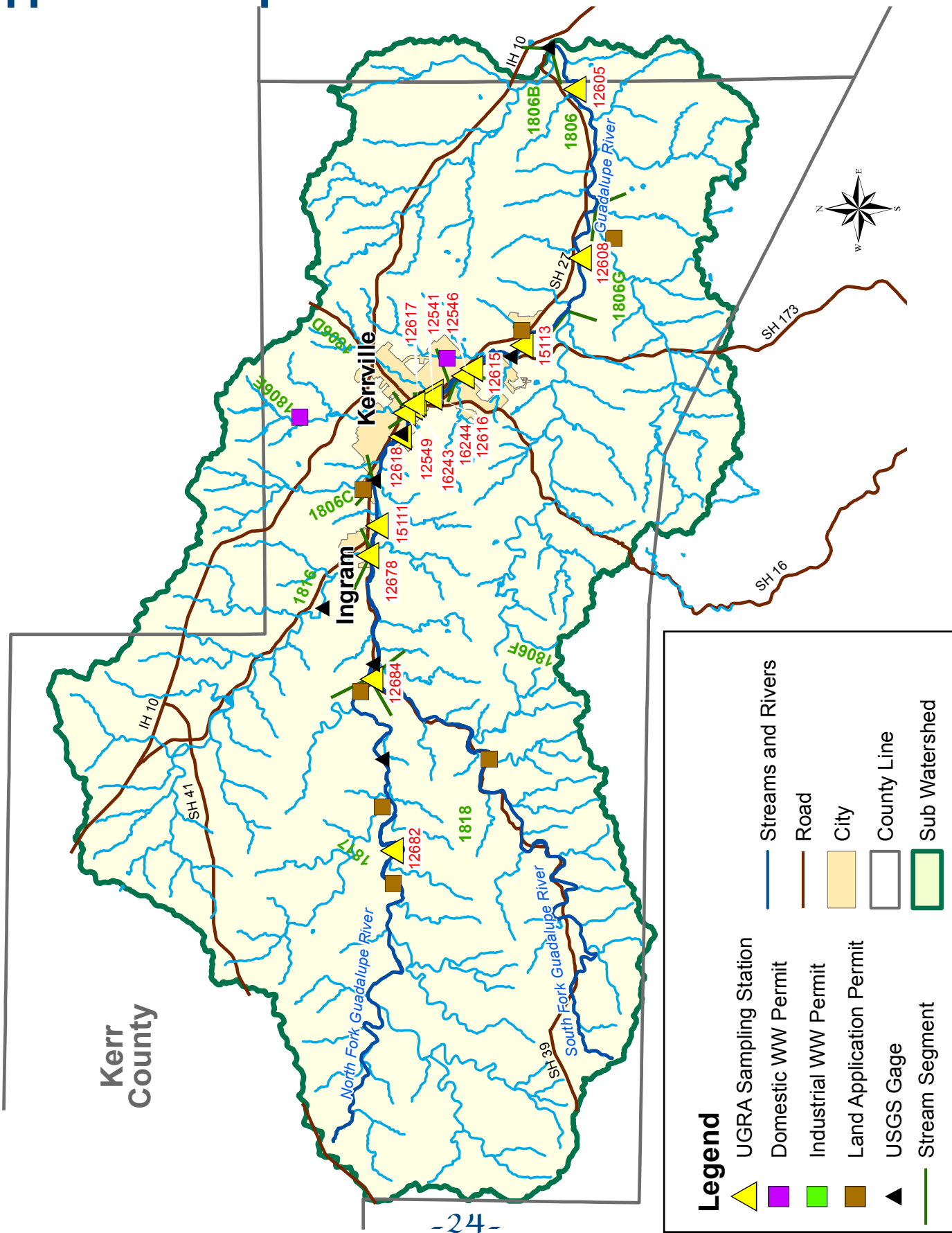


Upper Guadalupe River Watershed above Comfort



Upper Guadalupe River Watershed above Comfort River Segments, Descriptions and Concerns

Drainage Area: 850 square miles

Streams and Rivers: North Fork and South Fork of the Guadalupe River, Johnson Creek, Quinlan Creek, Camp Meeting Creek, Town Creek, Cypress Creek, Goat Creek, Turtle Creek, Verde Creek, Bear Creek

Aquifer: Trinity, Edwards Plateau

River Segments: 1816, 1817, 1818, 1806A-G

Cities: Center Point, Ingram, Kerrville, Comfort, Hunt

Counties: Kerr, Gillespie, Bandera, Kendall

EcoRegion: Edwards Plateau

Vegetation Cover: Evergreen Forest 46.9%, Grass/Herbaceous 14.4%, Shrublands 28.8%

Climate: Average annual rainfall 30 inches, Average annual temperature January 32°, July 94°

Land Uses: ranching, farming, tourism, light manufacturing

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

Soils: Dark and loamy over limestone; to the south and east soils are variable with light colored brown to red soils in some areas and dark loamy or loamy soils over clay subsoils elsewhere

Permitted Wastewater Treatment Facilities: Domestic 2, Land Application 6, Industrial 0

Segment 1816 (Johnson Creek) This spring-fed 21 mile segment consisting of Johnson Creek to its confluence with the Guadalupe River in Kerr County has good water quality. Intermittent in stages, the stream crosses an area characterized by steep slopes. The generally shallow, stony soils support grasses and open stands of live oak and ashe juniper.

Segment 1817 (North Fork Guadalupe River) The spring-fed 29 mile North Fork of the Guadalupe River is a perennial stream with exceptional aquatic life designation. River flow is swift but shallow. Typical vegetation are baldcypress, live oak and ashe juniper trees.

Segment 1818 (South Fork Guadalupe River) The spring-fed 27 mile South Fork of the headwaters of the Guadalupe River is clear, with moderately flowing water and has excellent water quality. It is a narrow and shallow scenic river with baldcypress-lined banks.

Segment 1806 (Guadalupe River above Canyon Lake) The Guadalupe River from the city of Comfort in Kendall County to the confluence with the North and South Forks of the Guadalupe River in Kerr County is scenic with crystal clear water between baldcypress-lined banks. The shallow riffle areas, punctuated with deep pools create an exceptional aquatic life ecosystem.



Upper Guadalupe River Watershed above Comfort

River Segments, Descriptions and Concerns

Upper Guadalupe River Watershed above Comfort

The Upper Guadalupe River watershed above Comfort, Texas drains an area of 850 square miles. The majority of this drainage area is contained within Kerr County, although a small portion of the watershed includes areas in Gillespie, Bandera, and Kendall counties. Major streams and rivers within this drainage area include the North and South Fork of the Guadalupe River, Johnson Creek, Indian Creek, Quinlan Creek, Camp Meeting Creek, Town Creek, Third Creek, Cypress Creek, Goat Creek, Turtle Creek, Verde Creek, and Bear Creek. Cities include Hunt, Ingram, Kerrville, Center Point, and Comfort (Kerr and Kendall County).

Soils are generally dark and loamy over limestone, but are more variable in the southern and eastern portions of the watershed. Vegetation cover is primarily herbaceous and dominated by ashe juniper with portions of shrub lands and grass or herbaceous land cover. Average annual rainfall is 30 inches and average temperature is 32°F in January and 94°F in July.

Land use in the Upper Guadalupe watershed is defined by ranching, farming, tourism, and light manufacturing. Water bodies are used for aquatic life, contact recreation, fish consumption, and as public water supplies. There are two domestic permitted wastewater treatment facilities (only one is currently in operation) and six land application

facilities in the watershed. The City of Kerrville is permitted to release treated effluent into Third Creek from their wastewater treatment facility. Average annual discharge from this facility in 2012 was 1.42 million gallons per day (MGD) into Third Creek and 0.69 MGD of reclaimed water was sold, primarily for irrigation. Quality limits for this facility are a daily average of 5 milligrams per liter (mg/L) carbonaceous biochemical oxygen demand, 5 mg/L total suspended solids, 1-2 mg/L ammonia nitrogen (flow dependent), 0.5-1 mg/L total phosphorus (flow dependent), and 126 colonies *E. coli* per 100 mL.

Stakeholder Concerns

Stakeholder concerns in this portion of the Guadalupe River basin are focused on preserving the nearly pristine water quality of the area and conserving the water resource of the Guadalupe River. In addition, many are concerned about the predominance of ashe juniper in the landscape.

Ashe juniper (cedar) is very efficient at intercepting rain, and can capture over ½ inch of rain before it reaches the soil. In a normal year, most rain events produce ½ inch or less of rain. Therefore, rain falling over an area of dense cedar cannot be captured or stored by the watershed. Through brush management, ashe juniper can be replaced with other native vegetation that will help enhance and maintain aquifer recharge and spring flow. Approximately 90% of all flow in the Guadalupe River in Kerr County is attributed to spring flow. Therefore, actions that enhance spring flow are crucial to conserving this precious water resource.

Portions of the Guadalupe River in Kerrville have experienced high *E. coli* bacteria levels in recent years. Many stakeholders are concerned that bacteria contamination will affect the recreational use of their favorite swimming holes, and that the levels indicate degrading water quality. The Bacteria Reduction Plan has been initiated to address this concern.

Additional stakeholder concerns include riparian area management particularly in urban areas and the expansion of *Arundo donax*, an exotic invasive riparian plant. Water conservation is also a high priority for stakeholders. The use of natural, drought



Photo by Travis Linscomb

Upper Guadalupe River Watershed above Comfort

River Segments, Descriptions and Concerns

tolerant plants in landscaping and rainwater harvesting are gaining popularity throughout the watershed. In fact, the Upper Guadalupe River Authority (UGRA) offers a rebate on rainwater catchment system equipment.

Water Quality Monitoring

The designated river segments in the Upper Guadalupe River watershed above Comfort listed under the state of Texas Water Quality Management Plan are Segment 1816 (Johnson Creek), Segment 1817 (North Fork Guadalupe River), Segment 1818 (South Fork Guadalupe River), and Segment 1806 (Guadalupe River above Canyon Lake). River Segment 1806 can be further divided into segments 1806A thru 1806G to describe specific streams that contribute flows directly to Segment 1806.

The Guadalupe-Blanco River Authority (GBRA), together with the Upper Guadalupe River Authority (UGRA), carry out the water quality management efforts in this basin under contract with the Texas Commission on Environmental Quality (TCEQ). Ten stations in Kerr County are monitored on a quarterly basis as part of the Clean Rivers Program (CRP). During each sampling event, the following parameters are monitored: pH, dissolved oxygen, conductivity, temperature, flow, total suspended solids, volatile suspended solids, turbidity, sulfate, chloride, nitrate, total kjeldahl nitrogen, total phosphorus, chlorophyll a, and *E. coli*. In addition to these routine parameters, sampling is also conducted to assess the biological community. In the past, the biological assessment could not have been conducted annually because of unfavorable conditions due to the flash flood flow regime of the Hill Country and persistent high flow at the sample stations during some years. In general, the water quality of the Upper Guadalupe River watershed is highly impacted by flow because this area frequently experiences times of extremely high and low flow.

Segment 1806, the Guadalupe River above Canyon Lake, was first identified in 2002 by the TCEQ as not supporting designated uses due to elevated *E. coli* bacteria concentrations. The bacteria impairment is concentrated in a small portion of the Guadalupe River in Kerrville. Since 2002, UGRA has worked with TCEQ to address the bacteria impairment, and is currently putting bacteria reduction strategies in place through the Bacteria Reduction Plan.

In 2010, Town Creek and Quinlan Creek, both tributaries to the Guadalupe River in Kerrville, were identified as not meeting the contact recreation criteria due to elevated *E. coli* bacteria concentrations. There is also a concern for depressed dissolved oxygen levels on Town Creek. Both of these creeks have extremely low flow throughout the year, and are reduced to non-flowing pools during the summer months.

These water quality concerns, as well as the continued urbanization of areas adjoining the Guadalupe River in Kerr County, have made it a priority for UGRA to conduct extensive water quality monitoring in addition to the quarterly monitoring that is conducted for the Clean Rivers Program. The cornerstone of UGRA's water quality monitoring program is the County-Wide Goal based monitoring plan that was developed in 2008. The plan will track changes and identify water quality concerns in the primary tributaries that feed the Guadalupe River as well as provide more frequent monitoring of stations along the main stem. In addition, UGRA measures *E. coli* bacteria levels at 21 popular swimming holes on a weekly basis throughout the summer; monitors nine stations on a monthly basis in support of the Bacteria Reduction Plan, and investigates concerns for water quality. In all, over 40 stations are monitored on a routine basis and in 2012 over 2,400 tests were conducted on water bodies in Kerr County.

Guadalupe River above Canyon Lake, Segment 1806

Segment 1806, **Guadalupe River above Canyon Lake**, extends from a point (1.7 miles) downstream of Rebecca Creek Road in Comal County to the confluence of the North Fork Guadalupe River and the South Fork Guadalupe River in Kerr County. The segment is approximately 103 miles long. The segment is broken into eight assessment units, however only the following are within the Upper Guadalupe River watershed above Comfort: from confluence with Big Joshua Creek to Flat Rock Dam in Kerrville (1806_02), from Flat Rock Dam in Kerrville to 1 mile upstream (1806_03), from 1 mile upstream Flat Rock Dam to confluence with Camp Meeting Creek (1806_04), from confluence with Camp Meeting Creek to 2 miles upstream (1806_5), from RR 394 one mile downstream (1806_06), and the upper 10 miles of Segment (1806_07). There are five USGS gauging stations located in Segment 1806. Median annual

Upper Guadalupe River Watershed above Comfort

River Segments, Descriptions and Concerns

flow of the Guadalupe River at Hunt is 67 cubic feet per second (cfs) and median annual flow of the Guadalupe River at Comfort is 186 cfs.

The following information covers the portion of Segment 1806 above Comfort. For the discussion on the portion of the segment that is below the City of Comfort refer to the watershed summary entitled "Guadalupe River Below Comfort" that follows this section in the *Basin Summary Report*.

The assessment units contain six stations which have been monitored by UGRA quarterly since 1998 as part of the CRP. Guadalupe River at Hermann Sons Road (station no. 12605), Guadalupe River at Center Point Lake (station no. 12608), Guadalupe River at G Street (station no. 12616), and Guadalupe River at Kerrville-Schreiner Park (station no. 12615) also contain historical data dating back to the mid 1970s and early 1980s. Guadalupe River at Split Rock Road (station no. 15113) and the Guadalupe River at Riverview Road (station no. 15111) have been monitored since the beginning of the CRP only. Several additional stations in this segment were monitored during the summer from 2002 through 2007 for *E. coli* and turbidity only. These stations are Guadalupe River at IH 10 in Comfort (station no. 12603), Guadalupe River at Louise Hays Park dam (station no. 16243), Guadalupe River at SH 16 (station no. 12617), Guadalupe River at Louise Hays Park footbridge (station no. 16244), Guadalupe River at UGRA Lake (station no. 12618), Guadalupe River at Bear Creek Road (station no. 12619), Guadalupe River at Ingram Dam (station no. 12620), and Guadalupe River at Kelly Creek Road (station no. 16241).

The 2012 Texas Water Quality Inventory lists two impairments and two concerns in Segment 1806. Assessment units 1806_6, and 1806_8 are impaired for bacteria geometric mean value exceeding state standard for contact recreation. The TCEQ first identified the impairment to the contact recreation use of Segment 1806 in the 2002 Texas Water Quality Inventory and 303(d) List. Due to this concern, a Total Maximum Daily Load (TMDL) study was conducted on the impaired portion of Segment 1806 that flows through the City of Kerrville. The impaired reach is defined as the Guadalupe River from its confluence with Town Creak downstream to Flat Rock Lake. The TMDL was adopted by the TCEQ on July 25, 2007

and accepted by the Environmental Protection Agency (EPA) on September 25, 2007. This TMDL, titled *One Total Maximum Daily Load for Bacteria in the Guadalupe River Above Canyon Lake*, is now a part of the state's *Water Quality Management Plan*.

After the completion of the TMDL, UGRA received a grant from TCEQ to develop an implementation plan at the local level that outlines strategies aimed at reducing bacteria levels in the impaired reach of the Guadalupe River. This Implementation Plan for One Total Maximum Daily Load for Bacteria in Guadalupe River Above Canyon Lake was adopted by TCEQ in August 2011. During that same year, UGRA was selected to receive additional grant funding from TCEQ to put the bacteria reduction strategies in place with the assistance of the City of Kerrville, TXDOT, and Kerr County. This project is called the Bacteria Reduction Plan. The strategies in the plan will address the primary sources of bacteria pollution that have been identified in the section of the Guadalupe River in Kerrville. Sources identified are birds nesting on bridges, large flocks of domestic waterfowl congregating in lakes, septic systems, and pollution from general urban runoff. The ultimate goal of the project is to reduce the bacteria levels in the Guadalupe River to a concentration that does not represent a health risk to swimmers and will allow this segment to be removed from the impaired water body list.

In the 2012 Water Quality Inventory, assessment units 1806_2, and 1806_7 were identified as having concerns for impaired habitat based on annual biological assessments conducted at one station in each assessment unit. Due to the small number of samples included and the drought conditions that were persistent during the assessment period, more data is needed to determine if this trend is consistent.

Despite bacteria concerns, overall water quality in Segment 1806 is very good and all assessment units in the segment maintain an exceptional aquatic life use designation. The Guadalupe River at Riverview Road (station no. 15111) is sampled quarterly by UGRA staff as part of the CRP. This station is located between the cities of Ingram and Kerrville. A review of the data available for the Guadalupe River at Riverview Road indicates a water body with slightly elevated values for nearly all parameters when compared to the upstream North Fork and South

Upper Guadalupe River Watershed above Comfort River Segments, Descriptions and Concerns

Fork stations. However, the slight elevations still are not sufficient to lower the water quality below a good rating for this section of the river. **Specific conductivity** ranges from 407 micromhos per centimeter (umhos/cm) to 511 umhos/cm with the bulk of values within the 400 umhos/cm to 500 umhos/cm range. The trends are very consistent year to year. **Dissolved oxygen** ranges from 5.8 milligrams per liter (mg/L) to 11.6 mg/L with only one value out of 41 readings below the assessment criteria of 6.0 mg/L. No dissolved oxygen impacts were seen. **Nitrate nitrogen** values ranged from 0.05 mg/L to 1.04 mg/L. **Total phosphorus** ranged from 0.006 mg/L to 0.07 mg/L with the bulk of values being less than 0.02 mg/L. **Chlorides** ranged from 10 mg/L to 22.2 mg/L. The relatively clean nature of this body of water can be seen by the lack of dissolved salts. **Sulfates** ranged from 7.6 mg/L-16.3 mg/L. There was little variation exhibited annually or from year to year. The geometric mean for *E. coli* at this station is 26 MPN/100mL of water.

The land use in this area of the Guadalupe River may be affected by urbanization from the City of Ingram. However, there does not seem to be any obvious degradation of water quality occurring at this time. The more obvious change in water quality at this station is the significant reduction in stream flow over time as a result of drought conditions beginning around 2003 (Figure 1). Ambient pH concentrations in this portion of the Guadalupe River are significantly increasing over time (Figure 2). One explanation for this upward trend could be an increase in photosynthetic activity that comes with a reduction in flow and longer residence times. As algae and aquatic plants take up carbon dioxide in the photosynthetic process the pH concentrations rise.

Figure 1.

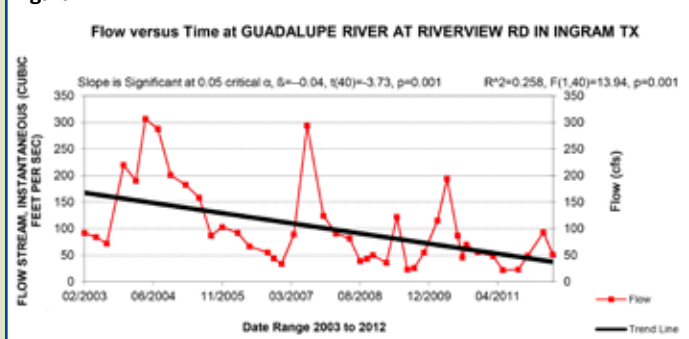
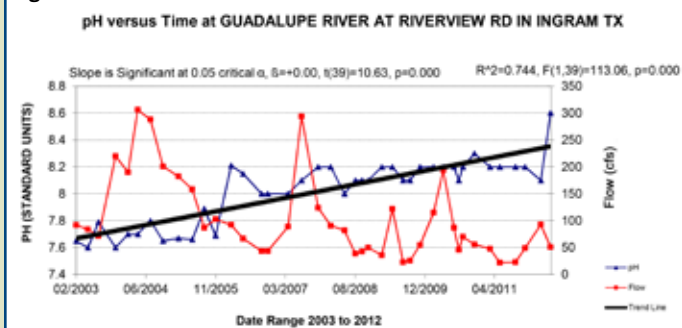


Figure 2.



The Guadalupe River at Split Rock Road (station no. 15113) is sampled quarterly by UGRA staff as part of the CRP and serves as a reference of Guadalupe River conditions downstream of the City of Kerrville. This station is located between the cities of Kerrville and Center Point. A review of the data available indicates some effects on water quality by the increased urbanization in this section of the river. However, the available data indicate that the water quality is still very good. **Specific conductivity** ranges from 412 umhos/cm to 552 umhos/cm with the bulk of values within the 400 umhos/cm to 500 umhos/cm range. The trends are very consistent year to year. **Dissolved oxygen** concentrations ranged from 5.5 mg/L to 14.2 mg/L. Only three measurements out of 43 measurements were below the 6.0 mg/L water quality standard. **Nitrate-nitrogen** values ranged from 0.05 mg/L to 1.4 mg/L. **Total phosphorus** ranged from 0.01 mg/L to 0.08 mg/L with the bulk of values being less than 0.025 mg/L. **Chlorides** ranged from 17.6 mg/L to 31.5 mg/L. **Sulfates** ranged from 10.8 mg/L to 23.8 mg/L with not much variation exhibited annually or from year to year. The geometric mean for *E. coli* at the station at Split Rock Road was 19 MPN/100mL. The low levels of *E. coli* at this station are surprising since this station is downstream of the impacted section of the Guadalupe River that flows through Kerrville, but the river appears to recover from any urbanization effects by this point. The land use just upstream of this section of the Guadalupe River is fairly dense residential and commercial urban development on both sides of the river.

Tributaries to Segment 1806

Two of the tributaries to Segment 1806 have been identified as either having an impairment or concern for water quality. The 2012 Texas Water Quality Inventory,

Upper Guadalupe River Watershed above Comfort

River Segments, Descriptions and Concerns

classifies Segment 1806D **Quinlan Creek** as impaired for bacteria geometric mean value exceeding state standard for contact recreation. Quinlan Creek is an unclassified water body in the City of Kerrville with very intermittent flow. The majority of the bacteria samples considered in the Water Quality Inventory were collected during times of extreme low flow or from a stagnant pool. Segment 1806E **Town Creek** was also classified by the 2012 Texas Water Quality Inventory as impaired for the bacteria geometric mean value exceeding the state standard for contact recreation. A concern for depressed dissolved oxygen was also identified. Town Creek is an unclassified water body in the City of Kerrville with very intermittent flow and very low flow during the assessment period.

A review of the data from the Quinlan Creek (station no. 12541) shows a stream that is severely impacted by *E. coli*. This segment has a geometric mean of 310 MPN/100 mL, which is more than twice the stream standard of 126 colonies/100 mL. The *E. coli* concentrations at this station have ranged from 10 MPN/100mL to 30,000 MPN/100mL. The Bacteria Reduction Plan efforts on this creek appear to be making a difference as there is a significant decline in *E. coli* over time from 2005 to 2012 (Figure 3).

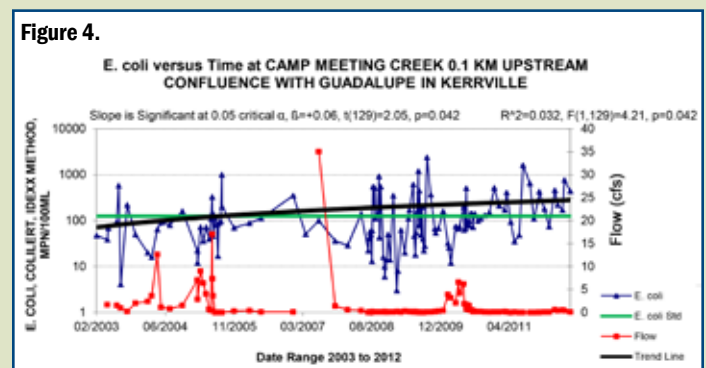
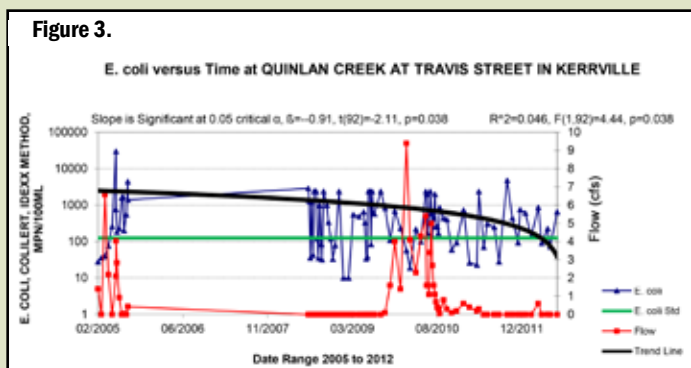
The green horizontal line on the graph represents the geometric mean contact recreation standard of 126 colonies of *E. coli* per 100 mL of water.

Segment 1806A, Camp Meeting Creek, is an unclassified water body ranging from the confluence of Flat Rock Lake in southeastern Kerrville to the upstream perennial portion of the stream west of Kerrville. The segment contains two assessment units: the lower nine miles of the Segment (1806A_02) and the upper nine miles of the

Segment (1806A_03). UGRA has been monitoring Camp Meeting Creek (station 12546) quarterly since 1998 as part of the CRP. This station is located in the most downstream assessment unit of the segment. This location is also a historical station and has data from 1976 to 1997. The Camp Meeting Creek segment is approximately 2.7 miles long and median flow at station no. 12546 is 1.4 cfs. Overall water quality at station no. 12546 is fair and the segment only maintains a limited aquatic life use designation.

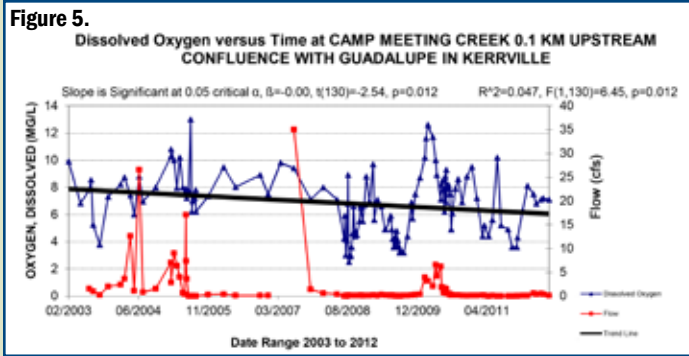
A review of data available for station no. 12546 indicates that water quality in this stream is degrading. The median concentration for **dissolved oxygen** is 7.1 mg/L, ranging from a minimum of 2.5 mg/L to a maximum of 13.0 mg/L. On several occasions during the period of 2003 to 2012, the dissolved oxygen values have dropped below the stream standard for dissolved oxygen.

Camp Meeting Creek travels through a densely populated area occupied by single family residences, a golf course, and mobile home parks. Numerous bridges also cross the creek creating opportunities for nonpoint source pollutants to enter the creek as runoff. Many residents in the upper section of Camp Meeting Creek rely on private septic systems. In 2004, the City of Kerrville and UGRA partnered to address potential water quality concerns and initiated municipal sewer collection for some homes in this area, although there are still many more homes on septic systems. Since the end of 2003 the geometric mean for *E. coli* is 91 MPN/100mL and the dissolved oxygen concentration has dropped below the state standard of 4.0 mg/L at this station fifteen times (Figures 4 and 5). Due to the low and intermittent flow of this segment, it is difficult to identify the exact source of *E. coli* and low dissolved oxygen concentrations, but it is likely due to



Upper Guadalupe River Watershed above Comfort

River Segments, Descriptions and Concerns



persistent drought.

Johnson Creek, Segment 1816

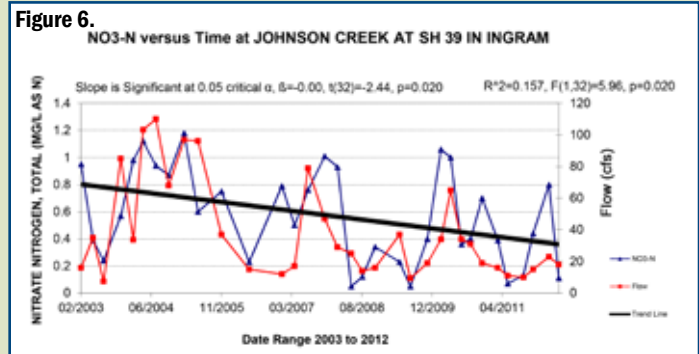
Segment 1816, **Johnson Creek**, extends from the confluence with the Guadalupe River in Kerr County to a point 1.2 km (0.7 miles) upstream of the most upstream crossing of SH 41 in Kerr County. This segment consists of one assessment unit and one monitoring station. UGRA has been monitoring Johnson Creek at SH 39 (station 12678) quarterly since 1998 as part of the CRP. Data was analyzed from 2003 through 2012 for possible trends in water quality conditions. The Johnson Creek segment is spring-fed and approximately 21 miles long. Average **flow** at station no. 12678 over the period of data was 41 cfs. A USGS gauging station is located in this segment approximately 3.5 miles upstream from station no. 12678. Due to severe drought four out of the last five years, the analysis of the instantaneous flow at this station is showing a statistically significant downward trend.

The 2012 Texas Water Quality Inventory has no impairments or concerns listed for Segment 1816. The water quality at station no. 12678 is consistently good and the segment maintains an exceptional aquatic life use designation. The median concentration for **dissolved oxygen** is 8.0 mg/L, ranging from a minimum of 5.8 mg/L to a maximum of 11.4 mg/L. At no time during the period of record analyzed did the dissolved oxygen drop below the state standard (4 mg/L). The **specific conductance** ranged from 360 umhos/cm to 600 umhos/cm, with a median conductivity of 466 umhos/cm.

Water quality is very consistent from year to year. **Nitrate nitrogen** values ranged from 0.05 mg/L to 1.2 mg/L. The data shows a downward trend in nitrate

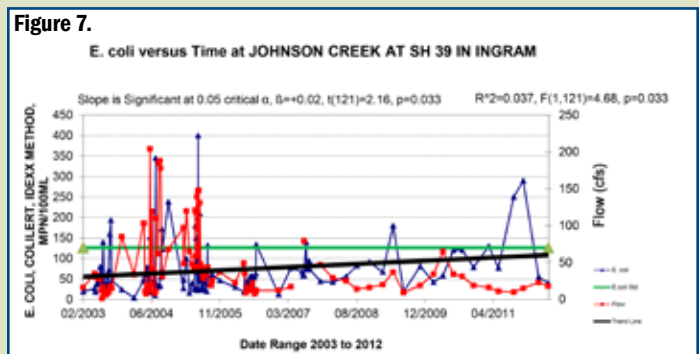
concentrations over time as well as a correlation between increases in flow with corresponding increases in nitrate nitrogen (Figure 6).

Total phosphorus ranged from 0.003 mg/L to 0.12 mg/L.



The detection limit for the total phosphorus analysis changed in 2006 from 0.002 mg/L to 0.05 mg/L due to a change in method. **Chloride** ranged from 13 mg/L to 32.1 mg/L with a median value of 23.9 mg/L. **Sulfate** ranged from 9 mg/L to 27 mg/L with a median of 12.6 mg/L. There was little variation exhibited annually or from year to year.

The land use in the Johnson Creek watershed is rural with very low density residential development and some camps upstream of Ingram. The scenery and recreational opportunities attract many people to Segment 1816. In fact, station no. 12678 is a very popular swimming hole for local residents. The stream standard for contact recreation is a geometric mean of 126 colonies/100mL. The geometric mean for *E. coli* at station no. 12678 from 2003 to 2012 is 53 MPN/100mL. Figure 7 shows that the concentration of *E. coli* is trending upwards.

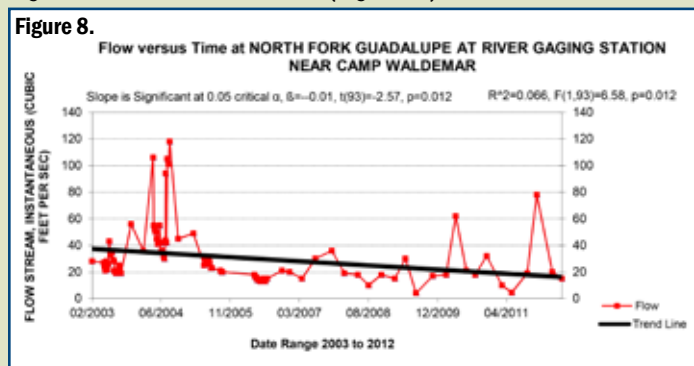


Upper Guadalupe River Watershed above Comfort

River Segments, Descriptions and Concerns

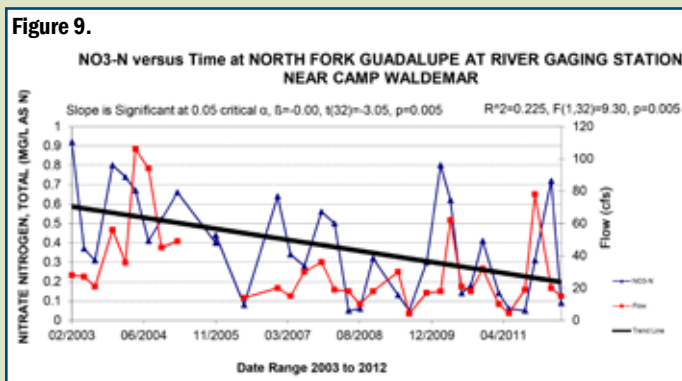
North Fork Guadalupe River, Segment 1817

Segment 1817, **North Fork Guadalupe River**, extends from the confluence with the Guadalupe River in Kerr County to a point 18.2 km (11.3 miles) upstream of Boneyard Draw in Kerr County. This segment consists of one assessment unit and three monitoring stations. UGRA has been monitoring the North Fork Guadalupe near Camp Waldemar (station 12682) station quarterly since 1998 as part of the CRP. Two additional stations in this segment were monitored during the summer from 2002 - 2007 for *E. coli* and turbidity only. These stations are North Fork Guadalupe River at FM 1340 (station no. 12681) and North Fork Guadalupe River at Rock Bottom Road (station 16245). The North Fork Guadalupe River segment is spring-fed and approximately 29 miles long. Average flow at station 12682 is 30.8 cfs. A USGS gauging station is located in this segment approximately 0.5 miles downstream from station no. 12682. Due to severe drought four out of the last five years, the analysis of the instantaneous flow at this station shows a statistically significant downward trend (Figure 8).



The 2012 Texas Water Quality Inventory lists no impairments for Segment 1817. Overall water quality at station 12682 is very good and the segment maintains an exceptional aquatic life use designation. The median concentration for **dissolved oxygen** is 7.4 mg/L, ranging from a minimum of 5.0 mg/L to a maximum of 10.8 mg/L. At no time during the period of 2003 to 2012 did the dissolved oxygen drop below the state standard (4 mg/L). The **specific conductance** ranged from 333 umhos/cm to 524 umhos/cm, with a median conductivity of 392 umhos/cm.

A review of the data available for the North Fork of the Guadalupe at this location indicates that consistently good water quality is maintained in this section of the river. Recent **nitrate nitrogen** data ranged from <0.05 mg/L to 0.92 mg/L with a median concentration of 0.36 mg/L. Figure 9 shows a downward trend in the nitrate nitrogen concentration over time at the North Fork monitoring station. **Total phosphorus** was below current detection limit for the analysis method. **Chloride** ranged from 6.1 mg/L to 12 mg/L with a median concentration of 10 mg/L. Again, this reinforces the relatively clean nature of this body of water. **Sulfate** ranged from 4.7mg/L to 13 mg/L with a median concentration of 6.1 mg/L.



Land use upstream in the North Fork Guadalupe River is rural with very low density residential development. Many Hill Country summer camps are located in Segment 1817 due to the beautiful scenery and numerous recreational opportunities. The stream standard for contact recreation is a geometric mean of 126 colonies/100mL of *E. coli*. The geometric mean at station 12682 from 2003 to 2012 is 32 MPN/100mL.

South Fork Guadalupe River, Segment 1818

Segment 1818, **South Fork Guadalupe River**, extends from the confluence with the Guadalupe River in Kerr County to a point 4.8 km (3.0 miles) upstream of FM 187 in Kerr County. This segment consists of five assessment units and each assessment unit contains one monitoring station. UGRA has been monitoring the South Fork Guadalupe River adjacent to Hunt Lions Park (station no. 12684) quarterly since 1998 as part of the CRP. This station is located in the most downstream assessment unit of the

Upper Guadalupe River Watershed above Comfort

River Segments, Descriptions and Concerns

segment. The four additional stations in this segment were monitored during the summer from 2002 - 2007 for *E. coli* and turbidity only. These stations are South Fork Guadalupe adjacent to Camp Arrowhead (station no. 12685), South Fork Guadalupe River at Seago Rd (station no. 16246), South Fork Guadalupe adjacent to Camp Mystic (station no. 12686), South Fork Guadalupe adjacent to Lynxhaven Lodge at SH 39 (station no. 12688). The South Fork Guadalupe River segment is spring-fed and approximately 27 miles long. Average **flow** from 2003 to 2012 at station no. 12684 is 24.6 cfs.

The 2012 Texas Water Quality Inventory lists no impairments or concerns in Segment 1818. Water quality at station no. 12684 is very good and the segment maintains an exceptional aquatic life use designation. The median concentration for **dissolved oxygen** is 7.7 mg/L, ranging from a minimum of 4.8 mg/L to a maximum of 10.8 mg/L. At no time during the period of record did the dissolved oxygen drop below the state standard for dissolved oxygen (4 mg/L). The **specific conductance** ranged from 367 umhos/cm to 481 umhos/cm, with a median conductivity of 417 umhos/cm.

A review of the data available for the South Fork Guadalupe River station indicates consistently good water quality is maintained in this section of the Guadalupe River. **Nitrate nitrogen** values ranged from <0.05 mg/L to 0.74 mg/L with a median concentration of 0.17 mg/L. **Total phosphorus** was consistently less than the detection limit of the analytical method. **Chloride** ranged from 7 mg/L to 36 mg/L with a median concentration of 9.8 mg/L. **Sulfate** ranged from 5 mg/L to 15.3 mg/L with a median

concentration of 7.7 mg/L. There was little variation exhibited annually or from year to year.

The land use in the South Fork Guadalupe River watershed is rural with very low density residential development. Much like the North Fork Guadalupe River, Segment 1818 is home to numerous Hill Country summer camps promoting various recreational activities. The stream standard for contact recreation is a geometric mean of 126 colonies/100mL of *E. coli*. The geometric mean at station no. 12684 from 2003 to 2012 was 16 MPN/100mL. 🐾



Photo courtesy of Texas Parks and Wildlife Department

Upper Guadalupe River above Comfort Issues and Concerns			
Water Quality Issue	Affected Area	Possible Influences/Concerns	Possible Actions Taken/to be Taken
Bacteria	Upper Guadalupe River	Pet waste; nesting by birds under bridge crossings; urban storm water	TMDL adopted; Implementation Plan underway - installation of pet waste stations; outreach and education; street sweeping; river clean ups; installation of bird deterrents at bridge crossings
Bacteria	Town Creek, Quinlan Creek	Dry to low flow conditions	Recreational Use Attainability Assessment
Depressed Dissolved Oxygen	Town Creek	Dry to low flow conditions	Review of water quality standards