



Canadian River Basin Highlights Report ~ 2007



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Texas Commission on Environmental Quality*

INTRODUCTION

In 1991, The Texas Legislature passed the Texas Clean Rivers Act (Senate Bill 818). The Act was intended to move Texas toward comprehensive water resources planning and management to ensure the integrity of the state's water supply over the long term.

The Act established the Texas Clean Rivers Program (CRP) under the Texas Water Commission (now the Texas Commission on Environmental Quality or TCEQ, after TWC's merger with the Texas Air Control Board in 1992).

The CRP has proven to be a huge success as it has evolved into an ongoing, systematic, quality-controlled monitoring system that helps protect and improve the surface water quality in Texas. It began by contracting with 15 partner agencies, which included twelve river authorities, one water district, one federal agency, and one council of government. For fifteen years, this group has successfully managed the surface water quality in Texas by developing monitoring programs and assessing the results of the monitoring.

CRP goals parallel those of the Red River Authority of Texas and the TCEQ and their mutual efforts to share this expertise with the public. Responding to the stakeholders, focusing on priority issues, and keeping abreast of regulatory mandates enables the Authority and the TCEQ to reach the CRP goals.

CANADIAN RIVER BASIN WATERSHED MANAGEMENT PROGRAM

To assist in planning, monitoring, geographically analyze, and disseminate data, the Authority divided the basin into five reaches (see Figure 1). A five-year rotational approach was developed to adequately monitor the aquatic health of the basin. This rotational approach provides emphasis to be given to a different reach per year, ultimately intensively covering the entire basin over the five-year time span. Discussion of the water quality in each reach is included later in this report.

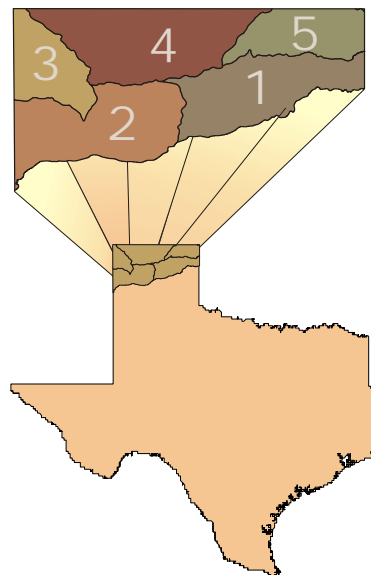


Figure 1

WATER QUALITY IN THE CANADIAN RIVER BASIN

The water quality in the Canadian River Basin is generally good and the majority of the basin supports aquatic life and recreational uses. Two issues that do affect the water quality are the continued **drought** conditions and excessive levels of **chloride**.

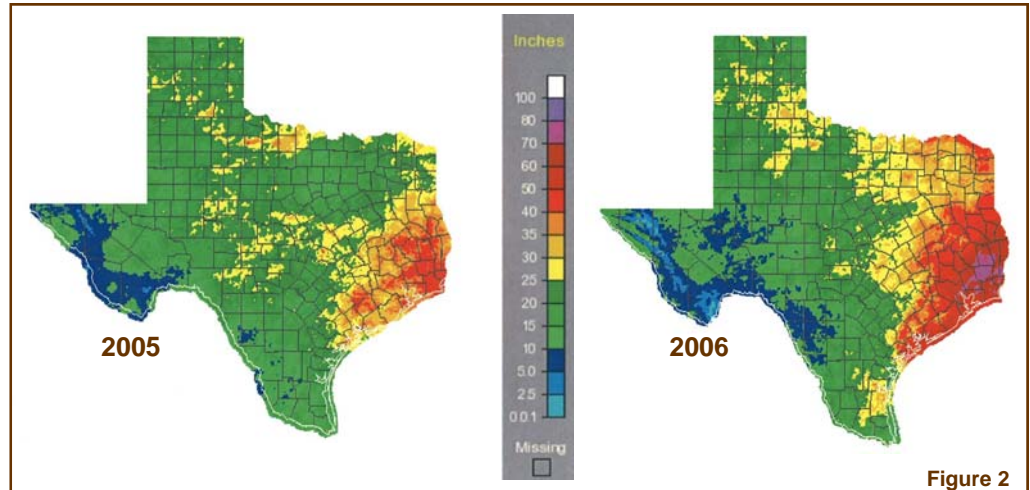
Drought conditions have affected most of the State of Texas. While a burn ban was in effect for much of the state, low relative humidity and high winds produced massive wildfires in the early part of 2006 which scorched over **200,000** acres in the Texas Panhandle. Lands scarred by fire can have a negative short-term impact on a river system's water quality.



McClellan Creek at SH 273, North of McLean

While the basin continues to experience drought conditions, much needed rainfall was received after the devastating wildfires.

Figure 2 shows a comparison of precipitation for 2005 and 2006. As shown, the Canadian River Basin received approximately 10 to 15 inches more rainfall in 2006 as compared to the 2005 totals. This increase has helped the drought conditions in the basin, as well as providing additional water in the basin's two major reservoirs. **Table 1** shows the capacity of major reservoirs in the Canadian River Basin versus the current percentage of capacity as of December 2006.



Courtesy of the Southern Regional Climate Center

Impounding the Canadian River, Lake Meredith is a major reservoir in the basin which supplies water to eleven cities in the Texas Panhandle. In addition to supplying municipal water, Lake Meredith provides flood control, fish and wildlife, and recreational benefits.

Located ten miles north of Spearman in Hansford County, Palo Duro Reservoir was completed in 1991 by impounding the waters in Palo Duro Creek. Although it is not used as a water supply, Palo Duro Reservoir provides fish and wildlife benefits, as well as recreational benefits.

Elevated chloride levels in the Canadian River Basin have been an ongoing issue in water quality. An area in New Mexico just downstream from Ute Dam near Logan has been identified as being a major contributor of saline water to the Canadian River System. Studies by the Bureau of Reclamation and consultants have indicated that approximately 70 percent of the chlorides reaching Lake Meredith originate in this localized area, filtering into the river channel from a shallow brine aquifer which is under artesian pressure. Water in the brine aquifer is roughly as salty as seawater.

The *Lake Meredith Salinity Control Project* is designed to intercept the flow with wells drilled along the river, and then dispose the brine by deep well injection or other means. The effectiveness of the project is a means of reclaiming full benefit of the resource. Treated discharges are monitored closely to ensure the impact to receiving waters is compatible with the ecosystem and maintains balance with natural habitats. Additional information on the *Lake Meredith Salinity Control Project* can be found at www.crmwa.com.

Table 1—Reservoir Capacities		
Reservoir	Conservation Storage Capacity (Ac/Ft)	Conservation Storage (Ac/Ft)
Lake Meredith	500,000	21%
Palo Duro Reservoir	60,897	1%
* as of December 2006 — Texas Water Development Board		

While regional activities impact the local watersheds, site specific problems are intensified by the larger scale influences of naturally occurring and anthropogenic pollution to receiving waters. Watershed run-off from urban and agricultural activities are also major contributors of pollution. Control programs, such as storm water run-off monitoring and the inclusion of more stringent requirements in livestock permits are being implemented to reduce adverse impacts to watersheds from these types of pollution.

IMPACT AND RESPONSE TO WATER QUALITY ISSUES

With the larger urbanized areas of the Canadian River Basin developing rapidly and the seemingly endless drought depleting the ever dwindling water resources of the Canadian River Basin, the Panhandle Water Planning Group Region A (PWPG-A) was tasked with developing plans and strategies to meet the water needs of the citizens of the Panhandle of Texas.

In an effort to reduce the affects of the drought conditions in the basin, strategies have been identified. Overall strategies include conservation and reuse of water, expansion and enhancement of existing supplies or acquiring new supplies, brush control, and control of naturally occurring salts. Irrigation strategies specifically identified for farming in the basin include: precipitation enhancement, an evapotranspiration network for scheduling irrigation, installation of low energy precision application equipment, changes in crop variety, and implementation of conservation tillage methods, as well as aquifer management. The PWPG-A has posted their 2006 Regional Water Plan, detailing the strategies to meet the needs for the next 50 years at www.panhandlewater.org.

SURFACE WATER QUALITY MONITORING

The collection, management, and assessment of water quality data within the Canadian River Basin are integral components of the Clean Rivers Program. The Authority holds a Coordinated Monitoring Meeting annually to coordinate sites, parameters of concern, and frequency of collection with other agencies and program participants that assist in planning, data collection, and analysis. This meeting allows for the development of a monitoring schedule that reduces duplicative efforts, which in turn maximizes the funds available for sampling. It is an essential element in the successful planning process of the basin and is open to any interested group or entity that would like to attend and/or participate in monitoring in the Canadian River Basin. A summary of the monitoring schedule for 2006 is listed in **Table 2** or a more detailed Coordinated Monitoring Schedule for the Canadian River Basin can be found at www.cms.lcra.org.

Selected physical, chemical, and biological parameters collected by the Environmental Services Division (ESD) of the Authority are analyzed either in the field or at the Authority's environmental laboratory. Within days of collection, the results of the analyses are entered into the data repository, which contains years of quality-assured water resource information in the Canadian River Basin.

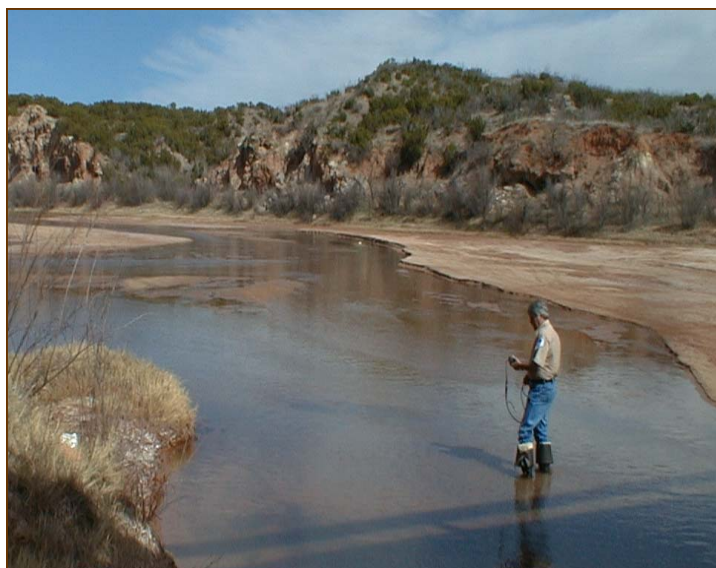


Table 2 – Overview of Coordinated Monitoring Schedule - 2006

Agency	Reach	Cont Flow	24-Hr DO	Metals Water	Organ Water	Metals Sed	Organ Sed	Conv	Ind Bact	Instant Flow	Field	RT	IS	DI	SS
RRA	I							16	16	16	16	4			
TCEQ	I			4	2			8	8	8	8	2			
CRMWA	I							36	120			11			
USGS	I	365										1			
Total Reach I		365		4	2			60	144	24	24	18			
RRA	II							16	20	16	20	2	3		
TCEQ	II							12	12	8	12	4			
CRMWA	II														
USGS	II	365						6			365	1			
Total Reach II		365						34	32	24	397	7	3		
RRA	III														
TCEQ	III							4	4		4	1			
CRMWA	III														
USGS	III														
Total Reach III								4	4		4	1			
RRA	IV														
TCEQ	IV							2	2		2	1			
CRMWA	IV														
USGS	IV	365										1			
Total Reach IV		365						2	2		2	2			
RRA	V							8	8	8	8	2			
TCEQ	V							4	4		4	1			
CRMWA	V														
USGS	V	365										1			
Total Reach V		365						12	12	8	12	4			
Basin Total		1,460	0	4	2	0	0	112	194	56	439	32	3	0	0

Cont Flow Continuous Flow

Organ Water Organics in Water

Ind Bact Indicator Bacteria

RT Routine Sampling

24-Hr DO 24-Hour Dissolved Oxygen

Metals Sed Metals in Sediment

Instant Flow Instantaneous Flow Measurements

IS Intensive/Systematic Sampling

Metals Water Metals in Water

Conv Conventional Parameters

Field Field Parameters

DI Diurnal Sampling

*Continuous flow measurements by the USGS are recorded on an hourly basis.

SS Special Studies

Regular monitoring is necessary to collect quality-assured data to complete an assessment of water quality conditions and impairments. There are four types of monitoring in the Canadian River Basin performed by the Authority, CRMWA, TCEQ, and USGS.

1. **Routine** monitoring is the traditional type of monitoring conducted at regular intervals every year at key sites.
2. **Systematic Watershed** (Intensive) monitoring is conducted at specific sites on the annual reach of focus.
3. **Permit Support** monitoring identifies specific areas where additional information on water quality and quantity is needed for the permitting process.
4. **Special Studies** on priority watersheds are conducted where special attention is required.

There are two primary types of data collected at each sampling site: *field and conventional*. Field parameters are collected and utilized as real time indicators of the water quality at each site. Conventional parameters are collected, preserved, and taken back to the laboratory for processing and analysis. **Table 3** provides a list of some of the field and conventional parameters that are currently being collected in the Canadian River Basin. In addition, the quality-assured data collected by the Authority are entered into the Authority's database and made available on the Authority's website at www.rra.dst.tx.us.

Table 3 — Collected Water Quality Parameters	
FIELD PARAMETERS	
<i>Collected and processed in the field laboratory. Results are expressed in mg/L except as noted.</i>	
Temperature	The temperature of water at the time of collection. An important physical relationship exists between the amount of dissolved oxygen in a body of water and its temperature. Simply put, the warmer the water, the less dissolved oxygen.
pH	The hydrogen-ion activity of water caused by the breakdown of water molecules and the presence of dissolved acids and bases. pH determines whether a water body is acidic, neutral, or basic. The pH of the water can affect the toxicity of many substances.
DO	Dissolved Oxygen (DO) – The oxygen that is freely available in water. DO is vital to fish and other aquatic life and the prevention of odors. Traditionally, adequate ranges of dissolved oxygen levels have been accepted as the single most important indicator of a water body's ability to support desirable aquatic life.
Conductivity	A measurement of the electrical current carrying capacity of water. Dissolved substances, such as salts, have the ability to conduct electrical current. Conductivity is a measure of how salty the water is. Salty water has a high conductivity. This can be used as an indicator of how much dissolved solids are polluting the water.
Turbidity	A measure of clarity of a water sample expressed in NTU's (Nephelometric Turbidity Units). The higher the turbidity, the muddier the water.
Flow	The velocity of the water body at the time of sampling, expressed in CFS (cubic feet per second) or how fast the water is moving. Flow combined with other parameters can be a good indicator of water quality.
Flow Measurement Method	The manner in which flow is measured, usually by gage or electrical device.
<i>E. coli</i>	The current indicator bacteria to determine if the water body is suitable for contact recreation. It is expressed in MPN (most probable number) per 100 mL of water. High results on the <i>E. coli</i> test can indicate a potential pollution problem. <i>E. coli</i> is used as an indicator because it can be potentially harmful to people.
Water Clarity	Clearness of the water as it appears in the water body at the time of sampling.
Water Odor	Odor of the water, if any. Odors can aid in discovering problems in a water body.
Weather	Listing of basic weather conditions at the time of sampling. This information is useful if a problem is weather related.
Days Since Last Significant Precipitation	The number of either estimated or actual days since the last beneficial rainfall event.
CONVENTIONAL PARAMETERS	
<i>Processed by the Authority's ESD and subcontract laboratories. Results are expressed in mg/L except as noted.</i>	
Alkalinity	A measure of the acid-neutralizing capacity of water.
Ammonia	Naturally occurring in surface and wastewater, and is produced by the breakdown of compounds containing organic nitrogen. Elevated ammonia levels are a good indicator of organic pollution.
Calcium	Dissolved metal associated with chloride, sulfate, and alkalinity.
Hardness	The sum of the calcium and magnesium concentrations in water and is expressed as calcium carbonate.
Chloride	One of the major inorganic ions in water and wastewater. Concentrations can be increased by industrial processes. High chloride concentrations can affect metallic objects, growing plants, and make water unsuitable for drinking. Chloride compounds, often known as salts, can be an indicator of natural or manmade pollution, as in the case of oil field brines.
COD	Chemical Oxygen Demand (COD) — A measure of the amount of oxygen required to oxidize all compounds in the water. COD is an indicator of how much organic load is placed on the oxygen in a water body.
Total Phosphorus	An essential nutrient to the growth of organisms and can be the nutrient that limits the primary productivity of water. In excessive amounts from wastewater, agricultural drainage, and certain industrial wastes, it also contributes to the eutrophication of lakes and other water bodies. Phosphorus is commonly known as a man made pollutant.
Sulfate	Usually dissolved into waters from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Sulfides are widely distributed in nature and in high concentrations, sulfate can affect drinking water.
TDS	Total Dissolved Solids (TDS) – A measure of solids, both organic and inorganic, dissolved in water.
TSS	Total Suspended Solids (TSS) – A measure of the total suspended solids in water, both organic and inorganic.
TOC	Total Organic Carbon (TOC) is all of the organic carbon portions, in a water body.
Chlorophyll a	A photosynthetic pigment which is found in all green plants. The concentration of chlorophyll a is used to estimate phytoplankton biomass in surface water. Results are expressed in µg/L (micrograms per liter).
Pheophytin	An important degradation product of chlorophyll a and interferes with the measurement of chlorophyll a. It is used to determine a more accurate measure of chlorophyll a. Results are expressed in µg/L (micrograms per liter).
Nitrate+Nitrite Nitrogen	Most of the time, it is a good indicator of the level of human caused pollution in a water body.
VSS	Volatile Suspended Solids (VSS) – A portion of the TSS that is lost after cooking at high temperatures. This represents the organic part of the TSS.

NELAC

In 2001, the 77th Texas Legislature passed HB 2912, requiring that all data used by TCEQ for commission decisions regarding permits or other authorizations, compliance matters, enforcement actions, or corrective actions be from an accredited environmental laboratory.

HB 2912 also transferred authority for environmental laboratory accreditation and drinking water certification from Texas Department of Health to the TCEQ and required that the state's environmental testing laboratory accreditation program be consistent with NELAC. This transfer of authority became effective on September 1, 2001.

Prior to NELAC, the existing state programs varied widely in scope and requirements. The NELAC Standard provides uniform requirements for accreditation of environmental laboratories to ensure that decisions being made are based on data that is scientifically accurate.



Red River Authority's new facilities located at 3000 Hammon Road in Wichita Falls



The deadline for all environmental laboratories that submit data to the TCEQ to become NELAC accredited is June 1, 2008. Since April of 2005, the Authority has been working diligently on obtaining its NELAC accreditation. To assist the Authority's Environmental Laboratory in becoming NELAC accredited, the Authority relocated its laboratory to our new facilities in Wichita Falls. The new facility expanded the capabilities of the Authority's Laboratory to meet the NELAC requirements. In addition, the Authority enlisted a consulting firm to conduct a NELAC-Readiness audit of the facilities. Laboratory personnel are continuing to attend NELAC training workshops to prepare for the NE-



LAC accreditation. The Authority's Environmental Services Laboratory is also involved in a meticulous preparation process for the application, which

includes the completion of proficiency testing for all parameters that are analyzed under the Clean Rivers Program and an on-site assessment by the TCEQ in the Authority's Environmental Laboratory.

WATER QUALITY DATA ASSESSMENT

The water quality data assessment is designed to compare conditions in Texas surface waters to established *water quality standards* set uniquely for classified stream segments in the state (see **Table 4** for a complete stream segment list of the Canadian River Basin). Water quality standards are set by the TCEQ in an effort to ensure water quality in Texas is consistent with public health and enjoyment, protection of aquatic life, and the operation of existing industries and economic development of the state. Information and a list of surface water quality standards for water bodies in Texas can be found at the TCEQ website at www.tceq.state.tx.us/nav/eq/eq_swqs.html.

Table 4—Canadian River Basin Segment Descriptions	
Segment	Detailed Description
0101	Canadian River Below Lake Meredith - From the Oklahoma State Line in Hemphill County to Sanford Dam in Hutchinson County.
0101A	Dixon Creek (unclassified water body) - From the confluence of the Canadian River to the upstream perennial portion of the stream east of Borger in Hutchinson County.
0101B	Rock Creek (unclassified water body) - Perennial stream from the confluence with the Canadian River up to SH 136 in the City of Borger.
0102	Lake Meredith - From Sanford Dam in Hutchinson County to a point immediately upstream of the confluence of Camp Creek in Potter County, up to the normal pool elevation of 2936.5 feet (impounds Canadian River).
0102A	Big Blue Creek (an unclassified water body) - From confluence of Lake Meredith in Carson County to the upstream perennial portion of the stream in Moore County
0103	Canadian River Above Lake Meredith - From a point immediately upstream of the confluence of Camp Creek in Potter County to the New Mexico State Line in Oldham County.
0103A	East Amarillo Creek (unclassified water body) - From the confluence of the Canadian River to the upstream perennial portion of the stream northwest of Amarillo in Potter County.
0103B	Punta de Agua (an unclassified water body) - From the confluence of the Canadian River to the New Mexico State Line in Hartley County.
0104	Wolf Creek - From the Oklahoma State Line in Lipscomb County to a point 2.0 kilometers (1.2 miles) upstream of FM 3045 in Ochiltree County.
0105	Rita Blanca Lake - From Rita Blanca Dam in Hartley County up to the normal pool elevation of 3860 feet (impounds Rita Blanca Creek).
0199A	Palo Duro Reservoir (unclassified water body) - From Palo Duro dam up to the normal pool elevation of 2,892 feet north of Spearman in Hansford County (impounds Palo Duro Creek).

Water quality is reviewed in accordance with the *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data*. The results are then analyzed and evaluated for the assessment. The assessment occurs every two years utilizing the previous five year's data. The results are then published periodically in the *Texas Water Quality Inventory and 303(d) List*, as required by Sections 305(b) and 303(d) of the Federal Clean Water Act. These reports are also available online at www.tceq.state.tx.us/compliance/monitoring/water/quality/data/04twqi/04_summary.html.

There are three main aspects of the water quality assessment performed by the TCEQ:

1. The **2004 Texas 303(d) List** identifies water bodies for which effluent limitations are not stringent enough to implement water quality standards. The TCEQ also develops a schedule identifying Total Maximum Daily Loads (TMDLs) that will be initiated in the next two years for priority impaired waters. Water quality permitting in 303(d)-listed water bodies is described in the TCEQ regulatory guidance document *Procedures to Implement the Texas Surface Water Quality Standards*. Water bodies in the Canadian River Basin which are listed on the *2004 Texas 303(d) List* include:

Segment	Water Body	Parameter(s)
0101A	Dixon Creek	Bacteria, Depressed Dissolved Oxygen
0102	Lake Meredith	Mercury in Walleye
0105	Rita Blanca Lake	Total Dissolved Solids
0199A	Palo Duro Reservoir	Depressed Dissolved Oxygen

2. The **2004 Water Quality Inventory Summary of Water Bodies with Concerns for Use Attainment Report** lists water bodies with concerns identified for indicators, such as dissolved oxygen. These indicators are directly tied to support of designated uses and criteria adopted in the *Texas Surface Water Quality Standards*. Water bodies in the Canadian River Basin which were identified with use attainment concerns include:

Segment	Water Body	Use Concern	Parameter(s) of Concern
0101B	Rock Creek	Contact Recreation Use	Bacteria
0103	Canadian River above Lake Meredith	Contact Recreation Use	Bacteria
0103A	East Amarillo Creek	Contact Recreation Use	Bacteria
0104	Wolf Creek	Contact Recreation Use	Bacteria
0105	Rita Blanca Lake	General Use	Total Dissolved Solids, pH

3. The **2004 Water Quality Inventory Summary of Water Bodies with Water Quality Concerns** identifies water quality concerns in water bodies with indicators such as nutrients that are not tied to support of a designated use with a quantitative criterion. Screening levels used to identify these concerns have generally not been adopted as standards with the exception of secondary drinking water standards. Water bodies in the Canadian River Basin which are included on the summary of water bodies with water quality concerns are:

Segment	Water Body	Use Concern	Parameter(s) of Concern
0101	Canadian River below Lake Meredith	Nutrient Enrichment Concern	Ammonia
0102	Lake Meredith	Public Water Supply Concern	Chloride, Sulfate, Total Dissolved Solids
0103A	East Amarillo Creek	Nutrient Enrichment Concern	Nitrate+Nitrite Nitrogen
0199A	Palo Duro Reservoir	Nutrient Enrichment Concern	Ammonia, Nitrate+Nitrite Nitrogen, Orthophosphorus, Total Phosphorus

Reach I of the Canadian River Basin encompasses an area about 90 miles long and 40 miles wide. It is located on the main stem of the Canadian River and represents a watershed from the Texas-Oklahoma state line upstream to the Sanford Dam on the Canadian River where it encompasses the northern portion of Hemphill County and the southernmost section of Lipscomb County. The largest cities within the reach are Pampa and Borger with populations of 17,887 and 14,302, respectively. Other towns include Canadian, Stinnett, Skellytown, Miami, and Sanford.

There are many farms and ranches in **Reach I** that produce cattle, swine, poultry, wheat, oats, corn, sorghum, hay, barley, alfalfa, and soybeans. Although there is some irrigated farm land, the majority of farm land consists of either dry land farming or pasture land for cattle. The soils range from sandy alluvial to dark and reddish clay loams over flat plains to broken rocky valleys where the plains break into the Canadian River Valley.

Included in **Reach I** are 23 permitted municipal and industrial discharges, five active permitted solid waste disposal sites, and four concentrated animal feeding operations. In addition, there are more than 1,200 ground water wells which utilize water from the Ogallala Aquifer.

Segments located in **Reach I** include:

- 0101 – Canadian River below Lake Meredith**
- 0101A – Dixon Creek**
- 0101B – Rock Creek**

During the reference period of September 1, 2005 through August 31, 2006, the Authority conducted 16 monitoring events and collected approximately 464 parameters from four water quality monitoring stations. The TCEQ conducted eight monitoring events and collected around 206 parameters from two water quality monitoring stations during the same reference period. In addition, the United States Geological Survey (USGS) took continuous flow measurements from one monitoring station.

Figure 3 illustrates the monitoring coverage of **Reach I** in 2006, where each monitoring station is designated by a five digit numeric code.

Elevated nutrients and bacteria (*E. coli*) are the main water quality issues in **Reach I**. Most of the elevated bacterial issues arise from run-off from pastures and fields or from animals congregating around available water sources. Additionally, run-off can increase these nutrients levels in the water bodies.

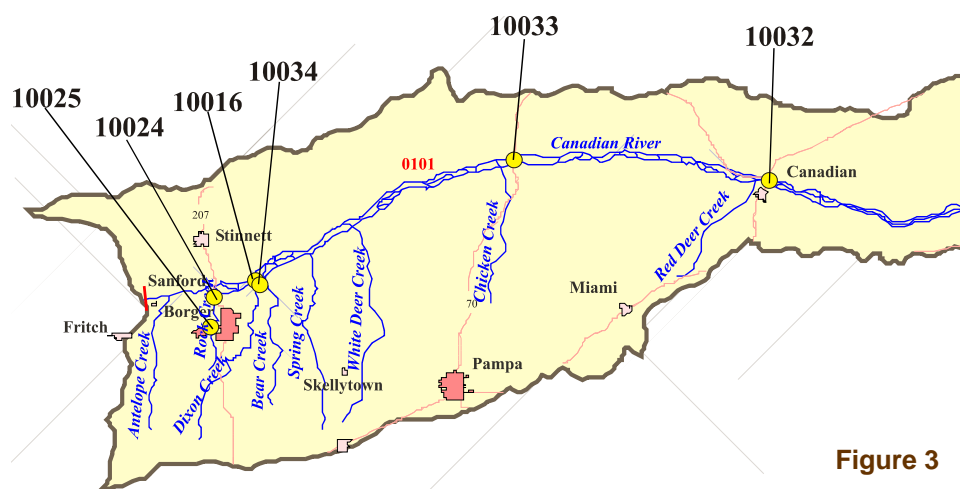


Figure 3

This is the case in the **Canadian River below Lake Meredith, Segment 0101**, where concerns for elevated nutrient levels can be found. Most of the terrain surrounding this portion of the Canadian River is fairly rugged and sparsely populated. The flood plain of the river is generally very sandy and supports large numbers of cattle on the native grasses and scrubby trees that are found there. In the upper portions of the reach, the river is fed by two creeks; Dixon Creek and Rock Creek. Flow in Dixon Creek

comes primarily from an industrial discharger and Rock Creek receives flow from a municipal discharger. Above the city of Borger, the Canadian River is generally dry. As the river flows eastward, springs contribute to the flow.

Dixon Creek, Segment 0101A, a tributary of the Canadian River near Borger, is listed on the TCEQ's 2004 Texas Water Quality Inventory Status and Category of All Waters for not meeting contact recreation and aquatic life use standards. Reviews of recent data by the Authority indicate that the issue of depressed dissolved oxygen levels in the creek has been alleviated, while the problem with the bacteria remains. Additionally, the Authority's review of the data has found concerns for excessive algal growth and nitrate+nitrite nitrogen. Elevated levels like these can be the result of run-off or from wildlife or livestock congregating around the creek or as a result of a by product of the discharge. However, without flow from the industrial discharger, Dixon Creek would be an intermittent water body. An Aquatic Life Assessment has been conducted by the TCEQ above and below the discharger and the results are pending.



Rock Creek at Electric City

The 2004 Texas Water Quality Inventory lists **Rock Creek, Segment 0101B**, as fully supporting its overall uses and meeting all criteria, except having a Contact Recreation Use Concern for bacteria. Rock Creek is also located near Borger and receives treated effluent discharge from a local municipality. It flows through areas of the Panhandle that could be called tortuous. As the creek winds its way to the flood plain of the Canadian River it weaves through fields pastures and steep walled arroyos. Recent reviews of the water quality data by the Authority found elevated bacteria, nitrate+nitrite nitrogen and ortho-phosphate levels. These high data points could be originating from run-off, as well as from live-

stock and/or wildlife. The higher than normal nitrate+nitrite nitrogen levels that have been found in the upper portion of this unclassified segment may be attributed to a seep or leaching from a fertilizer manufacturing plant located in the upper reaches of Rock Creek. This plant is permitted for underground disposal. With all of the oilfield drilling, both recent and historic, it is possible that an unknown pathway is providing a way for contaminants to enter this watershed. It is well known that the older practices of drilling and closing old oil wells can be a major contributor to salt leach, seeps or scalds. Additionally, the highly corrosive nature of oil field brines is well known as a causative agent in degrading older uncapped well casings.

As one of two major contributors to the flow of the Canadian River in this portion of the segment, it is likely that most of the nutrient enrichment problems originate in Rock Creek. The results of the recent Aquatic Life Assessment on Dixon Creek will yield valuable information that could lead to rectification of the water quality problems in Rock Creek.

Reach II is located from the Sanford Dam at Lake Meredith to the Texas-New Mexico state line and up to Oldham and Hartley Counties. Amarillo, the largest city in the Canadian River Basin, has a total population of over 174,000, and is dissected by both the Red and Canadian River Basins. **Reach II** encompasses about a fourth of the northwestern portion of the city. The total population of the reach is approximately 120,000. The economics of the majority of the reach consist of agribusiness and oil and gas production. Amarillo is also home to a large refinery that produces copper, selenium, nickel, and tellurium. Also found only in this reach is the unique resource of free gaseous helium.

The reach contains 12 permitted municipal and industrial discharges, seven active permitted solid waste disposal sites, and four concentrated animal feeding operations. In addition, there are more than 550 ground water wells in this reach that use water from the Ogallala and Dockum Aquifers.

Reach II contains many farms and ranches which produce principally cattle, wheat, oats, corn, sorghum, hay, barley, alfalfa, and soybeans. The majority of the area is irrigated farm land, with some dry land farming or pasture land for cattle.

Segments located in **Reach II** are:

0102 – Lake Meredith
0102A – Big Blue Creek
0103 – Canadian River above Lake Meredith

0103A – East Amarillo Creek
0103B – Punta de Agua Creek

During the reference period of September 1, 2005 through August 31, 2006, the Authority conducted 20 monitoring events and collected approximately 580 parameters from five water quality monitoring stations. The TCEQ conducted 12 monitoring events and collected around 300 parameters from four water quality monitoring stations. The Canadian River Municipal Water Authority (CRMWA) conducted 132 monitoring events and collected approximately 588 parameters from 11 water quality monitoring stations on Lake Meredith. In addition, the USGS monitored one station collecting continuous flow measurements.

Figure 4 illustrates the monitoring coverage of **Reach II** for 2006, where each monitoring station is designated by a five digit numeric code.

The largest reservoir in the Canadian River Basin is Lake Meredith with a total flood pool storage capacity of 1,569,800 acre-feet and a surface area of 21,640 acres at an elevation of 3,011 feet above mean sea level. Water from Lake Meredith is distributed to eleven area cities located within parts of the Canadian, Red, and Brazos River Basins. Because of the elevated chloride and sulfate levels the water from Lake Meredith is blended with high quality ground water with existing surface water supplies, which is designed to improve both quality and quantity of the water delivery to all of its member cities.

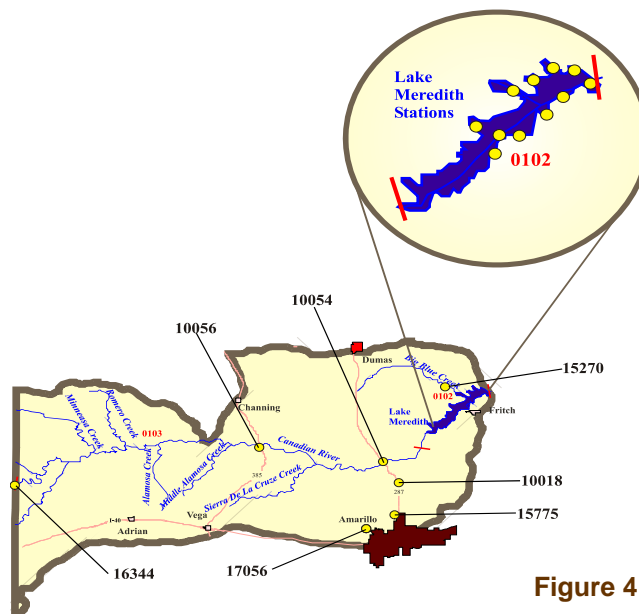


Figure 4

The TCEQ's 2004 Texas Water Quality Inventory Status and Category of All Waters lists **Lake Meredith, Segment 0102**, as having a public water supply concern for chloride, sulfate, and total dissolved solids in the lake and in finished drinking water. The Authority's review of the data agrees with this assessment. The elevated parameters are due to inflow of highly saline waters from the Canadian River into the lake. Previous studies have determined that a major contributor of the saline water originates from a shallow

brine aquifer under artesian pressure that filters into the river channel. In September 2001, the Canadian River Municipal Water Authority (CRMWA) implemented the *Lake Meredith Salinity Control Project*, which has greatly improved the salinity problem in the lake. Additional information on the project can be found on the CRMWA website at www.crmwa.com/lmscp2.htm.

Lake Meredith is also listed as on the *2004 Texas 303(d) List* for partially supporting its fish consumption use because of elevated mercury levels found in walleye. Mercury forms toxic compounds, such as methyl-mercury, that are known to accumulate in fish at the top of the food chain. Walleye, being a longer lived creature, is the cool-water predator sport fish that predominates the food chain in Lake Meredith. As walleye grow and mature, they consume smaller, shorter-lived contaminated prey species, thus accumulating the methyl-mercury in its tissues over time. The Environmental Protection Agency (EPA) has stated that consumption of mercury contaminated species such as walleye may cause health problems in pregnant women, infants, and young children. The source of the mercury is questionable, however the EPA has speculated that such sources are most likely coming from the exhaust of refineries and coal fired power plants. The exhausts travel the prevailing winds, settling in water bodies, and contaminating the food chains. The EPA is currently implementing nationwide, intensive surveys on affected water bodies to scientifically ascertain the mercury sources. For more information regarding mercury and emission rules, see the EPA's website at www.epa.gov/mercury/control_emissions/decision.htm.

Overall water quality in the **Canadian River, Segment 0103** above Lake Meredith is good. The *2004 Texas Water Quality Inventory* lists Canadian River as fully supporting its overall uses and meeting all criteria. It does list the river as having a contact recreation use concern for bacteria. However, the Authority's most recent screening of the data found only chloride exceeding the criteria set for this water body. The elevated parameters are due to an upwelling of highly saline waters originating from a shallow brine aquifer under artesian pressure that filters into the river channel. In September 2001, the CRMWA implemented the Lake Meredith Salinity Control Project to assist in the reduction of salt entering the lake. Additional information on the project can be found on the CRMWA website at www.crmwa.com/lmscp2.htm.

Also included in **Reach II** is **East Amarillo Creek, Segment 0103A**. The *2004 Texas Water Quality Inventory* lists East Amarillo Creek as fully supporting its overall uses and meeting all criteria. However, it is listed as having a contact recreation use concern for bacteria and a nutrient enrichment concern for nitrate+nitrite nitrogen. East Amarillo Creek originates in northern Amarillo where the city has impounded the headwaters of the creek into a series of small impoundments collectively known as Thompson Park Lake. Storm water run-off and natural drainage from the City of Amarillo supply the creek with flow. Overall water quality conditions in East Amarillo Creek have been fair, however, the recent screening of data revealed elevated levels of bacteria, nitrate+nitrite nitrogen and chlorophyll *a*. The creek receives run-off from urban areas, as well as from rural areas of northern Amarillo and Potter County. The Authority's preliminary observations of new data from Thompson Park Lake indicates the bacteria and elevated nutrients may be entering the creek somewhere below the lake. Additional data and more research are needed to identify actual sources of these problems.

Data were not available for the Authority to screen for **Segment 0103B, Punta de Agua Creek** for the reference period. Punta de Agua Creek was determined to be dry and efforts were utilized elsewhere to maximize program resources.

The *2004 Texas Water Quality Inventory* lists **Big Blue Creek, Segment 0102A**, as fully supporting its overall uses and meeting all criteria. The Authority is currently monitoring Big Blue Creek as part of its intensive systematic program. It is a tributary of Lake Meredith, and like many of the creeks in the area, the drought has caused it to become an intermittent stream, flowing mainly after rainfall events when the water table is higher.

Reach III represents the Rita Blanca Creek watershed upstream to the Texas-New Mexico state line encompassing Hartley and Dallam Counties. The three subwatersheds contained in this reach include approximately 3,600 square miles, of which an estimated 1,500 square miles are contributing drainage.

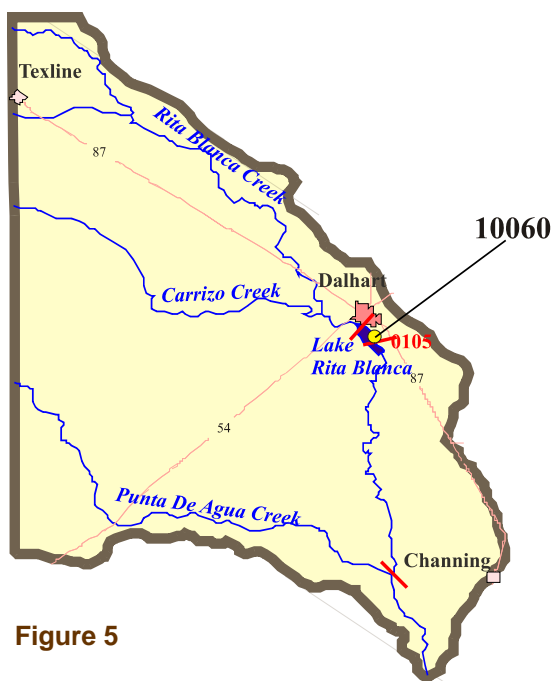


Figure 5

Dalhart is the largest city in **Reach III** with a population of 7,200; more than 9,000 persons populate this reach. There are five other small towns including Texline and Channing. The economy of the reach is basically agribusiness, oil and gas production, and hunting. Rainfall averages from 16 inches to a little over 17 inches annually.

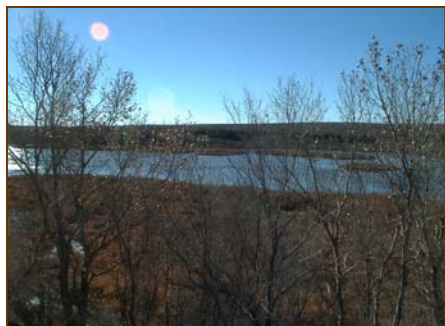
Within the reach are 16 concentrated animal feeding operation permits, one active permitted solid waste disposal site, and more than 350 ground water wells that use water from the Ogallala and Dockum Aquifers in Reach III.

There are many farms and ranches that produce cattle, wheat, oats, corn, sorghum, hay, barley, alfalfa, and soybeans. As described in the preceding reaches, only a small portion is irrigated. The soils range from sandy alluvial soils to dark and reddish clay loams over flat plain to broken rocky valleys where the plains break into the Canadian River Valley.

The only segment located in **Reach III** is: 0105 – Rita Blanca Lake

During the reference period of September 1, 2005 through August 31, 2006, the TCEQ conducted four monitoring events and collected about 100 parameters from one water quality monitoring station on Rita Blanca Lake. **Figure 5** illustrates the monitoring coverage of **Reach III**, where the monitoring station is designated by a five digit numeric code.

Rita Blanca Lake is unique in that it is the only segment in the Canadian and Red River Basins to be classified as a non-contact recreation water body. Even with this categorization, Rita Blanca Lake is listed on the 2004 Texas 303(d) List as not supporting the general use due to elevated total dissolved solids. The only steady inflow Rita Blanca Lake receives is treated effluent from the City of Dalhart's wastewater treatment plant and from occasional rainfall. Without a steady inflow, Rita Blanca Lake has become a shallow, marshy wetland.



The Texas Parks and Wildlife Department has designated Rita Blanca Lake as a high quality water fowl habitat since it is located in the flyway of migratory waterfowl. Because large numbers of waterfowl utilize the lake as a stopover in their annual migration, their waste deposition places an unusually heavy organic load on Rita Blanca Lake which results in elevated total dissolved solids and in turn influences the pH levels.

Reach IV includes Palo Duro Creek from the northern Texas-Oklahoma state line upstream to its headwaters including portions of Coldwater Creek, Frisco Creek, and Lower Beaver River. It contains three subwatersheds with 6,500 square miles of which 3,500 are contributing drainage in Texas.

Major cities located in **Reach IV** include Dumas, Spearman, Cactus, Stratford, Sunray, and Gruver. Rainfall averages from 19 to 20 inches annually. The area contains many farms and ranches that produce cattle, wheat, oats, corn, sorghum, hay, barley, alfalfa, and soybeans. Soils range from sandy alluvial to dark and reddish clay loams over flat plain to broken rocky valleys.

There are nine permitted municipal and industrial dischargers, four active permitted solid waste disposal sites, about 45 concentrated animal feeding operations, and one superfund site. In addition, **Reach IV** includes more than 1,450 ground water wells that utilize water from the Ogallala and Dockum Aquifers.

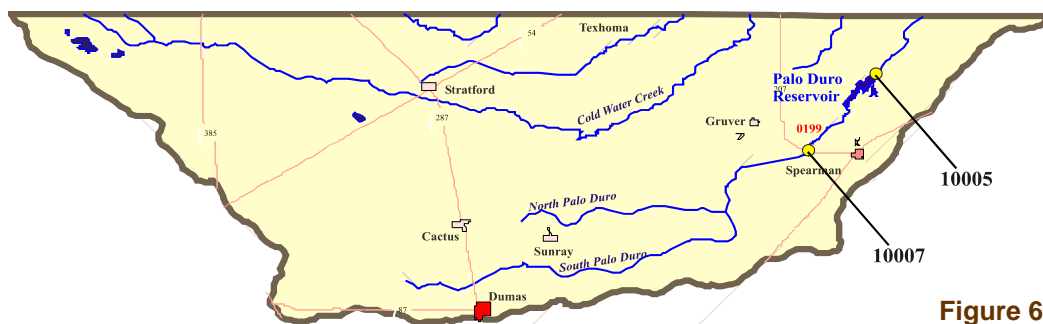


Figure 6

The only segment located in **Reach IV** is **0199A – Palo Duro Reservoir**.

Palo Duro Reservoir has a total storage capacity of 60,900 ac/ft with a drainage area of about 614 square miles. Total surface acres are 2,413 with an approximate shore line of 48 miles. The recent drought conditions combined with the naturally arid nature of this region has slowed the filling of Palo Duro Reservoir.

During the reference period of September 1, 2005 through August 31, 2006, the TCEQ conducted two monitoring events and collected approximately 50 water quality parameters from one water quality monitoring station on Palo Duro Reservoir. In addition, the USGS monitored continuous flow from one monitoring station. Refer to **Figure 6** for surface water monitoring coverage of **Reach IV**, where each monitoring station is designated by a five digit numeric code.

Palo Duro Reservoir is listed on the *2004 Texas 303(d) List* for the partial support of aquatic life use due to depressed dissolved oxygen. In the 2002 assessment of Palo Duro Reservoir there were an insufficient number of 24-hour dissolved oxygen values available for proper analysis for the Aquatic Life Use Assessment. The TCEQ has also noted Palo Duro Reservoir as having nutrient enrichment concerns. The Authority's review



of the recent data revealed elevated chlorophyll *a* levels. Palo Duro Reservoir will remain on the *2004 Texas 303(d) List* until a sufficient number of 24-hour dissolved oxygen measurements are available to demonstrate its support of the aquatic life use criteria. Like Rita Blanca Lake, Palo Duro Reservoir is also in a major flyway for migratory waterfowl. It is speculated that the heavy organic load from the waterfowl is causing the elevated nutrient and algal growth concerns.

Reach V comprises the Wolf, Mammoth, and Kiowa Creek watersheds from the Texas-Oklahoma state line upstream to the headwaters of each. It encompasses the upper eastern section of the Panhandle in Lipscomb and Ochiltree Counties. The largest city in **Reach V** is Perryton, which has a population of 7,800. Other towns include Booker, Higgins, Follett, and Darrouzett. The total population of the reach is approximately 11,000. Economics of the area are based on agribusiness, oil and gas production, and hunting. Farms and ranches in this reach produce cattle, wheat, oats, corn, sorghum, hay, and barley. There are two permitted municipal and industrial dischargers, three active permitted solid waste disposal sites, 17 concentrated animal feeding operations, and one superfund site. In addition, more than 375 ground water wells within the reach utilize water from the Ogallala Aquifer.

The only named segment located in **Reach V** is 0104 – Wolf Creek.

Wolf Creek is naturally spring-fed, and flows year round. Local ranchers utilize Wolf Creek as a valuable watering source for their livestock. Consequently, run-off from rainfall events causes the bacterial levels to rise sharply, then decrease during drier periods.

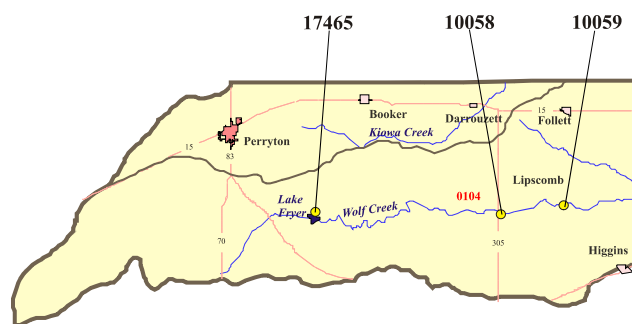


Figure 7

During the reference period of September 1, 2005 through August 31, 2006, the Authority conducted eight monitoring events and collected approximately 232 water quality parameters from two monitoring stations. The TCEQ conducted four monitoring events and collected about 100 water quality parameters from one water quality monitoring station at Lake Fryer. In addition, the USGS continuously monitored flow at one monitoring station in this reach. Refer to **Figure 7** for an illustration of the monitoring coverage for **Reach V**, where each monitoring station is designated by a five digit numeric code.

According to the *2004 Texas Water Quality Inventory*, the two sites located on **Wolf Creek** monitored by the Authority have no water quality issues at this time. Although this area has received much needed rainfall, there has not been enough to significantly end the drought that has plagued the area for many years. Wolf Creek is currently meeting all of its water body use criteria. The precipitation received over the past year in the Texas Panhandle was greatly needed for farmers and ranchers alike, but even more so in **Reach V** as some dry land fields have not made a crop in years. Continued rain and snow are needed to keep soil moisture levels high enough to sustain crops to maturity.



Lake Fryer is a popular recreational lake in the Texas Panhandle.

Lake Fryer is located on Wolf Creek in Ochiltree County. It was constructed in the 1940's for soil conservation, flood control, and recreation. Monitoring under the Clean Rivers Program began in 2002 and as the amount of quality assured data have increased, the Authority has been able to review and evaluate its water quality. Since Lake Fryer is not considered a classified water body at this time, the Authority assessed it utilizing criteria for similar reservoirs. According to the Authority's screening, the water quality in Lake Fryer is relatively good. Since this water body is used for recreational purposes, the Authority proposes classifying it for future assessments.

PUBLIC PARTICIPATION AND OUTREACH

One very successful component of the Clean Rivers Program is public participation. This enables the general public to broaden their awareness of water quality conditions, share knowledge and expertise of many, and cooperatively pursue avenues to rectify problems. The reflection of service with an emphasis on good science is fundamental to the Authority's purpose.

Steering Committee

Originally conceived as a grass-roots project, the Clean Rivers Program established a format for the citizens of Texas to participate in effective statewide watershed planning activities. Each Clean Rivers Program partner agency developed a steering committee which set priorities within its own individual basin. These committees bring together the diverse and unique interests within each basin. Steering committee participants include representatives from the public, municipal, county, state, and federal government, industry, business, agriculture, environmental, education, civic organizations, and others.

As one of the most successful components of the Clean Rivers Program within the Canadian River Basin, the Steering Committee has guided this program through the years. The committee provides valuable assistance and guidance concerning water quality issues.

The Steering Committee and Basin Advisory Committee are one and the same. When originally formed, the Steering Committee was created to meet when it was not been possible for the entire Basin Advisory Committee to meet. However, through the years, the two committees have evolved into one, which serves its purpose very well.

Basin Advisory Committee Meetings are held at least once per year and are designed to be open, friendly, casual, and informative. They are designed to provide in-depth technical information look regarding project work plans, monitoring schedules, reports, and any other relevant topics. Committee members are encouraged to ask questions and voice their ideas at the meetings, are encouraged to contact the Authority as well as throughout the year.

Volunteer Environmental Monitoring

The Texas Rivers Project, in its 16th year, provides an opportunity for area students from junior high through high school to actively collect and analyze samples from their own unique monitoring sites. More than 12 schools have participated in the program since it was initiated. However, due to budget restrictions and time restraints, educators are not able to participate in the Texas Rivers Project as they have done in the past. The Authority is currently exploring ways to revitalize the program.

Earth Day

The Authority is proud to be associated with local Earth Day celebrations. Earth Day is celebrated in cooperation with River Bend Nature Works, an environmental educational center located in Wichita Falls that provides hands-on environmental programs to children and adults. Last year's event was held in April, with more than 750 school children participating. The Authority's Environmental Services Division staff provided presentations on water quality and conservation to the students. Teachers were also provided with environmental educational materials for their students.



Education

Authority personnel also provide presentations to various organizations, clubs, and civic groups to spark interest and awareness in local natural resource issues. Additionally, the Authority provides all types of information and articles that appear regularly in newspapers throughout the basin.

Another program sponsored by the Authority is the distribution of educational materials. The *Major Rivers* and *Think Earth* curricula are provided to all schools upon request. These two publications are favored by teachers and students alike. Last year over 100 boxes of water quality educational material was provided to schools in the Red and Canadian River Basins.

Red River Authority of Texas Website

The Authority maintains an enthusiastic commitment to provide up-to-date scientifically correct information on the website at www.rra.dst.tx.us. The website provides a virtual on-line encyclopedia of information and resources. The home page allows the user to locate information about the Authority and historically research the Canadian River Basin and much more.

A popular feature on the Authority's website is the *Public Information Repository*, which guides one to a wealth of information. Facts and data on almost any aspect of the Canadian River Basin are just a few clicks away. Other information available include: data inventories, digital mapping, general information, legislation, environmental sites, and historical weather data. The Authority also maintains an online publication library that includes reports and studies prepared by the Authority.

FUTURE WORK IN THE CANADIAN RIVER BASIN

The Authority continues to monitor sites, analyze the data collected, determine trends, and assist in the development of Best Management Practices to maintain and/or improve the water quality in the Canadian River Basin.

The Clean Rivers Program has not received an increase in program fees since its beginning in 1991. With rising costs for services and supplies, monetary restrictions have been implemented. This has forced Clean Rivers Program partner agencies to reduce sampling events and parameters collected. Since the number of monitoring sites and parameters needed to meet the Clean Rivers Program goals are far more than can actually be sampled, an increase of continuous monitoring stations should be implemented to provide a constant, reliable source of water quality data. In addition, it is the Authority's opinion that water bodies associated with the greatest risks of not attaining its water quality standards should receive the greatest attention.

As an agency of the state, and in compliance with its mission, the Authority provides financial assistance as much as possible to alleviate some of the budget shortfalls, and also contributes to the Clean Rivers Program by payment of fees assessed to fund TCEQ's water programs. The Authority supports itself through contractual agreements with governmental and non-governmental entities, limiting the additional funding required to adequately monitor the basin's many water resources. Nevertheless, the Authority will continue to work toward full attainment of the Clean Rivers Program goals.

