TASK 5: DATA ANALYSIS AND REPORTING

Contents

Exhibits

TASK 5: DATA ANALYSIS AND REPORTING

Introduction

This task involves the examination of water quality conditions through data analysis and reporting in order to establish a more complete understanding of water quality conditions within the basin. The information in these reports will be communicated to basin stakeholders and will help shape decisions and the focus of work in the basin.

The major deliverables due as a part of this task are the:

- Basin Highlights Report (annually, except when Basin Summary Report is due)
- Basin Summary Report (once every 5 years)

Basin Highlights Report

The Basin Highlights Report provides information on water quality conditions throughout the basin and updates on Clean Rivers Program activities from the previous year. This document needs to be both user-friendly and accessible to a wide audience. Therefore, document layout and content should provide information in a manner that explains why conditions exist. It is important to get stakeholder input on the format and content of the document prior to its finalization. For ease of distribution, the Basin Highlight Report does not need to be printed but can be provided to interested parties on CD.

Basin Highlights Report Formats

There are three different report formats a Basin Planning Agency can use to communicate program activities and water quality information on an annual basis.

- The Standard Report
- Watershed Characterization Report
- Program Update

The different formats allow variety in the content of each year's report in an effort to reduce unnecessary repetition of information that does not change on an annual basis. The Basin Planning Agency will coordinate with the TCEQ CRP Project Manager to determine which formats to write into the contract work plan. The Basin Planning Agency will also negotiate report content with the TCEQ CRP Project Manager. Report format should fluctuate on a cycle similar to this:

Year 1 – Basin Summary Report
Year 2 – Program Update
Year 3 – Watershed Characterization (ABC & XYZ Watersheds)
Year 4 – Standard Basin Highlights Report
Year 5 – Watershed Characterization (DEF & TUV Watersheds)

The Standard Report

This report provides a complete overview of all major activities and water quality issues that occurred within the basin during the previous year. An outline for the Standard Basin Highlights Report is provided in Exhibit 5A with examples of satisfactory text. At a minimum, the report should include:

- an overview of basin water quality monitoring describing each organization's participation
- the top water quality issues in the basin for stakeholder prioritization and monitoring decisions
- a description of water quality conditions for each segment/water body
- a summary of findings from special studies
- maps showing the location of sampling sites and water quality issues
- Steering Committee and other public outreach activities
- instructions on how to become involved in steering committee meetings, volunteer monitoring, and other participation opportunities
- information on the CRP content featured on the Planning Agency's Web site

Watershed Characterization

This report serves to characterize impaired water bodies and/or water bodies of interest by reviewing data, mapping land use and permits, tracking watershed events, reviewing information from site visits and communicating with monitoring personnel, stakeholders and local residents.

The goal of this report is to describe key sources that are likely to impact water quality and provide a collection of "on the ground", local knowledge for other TCEQ program areas to use when prioritizing monitoring efforts. This document will provide useful information about a watershed that can be used for a variety of purposes including the Watershed Action Planning activities (see Task 6). An outline and example of the report is provided in Exhibit 5B. Characterization should occur by segment and include the following information:

- Segment descriptions
- Stream/reservoir hydrology
- Impairment/area of interest description
- Land use & natural characteristics
- Potential causes of impairment or interest
- Potential stakeholders
- Recommendations for improving water quality
- Maps
- Ongoing projects
- Images
- Major watershed events (present and future)

The Watershed Characterization report content must be coordinated and discussed in detail with the TCEQ CRP Project Manager while developing the CRP work plan and prior to beginning the report. The TCEQ CRP Project Manager must review and approve the watersheds before characterization begins. The following conditions apply:

- Characterization must include 1-3 watersheds
    - Exceptions, upon approval, can be due to watershed size or complexity
- Watersheds must be of suitable size and have impairments (i.e. the smallest watershed cannot be repeatedly chosen unless justifications are presented and approved)
- New watersheds must be chosen each year or on a rotating cycle
- Only discuss segments located within the watershed being characterized

The TCEQ CRP Project Manager must approve any exceptions to these conditions.

Program Update

This report strives to provide a brief update on the major basin activities and water quality issues that occurred during the previous year. It should be undertaken in an effort to reduce repetition of information that does not change on an annual basis and be thought of as a shortened version of the Standard Basin Highlights Report.

An example of the Program Update Report is provided in Exhibit 5C. The report should include:

- an update on major basin activities, changes and events
- an update of basin water quality monitoring activities
- an update on the top water quality concerns and issues in the basin
- a summary of findings from special studies
- maps showing the location of sampling sites and major water quality issues
- an update on public outreach and educational activities
- links to additional resources

Basin Summary Report

The Basin Summary Report is designed to provide a comprehensive review of water quality data and involves a detailed discussion of data analysis findings. This report serves to develop a greater understanding of basin water quality conditions, identify trends and changes, and aids in making decisions regarding water quality issues in each river and coastal basin in Texas. The report is completed once every five years for each river and coastal basin.

To aid in future planning, Basin Summary Reports are due according to the following 5 year rotation:

Year Due	River Authorities
2016	HGAC
2017	LCRA, BRA, LNRA
2018	IBWC, GBRA, NRA, SARA
2019	RRA, NETMD, SRBA, SRA
2020	LNVA, ANRA, TRA

Goals of the Report

This report serves to provide an explanation for ***why*** current water quality conditions exist by incorporating and interpreting the findings from the various data analysis functions. By explaining the findings, we can better describe the reasons for the problem and potentially determine future action plans.

The information from the review will support the following functions:

- developing monitoring plans and updating priorities
- enhancing knowledge and understanding of water quality issues
- verifying and explaining findings on the *Texas Water Quality Integrated Report*
- correlating water quality conditions with possible sources
- prioritizing water bodies for action
- selecting watersheds for special studies
- highlighting those sections of the basin that need more land use information
- assessing the success of water quality improvement projects

Report Content

The outline and description of content for the Basin Summary Report can be found in Exhibit 5D - Basin Summary Report Outline. The outline is provided to ensure content is consistent from basin to basin. Input from report users has been favorable when all information specific to a watershed is cohesively presented to provide a more complete picture of water quality. This report should answer the questions most stakeholders have, which tend to be:

- What are the water quality issues?
- Why do the issues exist?
- What are the possible effects?
- What should be/could be done about it?

In the watershed summary section in Exhibit 5D, there is a stepped approach to help answer these questions. The data review and analysis methods, Exhibit 5E, that can help answer the questions include: descriptive statistics (percentiles for comparison), trend analysis (changes over time), spatial analysis (differences from upstream to downstream, and watershed characteristics to describe why the issues exists).

Preparing for the Report

The following review process should be adhered to when preparing the Basin Summary Report:

- A planning meeting with the TCEQ CRP Project Manager to discuss the format and organization of the report will occur in September or October prior to significant work on the report. Report framework and data analysis methods should be discussed and confirmed.
- A pre-draft of at least one watershed summary will be submitted to the TCEQ by December 15th for review.

- After the pre-draft is approved, a draft of the entire Basin Summary Report will be submitted to the TCEQ CRP Project Manager by March 15th for review and comment.
- After the draft of the Basin Summary Report is approved by the TCEQ CRP Project Manager, the Planning Agency will request input from stakeholders. The draft can be made available to the public by posting on the Basin Planning Agency website, through email, and/or at the steering committee meeting.
- A copy of the completed final report is due to the TCEQ CRP Project Manager electronically by May 31, and written approval must be obtained before the report can be sent to printing.
- A copy of the final report needs to be made available to each stakeholder. This may be accomplished by: handing out copies at the steering committee meetings, putting the report on the Internet, and/or mailing notices of its availability in hard copy upon request.
- Five copies of the final printed report are to be sent to the TCEQ CRP Project Manager.
- At a minimum, the Executive Summary and maps of water quality issues should be posted to the Planning Agency's CRP Web page.

From the Texas Water Code, Section 26.0135, Clean Rivers Act, the summary report shall:

- be sent to the State Soil and Water Conservation Board and Parks and Wildlife Department
- identify water quality concerns, impaired or potentially impaired uses, the cause and possible source of use impairment, and recommended actions the commission may take to address those concerns
- discuss the public benefits from the water quality monitoring and assessment program, including efforts to increase public input in activities related to water quality and the effectiveness of targeted monitoring in assisting the permitting process
- be approved by the basin steering committee and coordinated with the public and the commission
- include a review of wastewater discharges, nonpoint source pollution, nutrient loading, toxic materials, biological health of aquatic life, public education and involvement in water quality issues, local and regional pollution within the watershed
- identify significant issues affecting water quality

and with respect to the assessment each Planning Agency shall:

- identify water quality problems and known pollution sources and set priorities for taking appropriate action regarding those problems and sources
- recommend water quality management strategies for correcting identified water quality problems and pollution sources
- inform those parties (persons who pay fees under Section 26.0291 and steering committee members) of the availability and location of the summary report for inspection and shall solicit input from those parties concerning their satisfaction with or suggestions for modification of the summary report
- summarize all comments received from persons who pay fees under Section 26.0291 and from steering committee members and shall submit the report and the summaries to the governor, the lieutenant governor, and the speaker of the house of representatives not later than the 90th day after the date the river authority submits the summary report to the commission and other agencies

EXHIBIT 5A

STANDARD BASIN HIGHLIGHTS REPORT OUTLINE AND EXAMPLES

EXHIBIT 5A
Standard Basin Highlights Report Outline

This Year's Highlights

- What were the major events or occurrences during the previous year (positive and negative)?
- What major issues (e.g., extreme drought, increasing development, confined animal operations, ongoing issues, natural salt pollution, record flood) are plaguing water quality for the basin?
- How have these events impacted water quality?
- What has been done to respond to water quality issues?

Water Quality Monitoring

This section involves a summarization of the monitoring that was planned, or occurred, during the past year including any participating entities and special projects. Present information on monitoring for the current fiscal year, to include:

- Number of sites per entity, frequency, type of monitoring
- Map the coordinated monitoring schedule for the entire basin
- Show and label sampling sites, water bodies, county boundaries, highways, & cities
- Explain what the water quality parameters mean and why they are important
- Provide a link to the web page that shows the entire monitoring schedule
- Highlight other organizations' participation in the monitoring program

Water Quality Conditions

The key to ensuring this portion of the report is adequate is to answer the questions the reader would ask, "why are levels elevated and what is being done about it?" When the answers to the questions are unknown and/or cannot be estimated, this *information gap* should be stated. If the previous year's report (including Basin Summary Report) contains a description of water quality for each TCEQ segment, then this section can be copied from the previous year's report. A statement should be included that no new assessment information is available since the previous report. The examples provided after this outline are highly recommended.

Explain the TCEQ assessment and categorization process

- Explain the assessment and categorization methods used for the latest state-approved Texas Water Quality Integrated Report and provide the web address for reference.

Describe water quality

- For each segment/water body, provide a concise description of the key watershed and water body characteristics that draw a picture of water quality
- Indicate the status of the segment/water body on the latest TCEQ Water Quality Inventory and provide some possible reasons if there is a *Concern, Use Concern,* and/or *Impairment*.
- Highlight those water bodies that may have a water quality issue, or are significant due to size,

location, or public interest, but which do not have a *Concern, Use Concern, and/or Impairment* and provide some possible reasons why the water quality is an issue.

Provide information on current or proposed work in the watershed

- Monitoring activities done in response to a water quality issue
- Proposed monitoring needed to better describe water quality (e.g., diel sampling for 2 years; monthly sampling for bacteria under a variety of flow conditions for 2 years; collect TDS in subwatersheds throughout the affected watershed to identify source areas)
- Describe **special studies**, activities to date, and any findings (reference special study reports that have been completed or will be completed in the near future)
- Accomplishments in the past year, or several years (e.g., 100 wells have been capped; 100,000 tons of manure have been composted and hauled out of the watershed; riparian buffers restored on over 15 miles of stream banks)

Map water quality issues

The map(s) should be at a scale that allows the reader to recognize where sampling sites and water quality issues are located in relation to major landmarks. It is important to show the location of factors influencing water quality, such as wastewater treatment plants, CAFOs, and row-crop operations in order to show their spatial relationship to the water quality conditions and the sampling sites.

- Highlight segments or sections of segments with water quality issues (e.g. *Concerns, Use Concerns,* and/or *Impairments*)
- Include and label, at a minimum: streams/reservoirs, county boundaries, highways, cities, and segment boundaries

Stakeholder Participation & Public Outreach

- Describe opportunities for involving other monitoring entities in the program
- Who is currently involved? What is their contribution?
- Explain the purpose of Steering Committee meetings (e.g. forum for providing input on water quality issues, establishing priorities for future work, and providing feedback on reports)
- Include a section on how individuals and organizations can get involved in the program
- Outline efforts that have been taken to get more involvement in the program
- Summarize prior Steering Committee discussions
- Summarize volunteer monitoring activities in the basin
- Include information on volunteer organizations and their activities, with contact information

Web Site

- Provide an overview of the information available on the web site
- Provide links to important pages, especially those with further detail on issues discussed in this report and those that allow the public to check on upcoming events

Example Text for the Basin Highlights Report

This Year's Highlights

The most significant factor affecting water quality throughout the basin in 2000 was the severe drought. In the upper portion of the basin, much of the River east of the City went completely dry, forcing some residents to transport water to storage tanks at their homes. The decreased flows resulted in elevated chloride levels in the river above the reservoir. In the middle portion of the basin, the Lake was 21 feet below average in August, a level not seen since 1984. The river at State Highway 180 also went dry. In November and December 2000, base flows returned to the River and many of its tributaries. The rains came with a cost, however. During one particularly heavy rain, approximately 37,000 fish were killed in the River when stormwater runoff transported pollutants that depleted the oxygen supply in the river.

The major events relating to water quality that occurred this year include the updated State of Texas Water Quality Inventory, the completion of the first year of the Reservoir #1 Water Quality Monitoring Program, the initiation of the dissolved metals study, identification of a leaking sewer main, improvements to the City #2 wastewater collection system, and a new fish consumption advisory for Lake #4. The State's Water Quality Inventory identified eight new concerns (3 for nutrients, 3 for dissolved oxygen, and 2 for pH) and 5 new impairments (3 for bacteria and 2 for dissolved oxygen). The Reservoir #1 Water Quality Monitoring Program was developed to address growing concerns over water quality conditions due to wastewater treatment facilities at the local paper mill. Significant improvements in wastewater discharge from the paper mill should help water quality in the long-term. In addition, the paper mill is in the process of renovating its wastewater treatment facility to significantly reduce waste loads.

For fiscal year 2002, the River Authority has added four routine and three flow sites to the monitoring plan. Three of the routine sites are on River #1. These sites were added in response to concerns about water quality impacts resulting from increased public use of the river. The fourth site was added downstream of a petrochemical plant on the River #2. A polluted groundwater plume has been identified very close to the river. Efforts have been made by the plant to keep the plume from entering the river. In addition, three sites were added to monitor flow on a monthly basis for one year to enable calculations to be made for wastewater effluent assimilative capacity. This data will replace assumptions made by the TCEQ when assigning allowable permit effluent limits.

Example Text for the Basin Highlights Report

Water Quality Monitoring

<table>
<tr><th colspan="8">Number of Sites Monitored</th></tr>
<tr><th>Sampling Entity</th><th>Field</th><th>Conventional</th><th>Bacteria</th><th>Biological</th><th>Metals in Water</th><th>Organics in Water</th></tr>
<tr><td>River Authority</td><td colspan="3">20 monthly
8 quarterly</td><td>2 annually</td><td>9 annually
1 semi-annually</td><td>2 semi-annually
2 quarterly</td></tr>
<tr><td>River Authority</td><td colspan="2">11 quarterly</td><td>11 quarterly
19 weekly (May - Aug)</td><td>4 annually</td><td>2 annually</td><td></td></tr>
<tr><td>TCEQ</td><td colspan="3">23 quarterly</td><td></td><td>5 annually
4 semi-annually</td><td>1 semi-annually</td></tr>
<tr><td>City</td><td colspan="3">4 quarterly</td><td></td><td></td><td></td></tr>
</table>

What are the Water Quality Groups?

Field - physical and chemical water quality characteristics that can be measured on-site. These generally include: dissolved oxygen (DO), specific conductance, pH, temperature, stream flow, flow severity, secchi disc, and field observations/conditions.

Conventional - chemical and biological constituents in water that typically require laboratory analysis, and generally include: nitrogen, phosphorus, chlorophyll-a, total dissolved solids, and total suspended solids.

... etc.

What is Dissolved Oxygen and Why is it Important?

Dissolved oxygen (DO) indicates the amount of oxygen available in the stream. Certain minimum concentrations are needed to support aquatic life. DO can be reduced by a number of factors such as elevated water temperatures and the loading of organic substances that require oxygen for decomposition (e.g., plant debris and wastewater effluent).

Why do we collect nutrients?

To determine compliance with water quality standards that are set by the TCEQ to protect human health and to determine if there is an unnatural loading of nutrients. High levels of nutrients can cause excessive plant growth which can lead to reduced dissolved oxygen in the stream; in turn this can reduce the survivability of fish. In addition, at certain levels nutrients can cause an excessive growth of algae which can result in taste and odor problems in drinking water.

See Exhibit 5F for example descriptions of water quality groups, dissolved oxygen, and nutrients.

Example Text for the Basin Highlights Report

Water Quality Conditions

Example #1

Segment Description: The Creek begins in northeastern County at about FM 2 and continues 15 miles to the confluence with the River south of City in County. The Creek is typically a shallow, slow moving stream flowing through gently rolling hills lined with agricultural fields and scrub oak trees.

Segment Concerns: In 2004, The Creek was identified as impaired for E. coli bacteria, with concerns for nutrients. Based on stakeholder input and land use analysis, sources of the bacteria pollutants include urban nonpoint sources, such as rapid urban development and pet waste in the upper portion of the watershed, and range cattle and wildlife sources in the middle and lower portions of the watershed. The nutrient concerns are related to significant inputs from wastewater treatment plants in the upper portion of the watershed with some spikes in ammonia found downstream of City.

Actions to Address Concerns: The Creek Watershed Partnership has completed the Watershed Protection Plan (WPP) for the Creek and its tributaries. The Creek WPP is the first watershed protection plan in the state to receive confirmation from EPA that it meets all nine elements of a WPP. The project has moved into the implementation phase of the WPP. Over seven tons of illegally dumped waste was removed from the stream at road crossings; training was provided for municipal officials, on-site septic systems maintenance providers and homeowners; and on-line educational computer modules were developed covering topics such as wastewater treatment, on-site septic systems and disposal for household hazardous wastes. Grant funding received in this phase is covering urban nonpoint source pollution management strategies for the cities of #1, #2 and #3, feral hog management education in the rural portions of the counties, and nonpoint source pollution outreach and education. A link to the status of activities and quarterly newsletters can be found at www.abc-organization.org.

Example #2

Segment Description: The Creek extends 27 miles beginning in County, including the 3,100-acre Creek Reservoir to the confluence with the River in County. Because of the size of the drainage basin, this normally slow moving creek can become a fast, flowing river during a typical Texas rainstorm. Much of the creek bottom is made up of sand with typical vegetation ranging from mesquite and huisache to large live oaks and anaque trees. Because of its rural setting and limited development you can still find a wide range of Texas wildlife along its shores ranging from turkey and deer, to red fox and bobcats.

Segment Concerns: The Creek Reservoir is used for cooling water by the LP coal-fired power plant. This use may impact aquatic life (temperature, dissolved oxygen). Other activities in the watershed that may impact water quality include oil field activities, increasing numbers of subdivision developments, land clearing on existing ranches along the creek, and introduction of non-native aquatic plant species into the Creek system. The watershed is mostly rural, but is undergoing land use changes, including a renewed interest in uranium mining.

Actions to Address Concerns: An examination of the hydrology and groundwater recharge/discharge in the upper Creek is being conducted by the U.S. Geologic Survey. Surface water from the #1 and #2 Creeks and groundwater data from the #1 and #2 aquifers are being collected. The study will provide information that can be used to develop appropriate natural-resource management strategies. The Uranium Corporation is proposing to lease property in County to mine uranium by in-situ leaching. In-situ mining is the stripping of uranium from underground formations by the injection of acid and water. The subsequent solution containing dissolved uranium is pumped to the surface and piped to a production facility. Interested in the possible impacts that this process could have on surface and ground water, stakeholders have asked CRP to collect background samples from the Creek for radiological compounds. Those samples are being collected through fiscal year 2010.

Stakeholder Participation & Public Outreach

Focus on Outreach

This River Authority's Clean Rivers Program public outreach activities include involving stakeholders and committee members in the watershed management planning and analysis process and providing watershed and water quality education to the public.

There are three main groups that help set priorities and direct water quality assessment activities for the program. They include a Steering Committee, a Technical Advisory Group, and a Regional Monitoring Workgroup. For more information on the roles of these committees and how to get involved, please visit: www.abcdefg.abcd.tx.us/intro/introcmte.html

The River Authority has instituted several new approaches to raising awareness of watersheds and water quality throughout the region. While continuing to participate in environmental festivals and outdoor events, the River Authority has also devised ways to reach others who may not attend or have access to those types of events.

One approach has been through direct mail outs. A brochure that summarizes Watershed #1 was mailed out randomly to approximately 3,000 residents in that watershed. Enclosed in the mailing was a postcard response survey that asked the recipient:

1) How familiar they were with the concept of a watershed,
2) Before receiving this document, did they know they lived in Watershed #1, and
3) Had they learned anything new about the health of the aquatic environment from the information provided?

Many of the cards received indicated that the recipient had never heard of the watershed concept, did not know they lived in Watershed #1, and did learn something about the health of the aquatic environment. In addition, almost half of the recipients who returned their survey cards requested more information.

How Do I Get Involved?

- Learn more about how to prevent nonpoint source pollution, request a FREE copy of our brochure, "What Watershed Do You Live In?"
- Be aware of local laws and ordinances that aim to protect our waterways
- Report spills, fish kills, or illegal dumping to TCEQ's Pollution Hotline at 1-800-3OURBAY or to Texas Parks and Wildlife at 281-842-8100

- Volunteer to monitor a nearby creek or lake. Join the River Authority Texas Watch team, please visit: www.abcd.123
- Volunteer for other activities such as the annual Trash Bash, which aims to remove thousands of pounds of trash from area waterways, visit www.trashbash.org
- Check out our Data Clearinghouse for information, interactive maps, online databases, and more at: www.abcdefg.123.org
- Attend our next Clean Rivers Program Steering Committee Meeting which will be posted on our web site at www.abcdefg.123.steeringcmtmtgs.org

Web Site

The River Authority Clean Rivers Program web page contains a variety of different information. The Data Clearinghouse, www.abcdefg.123/waterdata, is full of information on watersheds, water quality, and includes other data resources. The main features of the clearinghouse are: interactive mapping and customized water quality data query.

The complete 2001 Basin Summary Report, including trend analyses and detailed data reviews for each watershed, is available online at: www.abcdefg.123.resources/crp/watersheds.html
Special study summaries and reports are highlighted on the main CRP page at: www.abcdefg.123/intro.html.

EXHIBIT 5B

WATERSHED CHARACTERIZATION REPORT CONTENT & EXAMPLES

EXHIBIT 5B
Watershed Characterization Report Contents

Each segment discussed in this document should be organized numerically by segment number followed by the watershed name.

Segment Description	Describes the segment, assessment unit boundaries contained in each segment, historically monitored sites and site(s) believed to be responsible for the impairment or interest.
Hydrologic Characteristics	Streamflow variability, reservoir dynamics, seasonality of flow, typical flow trends
Description of Water Quality Issue	Identify why the water body is listed and when it first appeared on the 303(d) List or why it is an area of interest. Include the number of samples, parameter(s) of concern or impairment, assessment results and the appropriate state standards for comparison.
Land Use & Natural Characteristics	Describe the land surrounding the segment with the help of Google Earth satellite imagery or GIS. Include cities, agricultural lands, location(s) of permitted discharges, landfills, quarry operations, industrial areas, animal feeding operations and oil/gas operations. Other information could be included, such as, topography, slope, soils, vegetation, wildlife, average annual precipitation, average high and low temperatures, eco-regions.
Potential Cause of Water Quality Issue	Identify possible causes of the water quality issue using satellite imagery, watershed surveys, and communication with stakeholders and staff from state and local agencies.
Potential Stakeholders	Companies, agencies or organizations who have a vested interest in the area and who may have a representative serve as a stakeholder.
Recommended Actions	Proposed next steps based on the potential causes of impairment or interest, number of years on the 303(d) List, quality of the listing data and knowledge of the site.
Maps	Include Google Earth aerial images or GIS renderings beginning at the watershed level and "drilling down" to the monitoring site level. Maps define segment and AU boundaries, watersheds, monitoring sites, permitted discharges and animal feeding operations.
Ongoing Projects	Describe current or future projects that will occur in the segment (e.g. TMDLs, special studies, NPS projects, etc.)
Major Watershed Events	Anticipated or known occurrences that have the potential to either positively or negatively impact water quality (e.g., new/amended permits, fish kills, flood/drought, implementing management measures, land development).
Images	Photographic images of the watershed and areas of interest

EXHIBIT 5B
Watershed Characterization Report Example Text

Segment # and Name

Segment Description:
Segment # begins from a point just upstream of the confluence with the Bayou and stretches up to its headwaters near the Road in the County. The segment is approximately # miles long and has historically been monitored at the following sites (bolded sites are currently monitored):

– the Creek at FM
– the Creek at SH
– the Creek at FM #, southwest of CR
– the Creek above Tidal at the Ranch

There are two impaired AUs in above tidal segment of the Creek, #1 and #2. AU #1 is defined as the # miles surrounding SH #. AU #2 is defined as the upper # miles of the Creek. Data responsible for the listings are from sites #, # and #.

Hydrologic Characteristics:
The median instantaneous flow at the site during the historical record of sampling events was 232 cubic feet per second (cfs) and 127cfs at FM. State of the site during high flows, is it flashy, evidence of scouring? Is it often affected by drought? What seasonal trends are observed?

Impairment/Area of Interest Description:
Segment # is identified on the Draft 2008 303(d) List for not supporting contact recreation and its designated aquatic life use. The segment was first listed for not meeting contact recreation criteria in 2002 and its aquatic life use in 1999.

In Segment #1, the geometric mean of 24 samples of E.coli bacteria that were assessed was 139 MPN, exceeding the criteria of 126. The bacteria impairment is currently classified as 5a, meaning a TMDL will be scheduled. The assessment indicated that dissolved oxygen levels were consistently low at monitoring sites in Segment 31. Twenty-four hour average dissolved oxygen levels did not meet screening levels for 3 of 4 samples (75 percent) assessed, and 16 out of 32 grab samples (50 percent) were below screening levels triggering a concern for aquatic life use.

In Segment #2, three of six samples failed to meet the criteria for 24-hour average dissolved oxygen levels resulting in an impaired aquatic life use with limited data. From 2003 to 2005, TCEQ performed a Use Attainability Analysis (UAA) on Segment # to assess the aquatic life use and determine if the dissolved oxygen standard of 5.0 mg/L was appropriate. Results of the biological portion of the UAA found that a high aquatic life use criteria was met. Analysis of the dissolved oxygen data did not show such clear results. Average dissolved oxygen levels varied from 2.0 mg/L to 4.0 mg/L at each site. At the time of this printing a report on the UAA was not completed. The dissolved oxygen impairment is currently classified by TCEQ as 5b, meaning a review of water quality standards for this segment will be conducted before a TMDL is scheduled. The TCEQ Draft 2008 Water Quality Inventory also identified concerns for dissolved oxygen levels and orthophosphorous based on data collected from site #.

Land Use:
Based on satellite imagery, the majority of the land in the segment is farmed or ranched.
There are two permitted dischargers at the upper end of Segment #1; the Municipal Water District, and the County Power. The Farm is a permitted facility that does not discharge into a stream, but applies chicken manure to land in the area.

There are no urban developments in Segment #. A small subdivision is located along the river at the monitoring site. The houses appear to have been built in the 1960s and 1970's and presumably use septic systems. Two permitted discharges are located upstream of the monitoring site. One belongs to the Corporation, a maker of solvents. The corporation has a permit to discharge 2.28 MGD of treated domestic wastewater and process water and is located eight miles upstream of the monitoring site. The other permit belongs to the Chemical plant, a producer of polymers and plastics. The chemical plant has a permit to discharge 0.65 MGD of treated domestic wastewater and process water and is located two miles upstream of the monitoring site.

Possible Causes of Impairment or Interest:
Nonpoint Sources - The Creek is a meandering creek with oxbow lakes and natural dams that slow flow, creating pools of stagnant water and hindering aeration. The lack of aeration coupled with the breakdown of naturally occurring organics in the water may cause dissolved oxygen levels in the creek to frequently fall below the state standard of 5.0 mg/L. Deer, hog and bird populations likely contribute to bacteria levels in the creek. Further study would need to occur before determining the extent of bacteria from wildlife sources.

Agricultural - practices such as plowing to the creek bank and watering cattle in-stream contribute to low dissolved oxygen and elevated bacteria levels. Farming practices in the area are not known, but the results of the UAA performed by TCEQ in 2006 may help determine current agriculture practices in the segment and their impact on water quality.

Wildlife – The field crew make every effort to sample upstream of the bridge at the sampling site, but sometimes access to a safe area upstream of the bridge is limited and samples are collected under the bridge. Influence of waste from birds nesting in the bridge is unknown. Deer live in the area upstream of the sampling site. According to a rancher, who has lived near the sampling site since 1960, feral hog populations have increased dramatically. Wildlife probably contributes to bacteria levels at the site, but the extent can't be determined.

Urban Runoff - The City is less than a mile south of the site. GIS analysis shows that the western portion of the city drains storm water into the river upstream of the site.

Influences of Flow - Since Segment # is tidally influenced, flow is not measured at Site #. The influence of the tide and pulsed releases from upstream dams play a role in how bacteria are transported, but further study is necessary to determine the extent of flow on bacteria at this site.

Potential Stakeholders:

AgriLife Extension
Landowners
Natural Resource Conservation Service
Texas Department of Agriculture
Texas State Soil and Water Conservation Board
Texas Parks and Wildlife Department
US Fish and Wildlife Service

Recommendation(s):

After the Segment # UAA is complete, work with TCEQ to help determine the status of the water body and if a TMDL is needed. Continue to monitor monthly to obtain enough data for a full assessment in 2010. Evaluate wastewater collection infrastructure including a review of the City Clean Water Program Survey the watershed to verify potential sources of bacteria.

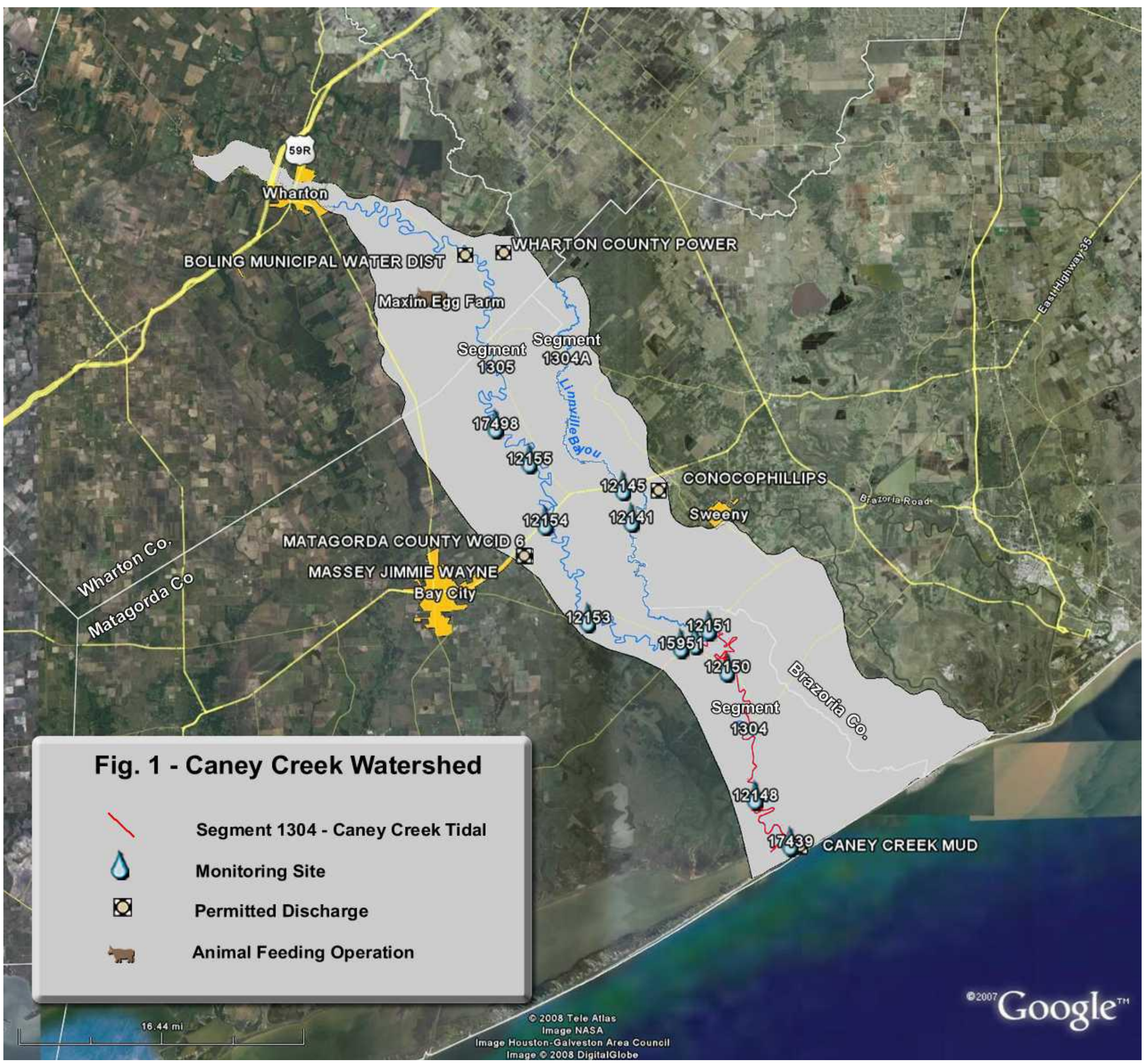


Fig. 1 - Caney Creek Watershed


Fig. 2 - Segment 1304
Caney Creek Tidal
Assessment Unit 01 Boundary
Water Monitoring Site
Permitted Discharge
FM-457
12150
521
FM-2611
FM-521
Seg 1304
12148
17439
CANEY CREEK MUD
3.95 mi
Image © 2008 TerraMetrics
Image Houston-Galveston Area Council
Image © 2008 DigitalGlobe
© 2008 Tele Atlas
©2007 Google™


Fig. 4 - Segment 1304
Caney Creek Tidal
Site 12148

EXHIBIT 5C
OUTLINE & EXAMPLE FOR THE PROGRAM UPDATE REPORT

EXHIBIT 5C
Program Update Report Outline & Example

Introduction

The Introduction should succinctly provide the reader with the purpose of the report and sufficient background to understand the scope of the Clean Rivers Program (CRP) and the information provided within the report.

This Year's Highlights

- What were the major events or occurrences during the previous year (positive and negative)?
- What major issues (e.g., extreme drought, increasing development, confined animal operations, ongoing issues, natural salt pollution, record flood) are plaguing water quality for the basin?
- How have these events impacted water quality?
- What has been done to respond to water quality issues?

Public Involvement/How to Get Involved

This section describes basin efforts to promote public involvement in water quality issues. Planning Agencies will summarize public information and education activities undertaken and evaluate the success of these activities.

Water Quality Monitoring

This section should include a summarization by segment of the monitoring that was planned, or occurred, during the past year including any participating entities and special projects. Ideas for this section include:

- Present information on monitoring for the current fiscal year, to include:
- Number of sites per entity, frequency, type of monitoring
- Provide a table showing water quality impairments and concerns from the Texas Water Quality Integrated Report
- Map the coordinated monitoring schedule for the entire basin
- Show and label sampling sites, water bodies, county boundaries, highways, & cities.

Introduction

This report highlights the activities that occurred in 2008 in the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin under the Clean Rivers Program (CRP). The CRP is managed by the Texas Commission on Environmental Quality (TCEQ), and funded entirely by fees assessed to wastewater discharge and water rights permit holders. The Guadalupe-Blanco River Authority (GBRA) together with the Upper Guadalupe River Authority (UGRA) carry out the water quality management efforts in the basins under contract with TCEQ. The activities described in this report include water quality monitoring, a review of the 2008 305b Water Quality Inventory and public communications efforts. Information on other water quality studies, planning efforts and events that could impact water quality are also included in the *2009 Basin Highlights Report*.

This Year's Highlights

The drought of 2008-09 is on track to go down as one of the worst droughts in Texas history (see section The Drought of 2008-09). However, the decrease in rainfall and subsequent diminishing stream flow did not result in major changes in the water quality of the main stem in 2008. Receiving streams (streams that are the final destination of treated wastewater) have become more effluent-dominated, as seen at the two monitoring locations on Plum Creek. Nitrate-nitrogen and total phosphorus concentrations at the Plum Creek stations are some of the highest in the river basin. Less base flow from Canyon Reservoir resulted in longer water residence times in the run-of-river hydroelectric impoundments along the middle Guadalupe River. The longer residence time promoted higher chlorophyll *a* concentrations in Lake McQueeney which ranged from below detection in January 2008 to 24.8 milligrams per liter in September. The smaller tributaries throughout the upper watershed have become dominated by pools rather than by normal runs and riffles.

The Comal River was affected by elevated bacterial concentrations coming from it's major tributary, the Dry Comal, causing the site at Hinman Island on the Comal River to exceed the stream standard for contact recreation five times in 2008. The Dry Comal is a very large, mostly rural watershed, but the monitoring site is in an urban setting. The City of New Braunfels was contacted for possible sewer main breaks. The collection system was inspected and found to be in good shape, with no leaks. No other cause for the elevated numbers was identified.

In 2007, at the request of stakeholders concerned about the *in situ* mining of uranium in Goliad County, water samples from Coleto Creek were analyzed for background concentrations of uranium and its radioactive by-products. No detections were measured above the minimum analytical limit of the method. Sediment samples taken at the Kerrville-Schreiner Park site on the Guadalupe River were analyzed for metals and organic compounds associated with urban runoff. Total petroleum hydrocarbons were detected (1630 micrograms per kilogram) in the sediment but no benzene, ethylbenzene, toluene and xylenex (BTEX) compounds were detected. All sediment metals concentrations at the Kerrville site were below the TCEQ screening concentrations. Sediment samples collected from the San Marcos River below the City of San Marcos and the San Marcos River at Luling were analyzed for organic compounds associated with urban runoff. No measurable concentrations of total petroleum hydrocarbons (TPH) or BTEX were detected. A water sample collected at Plum Creek at CR135 was analyzed for TPH and BTEX; no compounds were detected. Metals in sediment were analyzed at the Geronimo Creek site, and aluminum, copper, nickel and chromium were detected but well below the TCEQ screening concentration.

A new sampling location has been established in the main stem of the Guadalupe River to replace the sampling location at Dupont in Victoria County. The Dupont site was discontinued due to lack of access to the area downstream of the facility's effluent discharge point and mixing zone. The site on the Guadalupe River near the community of Hochheim, off of SH-183 will be monitored quarterly for flow, field parameters, conventional parameters, and bacteria.

GBRA continues to support Texas Stream Team monitors in the river basin. Groups are monitoring on the Blanco River and its tributaries near Wimberley; the Guadalupe River and tributaries downstream of the release from Canyon Reservoir (Lindheimer Master Naturalists-New Braunfels); Lake Placid on the Guadalupe River near Seguin; and Plum Creek and its tributaries in Caldwell and Hays Counties.

The data collected by CRP are not just for use by TCEQ and GBRA. The data are being used to develop watershed protection plans for Plum Creek, Cypress Creek and Geronimo Creek. Additional comprehensive monitoring is occurring in these watersheds, through funding by Clean Water Act 319(h) grants administered by TCEQ and the Texas State Soil and Water Conservation Board, utilizing the labor and analysis costs through CRP activities as match.

Additional Resources

Link to State Coordinated Monitoring Schedule: http://cms.lcra.org/
Link to Texas Clean Rivers Program Resources (including historical data and maps): http://www.tceq.state.tx.us/compliance/monitoring/crp/data/crp-resources.html
GBRA Clean Rivers Program page: www.gbra.org/CRP/Default.aspx
TCEQ Real-time Water Quality Monitoring Network: http://www.tceq.state.tx.us/assets/public/compliance/monops/water/wqm/tx_realtime_swf.html

How Can You Get Involved?

GBRA and UGRA promote communication and participation from the general public. Anyone who is interested in volunteering, or has a specific concern may send an e-mail addressed to dmagin@gbra.org or write a letter to Debbie Magin, 933 East Court Street, Seguin, TX 78155. Indicate the topics you are interested in and provide enough information to receive mailed notices of meetings and reports. This information will help participants develop sub-watershed groups that have specific interests and may become involved in designing and providing input on special studies. Public participation is highly encouraged in meetings and input on water quality issues in the basin.

The Drought of 2008-09

The drought of 2008-09 is making history. The period between September 2007 and December 2008 recorded only 16.4 inches of rain at the San Antonio National Weather Service Station, becoming the driest 16-month period on record. Previously, 1955-56 held that record, with only 17.71 inches of rain. The U.S. Drought Monitor map (shown below) is issued by the Western Regional Climate Center. The conditions show that the Guadalupe River Basin has experienced "extreme" to "exceptional" drought conditions over the last year. Another statistical tool that meteorologists use to gage the severity of drought is the Palmer Drought Severity Index (PDSI). PDSI is an index that takes into account various meterologic and hydrologic factors such as precipitation, evaporation and soil moisture. South Central Texas and the Edwards Plateau score in the moderate to severe drought range (-3.7). Comparing this PDSI to historical, the period of 1983-85 had a score of -3.1; 1996-98 had a peak score of -4.2 and the drought of record in the 1950's, scored approaching -6.0. According to StormFax.com, in late 2007 through early 2008, the United States was in a La Niña weather pattern. La Niña weather is created when the sea surface temperatures in the tropical Pacific Ocean fall below normal. This phase is characterized by warm winters in the southeastern U.S. Conversely, El Niño, above average sea surface temperatures, creates conditions that are characterized by large scale weakening of the trade winds and warming of the surface layers in the equatorial eastern and central Pacific Ocean. El Niño is synonymous with large scale, climatically-significant warm events, and wet periods in the southern U.S. For additional information and current drought monitor maps visit http://drought.unl.edu/dm/archive.html.

No significant changes in water quality was noted in 2008, nor the need for water use restrictions because early to mid 2007 was a very wet year and contributed a significant volume to recharge. Without rain, as the demand on groundwater picks up in the spring of 2009, the flow from springs and seeps will diminish, severely affecting the base flow of the Guadalupe, Comal, San Marcos and Blanco rivers. Endangered species living in the Comal and San Marcos rivers could be affected as flows drop off, and longer residence times promote higher water temperatures. The streams will become more effluent-dominated, until such time as the reuse of wastewater is in greater demand and then even that flow will not be returned to the stream.

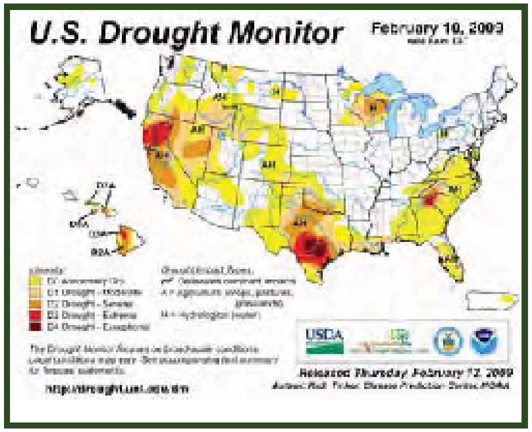


Table of Water Quality Impairments and Concerns from the 2008 305(b) Texas Water Quality Inventory and 303(d) List of Impaired Waterbodies

Segment Number	Area	Parameter of Impairment	Parameter of Concern
1801	Guadalupe River Tidal		Nitrate-Nitrogen
1803A	Elm Creek (entire water body)	DO[1], Bacteria	
1803B	Sandies Creek (from the confluence with Elm Creek to upper end of water body)	DO	
1803B	Sandies Creek (from the confluence with Guadalupe River to the confluence with Elm Creek)	DO, Bacteria	
1803C	Peach Creek (lower 25 miles)	Bacteria	
1803C	Peach Creek (from 1.2 miles down-stream of FM 1680 in Gonzales County to confluence with Elm Creek in Fayette County)	DO, Bacteria	
1804C	Geronimo Creek (entire water body)	Bacteria	
1805	Canyon Lake (entire water body)	Mercury in fish tissue	
1805[2]	**Canyon Lake (upper end of segment)**		**Nitrate-Nitrogen, Ortho-phosphate**
1805	**Canyon Lake (north end Crane's Mill Park peninsula to south end Canyon Park)**		**Ortho-phosphate**
1805	**Canyon Lake (lower end from dam to Canyon Park)**		**Ortho-phosphate**
1806	Guadalupe River above Canyon Lake (from 1 mile upstream of Flat Rock Dam to the confluence with Camp Meeting Creek)	Bacteria	
1806	Guadalupe River above Canyon Lake (from 25 miles upstream of the lower end to the confluence with Big Joshua Creek)	Bacteria	
1806A	Camp Meeting Creek (entire water body)	DO	
1810	**Plum Creek (from approximately 0.5 miles upstream of SH 21 to upper end of segment)**	**Bacteria**	**DO, Total phosphorus**
1810	Plum Creek (from approximately 2.5 miles upstream of confluence with Clear Fork Plum Creek to approximately 0.5 miles upstream of SH 21)		Total phosphorus, Ortho phosphate, Ammonia-Nitrogen
1810	**Plum Creek (confluence with San Marcos River to approximately 2.5 miles upstream of confluence with Clear Fork Plum Creek)**	**Bacteria**	
1813	Upper Blanco River (from Hays CR 1492 to Blanco CR 406)		DO
1815	Cypress Creek (lower 7 miles of segment)		DO
1817	North Fork of Guadalupe River (entire water body)		DO

[1] Dissolved Oxygen. If DO is listed as a concern then the mean concentration exceeded the screening level for a grab sample.
[2] Bolded text is new listing in the 2008 inventory.

Stream Segments	Water Quality Projects/Issues
Segment 1804	**New Braunfels Utilities Releases Results of Water Quality Study on Lake Dunlap** The New Braunfels Utilities (NBU) was required to perform a water quality study on Lake Dunlap, a hydroelectric impoundment, located just downstream of the city of New Braunfels. NBU operates three wastewater treatment plants that discharge upstream of or into the impoundment. The study was conducted over two years. The purpose of the study was to determine if nutrient limitation on point source discharges from the NBU wastewater treatment plants would prevent growth of excessive vegetation. Based on the results from the sampling events and the bioassay investigations, the river system upstream of the wastewater treatment plants and downstream of the Comal River appears to be nitrogen-limited. Chlorophyll *a* growth was directly attributable to increases in nitrate concentrations. The results of the bioassays indicate that growth is independent of orthophosphate concentrations. The study demonstrates that the system is nitrogen-limited and that the water quality of the system is directly related to the percentage of flows from the Guadalupe and Comal rivers. (New Braunfels Utilities) **To get more information:** http://www.nbutexas.com
Segment 1810	**Plum Creek Watershed Protection Plan Completed and in the Implementation Phase** The Plum Creek Watershed Partnership (PCWP) has completed the Watershed Protection Plan (WPP) for Plum Creek and its tributaries in Hays and Caldwell counties. In 2004, Plum Creek was identified as impaired for *E. coli* bacteria, with concerns for nutrients. The Texas State Soil and Water Conservation Board (TSSWCB) selected Plum Creek for the development of the WPP. The project was facilitated by the Texas AgriLife Extension Service. Load duration curve analysis indicated that both point and non-point sources contribute to the impairment. Based on stakeholder input and land use analysis, sources of the pollutants include urban sources, such as urban runoff and pet waste, as well as agricultural activities and wildlife sources (deer and feral hogs). As a result of the watershed planning efforts, other grant funded projects are active in the watershed. A grant from the TCEQ and the US EPA is funding several education and outreach projects. In this project, over seven tons of illegally dumped waste was removed from the stream; training was provided for municipal officials, on-site septic systems maintenance providers and homeowners; and on-line educational modules are in development, covering topics such as wastewater treatment, on-site septic systems and disposal of household hazardous wastes. The TSSWCB is funding a monitoring project that is collecting both baseline water quality data as well as data from Plum Creek and its tributaries under wet weather conditions. The WPP has moved into the implementation phase. Grant funding received for this phase is covering urban nonpoint source pollution management strategies for the City of Kyle, feral hog management education in the rural portions of the counties, and nonpoint source pollution outreach and education. Technical and financial assistance for farmers and ranchers is also being funded. The Texas AgriLife Extension will continue to work in the watershed for three more years. (Texas AgriLife Extension Service) **To get more information:** http://plumcreek.tamu.edu/ **and** http://www.gbra.org/PlumCreek/
Segment 1806	**Upper Guadalupe River Implementation Plan Underway in Kerrville** A portion of the Guadalupe River above Canyon Lake is included in the Texas List of Impaired Waters (also called the 303(d) list). This area exceeded the state standard for *E. coli* bacteria and a Total Maximum Daily Load Study (TMDL) was completed. The TMDL determined the maximum amount of *E. coli* bacteria the river could accept and still maintain its use for contact recreation. An implementation plan (I-Plan) is currently underway to put the TMDL into action by outlining the steps necessary to reduce the bacteria load. The Upper Guadalupe River Authority (UGRA) is working with TCEQ to develop the TMDL I-Plan. Routine monitoring will provide better identification of *E. coli* sources as well as evaluation of control measures. (UGRA) **To get more information:** http://www.ugra.org/projects.html
Segment 1815	**Cypress Creek Project in Wimberley (Hays County)** Understanding that new development is certain, the Cypress Creek Project will create a watershed management plan to ensure that the water quality of the creek improves and remains healthy. The project is being facilitated by the Texas River Systems Institute, through funding provided by TCEQ and US EPA. Phase one of the project will focus on stakeholder recruitment, education and input, which are key to the development of a Decision Support System (DSS). The DSS is a free computer-based tool for decision-makers, local planners and stakeholders to use to examine the impacts of proposed development activities and land management practices on water flows and water quality in Cypress Creek. (Texas River Systems Institute) **To get more information:** http://cypresscreekproject.org/about.html
Segment 1804A	**Development of Geronimo Creek WPP Funded by TSSWCB** Geronimo Creek and its tributary, Alligator Creek, are located in Guadalupe and Comal counties. The 2008 Texas Water Quality Inventory listed Geronimo Creek as impaired for *E. coli* bacteria, with a concern due to elevated nitrate-nitrogen. The TSSWCB and the US EPA have funded the development of a watershed protection plan for the creek. The study will collect additional water quality data over twelve months and will use the data to develop a model of the creek to determine the sources of the impairments and the load reductions needed to bring the stream back into compliance with stream standards. **To get more information: Debbie Magin,** dmagin@gbra.org **or Nikki Dictson,** ndictson@tamu.edu **and** www.tsswcb.state.tx.us/watersheds#geronimocreek
Segment 1803	**New CRP Monitoring Site on Guadalupe Near Gonzales** A new monitoring location has been established on the Guadalupe River located near the community of Hochheim, southeast of Gonzales, on US Hwy 183. The site will be monitored quarterly. It replaces the Dupont site near Victoria, which was discontinued due to the lack of access to a proper sampling location downstream of the industrial complex. **To get more information:** http://www.gbra.org/CRP/WaterQualityDataCollection.aspx

Stream Segments	Water Quality Projects/Issues *(continued)*
Segment 1810 and 1808	**Regional Water and Wastewater Planning Study for Caldwell County** GBRA and Caldwell County received funding from the Texas Water Development Board to conduct a regional planning study for the county. The study is assessing the ability of current development and municipal infrastructure to serve proposed growth in the county, while protecting the water quality of Plum Creek and the San Marcos River. Regional water supply and wastewater treatment alternatives will be evaluated. The process relies on stakeholder inputs and consensus on proposed regional alternatives. This study supports implementation of the wastewater components in the Plum Creek Water Protection Plan. **To get more information: Debbie Magin,** dmagin@gbra.org **or Alan Thompson,** Alan.Thompson@klotz.com
Segment 1807	**Gain/Loss Study Underway on Coleto Creek** An examination of the hydrology and groundwater recharge/discharge in the upper Coleto Creek is being conducted by the U.S. Geologic Survey. Surface water from the Coleto and Perdido creeks and groundwater data from the Chicot and Envangeline aquifers are being collected. The watershed is mostly rural, but is undergoing land use changes, including a renewed interest in uranium mining. The study will provide basin information that can be used to develop appropriate natural-resource management strategies. (Goliad County Groundwater District) **To get more information: Goliad County GCD,** gcgcd@att.net
All Segments	**Guadalupe-Blanco River Trust to Develop Continuous Water Quality Monitoring Network** The Guadalupe-Blanco River Trust (Trust), GBRA, TCEQ and the U.S. Geological Survey are partnering to launch the Guadalupe River Basin Monitoring Network. The Guadalupe River Basin Monitoring Network will be a system of water quality monitors in streams and rivers in the Guadalupe River Basin that collect data at regular intervals, some as often as every 15 minutes. Data will be used for flood-control planning, water quality regulation, and to allow the TCEQ and project partners to detect water quality events in near-real time. Accessing such data allows agencies to take immediate action to remediate problems, thereby minimizing the impact to the environment and people of the area. The network will be accessible over the Internet as will the data that the network collects. (Trust) **To get more information:** http://www.gbrtrust.org
Segment 1802	**Exelon Nuclear Plant Proposed for Victoria County** Exelon Nuclear has selected Victoria County as its site in southeast Texas for a federal license application that would allow construction and operation of a new nuclear plant should the company decide to build one. After conducting in-depth field investigations and research as part of the company's site selection process, Victoria County was identified as the site best suited to satisfy NRC requirements as well as other federal and state laws and regulations. Exelon Nuclear submitted the Combined Construction and Operating License application (COLA) to the federal Nuclear Regulatory Commission in September 2008. The Victoria County site, which was identified in the license application, is an 11,500-acre tract about 20 miles south of Victoria in Victoria County. If built, the facility at the site will use a man-made freshwater lake for cooling. A combined construction and operating license is required for construction of a new nuclear energy plant, but the application does not imply that Exelon has made a commitment to build a plant. Among the various conditions that must be resolved to Exelon's satisfaction before any formal decision to build are: a solution to used fuel disposal, broad public acceptance of a new nuclear plant and assurances that a new plant using new technology can be financially successful. No decisions have been made about when or if the nuclear facility will be built in Victoria County. (Exelon) **To get more information:** http://www.exeloncorp.com/
Segments 1808, 1811, and 1814	**Recovery Implementation Program Being Conducted to Protect Endangered and Threatened Species at Comal and San Marcos Springs** The Edwards Aquifer is in the second year of a Recovery Implementation Program (RIP). A RIP is a multi-stakeholder initiative that seeks to balance water use and development with the recovery of federally listed endangered or threatened species. RIPs use a long-term interdisciplinary approach of policy formation, scientific research, habitat restoration, and education. Stakeholders develop a comprehensive document that outlines goals, activities, timelines, measures of success, and roles of the participants, who then sign a cooperative agreement to implement the activities. The Edwards Aquifer RIP's 26-member steering committee includes representatives of state and regional water agencies, municipalities, industries, agriculture, environmental organizations and the public. The procedural tasks have been completed and the Expert Science Sub-committee is tackling the difficult questions, including the necessity to maintain minimum spring flows. The Edwards Aquifer Authority, state agencies and the U.S. Fish and Wildlife Service are required to approve and execute a RIP agreement by the Fall of 2012. (Votteler) **To get more information:** http://earip.tamu.edu/ **or Todd Votteler,** tvotteler@gbra.org
All Segments	**Aerobic On-Site Treatment Systems Training Offered to Homeowners** Recognizing that failing aerobic on-site treatment systems for domestic sewage have the potential for environmental and public health hazards, GBRA and the Texas AgriLife Extension developed an eight-hour homeowner training course on the operation and maintenance of aerobic wastewater treatment systems. The course was first presented in Comal County and was very well received. The class will be offered again in the Summer of 2009 in Caldwell and Hays counties. Homeowners are taking on the maintenance of their own systems because of frustration with maintenance providers. Home aerobic wastewater treatment systems dispose of the treated, disinfected wastewater on the ground by spray irrigation. If the disinfection system or spray heads fail, the untreated wastewater can expose the homeowner, the family and the environment to harmful pathogens. In order to sustain the program, a "train the trainer" course will be offered to county designated representatives so that they can offer the class in their jurisdiction on a frequent basis. For more information on the class, contact Debbie Magin at GBRA. **To get more information:** http://www.gbra.org/septic.swf

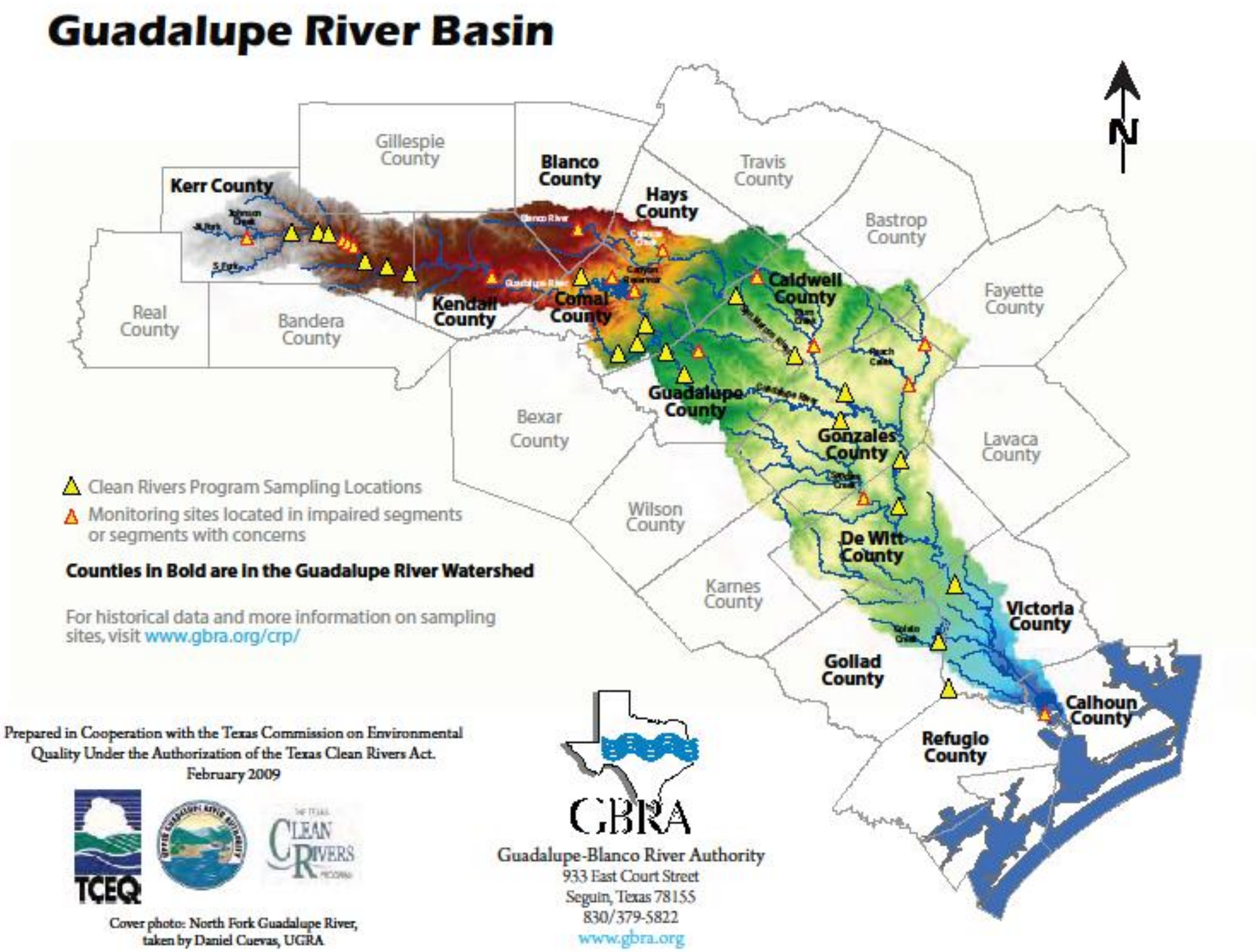

Guadalupe River Basin
N
Gillespie County
Blanco County
Kerr County
Hays County
Travis County
Bastrop County
Caldwell County
Fayette County
Real County
Bandera County
Kendall County
Comal County
Bexar County
Guadalupe County
Gonzales County
Lavaca County
Wilson County
De Witt County
Karnes County
Victoria County
Goliad County
Calhoun County
Refugio County
Clean Rivers Program Sampling Locations
Monitoring sites located in impaired segments or segments with concerns
Counties in Bold are in the Guadalupe River Watershed
For historical data and more information on sampling sites, visit www.gbra.org/crp/
Prepared in Cooperation with the Texas Commission on Environmental Quality Under the Authorization of the Texas Clean Rivers Act.
February 2009
TCEQ
Cover photo: North Fork Guadalupe River, taken by Daniel Cuevas, UGRA
GBRA
Guadalupe-Blanco River Authority
933 East Court Street
Seguin, Texas 78155
830/379-5822
www.gbra.org

EXHIBIT 5D
BASIN SUMMARY REPORT OUTLINE

EXHIBIT 5D
Basin Summary Report Outline

Executive Summary

The Executive Summary is intended to be an informative digest of the significant content and conclusions of the report. It is meant to be intelligible by itself, summarizing the purpose, findings, conclusions and recommendations. The following is an outline for this overview:

Activities and Accomplishments - Describe the successes of the program and how the basin objectives have been accomplished over the past five years. Discuss how efforts undertaken with regard to monitoring (i.e., level of effort), geographic data sets, prioritization of water quality issues, efforts to involve basin stakeholders, and public outreach endeavors, have provided a benefit to the public.

Significant Findings - Summarize the results of the data analyses (e.g., number of sites with high levels of nutrients, positive and negative trends, and any hits with toxics). Describe major water quality issues and the most likely reasons for the water quality conditions. Highlight water quality that appears to be improving and report on any actions that have been taken to improve water quality.

Recommendations - Include specific recommendations for each watershed and explain the basis for the recommendation. Describe how the findings from the data analyses will be used to focus resources in the next biennium.

Summary Report

1.0 Introduction

The Introduction will provide the reader with the purpose of the report and sufficient background to understand the scope of the Clean Rivers Program (CRP) and the information provided within the report. The introduction will also include subsections with the following general headings:

- CRP and basin goals/objectives;
- coordination/cooperation with other basin entities;
- descriptive overview of the basin's characteristics, including key factors influencing water quality;
- summary of basin's water quality characteristics.

2.0 Public Involvement

This section describes basin efforts to promote public involvement in water quality issues. Planning Agencies will summarize public information and education activities undertaken and evaluate the success of these activities. The report will also identify and discuss any public outreach materials developed (e.g., pamphlets for septic tank maintenance, NPS pollution education).

The Basin Steering Committee needs to be discussed fully in this section. This may include a general description of membership, how the committee functions, and typical topics that are discussed at the meetings. This section should define how the committee's input is incorporated in decisions for focusing CRP resources (e.g., special studies, adding sites, adding parameters).

This section also should include efforts to seek public input for prioritizing water quality issues and monitoring projects, including Watershed Protection Plan/TMDL coordination efforts, review of stream standards, the State's Water Quality Inventory, and basin planning initiatives. Where applicable, include a discussion on volunteer environmental monitoring (VEM) groups and the function of these groups.

If any watershed-based technical sub-committees have been formed, a short overview of the functionality of those committees should be provided. A more in-depth discussion of how a committee has been involved in a special study can be provided in the Watershed Summaries section of this report.

3.0 Water Quality Review

3.1 Water Quality Terminology

This section needs to provide a description of any technical terms, including monitoring parameters and how they relate to maintaining water quality standards. A short discussion of the quality controls behind the data should also be included.

A table with parameter descriptions can be found in Exhibit 5F.

3.2 Data Review Methodology

This section will include a discussion of the methods used to evaluate the data and should provide enough detail for the reader to be able to re-create your steps. Some of the process overviews include:

- an explanation of TCEQ's assessment methodology, along with how the State's information will be used in the report
- a discussion of the methods used to conduct the Trend Analysis specifying the parameters used to screen the data (e.g., number of records, period of record) and the criteria used to determine whether a trend exists (e.g., percent change per parameter)
- an explanation of any additional evaluation methods (e.g., compare descriptive statistics from site to site for similar watersheds to determine the relative level of concern; compare descriptive statistics upstream to downstream to find significant changes, then relate factors in the watershed to the change)
- a description of the index of biotic integrity used for biological surveys

3.3 Watershed Summaries

The review of water quality data and watershed characteristics should be presented within the context of a watershed to keep information for stations that are in close geographic proximity and subject to similar watershed characteristics together. For our purposes, a watershed is typically defined by a segment and the land/tributaries that drain to it. The following information will make up each

Watershed Summary (see Exhibit 5E for Data Analysis Steps and Exhibit 5F for an example Watershed Summary) and will help answer the questions:

- what are the water quality issues?
- why do the issues exist?
- what are the possible effects?
- what should be/could be done about it?

What are the Water Quality Issues?

The first step in the review of water quality is to *identify water quality issues*. A water quality issue may be identified in one or more of the following ways:

- listed as an Impairment or Concern on the latest TCEQ Water Quality Integrated Report;
    - Impaired/concern because 8 samples out of 28 collected over the past five years were over the criteria/screening level
- local concern of stakeholders; and/or
- through the Data Analysis (see Exhibit 5E) conducted by the Planning Agency
    - The 8 samples typically 3 times higher than the criteria/screening level
    - The trend analysis indicates a significant upward trend, and concentrations are getting close to the criteria/screening level
    - This water body exhibits the third highest median concentration of the parameter in the central watershed over the past five years

Note: In those cases where there is no "identified water quality issue", the report needs to include some discussion of water quality. The discussion should include an overview of the watershed characteristics, results from the latest TCEQ Assessment, and the descriptive statistics (e.g., percentiles) to show how they compare to other similar water bodies in the area.

Next, for identified water quality issues, a description of the findings from a data analysis is needed to lay the groundwork for understanding the status of water quality. This will be a discussion based on the *Data Analysis* (see Exhibit 5E) conducted to determine if any trends exist, and how other corollary factors, such as flow or another parameter, are influencing water quality conditions. Examples for this type of discussion are provided in *Exhibit 5F – Example Watershed Summary*.

Why Do the Issues Exist?

Once a water quality issue has been identified and defined, a description is needed *explaining the possible reason(s) it is an issue* (e.g., what is causing the problem) to improve overall understanding of the issue and its relative importance. The following is example text for this type of explanation:

- rapid urban development bringing additional land application of fertilizers, pesticides, pet waste, septic systems, and new sewage outfalls, which can result in increased concentrations of nutrients, bacteria, and organic constituents in the water body

- large areas of cropland involving tillage, the use of fertilizers and pesticides, which can result in increased sediment loads to the water body, as well as nutrients and organic constituents from the fertilizers and pesticides
- wildlife waste which can add bacteria and nutrients
- low flows, combined with pollution sources, do not provide adequate assimilative capacity
- a review of the flows related to the 8 elevated samples shows a direct correlation to rainfall and run-off, indicating that nonpoint sources are more likely to cause concentrations to exceed criteria, although base-level concentrations are somewhat elevated pointing to some influence from wastewater outfalls
- a review of the water quality upstream and downstream of the site show a decline from upstream to downstream possibly due to increased spring flows and distance from the rapid urban development in the upper portion of the watershed

Note: A set of base maps showing the relationship of watershed characteristics with water quality conditions will be included in each Watershed Summary. The maps need to be at a suitable scale and contain an appropriate amount of detail, such as: water bodies with labels, major roads with labels, sampling sites with labels, counties and cities, segment boundaries, locations of water quality issues and factors influencing water quality.

What are the Possible Effects?

An explanation about how the water quality issue will affect the uses of the water body is important to determining the relative importance of the issue. Some examples for the possible effects of the water quality issue include:

- the increased sedimentation can reduce the survivability of aquatic life and reduces the aesthetic use of the stream
- when flows increase after a rain event, the stream may not be suitable for swimming because bacteria concentrations increase by up to five times the state-established criteria
- nitrate concentrations at levels above 10 mg/L are considered too high for drinking water use, and levels above 30 mg/L are shown to have a negative impact on aquatic life in the stream
- the EPA has stated that perchlorate can cause developmental problems in children if consumed in drinking water

What Should be/Could be Done About It?

A discussion of the “next steps” that need to be taken to reduce the impact of the water quality problem will help in setting future priorities for monitoring and strategies for improvement. Some examples of possible next steps to addressing a water quality issue include:

- continue the Planning Agency’s supporting/technical role in the ongoing Watershed Protection Plan
- enhance stormwater controls for rock quarry operations
- work with local farmers to find an alternative to the use of atrazine

- obtain support for the regional wastewater treatment plan from local municipalities, developers, and county government
- conduct a special study to include two biological surveys including 24 hour dissolved oxygen measurements, target monitoring to run-off events as well as non-run-off events, and monitor monthly for two years at five sites in the watershed at locations near potential sources

See Exhibit 5E for specific steps for conducting the Data and Trend Analysis

Evaluation of Biological and Toxics (Organics, Metals) Data

The information developed from biological surveys should be incorporated into the Water Quality Review to complement the findings from the water quality data. A comparison of the latest results to any previous results should be included to provide a long-term view of the information.

For toxics data compare the results to water quality standards, maximum contaminant levels, and/or screening levels and describe the relevance of the findings.

4.0 Recommendations and Conclusions

4.1 Recommendations and Comments

While watershed-specific recommendations are made in the Watershed Summaries (see Exhibit 5E), this section needs to include recommendations and comments made by stakeholders who reviewed the draft Basin Summary Report. In addition, an outline of the programmatic, regulatory, and legislative recommendations to protect and improve water quality throughout the basin need to be discussed. These recommendations may include a consideration of resources available for implementing the action.

The results of the analyses for this report, as well as input from stakeholders, should be used to set some preliminary priorities for addressing water quality issues. These priorities will help define where additional analysis may be needed for the Basin Summary Report. This will also help determine where additional information could be collected under the next biennium's Work Plan.

4.2 Conclusions

The report concludes with a discussion of how the Planning Agency's efforts have advanced the understanding of water quality. Also, this section will describe the Planning Agency's long-term vision of how basin efforts need to be directed during the next biennium to improve water quality.

Exhibit 5E
Data Analysis Steps
(for the Basin Summary Report Section 3.3)

EXHIBIT 5E
Data Analysis Steps

1. **Divide the basin into manageable sections (watersheds and/or segments)**
2. **Review the data and describe the water quality conditions**
   a. **Graph the Priority Parameters** (see Exhibit 3C for a list of priority parameters)
      (1) Graph data for all segments whether or not they have an impairment (this will help in describing water quality).
      (2) Graph data over time and include related parameters to help describe any correlations (especially flow).
   b. **Run a Trend Analysis**
      (1) If there is enough data (>9 years, >19 records, consistent sampling), run a regression against time and describe the results (trend is significant with t-ratio = or > |2|, p-value < 0.1).
   c. **Include Graphs for Identified Water Quality Issues**
      (1) Put graphs in the report for water quality issues that will benefit from a visual representation (especially for *Impairments, Concerns,* major exceedances, and other significant issues).
   d. **Describe the Water Quality Shown on the Graphs** (whether you include the graphs in the report or not).
      (1) Describe the range (variability).
      (2) Explain any measurements that do not meet criteria/screening levels.
      (3) Does water quality vary with flow?
      (4) Is there a seasonal component?
      (5) What percent of the data exceeds the screening level for the past 7 years? Is it a *Concern* or an *Impairment*?
      (6) Is a change in data over time visible?
      (7) Is there any corollary information to explain the effect of the issue (e.g., how do other related parameters vary)?

Tips for Conducting the Data Analysis

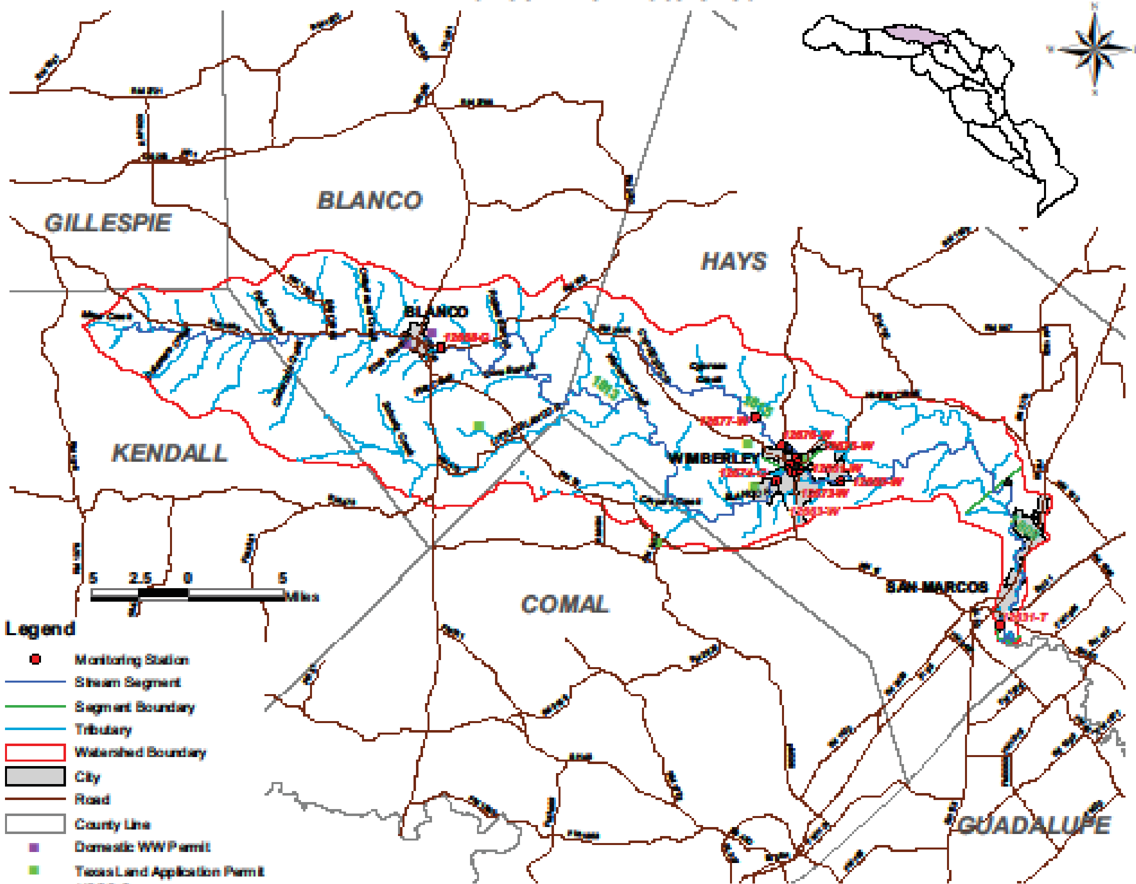
1. Pull all data for sites in the basin that provide a good representation of a water body. In some cases, more than one site will be needed to adequately represent a water body. Associate flow with every record, and in reservoirs, get information on releases and/or inflow if available.
    a. Put the data for each watershed into a spreadsheet (Station, Date, Time, Depth, Parameter code, GTLT, and value) for all data. Select stations based on longevity, significance, and coverage. (If there are stations that are very close to each other, then you may want to select one over the other. If there are significant differences in the data, or known influences between the two sites, it may be necessary to keep both.)
    b. In some cases, one station was dropped and a different one was picked up nearby, you will need to add those data sets together to achieve a longer data set; however, do not overlap data for the same period of record, since we do not want to double count data that may skew the results (e.g., data on the same day, data during the same month, more data in one month/quarter/year than in others).
2. Prepare the data for graphing and analysis.
    a. Sort the data by Parameter code, station, and date.
    b. Check for data that may need to be combined (e.g., put on the same graph) to lengthen the period of record (be careful not to double-up within a time period). For instance, nitrates have three or four different, yet comparable Parameter codes (00593, 00620, 00621, 00630, 00631), orthophosphate phosphorus has two (00671 and 70507), E. coli has at least two (31648, 31699), and chlorophyll a has two (32211, 70953). You might consider plotting fecal coliform values and E. coli values on the same graph to see if a trend is evident in both (but be sure to show them with different symbols).
    c. Consider converting spec. conductance to TDS (let the reader know you have done this).
    d. Non-detects can generally be left as is, ignoring the less than sign; however, in cases where a trend is visible, edit the non-detects to make them consistent. This can be done by changing all the non-detect measurements to the lowest non-detect measurement.
    e. In most cases, it will be necessary to transform the bacteria data by taking the log of that data prior to performing any type of regression analysis.
3. Graph the data for each significant Parameter over time (nitrate, phosphorus, DO, pH, bacteria, TDS, TSS, ammonia, chlorophyll *a*)
    a. Use a graph template and plot flow with the parameter whenever possible.
    b. Check the scale to see if it needs to be adjusted. There may be a few high values that cause all the low values to be unrecognizable. Use some judgment as to where you should draw the line, but be as consistent as possible for each parameter.
    c. If there are a few values that occurred years ago, exclude these from the graph.
    d. If the data set is very long, and the earlier years do not show anything significant, consider plotting only the last 15-20 years of the data set. Be consistent on period of time.
    e. If there is a value that appears to be unreasonable (almost impossible), it may be an outlier and should be excluded from the data review.
    f. Be sure to plot the criteria or screening level on the graphs.

Exhibit 5F
Example Watershed Summary
(Example for the Basin Summary Report Section 3.3)

Water Quality Issues Summary

Water Quality Issue	**Affected Area**	**Possible Influences / Concerns Voiced by Stakeholders**	**Possible Effects**	**Possible Solutions / Actions Taken**
Impairment for E. coli bacteria on 2006 Water Quality Inventory	Upper and lower portion of the watershed	▪ Rapid urbanization, impervious cover ▪ Construction stormwater controls failing ▪ Developments with septic tanks or small, privately-run wastewater treatment plants ▪ Small, slow moving stream with little assimilative capacity Illegal dumping at creek crossings	▪ Increased quantity of stormwater scouring stream beds, creating additional sediment loading and urban-related pollutants ▪ Bacteria load from land use and effluent is not reduced by instream flow ▪ Significant contact recreation (e.g., swimming) could lead to gastrointestinal illnesses	▪ Improve stormwater controls in new developments ▪ Adequate construction oversight ▪ Wastewater regionalization to prevent multiple small package plants and reduce septic tanks ▪ See *Response to Concerns*
Elevated Ammonia-N	Upper portion of watershed	Wastewater treatment plants	Detrimental effect on aquatic biological community	Wastewater treatment plant improve operations
Concern for Nutrient Enrichment (Nitrates and Phosphorus)	Entire watershed	▪ Wastewater treatment plant effluent ▪ Spring water high in nitrates from geology of aquifer formation ▪ Row-crop agriculture	▪ Can increase production of algae causing an aesthetic nuisance ▪ Can cause significant swings in dissolved oxygen, affecting viability of aquatic life ▪ In moderate amounts, can actually enhance the fish population	▪ If dissolved oxygen swings are significant and biology shows a related effect, then some phosphorus controls may be needed for wastewater treatment plants ▪ Water golf courses and other open areas with effluent- may actually reduce water quality due to reduced flows instream
Stakeholder concern for oil and gas operations	Lower portion of the watershed	▪ Recent increased oil and gas activity ▪ Historical stakeholder accounts indicate sheens in 70s and 80s, but not today	▪ Detrimental effect on biological community ▪ Drinking water polluted with organic oil field by-products ▪ Contact recreation use could lead to illnesses	RA sampled two sites, twice, and found no detection of related pollutants
Decreasing Trend for Total Phosphorus	Lower portion of the watershed	▪ Reduction in wastewater treatment plant effluent ▪ Unknown*	▪ Reduction in algae production instream ▪ Reduction in diurnal swings in dissolved oxygen, reducing stress on aquatic biology	Re-use of wastewater treatment plant effluent during dry, low-flow periods

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

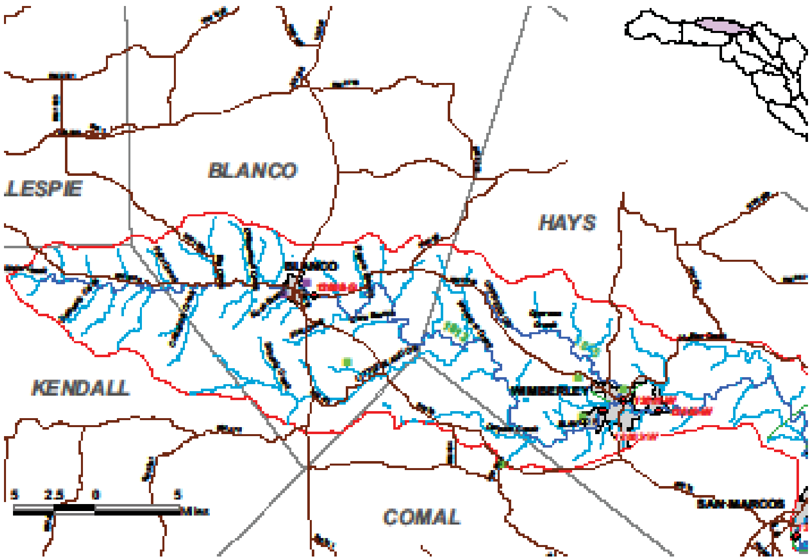
Water Body Uses: Aquatic Life Use, Contact Recreation Use, General Use, Fish Consumption Use, and Public Water Supply Use

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

Blanco River Watershed



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.

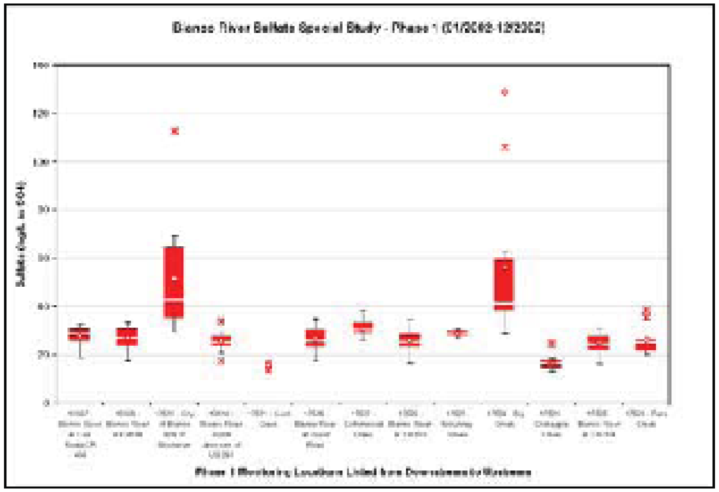


Figure 1. Box and whisker plot of sulfate concentrations at the 13 locations monitored during the first phase of the special sulfate study on the Upper Blanco River.

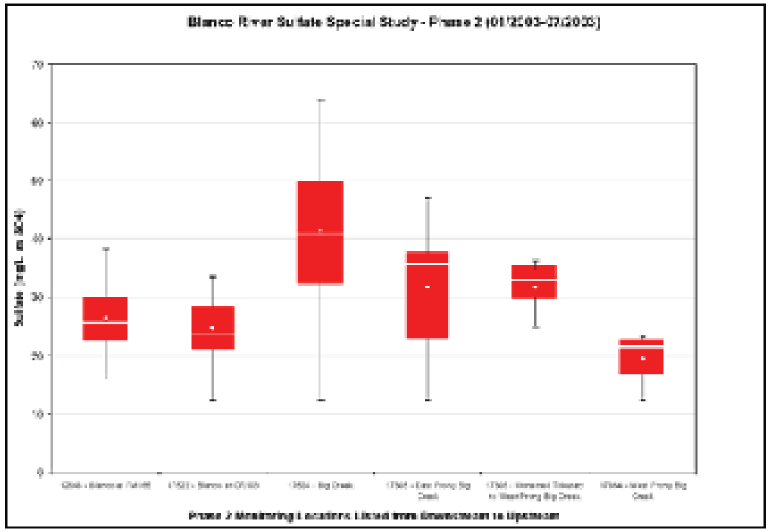


Figure 2. Box and whisker plot of sulfate concentrations at the 6 locations monitored during the second phase of the special sulfate study on the Blanco River.

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^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.

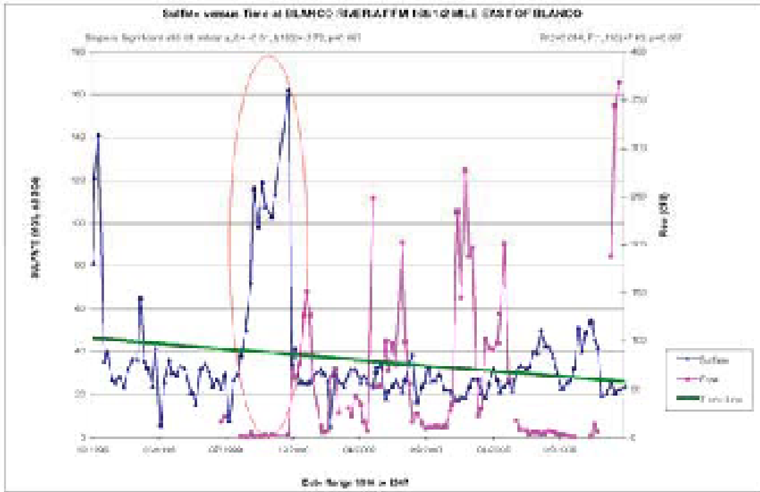


Figure 3. Sulfate concentration versus time at the Blanco River at FM 165 (12668) GBRA monitoring station (period of time that prompted sulfate special study is circled in red).

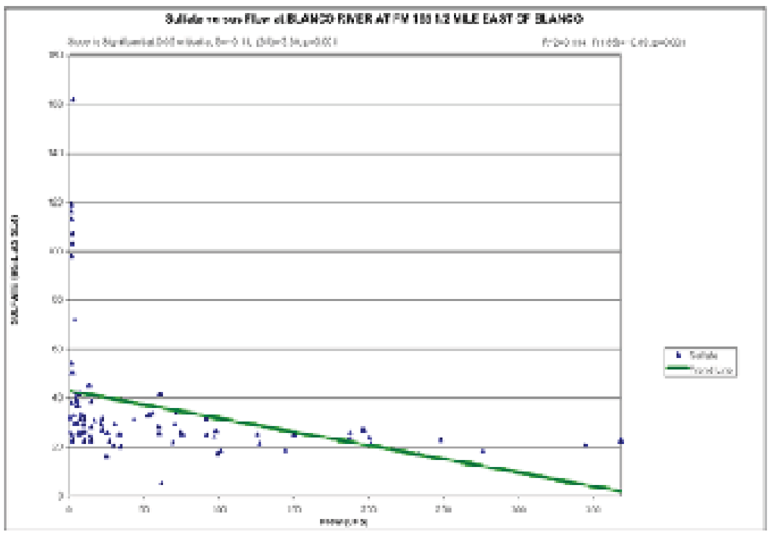


Figure 4. Sulfate concentration versus Flow at the Blanco River at FM 165 (12668) GBRA Monitoring Station. An inverse relationship was found to exist between sulfate and flow.

Nitrate nitrogen, ammonia nitrogen total phosphorus, and chlorophyll a were analyzed at the WWA 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 WWA 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 WWA took over monitoring duties from the TCEQ.

Nitrate nitrogen, ammonia nitrogen and total phosphorus were analyzed at the WWA 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 WWA 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 WWA took over monitoring duties from the TCEQ.

Nitrate nitrogen, ammonia nitrogen and total phosphorus were analyzed at the WWA 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 WWA 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 CR 173 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.

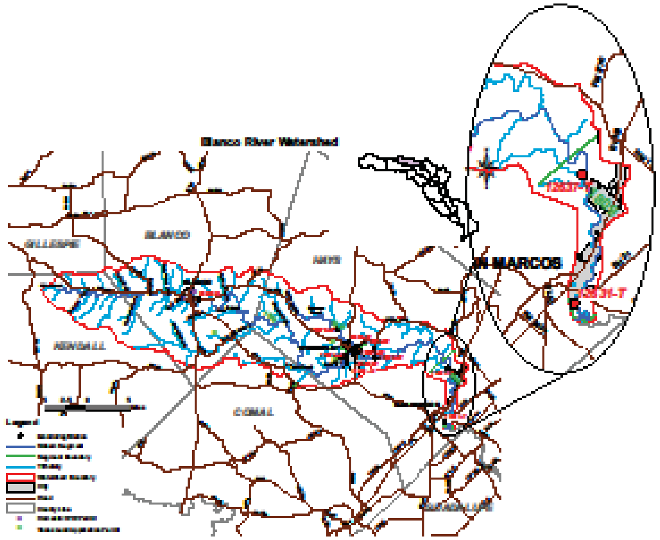
Land Uses

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 CR 173 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

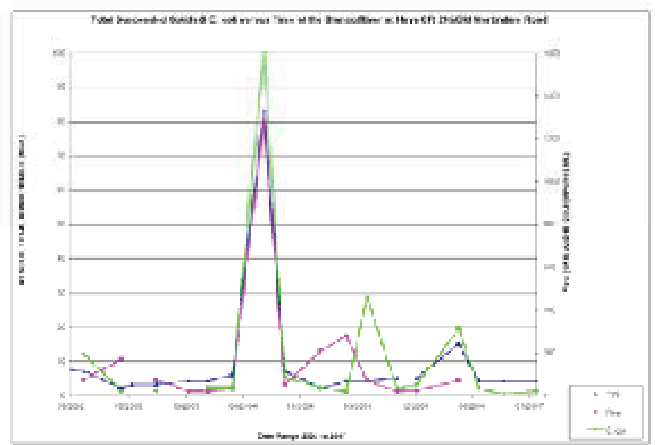


Figure 1 - Total suspended solids and *E. coli* over time at the TCEQ Blanco River at CR 295 (12631) monitoring location.

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.

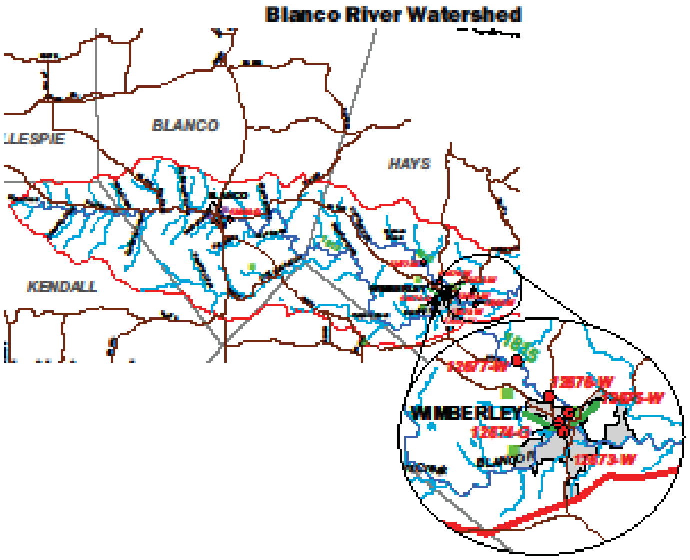
There are no permitted dischargers in segment 1809 of the Blanco River. The 2008 draft Texas Water Quality Inventory Report had no impairments or concerns listed for Segment 1809. The TCEQ CR295 monitoring site had median concentrations of **conductivity, chloride** and **sulfate** of 448 micromhos per 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).

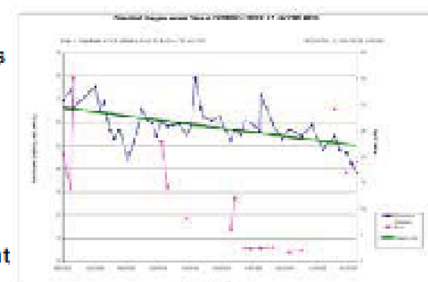


Figure 1. Dissolved oxygen over time at Jacob's Well (12677) on the Cypress Creek.

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 11.1°C to 26.8°C, 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 RR 12 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.

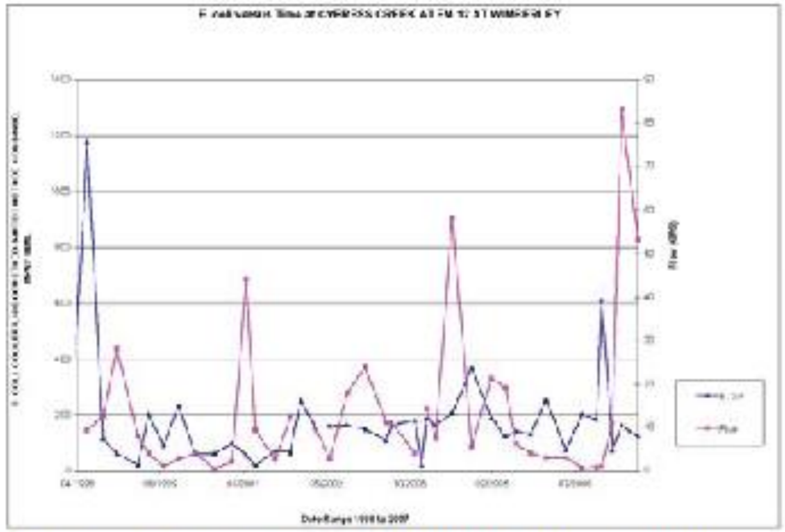


Figure 2. *E. coli* concentrations and flow over time at the Cypress Creek at FM 12 site (12674).

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).

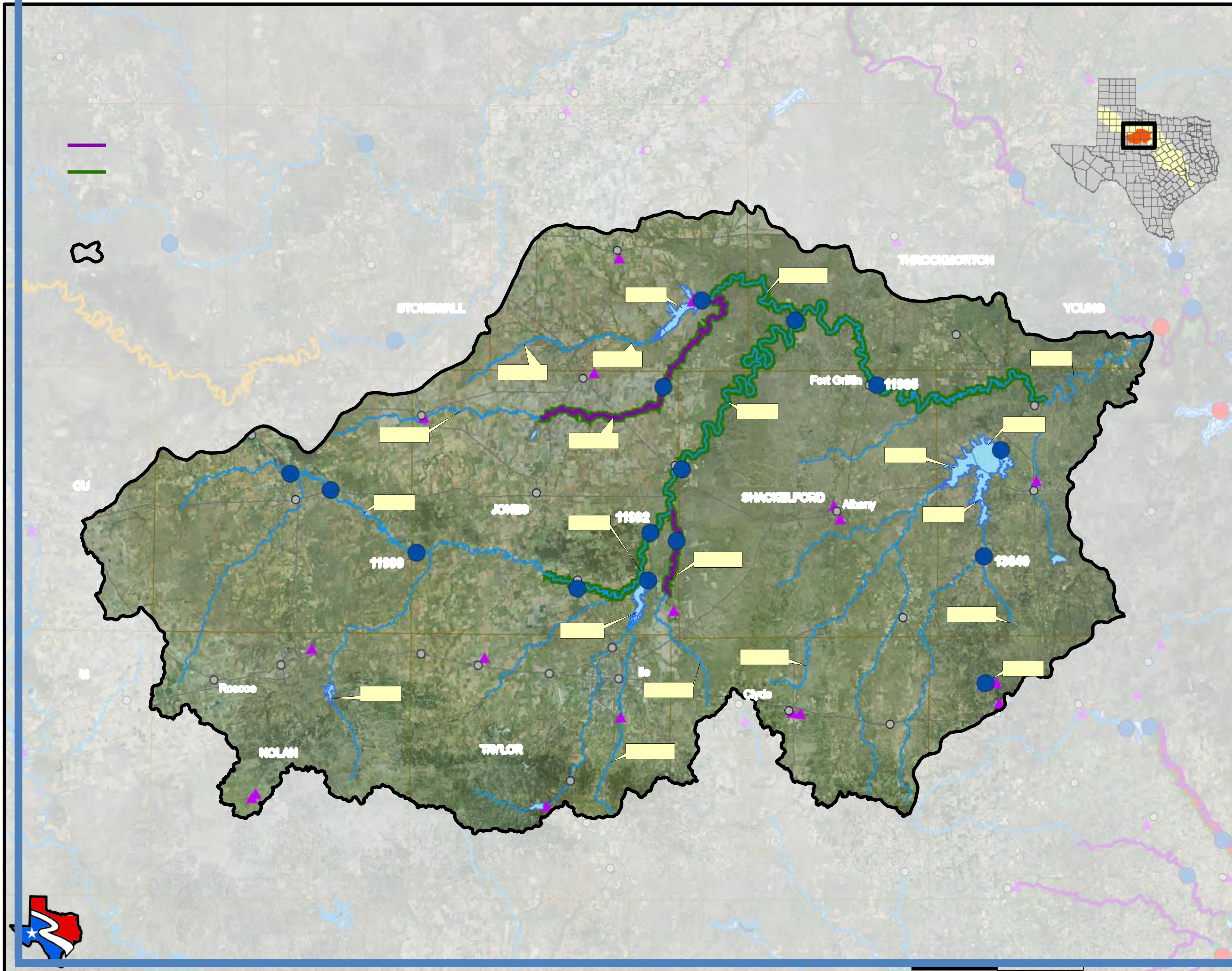

STONEWALL
THROCKMORTON
YOUNG
Fort Griffin
JONES
SHACKELFORD
Albany
Roscoe
Clyde
NOLAN
TAYLOR

Table 3.3.2.1 Segment Specific Water Quality Standards with Indications of Impairment and/or Concern from the 2010 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) and Significant Long-term Trends[1]

Clear Fork Watershed		Uses		Surface Water Quality Standards								Nutrient Screening Levels				
Segment	Name	Recreation[2]	Aquatic Life[3]	Cl (mg/L)	SO4 (mg/L)	TDS (mg/L)	Dissolved Oxygen Average/ Minimum (mg/L)	pH	Bacteria[3] (MPN/100ml)	Temperature (°F)	Chlorophyll *a* (µg/l)	Ammonia - N (mg/l)	Nitrate - N (mg/l)	Orthophosphate Phosphorus (mg/l)	Total Phosphorus (mg/l)	Chlorophyll *a* (µg/l)
1232	**Clear Fork Brazos River**	**PCR**	**H**	**1250↓**	**2200↓**	**4900↓**	**5.0/3.0↓**	**6.5-9.0**	**126**	**93**		**0.33↓**	**1.95↑**	**0.37**	**0.69**	**14.1**
1232A	California Creek	PCR	H	1250	2200↓	4900↓	5.0/3.0	6.5-9.0	126	93		0.33↓	1.95↑	0.37↑	0.69	14.1↓
1232B	Deadman Creek	PCR	I	1250↓	2200↓	4900	5.0/3.0	6.5-9.0↑	126	93		0.33↓	1.95↑	0.37↓	0.69	14.1↓
1232C	Paint Creek	PCR	H	1250	2200	4900	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.37	0.69	14.1
1233	**Hubbard Creek Reservoir**	**PCR**	**H**	**350**	**150↑**	**900**	**5.0/3.0**	**6.5-9.0**	**126↑**	**93**	**5.61↑**	**0.11↓**	**0.69**	**0.05↓**	**0.37**	
1233A	Big Sandy Creek	PCR	L	350↓	150↓	900	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.37	0.69	14.1
1233B	Hubbard Creek	PCR	H	350↓	150	900	5.0/3.0	6.5-9.0	126	93		0.33	1.95	0.37	0.69	14.1
1234	**Lake Cisco**	**PCR**	**H**	**75**	**75↓**	**350↓**	**5.0/3.0**	**6.5-9.0**	**126**	**93**	**5 .00↑**	**0.11↓**	**0.69**	**0.05↑**	**0.37↑**	
1235	**Lake Stamford**	**PCR**	**H**	**580↑**	**400**	**2100**	**5.0/3.0**	**6.5-9.0**	**126**	**93**	**16.85**	**0.11**	**0.69**	**0.05↑**	**0.37**	
1236	**Fort Phantom Hill Reservoir**	**PCR**	**H**	**130**	**150**	**550**	**5.0/3.0**	**6.5-9.0**	**126**	**93**		**0.11**	**0.69**	**0.05**	**0.37**	**26.7**
1237	**Lake Sweetwater**	**PCR**	**H**	**250**	**225**	**730**	**5.0/3.0**	**6.5-9.0**	**126**	**93**	**13.28**	**0.11**	**0.69**	**0.05**	**0.37**	

[1]Long-term trends were calculated with all data available and not less than 10 yrs. Significance was determined at p-value <0.05.
[2]PCR- Primary Contact Recreation
[3]E-Exceptional, H-High, I-Intermediate, L-Limited
[4] The criteria numbers represent the geometric mean for *E. coli*

Segment or portion of segment impaired

Segment or portion of segment has a concern for the standard or screening level

↑ Statistically significant increasing trend

↓ Statistically significant decreasing trend

Watershed of the Clear Fork of the Brazos River

The Clear Fork of the Brazos River begins in Fisher County and flows 284 miles east through Jones, Shackelford, Throckmorton, Stephens, and Young Counties, to its mouth on the Brazos River, near South Bend in southern Young County. The watershed drains approximately 5,728 square miles in the Central Great and Central Oklahoma/Texas plains, EPA Level III ecoregion. Land use is predominantly agricultural with Abilene representing the only urban area. There are five drinking water supply reservoirs within this watershed including Hubbard Creek Reservoir, Lake Cisco, Lake Stamford, Fort Phantom Hill Reservoir, and Lake Sweetwater.

All classified segments within the Clear Fork Watershed of the Brazos River meet water quality standards to support their designated uses. However, *E. coli* impairments are in place for two unclassified segments **1232A** and **1232B** (California and Deadman Creek) and nutrient concerns are present throughout segment **1232** (Figures 3.3.2.1 and 3.3.2.2)**.** Overall in segment **1232B**, there is an increasing trend in nitrate, however it should be noted that the first few years of monitoring resulted in low nitrate concentrations with increased concentrations beginning around 1985 and persisting until the late 1990s. Considering data only from the late 90's on, there is no statistical increasing trend. Because **1232B** is effluent dominated, it is reasonable to suggest that this is the result of a WWTP coming on line or changing processes in the mid 80's with improved operations and BMPs occurring from the late 90's to the present.

Figure 3.3.2.1 **1232 Nitrate**

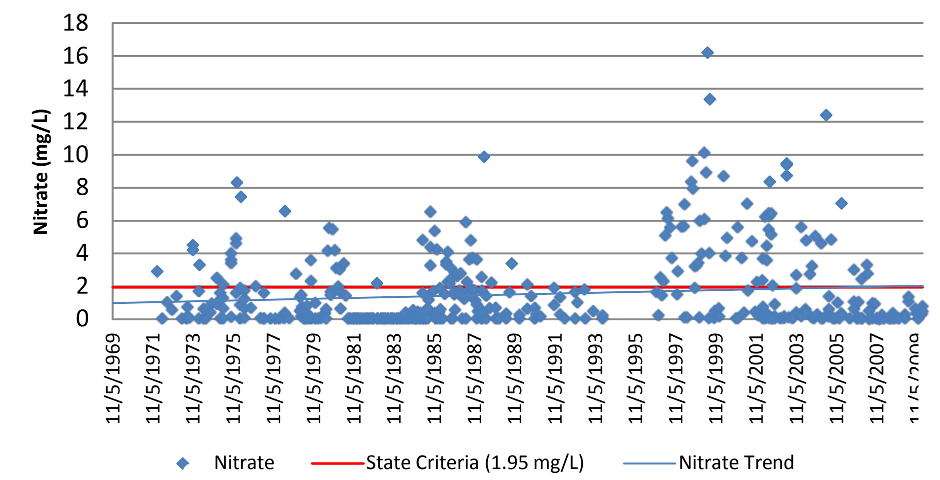
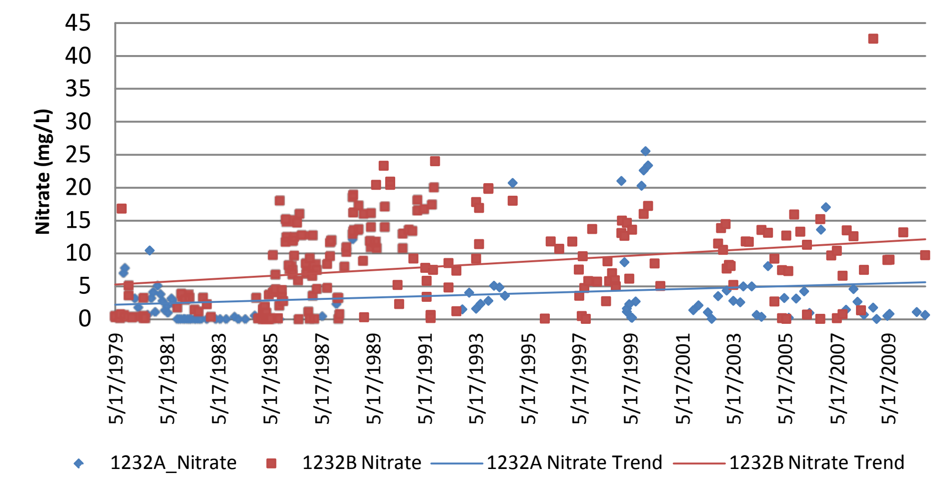


Figure 3.3.2.2 **1232A and 1232B Nitrate**



The 2010 Texas Integrated Report lists segment **1233A**, Big Sandy Creek, as a concern for near non-attainment for *E. coli*. Elevated levels of nutrients and bacteria in segment **1232A** (Figure 3.3.2.3) are likely attributed to nonpoint source pollution. Deadman Creek is an effluent dominated stream and municipal discharges are most likely the greatest contributor to the nutrient and bacteria loading in the stream. Other potential contributors in segment **1232B** (Figure 3.3.2.4) include agricultural runoff, urban runoff and wildlife.

Figure 3.3.2.3 Data collected at Station 11709 - CALIFORNIA CREEK AT FM 142 EAST OF STAMFORD is used to assess Segment 1232A_01.

Figure 3.3.2.4 Data collected at these four stations is used to assess Segment 1232B_01.

Special Studies:

Biological Assessments:

Segment 1232A, California Creek, an unclassified stream in the watershed of Clear Fork Brazos River Segment 1232, flows into Paint Creek just below Lake Stamford. The creek has not been assigned an aquatic life use (ALU) or dissolved oxygen (DO) criteria by TCEQ. Following TCEQ guidelines, a high ALU and 24-hour DO criteria of 5.0 mg/L (average) and 3.0 mg/L (minimum) are presumed to apply, since flow is perennial. Biological assessments were performed at FM 142 east of Stamford, Station 11709, on June 29-30 and August 10-11, 2009. The purpose was to assess the current condition of aquatic life in the creek. Routine water quality monitoring data has suggested a degree of water quality degradation in recent years, and previous 305(b) assessments have identified concerns for nitrate and chlorophyll *a*.

In the initial event, during the non-critical portion of the index period, a datasonde was deployed and physical habitat and fish assessments were completed on June 29. Due to overnight rainfall and rising flow, the event had to be terminated on the morning of June 30. No water chemistry or benthic macroinvertebrate samples were collected, and no flow measurement was performed. The datasonde deployment period was 21 hours, versus the normal 24 hours, which necessitated calculation of a time-weighted DO average. Event results showed that DO concentrations achieved an exceptional ALU, while physical habitat and fish attained an intermediate ALU.

In the second event, during the critical portion of the index period, reassessment of one habitat transect showed that characteristics had not changed appreciably; therefore, the 6/29/09 physical habitat data, reflective of an intermediate ALU, were re-utilized. Dissolved oxygen concentrations achieved an exceptional ALU, while benthic macroinvertebrates and fish attained a limited ALU.

Regarding 305(b) assessment concerns, no nitrate data were obtained. The single chlorophyll *a* value generated, in August, did exceed TCEQ's screening level.

Biological components did not meet high ALU expectations during either event. Fish IBI scores were depressed due mainly to lack of benthic invertivore species, low prevalence of piscivorous species, and dominant numbers of red shiner *Cyprinella lutrensis*, a tolerant species. The low benthic IBI score was due mainly to low total number of taxa (11), and dominance by two relatively tolerant organisms, the caddisfly *Cheumatopsyche* and the riffle beetle *Stenelmis*.

A number of environmental factors may contribute to suppressed biological integrity. As reflected by the Habitat Quality Index, physical habitat is not particularly favorable, due mainly to steep, erodible stream banks and low channel sinuosity. Information from the present study, TCEQ's SWQMIS data base, and USGS historical flow reports shows that base flow is minimal, generally <0.2 cfs during dry weather. Physicochemical-related stresses may occur under those conditions, particularly during the summer. An example is that the maximum water temperature on 8/10/09 was 32.7 °C, near the criterion for Segment 1232 and potentially stressful to some aquatic species. Conductivity generally is fairly high and sometimes exceeds 8,000 µmhos/cm, a level that may exclude salt-sensitive taxa. Nutrient concentrations are often elevated, particularly nitrate which sometimes exceeds 7 mg/L. This promotes excessive primary production, as is reflected by historical chlorophyll *a* levels exceeding 70 µg/L 64% of the time. At some point, exaggerated algal photosynthesis/respiration disrupts instream DO dynamics. A degree of disturbance was evident in fairly wide diel DO fluctuations during both 2009 events.

Other potentially detrimental hydrological influences include the fact that some species that might otherwise occur may be excluded by insufficient water volume during low flow. Maximum depth during the June event, when streamflow was 0.4 cfs, was only 0.76 m. Pool depths during flows <0.2 cfs, which regularly occur, may be insufficient to support some taxa such as larger species of fish. Similarly, limited depth of riffles and runs may exclude certain rheophilic species. Another consideration is that streamflow is flashy; during most years there are multiple rise events, with flow suddenly increasing from near zero to several thousand cfs when heavy rainfall occurs. This hydrological pattern is a product of the relatively arid climate together with the large drainage area (1,237 km^2). Such events undoubtedly produce severe scouring, and negatively affect aquatic life.

In conclusion, instream conditions are relatively harsh in California Creek, and a combination of stressful environmental factors limits biological integrity. Sensitive taxa are scarce, tolerant taxa predominate, and IBI scores are depressed. Natural factors appear to be primarily responsible. Anthropogenic influences may also be involved, but the significance is unknown.

Table 3.3.2.2 Water Quality Issues Summary

Water Quality Issue	**Affected Area**	**Possible Influences/Concerns**	**Possible Actions Taken/to be Taken**
Bacteria and Nutrient/Chlorophyll *a* concerns	• California Creek • Deadman Creek • California Creek (nutrients only)	• Municipal discharges • Nonpoint sources (NPS): agricultural runoff, urban runoff and wildlife	• Reevaluate permits • RUAA or standards review may be appropriate for NPS sources • More data collection • Watershed Review

Exhibit 5G
Example Parameter Descriptions
(Example for the Basin Summary Report Section 3.3)

EXHIBIT 5G
Parameter Definition Descriptions

Temperature	Water temperature affects the oxygen content of the water, with warmer water unable to hold as much oxygen. When water temperature is too cold, cold-blooded organisms may either die or become weaker and more susceptible to other stresses, such as disease or parasites.	Colder water can be caused by reservoir releases. Warmer water can be caused by removing trees from the riparian zone, soil erosion, or use of water to cool manufacturing equipment.
Conductivity	Conductivity is a measure of the water body's ability to conduct electricity and indicates the approximate levels of dissolved salts, such as chloride, sulfate and sodium in the stream.	Elevated concentrations of dissolved salts can impact the water as a drinking water source and as suitable aquatic habitat.
pH	Most aquatic life is adapted to live within a narrow pH range. Different organisms can live at and adjust to differing pH ranges, but all fish die if pH is below four (the acidity of orange juice) or above 12 (the pH of ammonia).	Industrial and wastewater discharge, runoff from quarry operations and accidental spills.
Dissolved Oxygen (DO)	Organisms that live in the water need oxygen to live. In stream segments where DO is low, organisms may not have sufficient oxygen to survive.	Modifications to the riparian zone, human activity that causes water temperatures to increase, increases in organic matter, bacteria and over abundant algae may cause DO levels to decrease.
Stream Flow	Flow is an important parameter affecting water quality. Low flow conditions common in the warm summer months create critical conditions for aquatic organisms.	At low flows, the stream has a lower assimilative capacity for waste inputs from point and nonpoint sources.
Secchi Disc	Transparency is a measure of the depth to which light is transmitted through the water column and thus the depth at which aquatic plants can grow.	Low secchi disc depth is an estimate of turbidity.
Turbidity	Turbidity is a measure of the water clarity or light transmitting properties.	Increases in turbidity are caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms.
Hardness	Hardness is a composite measure of certain ions in the water, primarily calcium and magnesium. The hardness of the water is critical due to its effect on the toxicity of certain metals	Higher hardness concentrations in the receiving stream can result in reduced toxicity of heavy metals.

Chloride	Chloride is an essential element for maintaining normal physiological functions in all organisms. Elevated chloride concentrations can disrupt osmotic pressure, water balance and acid/base balances in aquatic organisms which can adversely affect survival, growth and/or reproduction.	Natural weathering and leaching of sedimentary rocks, soils and salt deposits can release chloride into the environment. Other sources can be attributed to oil exploration and storage, sewage and industrial discharges, run off from dumps and landfills and saltwater intrusion.
Sulfate	Effects of high sulfate levels in the environment have not been fully documented. However, sulfate contamination may contribute to the decline of native plants by altering chemical conditions in the sediment.	Due to abundance of elemental and organic sulfur and sulfide mineral, soluble sulfate occurs in almost all natural water. Other sources are the burning of sulfur containing fossil fuels, steel mills and fertilizers.
Total Dissolved Solids	High total dissolved solids may affect the aesthetic quality of the water, interfere with washing clothes and corrode plumbing fixtures. High total dissolved solids in the environment can also affect the permeability of ions in aquatic organisms.	Mineral springs, carbonate deposits, salt deposits and sea water intrusion are sources for natural occurring high concentration TDS levels. Other sources can be attributed to oil exploration, drinking water treatment chemicals, storm water and agricultural runoff and point/nonpoint wastewater discharges.
Bacteria Escherichia coli (E coli) or Enterococci	Although fecal coliform bacteria may not themselves be harmful to human beings, their presence is an indicator of recent fecal matter contamination and that other pathogens dangerous to human beings may be present.	Present naturally in the digestive system of all warm blooded animals, these bacteria are in all surface waters. Poorly maintained or ineffective septic systems, overflow of domestic sewage or non-point sources and runoff from animal feedlots can elevate bacteria levels.
Ammonia Nitrogen	Elevated levels of ammonia in the environment can adversely affect fish and invertebrate reproductive capacity and reduce the growth of young.	Ammonia is excreted by animals and is produced during the decomposition of plants and animals. Ammonia is an ingredient in many fertilizers and is also present in sewage, storm water run-off, certain industrial wastewaters and runoff from animal feedlots.
Total Suspended Solids (TSS)	Suspended solids increase turbidity which reduces light penetration and decreases the production of oxygen by plants. They can also clog fish gills. Eventually, the suspended solids settle to the bottom of the stream or	Excessive TSS is the result of accelerated erosion and is often associated with high flows where river banks are cut or sediment is resuspended. It can also be the

	lake, creating sediment. Excessive sediment can cover instream habitat, smother benthic organisms and eggs.	result of sheet erosion, where over land flow of water causes a thin layer of soil to be carried by the water to the stream. Disturbing vegetation without a proper barrier to slow down overland flow (such as construction sites or row cropping) increases TSS.
Nutrients **• Nitrogen** **• Nitrate** **• Total Phosphorus** **• Ortho-phosphate phosphorus**	Nutrients increase plant and algae growth. When plants and algae die, the bacteria that decompose them use oxygen. This reduces the dissolved oxygen in the water. High levels of nitrates and nitrites can produce nitrite toxicity, or "brown blood disease," in fish. This disease reduces the ability of blood to transport oxygen throughout the body.	Nutrients are found in effluent released from wastewater treatment plants, fertilizers and agricultural runoff carrying animal waste from farms and ranches. Soil erosion and runoff from farms, lawns and gardens can add nutrients to the water.
Chlorophyll-a	High levels of chlorophyll can cause algae blooms, decrease water clarity and cause swings in dissolved oxygen level due to photosynthesis. Most commonly measured as chlorophyll a.	Algal blooms can result in elevated chlorophyll-a levels indicating an increase in nutrients that increase growth and reproduction in algal species.