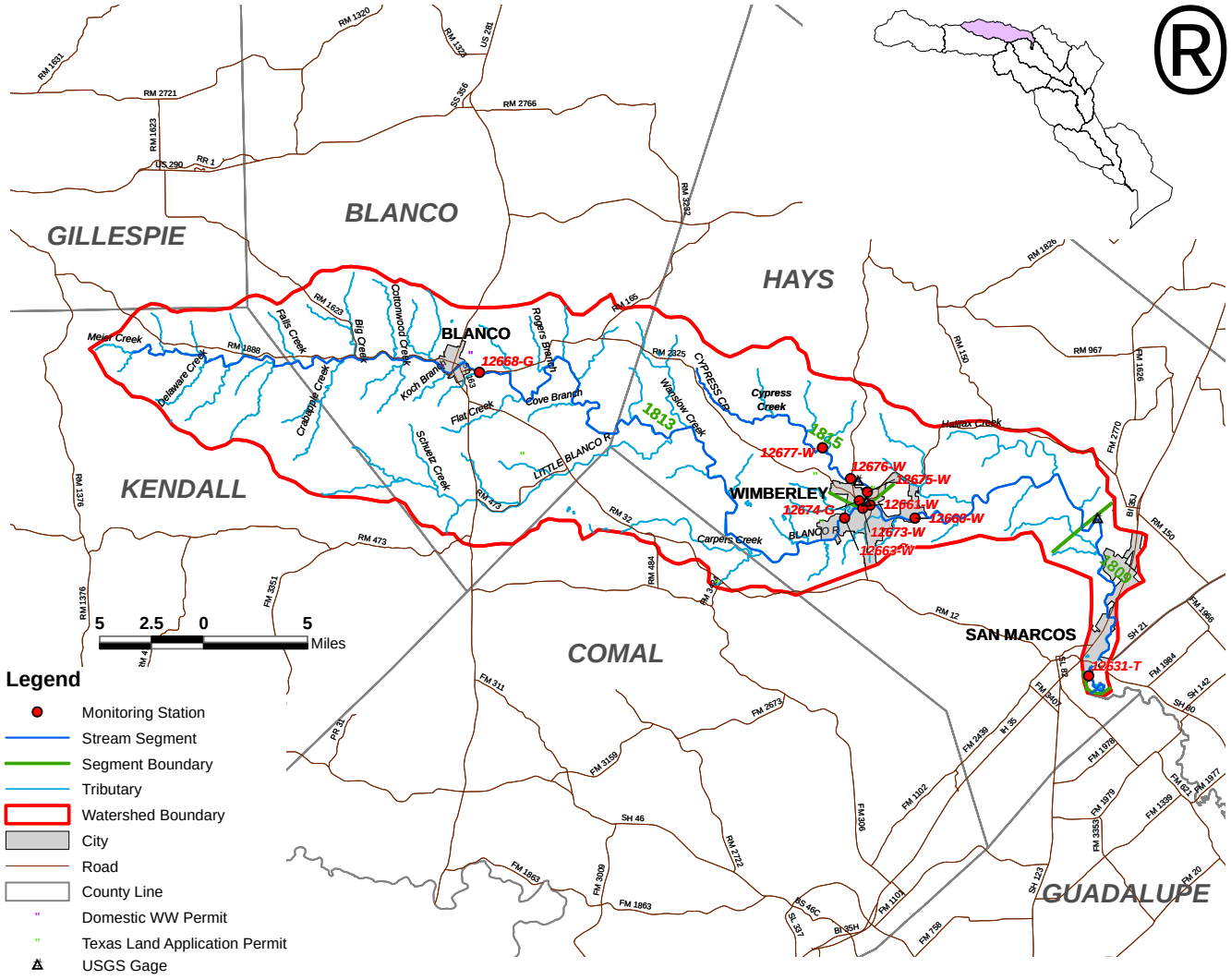
Blanco River Watershed



Monitoring Stations –
Blanco River and Cypress Creek Watersheds

12668-G	Blanco River at FM 165
12660-W	Blanco River at FM 174
12661-W	Blanco River at FM 21, downstream of confluence with Cypress Creek
12663-W	Blanco River at Pioneer Town (7A)
12677-W	Cypress Creek at Jacob's Well (headwaters)
12676-W	Cypress Creek at FM 12, north of Wimberley
12675-W	Cypress Creek at Blue Hole
12673-W	Cypress Creek, upstream of confluence with Blanco River
12674-G	Cypress Creek at FM 12, in Wimberley
12637-T	Blanco River 6.3 miles upstream of IH 35
12631-T	Blanco River at Old Martindale Road

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.

Blanco River Watershed

Drainage Area: 440 square miles

Streams and Rivers: Guadalupe River, Lower Blanco River, Upper Blanco River, Cypress Creek, Meier Creek, and Sycamore Creek

Aquifers: Edwards-Trinity, Trinity

River Segments: 1813, 1815, 1809

Cities: Blanco, Fisher, Wimberley, Kyle, San Marcos

Counties: Kendall, Comal, Blanco and Hays

EcoRegion: Edwards Plateau

Vegetation Cover:

Evergreen Forest - 42.9%	Shrublands - 11.0%
Grass/Herbaceous - 32.2%	Deciduous Forest - 7.7%

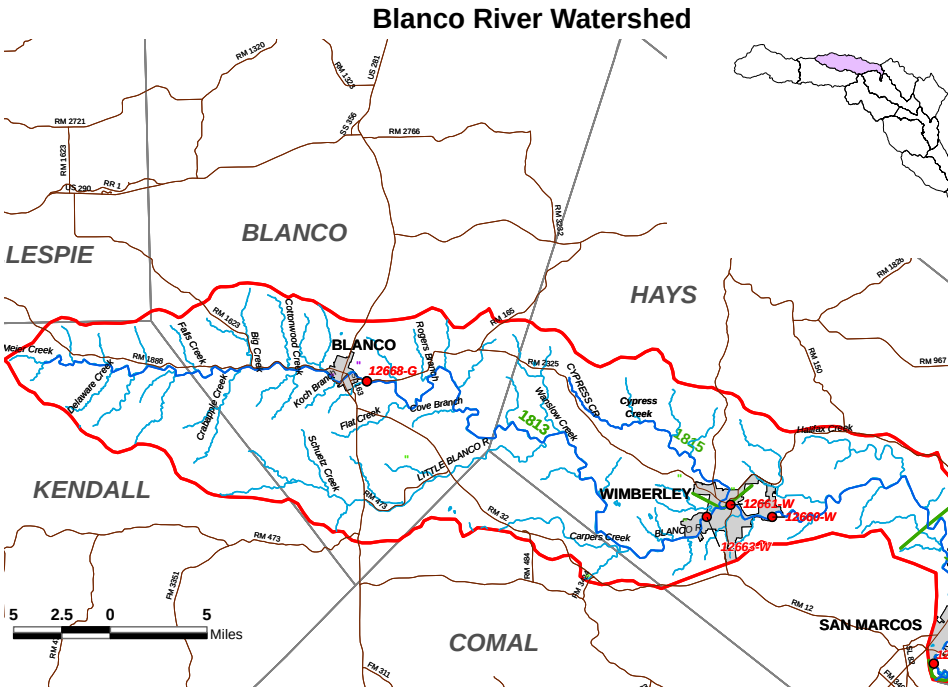
Climate: Average annual rainfall: 31 inches
Average annual temperature: January 34° July 94°

Land Uses: Urban, Agricultural Crops (wheat, hay, oats, peaches & pecans), Sheep, Cattle, Goats and Turkey Productions; Light Manufacturing 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, calcareous, stony, and clay loams

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



The Blanco River is divided into two classified stream segments. Segment 1813, the upper Blanco River, extends for 71 miles from Lime Kiln Road in Hays County, through Blanco County, to the spring-fed headwaters in northern Kendall County. Segment 1813 consists of 355 square miles of drainage basin that is separated into five assessment units. Assessment unit 1813_01 evaluates the 14.2 mile lower section of the segment, between Lime Kiln Road and Hays CR 314. Unit 1813_02 assesses the 3.5 mile section below the City of Wimberley, between Hays CR 314 and Hays CR 1492. Unit 1813_03 evaluates the 6.5 mile section, below the City of Blanco, between Blanco CR 406 and Highway 281 in Blanco County. Unit 1813_04 assesses the 17.3 mile section between Highway 281 and the headwaters of the segment. Unit 1813_05 assesses the 29.5 mile section between Hays CR 1492 and Blanco CR 406. This segment also receives the Cypress Creek tributary below the city of Wimberley. Cypress Creek has been designated as a separate segment 1815 and is discussed in a later section of this document. Segment 1809, the lower Blanco River, is described in the following section. GBRA has routinely monitored one site in segment 1813 (Station #12668), monthly, since October of 1996. The GBRA monitoring site is located at FM 165, ½ mile east of the City and 2 miles below the city's wastewater treatment plant discharge.

The Wimberley Valley Watershed Association recognized the need for more assessment data in this segment of the Blanco and partnered with the GBRA to initiate routine monitoring of three stations (#12660, #12661, and #12663) on the Blanco River, in February of 2003. The data collected by the Wimberley Valley Watershed Association (WVWA) is quality assured by the GBRA and submitted to the TCEQ under the GBRA quality assurance project plan. The WVWA Station #12660 is an historical site originally monitored by TCEQ and located 3.1 miles downstream of the Cypress Creek confluence at the Fulton Ranch Road crossing. The WVWA Station #12661 was initially sampled by the USGS in May of 1990 and is located 0.4 miles downstream of the Cypress Creek confluence, just below the Ranch Road 12 crossing. WVWA Station #12663 is a new station, located 1.2 miles upstream of the Cypress Creek confluence, at CR 1492, in the upper end of assessment unit 1813_02. Additional monitoring was conducted by the GBRA in assessment units 1813_03 and 1813_04, as part of a special study, between January 2002 and July of 2003.

Geology and Water Quality Concerns

Segment 1813 is spring-fed stream, on the Edwards Plateau. The majority of the segment exhibits limestone substrate with occasional gravel, silt, or clay strata. The limestone is known to contain gypsum deposits, which can contribute to high sulfate concentrations in groundwater. The stream has historically displayed exceptional water quality and usually exhibits extremely clear water. In general, most water quality concerns in this segment of the Blanco River are linked to highly variable stream flow. The upper portions of the river have been known to go dry during prolonged periods of drought and the banks and substrate of the entire segment exhibit significant scouring during extended wet periods. The 2008 Texas Water Quality Inventory and 303(d) list do not list any impairments or concerns for general water use throughout the entire segment. The Texas Water Quality Inventory Report lists a dissolved oxygen concern for aquatic life use in assessment unit 1813_05, but this is most likely due to low base flow conditions during portions of the assessment period. The increasing population in this area has raised concerns about strains on the available water supply and increased stream erosion potential. The United States Census Bureau estimates a 9.9% increase in the population of Blanco County between April of 2000 and July of 2006. As the population in this area continues to climb, so does the importance of maintaining the water quality of available surface water.

There are currently two domestic treatment plants that are permitted to discharge to the upper Blanco River. Both discharges occur just outside of the city of Blanco, in assessment unit 1813_03. The city of Blanco wastewater treatment plant is situated ½ mile east of central Blanco and discharges the majority of its effluent into irrigation ponds for fields of coastal bermuda. This plant is permitted to discharge excess effluent into the Blanco River at an average rate of 0.90 million gallons per day. The permitted discharge to the Blanco rarely occurs, except during periods when the coastal bermuda irrigation fields are being harvested. The municipal effluent must meet water quality standards of 30 milligrams per liter (mg/L) of biochemical oxygen demand, 30 mg/L of total suspended solids, 1.0 mg/L of chlorine residual, and a pH between 6.0 and 9.0 standard units. The second plant is the city of Blanco Water Treatment plant is permitted for an average discharge of 0.050 million gallons per day, in the form of backwash water and settling sludge supernatant. The water treatment plant discharge is permitted to have a total suspended solids level of 20 mg/L and a pH of between 6.0 and 9.0 standard units.

Special Study on the Blanco River

Between September of 1999 and November of 2000 eight of the thirteen sulfate samples collected at the GBRA routine monitoring station, on the Blanco River at FM165 (Station #12668), returned values greater than the stream standard of 50 milligrams per liter (mg/L). GBRA initiated a special study in the upper portions of this segment, in order to identify the reason for the high sulfate values. During the first phase of the study, 13 monitoring locations were sampled for sulfate and conductivity concentrations from January to December of 2002. The phase one study locations included a site on the Blanco River at Cox Road, which was 4.9 miles downstream of the GBRA routine monitoring station at FM165. Phase one of the special study also monitored 11 additional stations, up to 10.8 miles upstream of the GBRA monitoring station at FM165. The phase one study stations upstream of the GBRA monitoring site included 4 main stem sites and 6 tributaries, as well as the City of Blanco wastewater discharge, which was located 2 miles upstream of the GBRA FM 165 station. The first phase of the sulfate study revealed that only the samples from the Big Creek tributary and the city of Blanco WWTP discharge contained sulfate concentrations exceeding the stream standard, as seen in Figure 1. The city of Blanco WWTP discharge was eliminated as a cause for high sulfate concentrations because it was utilizing its permitted discharge water for crop irrigation during the study sampling dates, as well as during the initial period of high sulfate concentrations in 1999 and 2000. The second phase of the study investigated 4 sites on the Big Creek tributary, a well in the Big Creek drainage basin, and a station on the Blanco River 2 miles downstream of the Big Creek confluence, as seen in Figure 2. The analysis of the data from this study showed that the groundwater in this portion of the river basin significantly contributed to high sulfate concentrations, especially during times of low flow.

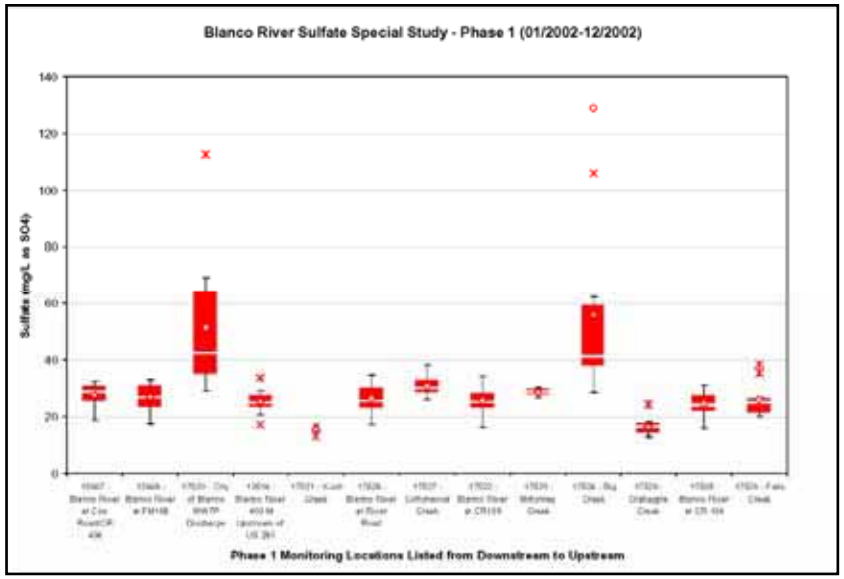


Figure 1. Box and whisker plot of sulfate concentrations at the 13 locations monitored during the first phase of the special sulfate study on the Upper Blanco River.

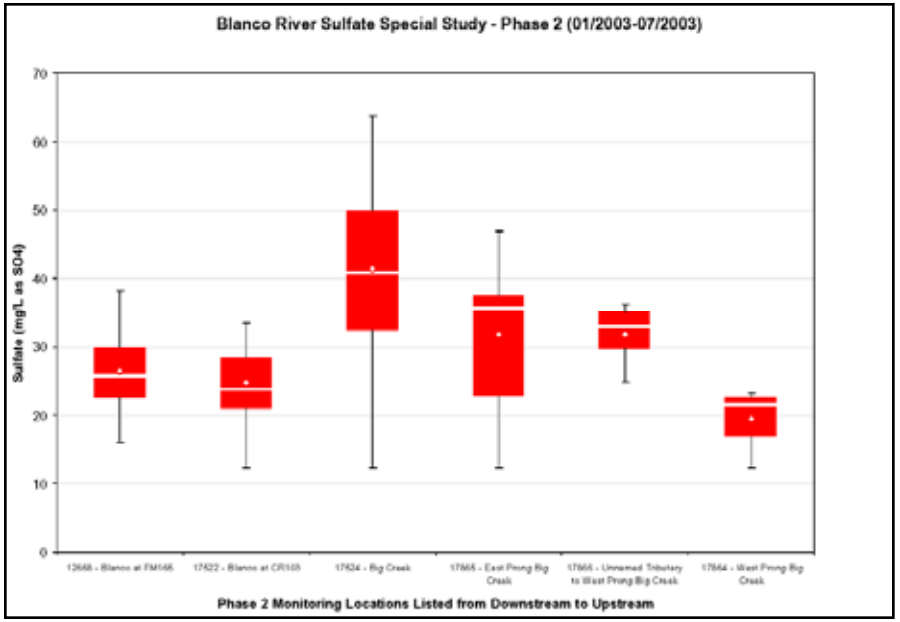


Figure 2. Box and whisker plot of sulfate concentrations at the 6 locations monitored during the second phase of the special sulfate study on the Blanco River.

Water Quality of the Stream

Over the period of record, the sulfate concentration at the *Blanco at FM 165* site (#12668) had a median value of 28.8 mg/L with a maximum value of 162 mg/L and a minimum value of 5.0 mg/L. The sulfate levels at this site exceeded the stream screening criteria of 50 mg/L 14 times over the period of record, as seen in Figure 3. The sulfate concentration at this site appears to be exhibiting a significant downward trend with time at the 0.05 critical α, ß= -0.01, t(130)=-2.72, p=0.007. A significant portion of the variance in sulfate levels at this site appears to be explained by stream flow, $R^{\wedge 2}$=0.114, F(1,85)=10.89,p=0.001, and over the period of record there appears to be an inverse relationship between sulfate concentration and flow at the 0.05 critical α, as a rise in flow results in a decrease in sulfate, ß= -0.11, t(85)= -3.30, p=0.001, as seen in Figure 4. Nitrate nitrogen, ammonia nitrogen, total phosphorus, and chlorophyll a were also analyzed at this monitoring location. Nitrate Nitrogen was reported under three different STORET codes at this location. Combining the results of all three STORET codes, the median nitrate concentration was 0.27 mg/L, with a maximum value of 1.78 mg/L and a minimum value of <0.01 mg/L. None of the samples exceeded the nitrate nitrogen screening criteria of 1.95 mg/L. The median ammonia nitrogen concentration of the GBRA monitoring location at FM 165 was 0.04 mg/L, with a maximum value of 0.34 mg/L and a minimum value of <0.02 mg/L. This station exceeded the ammonia screening concentration of 0.33 mg/L one time, in April of 2000, during a prolonged period of low stream flow. 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 was less than detection and there was never a measured value above the screening concentration of 14.1 microgram per liter.

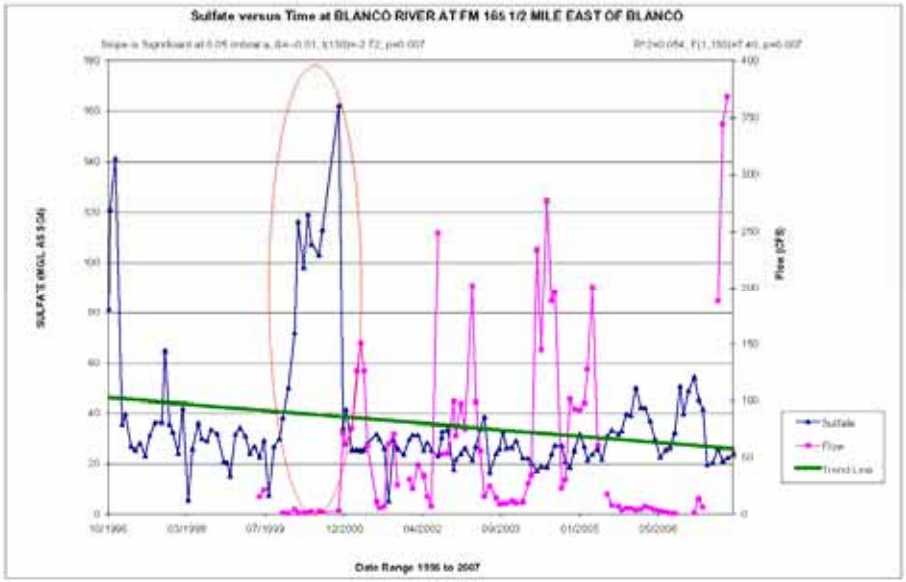


Figure 3. Sulfate concentration versus time at the Blanco River at FM 165 (12668) GBRA monitoring station (period of time that prompted sulfate special study is circled in red).

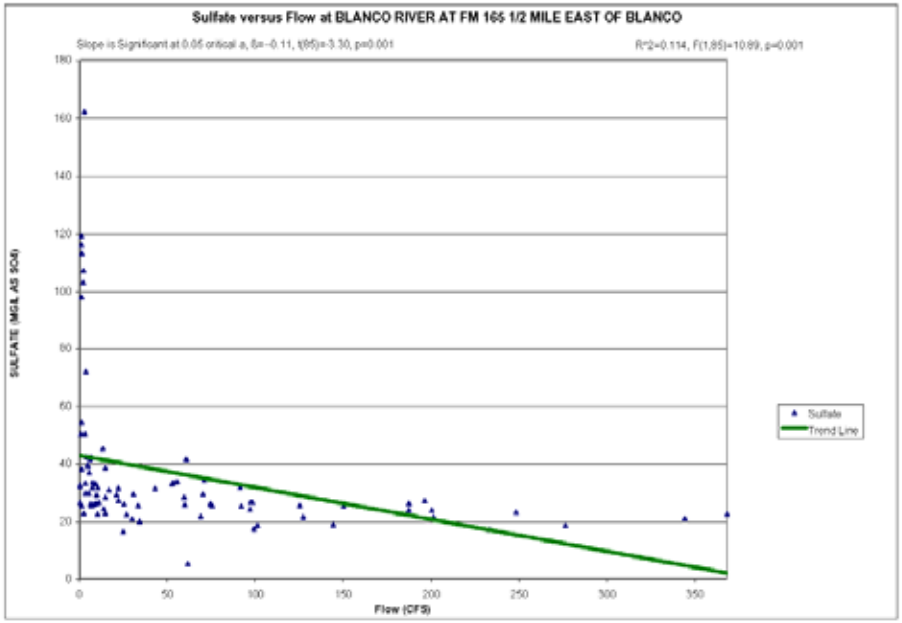


Figure 4. Sulfate concentration versus Flow at the Blanco River at FM 165 (12668) GBRA Monitoring Station. An inverse relationship was found to exist between sulfate and flow.

Nitrate nitrogen, ammonia nitrogen total phosphorus, and chlorophyll a were analyzed at the WVWA station on *Blanco River at RR12* (station #12661). Nitrate Nitrogen was reported under two different STORET codes at this location. Combining the results of both STORET codes, the median nitrate concentration was 0.28 mg/, with a maximum value of 1.9 mg/L and a minimum value of 0.02 mg/L. None of the samples exceeded the nitrate nitrogen screening criteria of 1.95 mg/L. The median ammonia nitrogen concentration of the WVWA monitoring location at RR12 was <0.02 mg/L, with a maximum value of 0.5 mg/L and a minimum value of less than the quantification limit for the method. This station exceeded the ammonia screening concentration of 0.33 mg/L one time, in February of 1992, during a prolonged high stream flow event. 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 was less than detection, however, there were two sample events with measured values above the screening concentration of 14.1 microgram per liter, in November of 1995 and July of 2003. Chlorophyll a has not been monitored at this location since August of 2003 when the WVWA took over monitoring duties from the TCEQ.

Nitrate nitrogen, ammonia nitrogen and total phosphorus were analyzed at the WVWA station on the *Blanco River at CR 1492* (station #12663). Nitrate Nitrogen was reported under two different STORET codes at this location. Combining the results of both STORET codes, the median nitrate concentration was 0.22 mg/L, with a maximum value of 0.78 mg/L and minimum value of 0.03 mg/L. None of the samples exceeded the nitrate nitrogen screening criteria of 1.95 mg/L. The median ammonia nitrogen concentration of the WVWA monitoring location at CR 1492 was less than the method detection limit, with a maximum value of 0.07 mg/L. This station never exceeded the ammonia 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 was less than detection, however, there were two sample events with measured values above the screening concentration of 14.1 microgram per liter, in November of 1995 and July of 2003. Chlorophyll a has not been monitored at this location since August of 2003, when the WVWA took over monitoring duties from the TCEQ.

Nitrate nitrogen, ammonia nitrogen and total phosphorus were analyzed at the WVWA station on the *Blanco River at CR 173* (station #12660). Nitrate nitrogen was reported under three different STORET codes at this location. Combining the results of all three STORET codes, the median nitrate concentration was 0.22 mg/L with maximum value of 0.75 mg/L and minimum value of 0.02 mg/L. None of the samples exceeded the nitrate nitrogen screening criteria of 1.95 mg/L. The median ammonia nitrogen concentration of the WVWA monitoring location at CR 173 was less than the method detection limit. This station never exceeded the ammonia 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 was less than detection,

however, there were two sample events with measured values above the screening concentration of 14.1 microgram per liter, in November of 1995 and July of 2003. Chlorophyll a has not been monitored at this location since May of 2002 when the TCEQ discontinued monitoring.

Segment 1813 provides clear, spring water for contact recreational opportunities. The low base flows in the river often prevent canoeing and tubing, but many dammed pools exist in the segment, which attract campers and swimmers. 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 FM165 site (station #12668) is 24 organisms per 100 milliliters. In the period of record, only six grab samples at the FM 165 site have exceeded the single sample *E. coli* standard of 394 organisms per 100 milliliters and all but one of these events occurred during periods of extremely high flow. The geometric mean for *E. coli* at the WVWA CR1492 site (station #12663) is 98 organisms per 100 milliliters. In the period of record, only six grab samples at the CR1492 site have exceeded the single sample *E. coli* standard of 394 organisms per 100 milliliters and all of these events occurred during periods of extremely high flow. The geometric mean for *E. coli* at the WVWA RR12 site (station #12661) is 80 organisms per 100 milliliters. In the period of record, only six grab samples at the RR12 site have exceeded the single sample *E. coli* standard of 394 organisms per 100 milliliters and all of these events occurred during periods of extremely high flow. The geometric mean for *E. coli* at the WVWA CR173 site (station #12660) is 41 organisms per 100 milliliters. In the period of record, only four grab samples at the CR173 site have exceeded the single sample *E. coli* standard of 394 organisms per 100 milliliters and all of these events occurred during periods of extremely high flow. The geometric means for *E. coli* in the monitoring stations of this segment appear to be lowest in the upper reaches of the segment, highest before the Cypress Creek confluence in the city of Wimberley and begin declining after the confluence, as the water leaves the city.

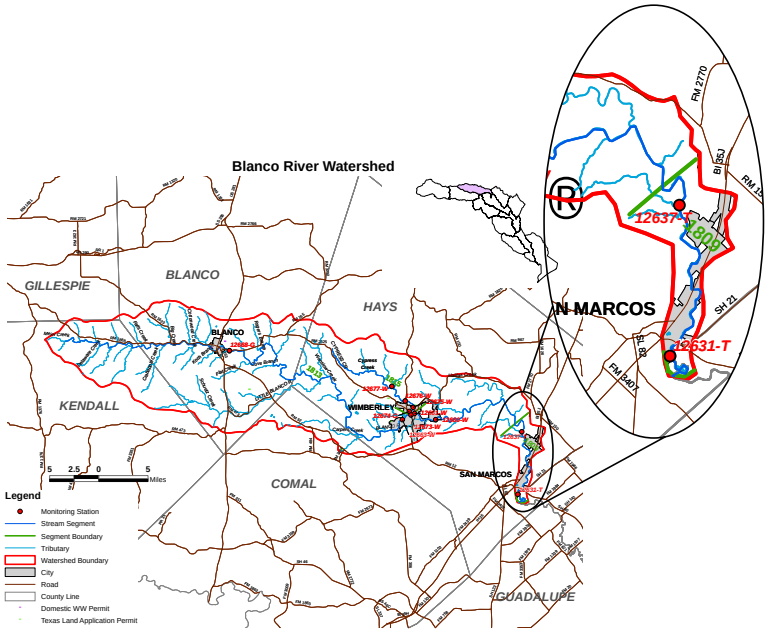
Land Uses

The land use in the segment consists of increasingly urbanized areas above or near the city of Blanco and the city of Wimberley. In the long stretches above and below these two cities farm and ranch land is prevalent. Many family farms are being sold and subdivided, and this area is expected to continue to increase its residential land use over the next few years. The impervious cover that is created by residential land use and subdivisions, i.e. streets, rooftops and parking lots, can be a source of nonpoint source pollution. The impervious cover forces water that could be captured by the soil to run off directly into the creeks and streams. This runoff can increase erosion and suspended sediment loading in the water bodies as well as carry other organic pollutants. The median total suspended solids (TSS) value at the Blanco River at FM165 monitoring station is 3.4 mg/L with a maximum value of 20 mg/L and a minimum value below the limit of quantification for the method. The WVWA monitoring sites exhibited median TSS values of 1.7 mg/L with a maximum value of 43.3 mg/L at the CR1492 site, 1.7 mg/L with a maximum value of 40.2 mg/L at the RR12 site and 1.6 mg/L with a maximum value of 49.7 mg/L at the CR173 site.

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 Blanco River at FM 165 (site no. 12668) during the drought of 2006.

Blanco River at FM 165 (site no. 12668) during normal to low flow.



The Blanco River is divided into two classified stream segments. Segment 1809, **the lower Blanco River**, extends from the confluence of the Blanco and San Marcos Rivers, just outside the city of San Marcos, upstream to the Lime Kiln Road crossing in Hays County. The segment is 15 miles long and is separated into two assessment units. Assessment unit 1809_01 consists of the segment from the confluence with the San Marcos River to 7 miles upstream. Assessment unit 1809_02 consists of the upper 8 miles of the segment from 7 miles upstream of the San Marcos River confluence, to Lime Kiln Road. The upper Blanco River, segment 1813, includes the area upstream of Lime Kiln Road and is described in the preceding section. TCEQ has been monitoring the Blanco River at Hays CR 295/Old Martindale Road, east of San Marcos (site no. 12631) quarterly since May of 1994. The TCEQ monitoring site is located in the lower half of the segment, in assessment unit 1809_01. TCEQ monitors this site four times per year. There is another TCEQ site in the second assessment unit of the segment, 6.3 miles upstream of the IH 35 bridge (site no. 12637), but this monitoring location only contained a very limited data set from 10 monitoring events and is not currently being monitored. The statistical review of the data in this segment focused on the CR 295 monitoring location.

Land Uses and Water Quality Concerns

The 85 square mile drainage area of the lower Blanco River is primarily located on the Edwards Plateau, but enters the Blackland Prairies on the eastern edge of Hays County. This segment consists of limestone substrate with occasional stony and clay loams. The changes in elevation as the river crosses the Balcones fault increase the streamflow, but there are also several slow moving stretches throughout the segment. The water is primarily used for aquatic life, contact recreation and fish consumption. The land in the basin is used for farming, ranching, recreation, light manufacturing and urban development. The urban development of this segment is increasing at a rapid pace due to the rivers location in the middle of the IH 35 corridor and its close proximity to the rapidly expanding cities of San Marcos and Kyle. The United States Census Bureau estimates that there was a 33% increase in the population of Hays County from April of 2000 to July of 2006. The rapidly increasing population in this area raises concerns about the growing amount of impervious cover and subsequent potential for non-point source pollution.

Water Quality of the Stream

The lower Blanco River has no major tributaries to contribute to flow and sediment loading of the stream. High flow events are almost exclusively associated with flow contributions from segment 1813 or runoff from dry creeks within the segment. The median instantaneous **flow** of the CR 295 monitoring station, in segment 1809, was 66 cubic feet per second (cfs). However, the stream experienced wide swings in flow, from 18 cfs to 1270 cfs, throughout the period of record. Due to the bedrock substrate of the lower Blanco, total suspended solid (TSS) values are relatively low in this segment of the river. The median TSS value for the CR 295 station is 4.0 milligrams per liter (mg/L), with a maximum value of 83 mg/L during a high flow event. Sediment loading during high flows is often indicative of bacteria in the water column (figure 1) because storm water brings in bacteria and the high flows keep solids suspended in the water, which keep ultraviolet light from the sun from penetrating the water and killing the bacteria. 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 CR 295 monitoring location has a geometric mean *E. coli* concentration of 50 organisms per 100 ml (MPN/100 mL). This site exceeded

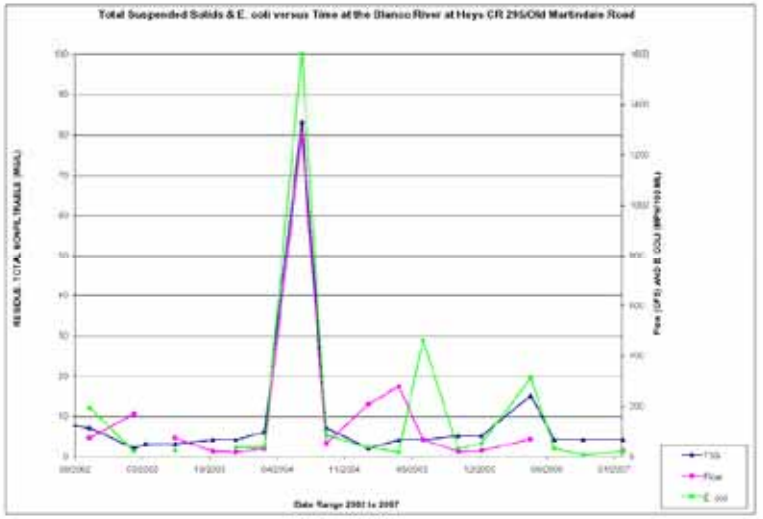


Figure 1. – Total suspended solids and *E. coli* over time at the TCEQ Blanco River at CR 295 (12631) monitoring location.

the stream contact recreation grab standard for *E. coli* two times throughout the period of record. Both events occurred during periods of high flows and the highest recorded *E. coli* number at this site, 1600 MPN/100ml, was recorded at the same time as the highest recorded total suspended solid concentration.

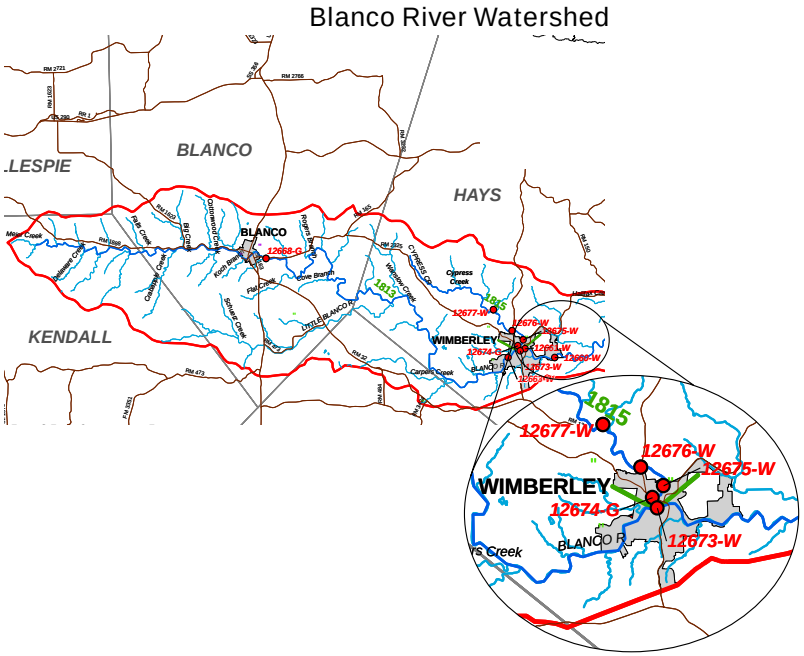
There are no permitted dischargers in segment 1809 of the Blanco River. The 2008 draft Texas Water Quality Inventory Report had no impairments or concerns listed for Segment 1809. The TCEQ CR295 monitoring site had median concentrations of conductivity, chloride and sulfate of 448 micromhos per centimeter, 13.0 milligrams per liter and 27.0 milligrams per liter respectively. The TCEQ site never exceeded the stream standard for chlorides or sulfates of 50 milligrams per liter (mg/L). The median concentration for dissolved oxygen is 8.6 mg/L, ranging from a minimum of 5.0 mg/L to a maximum of 11.1 mg/L at the TCEQ site at CR 295. The median pH value at this site was 7.8 and ranged from a low of 7.10 to a high of 8.30, never falling outside the stream standard range of 6.5 to 9 standard pH units.

Nitrate nitrogen, ammonia nitrogen and total phosphorus, were analyzed at the TCEQ CR 295 location. 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 of nitrate for all three methods was 0.31 mg/L, ranging from 0.05 to 1.75 mg/L and never falling outside of the screening concentration of 1.95 mg/L. The median concentration for ammonia nitrogen was below the limit of quantification for the method and the maximum ammonia nitrogen value recorded at this site was 0.08 mg/L, which was well below the screening concentration of 0.33 mg/L. The median total phosphorus concentration at the TCEQ CR 295 site was below the limit of quantification for the method and had a maximum value of 0.12 mg/L, which was well below the screening concentration of 0.69 mg/L. The data from this monitoring station indicates that the quality of the water at this monitoring station is of excellent quality.

A trend analysis of all the data available in segment 1809 showed no significant changes over time. Although there are no signs to indicate diminishing water quality in this segment, it will be watched closely in the future, as urbanization continues to grow and more information becomes available to supplement the limited data set that is currently available.

Blanco River at SH 21 in San Marcos (upstream view).

Blanco River at SH 21 in San Marcos (downstream view).



Segment 1815, the Cypress Creek, extends from the confluence of the Cypress Creek and the Blanco River in the city of Wimberley, to the Jacob's Well, its headwaters, north of the city. The entire segment lies within Hays County. GBRA monitors the Cypress Creek at Ranch Road 12 ("RR 12"; Site no. 12674) quarterly. TCEQ monitored the RR 12 site quarterly from 1991 until GBRA assumed the quarterly monitoring in 1998. The Wimberley Valley Watershed Association (WVWA), with funding from the city of Wimberley, established a monitoring program on the Cypress Creek in 2003. The WVWA established their monitoring guidelines to comply with the Guadalupe River Basin Quality Assurance Project Plan so that the data that they collected could be submitted to the TCEQ database and used for stream assessments. More on the WVWA and the goals of their monitoring project can be found in the *Coordination and Cooperation* section of this report. The sites in the WVWA monitoring project include the Cypress Creek at Jacob's Well, the headwaters of the Cypress Creek; the Cypress Creek at Ranch Road 12, one mile north of the city of Wimberley; and the Cypress Creek at the confluence with the Blanco River. They added a new site, the Cypress Creek near the Blue Hole recreational area, in late 2005.

Stakeholder Concerns

Stakeholders in the Cypress Creek watershed have raised three issues that they feel are impacting water quality. The issues include the small, overloaded septic tanks used by the businesses along the creek in the city which could be contributing bacteria to the stream. Another issue is the increased urbanization of previously unused areas which can bring in a variety of pollutants such as nutrients and suspended solids that can decrease oxygen in the stream, especially during periods of low flow. Finally, the stakeholders are concerned by the increasing demand on the groundwater resources in the area which reduces the flows from Jacob's well which in turn reduces the oxygen in the stream as well as the water becomes more stagnant during times of low flow. These concerns are not unfounded as the limited data set on Cypress Creek (dissolved oxygen, *E. coli* and nutrients) shows later in this section.

Wastewater Contributions

There is one wastewater plant in the watershed of the Cypress Creek. The Blue Hole wastewater plant is permitted to the city of Wimberley and GBRA, and is operated by GBRA. The facility disposes of the treated waste by subsurface irrigation at a volume not to exceed 15,000 gallons per day and at a rate that does not exceed 0.16 gallons per square foot. The permit allows for surface irrigation when the plant is expanded to 50,000 gallons per day. There is no permitted discharge to the waters of the Cypress Creek in either phase of operation. The Blue Hole plant has only one customer, a 122 -bed rehabilitation facility. The wastewater plant has been cited for being out of compliance due to biochemical oxygen demand concentrations that exceed the permitted amount. GBRA has been working to bring the plant into compliance. GBRA attributes the poor performance to the imhoff tank treatment process that is inadequate to treat the high organic waste being discharged by the rehabilitation hospital/nursing home. Because of the subsurface disposal method the high biochemical oxygen demand does not pose a threat to the water quality of the Cypress Creek. Some of the operating options that GBRA has been working on to bring the plant into compliance include working with the rehab hospital to lower the organic load by training their employees about what should be disposed of down the drains, pretreating the waste before it enters the imhoff tank and working with the city to build a new facility that would serve not only the rehab center but bring the area onto wastewater treatment. This final option would have the added benefit of taking downtown businesses along the creek off their failing septic tanks.

Water Quality

The 2008 draft Texas Water Quality Inventory lists Cypress Creek with a concern for depressed dissolved oxygen. Out of 161 measurements, 35 fell below the screening criteria of 6.0 milligrams per liter (mg/L.) The station located at Jacob's Well which is the headwaters of the creek has a median dissolved oxygen concentration of 5.9 mg/L, ranging from 3.8 to 7.9 mg/L. The water leaving the well, as expected for ground water, is low in dissolved *oxygen*, but over the period of time that data has been collected at the well we see a degrading trend in dissolved oxygen (figure 1).

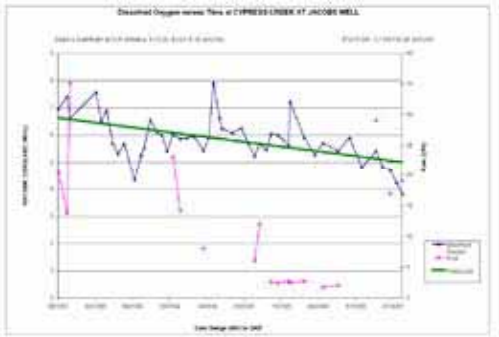


Figure 1. Dissolved oxygen over time at Jacob's Well (12677) on the Cypress Creek.

The WVWA site that is on RR12 has a median dissolved oxygen concentration of 6.9 mg/L, ranging from 3.0 to 9.13 mg/L. As the water in the creek travels downstream through the watershed it is aerated and the median concentration for dissolved oxygen goes up. The median concentration for dissolved oxygen at the GBRA RR12, further downstream, is 8.4 mg/L, ranging from 4.3 to 11.97 mg/L. Even though the median concentrations rise as the creek flows downstream, there is similar downward trend in dissolved oxygen over time at each site on the Cypress Creek as seen at Jacob's Well and may be linked with reduced flows from the well due to increased pressure on the groundwater.

The new monitoring site located near the Blue Hole recreational facility on Cypress Creek has a median dissolved oxygen concentration of 5.9 mg/L, ranging from 3.6 and 8.1 mg/L, but it has a very small data set compared to the other two sites downstream of Jacob's Well. This site was added by the WVWA in late 2005 after the park was purchased by the city of Wimberley. It is a location that is very important to the residents in the area, with historical, sentimental and ecological significance and warrants continued monitoring.

Considering all of the monitoring locations on the segment, the temperature varied between 11.1ºC to 26.8ºC, with a median temperature of 20.8°C. The **specific conductance** ranged between 376 and 712 micromhos per centimeter (umhos/cm), with a median conductivity of 542 umhos/cm. The median pH of the site was 7.61, ranging from 6.94 at the Jacob's Well site, to 9.0 at the GBRA RR12 location. The median concentrations for chloride and sulfate at the GBRA RR12 location were 14.2 and 17.3 respectively. At no time did the concentration of these dissolved constituents exceed the stream standard of 50 milligrams per liter.

Nitrate nitrogen, ammonia nitrogen and total phosphorus, were analyzed at all of the monitoring locations on the segment. 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 the locations ranged from 0.06 mg/L at the Blue Hole site, to 0.45 mg/L at the Jacob's Well location. When looking at the nitrate nitrogen concentrations over time, combining all methods, we see a slight upward trend and a positive correlation with flow. At no time did the nitrate nitrogen concentration, regardless of storet citing, exceed the screening criteria of 1.95 milligrams per liter. The median ammonia nitrogen concentration was below detection at all monitoring locations. 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 milligrams per liter.

Segment 1815 is a slow meandering stream with a bedrock substrate. The contact recreation stream standard, using *E. coli*, is a geometric mean of 126 organisms per 100 milliliters, and the single sample concentration of 394 organisms per 100 milliliters. The geometric mean for *E. coli* at the GBRA RR12 site is 125 organisms per 100 milliliters, just below the stream standard. In the period of record only two of the 40 measurements exceeded the single sample *E. coli* standard of 394 organisms per 100 milliliters. Often, ***E. coli*** concentrations rise with rises in flow due to storm water runoff. At the GBRA RR12 site, there are periods where the inverse appears to be true (Figure 2). A possible explanation for this phenomenon could be that the contributions of *E. coli* from failing septic tanks in the city are more easily detected when the baseflow is not sufficient enough to dilute the bacteria.

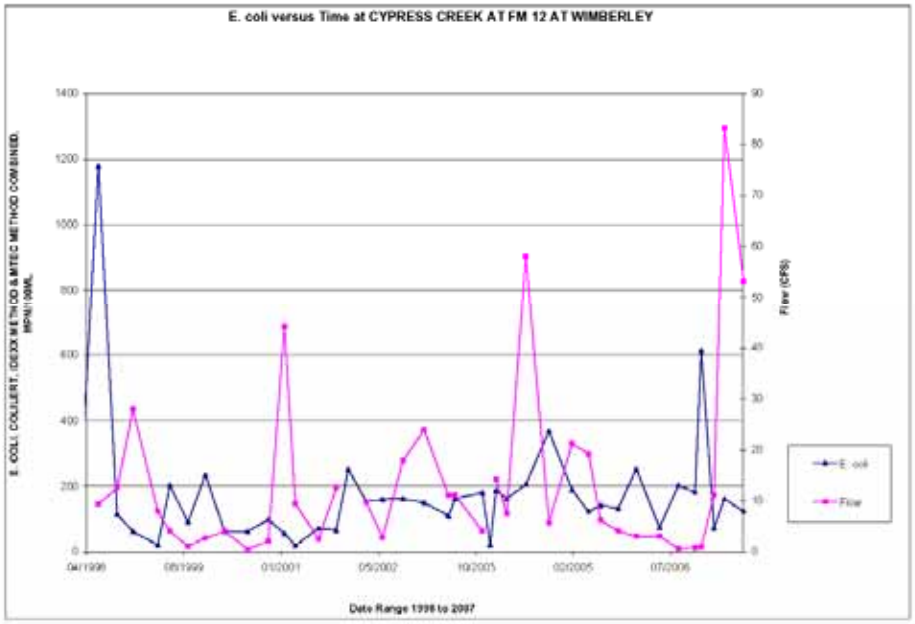


Figure 2. *E. coli* concentrations and flow over time at the Cypress Creek at FM 12 site (12674).

The suspended solids ranged from 1 to 35 milligrams per liter, with a median of 1.7 milligrams per liter. The median chlorophyll a concentration was less than detection and there was never a measured value above the screening concentration of 14.1 microgram per liter.

Cypress Creek at RR 12 in Wimberley (site no. 12674).