Managing

NONPOINT SOURCE POLLUTION IN TEXAS

2008 ANNUAL REPORT

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Texas Commission on Environmental Quality

Texas State Soil & Water Conservation Board

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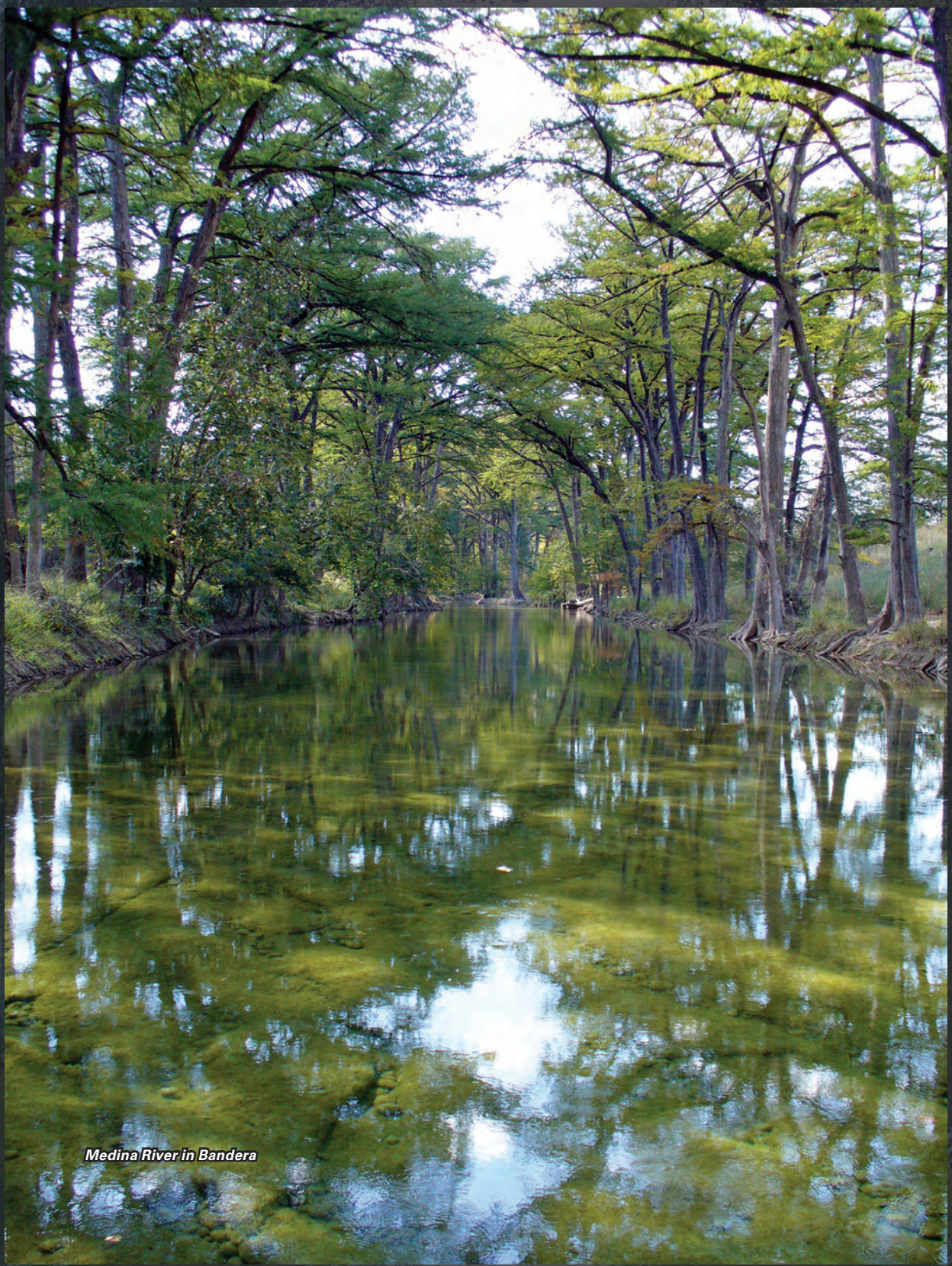

Medina River in Bandera

Managing Nonpoint Source Pollution in Texas

2008 Annual Report

Plum Creek Watershed (photo by Matt Berg, AgriLife Extension)

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From The Executive Directors

The Texas Nonpoint Source (NPS) Management Program is the State's official roadmap to protect and restore water resources impacted by NPS pollution and is jointly developed and administered by the Texas Commission on Environmental Quality (TCEQ) and the Texas State Soil and Water Conservation Board (TSSWCB). The Texas NPS Management Program utilizes baseline water quality management programs and regulatory, voluntary, financial, and technical assistance approaches to achieve a balanced program. The TCEQ and TSSWCB have established goals and objectives for guiding and tracking the progress of NPS management in Texas. The U.S. Environmental Protection Agency (EPA) provides grant funding to Texas to implement the Texas NPS Management Program. Success in achieving the goals and objectives are reported annually in this document, which is submitted to the EPA in accordance with Section 319(h) of the Clean Water Act (CWA).

Implementation of the Texas NPS Management Program involves partnerships among many organizations. With the extent and variety of NPS issues throughout Texas, cooperation across political boundaries is essential. Many local, regional, state, and federal agencies play an integral part in managing NPS pollution, especially at the watershed level. They provide information about local concerns and infrastructure and build support for the kind of pollution controls that are necessary to prevent and reduce NPS pollution. By establishing coordinated frameworks to share information and resources, the State can more effectively focus its water quality protection and restoration efforts.

In the past year, the TSSWCB and the TCEQ have invested a significant amount of funding and time in efforts to develop and implement watershed protection plans (WPPs). WPPs are holistic, stakeholder driven plans that merge the scientific and regulatory concerns of the state and federal agencies with the social and economic considerations of local groups and communities. Through these efforts, best management practices (BMPs) were installed in both urban and rural communities to help improve and restore water quality.

We are pleased to submit the 2008 Annual Report to the citizens of Texas. In partnership with the EPA and other federal, state, regional, and local watershed stakeholders, the TCEQ and the TSSWCB will continue to work toward the goal of ensuring clean water for future generations of Texans.

Rex Isom
Executive Director
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Environmental Quality

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CHAPTER 1

Introduction

Defining Nonpoint Source Pollution

NPS pollution is all water pollution that does not come from point sources. Point sources are regulated "end of pipe" outlets for wastewater or storm water from industrial or municipal treatment systems.

NPS pollution occurs when rainfall or snowmelt flows off the land, roads, buildings, and other features of the landscape. This runoff carries pollutants into drainage ditches, lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water. NPS pollution also includes flows of polluted water from non-permitted sources such as car washes and leaking septic tanks. Common NPS pollutants include:

- Fertilizers, herbicides, and insecticides from agricultural lands and residential areas;
- Oil, grease, and toxic chemicals from spills, roads, urban areas, and energy production;
- Sediment from construction sites, crop and forest lands, and eroding stream banks; and
- Bacteria and nutrients from livestock, pet wastes, and leaking septic systems.

Changes in the flow of waterways due to dams and other structures (hydromodification) can also cause NPS pollution.

North Concho River in downtown San Angelo (photo by Chuck Brown, UCRA)

What Guides NPS Pollution Management in Texas?

Under the federal CWA, Texas and other states must establish water quality standards for waters in the state, regularly assess the status of water quality, and implement actions necessary to achieve and maintain those standards. The mission of the Texas NPS Management Program is to protect the quality of the State's water resources from the adverse effects of NPS pollution. This protection is provided through cooperative implementation using the organizational tools and strategies defined below.

Partnerships

The TCEQ is designated by law as the lead state agency for water quality in Texas. The TSSWCB is the lead agency in the State for planning, implementing, and managing programs and practices for preventing and abating agricultural and silvicultural NPS pollution. The TCEQ administers the Texas NPS Management Program for all other sources of NPS pollution.

Management of NPS pollution in Texas involves partnerships with many organizations to coordinate, develop, and implement the Texas NPS Management Program. With the extent and variety of NPS issues across Texas, cooperation across political boundaries is essential. Many local, regional, state, and federal agencies play an inte-

gral part in managing NPS pollution, especially at the watershed level. They provide information about local concerns and infrastructure and build support for the kind of pollution controls that are necessary to prevent and reduce NPS pollution. By coordinating with these partners to share information and resources and to develop and implement strategies together, the State can more effectively focus its water quality protection efforts.

The Texas NPS Management Program

The Texas NPS Management Program approved by both TCEQ and TSSWCB in 2005 <www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/sfr/068-04_index.html>is the State's official roadmap for addressing NPS pollution, presenting the goals, priorities, programs, and milestones for the program. The program publication is updated every five years. The Texas NPS Management Program, which is prepared jointly by the TCEQ and the TSSWCB, is required by Section 319 of the CWA.

The Texas NPS Management Program, on pages 12-16, presents goals and objectives for addressing NPS pollution in the state. The Texas NPS Management Program utilizes a balanced approach incorporating baseline water quality management programs and regulatory, non-regulatory, financial, and technical assistance approaches. The goals describe high-level guiding principles for all activities under the Texas NPS Management Program. The objectives specify the key methods that will be used to accomplish the goals. The Texas NPS Management Program Annual Report, which is also required by Section 319, provides an annual update of progress toward meeting the goals and milestones set forth in the Texas NPS Management Program. Additionally, the Texas NPS Management Program Annual Report briefly summarizes the State's NPS Program and how it is integrated with the State's other water quality programs.

The goals stated in the Texas NPS Management Program are as follows.

Long-Term Goal

The long-term goal of the Texas NPS Management Program is to protect and restore water quality from NPS pollution through assessment, implementation, and education

Texas Stream Team Volunteer Monitor training in San Marcos (photo by Julie Tuason, Texas Stream Team)

Short-Term Goals

Goal One—Data Collection and Assessment

Coordinate with appropriate federal, state, regional, and local entities, private sector groups, and citizen groups and target CWA Section 319(h) grant funds towards water quality assessment activities in high priority, NPS-impacted watersheds, vulnerable and impacted aquifers, or areas where additional information is needed.

Goal Two—Implementation

Coordinate and administer the Texas NPS Management Program to support the implementation of Total Maximum Daily Load (TMDL) Implementation Plans (I-Plans) and/or WPPs and other state, regional, and local plans/programs to reduce NPS pollution. Manage all CWA Section 319(h) grant funds efficiently and effectively to target implementation activities to the areas identified as impacted, or potentially degraded with respect to use by NPS pollution.

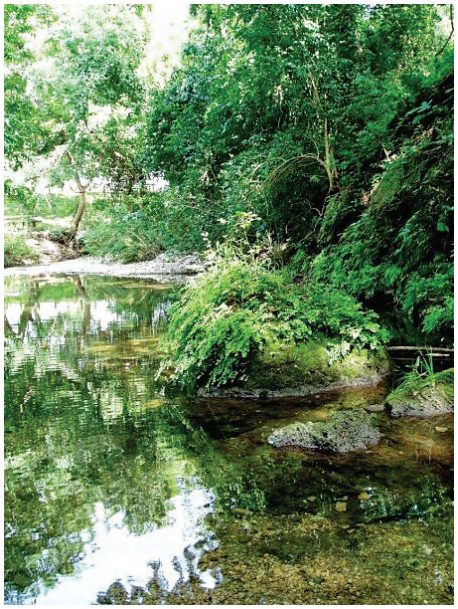
Goal Three—Education

Conduct education and technology transfer activities to help increase awareness of NPS pollution and prevent activities contributing to the degradation of water bodies, including aquifers, by NPS pollution.

The Texas Surface Water Quality Inventory and Clean Water Act Section 303(d) List

The TCEQ and other organizations collect water quality data statewide in order to develop the Texas Water Quality Inventory (TWQI) and CWA Section 303(d) List. The TWQI and 303(d) List includes the identification of surface water bodies that do not meet one or more of the standards defined in the Texas Surface Water Quality Standards (TSWQS). Data also indicate whether NPS pollution is a contributing factor to the impairment. In this context, the term "impairment" is defined as the combination of (1) a designated use (such as contact recreation) not being supported by an individual water body segment and (2) the parameter(s) of concern (such as bacteria) that is causing the water body to fail to support that use. The TCEQ and the TSSWCB prioritize water bodies identified as impaired or threatened by NPS pollution for CWA Section 319(h) grants and other available funding.

For the groundwater portion of the TWQI and CWA Section 303(d) List, select aquifers are represented by maps showing both the locations of water wells sampled and those exceeding health or risk-based criteria for constituents of concern. It also summarizes sources and types of groundwater contamination taken from the Joint Groundwater Monitoring and Contamination Report which is prepared by the Texas Groundwater Protection Committee (TGPC).



Lockhart City Park, Caldwell County. (photo by Matt Berg, AgriLife Extension)

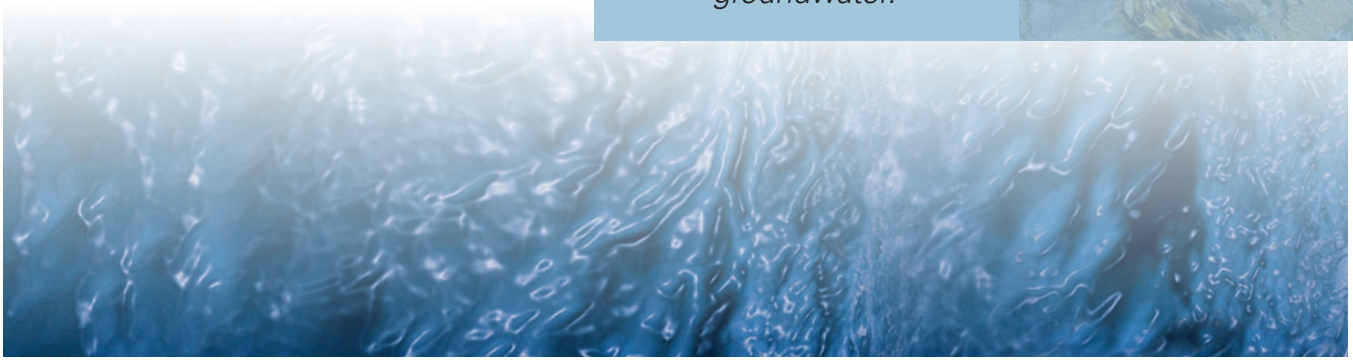
The Watershed Approach

Protecting the State's streams, lakes, bays, and aquifers from the impacts of NPS pollution is a complex process. Texas uses a Watershed Approach to focus efforts on the highest priority water quality issues of both surface water and groundwater. The Watershed Approach is based on the following principles:

- Geographic focus based on hydrology rather than political boundaries
- Water quality objectives based on scientific data
- Coordinated priorities and integrated solutions
- Diverse, well-integrated partnerships

For groundwater management, the geographic focus is on aquifers rather than watersheds. Otherwise, the approach is the same. Wherever interactions between surface water and groundwater are identified, management activities will support the quality of both resources.

Texas uses a Watershed Approach to focus efforts on the highest priority water quality issues of both surface water and groundwater.



Chapter 2

Progress in Improving Water Quality

Section 319(h) of the CWA requires state NPS annual reports include, "to the extent that appropriate information is available, reductions in nonpoint source pollutant loading and improvements in water quality…" This specifically applies to the water bodies of the state that have previously been identified as requiring NPS pollution control actions in order to "attain or maintain applicable water quality standards or the goals and requirements of the Clean Water Act."

The two primary ways of measuring improvement in water quality are:

- Reductions in pollutant loadings resulting from management measures implemented, estimated with the help of models or other calculations, and
- Water quality improvements measured by changes in pollutant concentrations before and after implementation of management measures.

Other indicators of progress toward water quality improvements include physical or behavioral changes that are associated with reductions in loadings or pollutant concentrations in water bodies. Examples include restored riparian or aquatic vegetation and reduced use of fertilizers and pesticides.

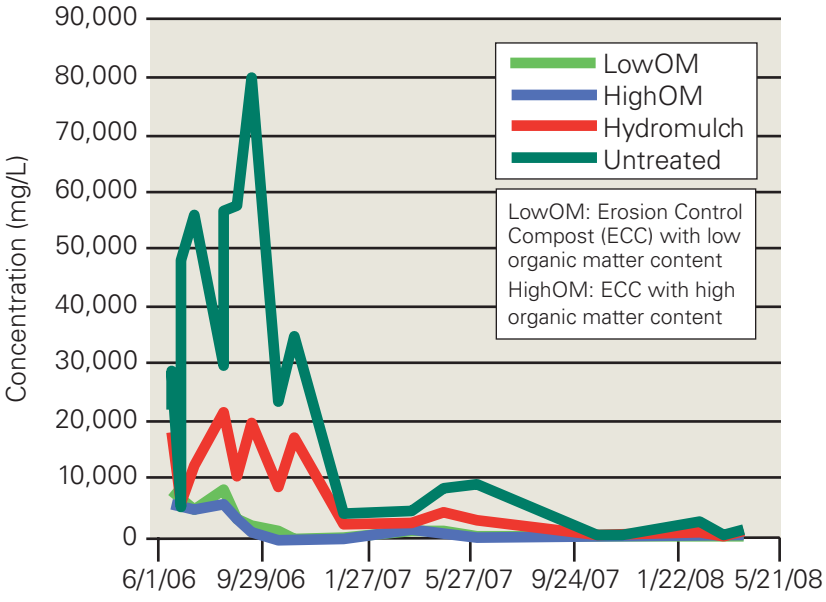
Measuring the Effectiveness of Best Management Practices

Quarry Reclamation Trial of Erosion Control Compost

Since 2000, the TCEQ and the TSSWCB have funded several projects supporting the composting and export of dairy manure from the North Bosque and Leon River watersheds. In 2006, the TCEQ commissioned a field study of the effectiveness of erosion control compost (ECC), a compost/mulch blend made from this manure, in reducing erosion and sediment loss. The test plots were part of a quarry reclamation site on a compacted 12% slope of marginal soils, typical of the challenging landscape establishment conditions at highway and other construction sites as well as mine reclamation sites in the region. The study, completed in 2008, found that ECC reduced sediment loss [Total Suspended Solids (TSS) in runoff] by 98% to 99% over a 2-year period after application. In contrast, a hydromulch treatment reduced sediment loss by only 78%. The ECC treatments also greatly reduced runoff volumes, supported much more rapid and thorough grass cover, and yielded less total nutrients in runoff over the 2-year period than either the hydromulched or untreated plots. The TCEQ used these scientific results to calculate the sediment load reductions resulting from the composted

Figure 2.1

Average Total Suspended Solid Concentrations in Sampled Storm Events



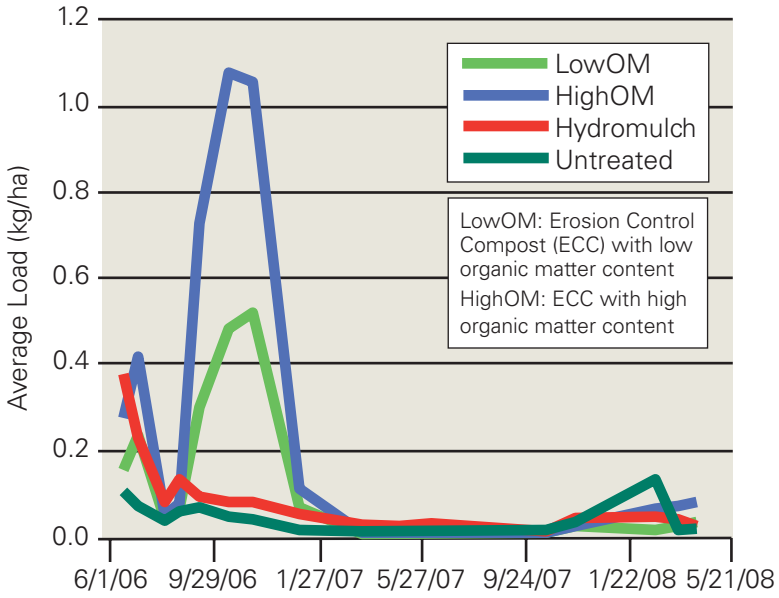
manure exported and used as ECC outside the two watersheds.

The one result raising concern for using this manure-based ECC BMP was higher concentrations of soluble phosphorus in the runoff from the first three heavy rainfalls following establishment of the site. However, after these initial rains, the ECC yielded about the same amount of soluble phosphorus as the other treatments, and, overall, it lost less than 1% of its phosphorus content per year to runoff. These results confirmed the significant beneficial effects of manure-based ECC where receiving streams are not already at risk of impairment by elevated levels of soluble phosphorus and/or where the ECC is not applied over a large percentage of the watershed.

The complete study report is posted at www.tceq.state.tx.us/compliance/monitoring/nps/projects/quarry.html

Figure 2.2

Average Loads of Dissolved Phosphorus from Sampled Storm Events



Reductions in Pollutant Loadings

City of Denton

The City of Denton, along with local stakeholders, completed the WPP for Hickory Creek, which flows into Lake Lewisville. As part of the WPP, demonstrations of BMPs were conducted. A series of stakeholder meetings were also conducted to solicit stakeholder opinions on BMP location, appearance, and performance specifications. Stakeholders requested that the demonstration BMPs be natural looking, effective at removing pollutant loads, and be located in highly visible public lands where they can serve as examples for developers. Stakeholders were presented with a list of candidate BMP sites, each with an analysis of expected design, installation and operation costs, pollutant load reductions, and unit cost (dollars spent versus pounds of pollutants removed). From this list, the stakeholders prioritized sites and then selected three locations for the demonstration BMPs to be constructed in the Hickory Creek Watershed. BMPs were constructed at the Denton Airport, the Denton Public Safety Training Facility, and the Lake Forest Dog Park. A combination of vegetated filter strips, detention ponds and bio-retention BMPs were used. The combined yearly estimates of pollutants that will be removed before entering Hickory Creek are as follows:

Sediment—61 tons Phosphorus—27 lbs Nitrogen—173 lbs

International Falcon Reservoir

International Falcon Reservoir is located on the Rio Grande bounded by Starr and Zapata counties, Texas, and the city of Nueva Ciudad Guerrero, Tamaulipas, Mexico. The dam and reservoir provide for water conservation, flood control, hydroelectric energy, and recreation. In essence, Falcon Reservoir is the "life blood" for Rio Grande Valley agriculture that is highly dependent on irrigation. The reservoir is owned, authorized, and operated by the United States and Mexico through the International Boundary and Water Commission (IBWC). It is estimated that siltation has reduced the storage capacity of Falcon Reservoir by about 189,000 acre/feet.

To address sedimentation issues in the Falcon Reservoir, the Zapata Soil and Water Conservation District (SWCD) worked through the TSSWCB and the United States IBWC to provide technical and financial assistance to implement BMPs.

Through this project, a total of 22 Water Quality Management Plans (WQMPs) were developed within the watershed protecting 22,952 acres from sediment loss. BMPs that were implemented through this project were critical area planting, diversions, terraces, range planting, brush management, cross fencing, and prescribed grazing. According to spreadsheet tool for estimating pollutant loads (STEPL) modeling, these BMPs provided the following load reductions:

Sediment—8,882 tons Phosphorus—79,735 lbs Nitrogen—833,376 lbs

Arroyo Colorado

The Arroyo Colorado (Segment 2201) flows through Hidalgo, Cameron, and Willacy County in the Lower Rio Grande Valley of Texas into the Laguna Madre. Flow in the Arroyo Colorado is sustained by wastewater discharges, agricultural irrigation return flows, urban runoff, and base flows from shallow groundwater. To address the Arroyo Colorado's bacteria and dissolved oxygen impairment as well as nutrient concerns, the Arroyo Colorado Watershed Partnership developed "A Watershed Protection Plan for the Arroyo Colorado—Phase I".

Irrigation land leveling in the Arroyo Colorado.

The Arroyo Colorado WPP calls for the voluntary adoption of agricultural BMPs on 33% of the irrigated cropland by 2010 and 50% by 2015. In response, the Southmost and Hidalgo SWCDs received a CWA Section 319(h) NPS Grant through the TSSWCB to provide technical and financial assistance to implement BMPs on agricultural land in the Arroyo Colorado.

Over the past year, 21 WQMPs were written on 1,325 acres. Through these efforts, a total of 123 WQMPs have been developed in the watershed, protecting over 6,400 acres. The BMPs being implemented include irrigation land leveling, residue management, conservation crop rotation, nutrient management, pasture planting, and prescribed grazing. According to BMP efficiency calculation in the Arroyo Colorado WPP, BMPs installed in fiscal year (FY)08 provided the following load reductions:

Sediment—132 tons Phosphorus—126 lbs Nitrogen—752 lbs

Water Quality Improvements

Lake Como

EPA NPS Success Story:
Removing Legacy Pollutants Restores Fish Consumption Use

In 1995, the Texas Department of State Health Services (DSHS) banned people from possessing fish from Lake Como because the fish contained high concentrations of potentially harmful chemicals. The fish possession ban prompted the TCEQ to include Lake Como on the state's 1996 CWA Section 303(d) List of impaired waterbodies. In response to the ban, local, state and federal agencies implemented a range of BMPs in the City of Fort Worth. The BMPs included education and outreach,

enhancing the city's household hazardous waste facility operations, and sampling fish tissue for evidence of improvement. Recent risk analyses by the DSHS showed that pollutant levels in fish have diminished to safe levels and the possession ban was lifted. The TCEQ then removed Lake Como from the 2008 CWA Section 303(d) List since the fish consumption use was fully supported. The EPA has recognized the water quality improvements achieved in Lake Como by including a summary of the project in its *Section 319 NPS Success Stories* for 2008. The success story, in more detail, is available online at <www.epa.gov/owow/nps/Success319/state/tx_como.htm>.

E.V. Spence Reservoir

In 2001, the TCEQ completed TMDLs for salinity in the E.V. Spence Reservoir (Segment 1411) an important drinking water source in Coke County. A wide range of implementation activities are yielding positive results. The annual mean concentrations for chlorides and sulfate are in compliance at all times, an enormous improvement from previous years. However, the mean concentration for Total Dissolved Solids (TDS) is not yet in compliance.

Table 2.1.
Reductions in Salinity, E.V. Spence Reservoir

Dissolved Salt Concentrations, mg/L			
	1994-1999	2000-2007	% Decrease
Chloride	981	761	22%
Sulfate	761	482	37%
TDS	3255	2068	36%

These improvements are due partly to good rainfalls since 2001 and to exceptional work by the Colorado River Municipal Water District (CRMWD) to accurately manage diversions of saline water during storms using real-time water quality monitors. Other implementation activities and their accomplishments are described below.

Targeted Brush Control

The TSSWCB aided the effort to support the *Implementation Plan for Sulfate and Total Dissolved Solids TMDLs in the E.V. Spence Reservoir* (Segment 1411) by chemically and biologically treating saltcedar in riparian areas along the Colorado River and its tributaries in an effort to reduce NPS pollution loadings.

The *Targeted Brush Control in the E.V. Spence Reservoir Watershed* project chemically treated saltcedar in riparian areas along the Colorado River and its tributaries below Lake J.B. Thomas to the E.V. Spence Reservoir in an effort to reduce NPS pollution loadings resulting from invasive brush species on agricultural land. In FY08, 7,475 acres were treated focusing on the lake basin and riparian areas immediately upstream. Over a three-year period, a total of 11,391 acres were treated.

To extend the life of the chemical treatment, the *Upper Colorado Saltcedar Control Project—Biological Control Component* demonstrated the effectiveness of biologically controlling saltcedars by introducing and releasing the leaf beetle, *Diorhabda elongata,* into saltcedar invaded river valleys in western Texas. The project established two sites, one at Lake Thomas and the other along Beals Creek outside of Big Spring, where the *Diorhabda* beetles were released then monitored for population and dispersal, defoliation and death of saltcedar, predator and competitor insects, and the effects on native plant and animal communities. Over a three-year period (2003–2006), the beetles repeatedly defoliated the entire 10 hectare demonstration plot along Beals Creek, resulting in 90–95% of the canopy dying, 25% of the trees dying, and revegetation of grasses and forbs. In FY08, with little food left in the original 10 hectare area, the beetles migrated 9 km along Beals Creek and defoliated the central 5 km.

West O'Daniel Seep Project

The Railroad Commission of Texas (RRC) has also implemented activities that contribute significantly to reducing salinity in the reservoir. To locate sources of salinity, the RRC conducted several surface water and groundwater investigations to better understand the nature and extent of known salinity contamination thought to be contributing to water quality problems in the E.V. Spence Reservoir. Investigations included the installation of groundwater monitor wells up- and down-gradient of the saltwater seep and in alluvial deposits along the drainage downstream of the seep, a non-invasive geophysical survey and a tracer dye study of the water flood system. Based on these results, analytical data provided by the CRMWD, and data from an airborne geophysical survey performed by the Bureau of Economic Geology for the TCEQ, the RRC determined that oil field operations have contaminated the Ogallala Aquifer in this area causing chloride and TDS in groundwater to be elevated as compared to background levels. The RRC hypothesized that the chloride-contaminated groundwater occurs under unconfined conditions in the sand unit of the Ogallala Aquifer within the West O'Daniel Drainage basin.

The West O'Daniel Seep in Howard County, Texas is one of several saltwater seeps found along the contact of two aquifers—the Ogallala Outlier and the Dockum Group—that discharge their water into intermittent streams and drainage ways flowing into Beals Creek, a tributary of the Colorado River. The confluence of Beals Creek and the Colorado River is located upstream of the E. V. Spence Reservoir.

To intercept and remove saline-contaminated shallow groundwater, the RRC installed a 300-foot recovery trench BMP into the Ogallala Aquifer and to the base of the underlying lower permeability silty clay unit (Dockum Contact). The recovery trench blocks groundwater migration through the trench by means of hydraulic control. The trench was backfilled with highly permeable fill material into which groundwater flows preferentially and is captured by a pump. The capture zone of the recovery trench is approximately the cross sectional area of saturated sediment that it intersects. Contaminated groundwater is captured in storage tanks and later hauled in vacuum trucks to a nearby commercial saltwater disposal well and disposed by injection into a deep formation that is not productive of oil or gas.

The RRC estimates that a total annual load of 114,975 pounds of chloride (315 pounds/day) and of 223,563 pounds of TDS (434 pounds/day) will be recovered from groundwater. This estimate is based on initial sampling results, while the trench system was operating at maximum efficiency that determined 50 barrels per day recovery of groundwater and average chloride and TDS levels of 18,000 mg/L and 35,000 mg/L, respectively. The RRC continues to conduct regular monitoring and evaluation of the system's effectiveness

E.V. Spence Reservoir (photo by CRMWD)

Chapter 3

Progress toward Meeting the Goals and Objectives of the Texas NPS Management Program

The Texas NPS Management Program utilizes baseline water quality management programs and regulatory, non-regulatory, financial, and technical assistance approaches to achieve a balanced program. NPS pollution is managed through assessment, planning, implementation, and education. The TCEQ and TSSWCB have established goals and objectives for guiding and tracking the progress of NPS management in Texas. The goals describe high-level guiding principles for all activities under the Texas NPS Management Program. The objectives specify the key methods that will be used to accomplish the goals. Success in achieving the goals and objectives are reported annually in this report, which is submitted to EPA in accordance with CWA requirements. Although not comprehensive, this chapter reports on a variety of programs that directly support the goals and objectives of the Texas NPS Management Program.

Plum Creek Watershed. (photo by Matt Berg, AgriLife Extension)

CWA Section 319(h) Grant Program

Section 319(h) of the CWA established a grant that is awarded annually by Congress to the EPA. The EPA then allocates these funds to the states to implement activities supporting the congressional goals of the CWA. The TCEQ and the TSSWCB target these grant funds toward all NPS activities consistent with the long- and short-term goals defined in the Texas NPS Management Program.

Emerging Issue Related to Funding Under the CWA Section 319(h) Grant Program

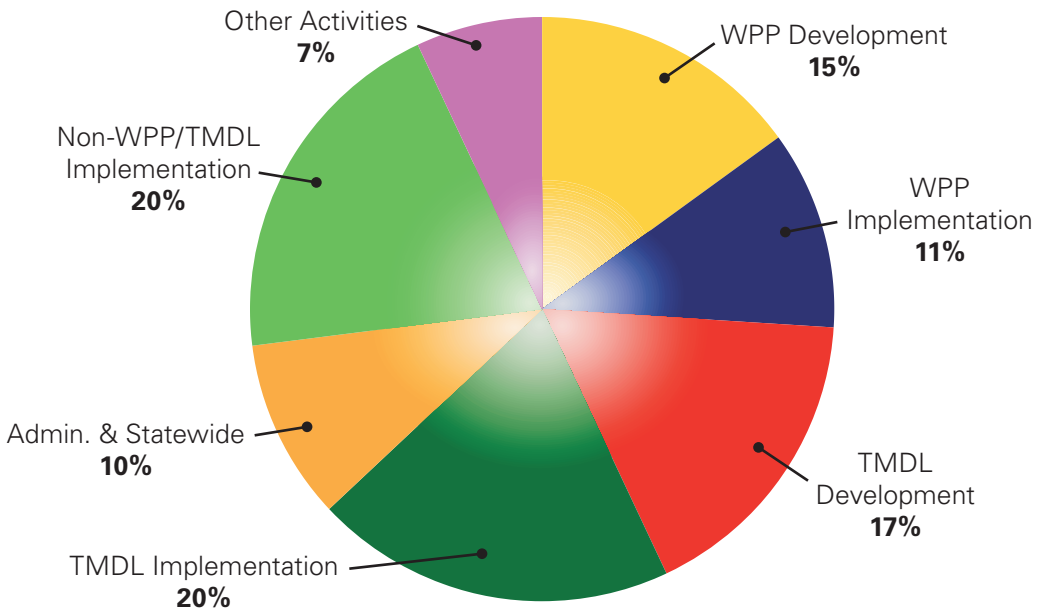
As new federal National Pollutant Discharge Elimination System (NPDES) rules as well as state rules have begun to regulate municipal storm sewer systems and other storm water pollution sources by permit, the distinction between point source and NPS has become more complex. This distinction is important in regard to federal funding of NPS activities. The Texas NPS Management Program created by Section 319 of the CWA is prohibited from funding activities required by a point source permit, including storm water permits. Storm water fits the traditional definition of NPS pollution but is collected and managed under permit requirements through a storm sewer system. As NPDES rules now require certain types of industrial facilities, construction sites, and entire urbanized areas to control runoff under storm water permits, much of the urban component of storm water management has been reclassified as point source and thus not fundable with Section 319(h) funds. Federal guidelines do, however, allow the Texas NPS Management Program to fund NPS management measures in permitted urbanized areas if the activities are not specifically required by the storm water permit.

Summary of CWA Section 319(h) grant-funded projects

In FY08, the TCEQ had 51 active multi-year CWA Section 319(h) grant-funded projects which had a total budget of approximately $16 million in federal funds, addressing a wide range of NPS issues as indicated in Figure 3.1. These projects focus on the development and implementation of WPPs and TMDLs where the primary sources of NPS pollution are not agricultural or silvicultural. General implementation project types

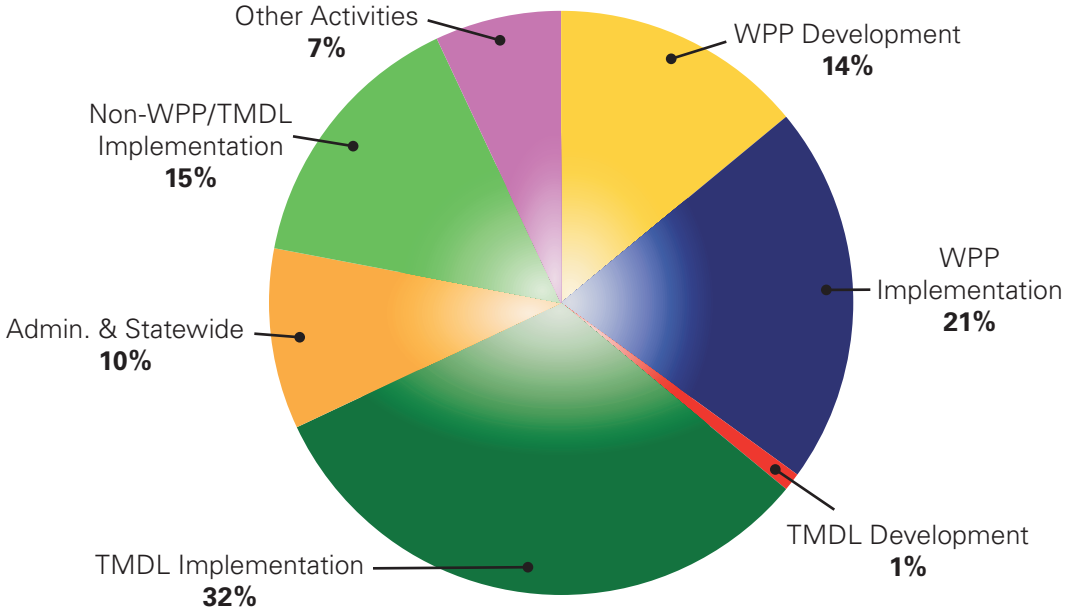
include urban storm water quality retrofits, on-site sewage facility (OSSF) upgrades, abandoned oil well plugging and related remediation, public education and outreach projects, demonstration projects, and a variety of other BMPs chosen on the basis of local water quality needs.

Figure 3.1
TCEQ Current NPS Grant-Funded Projects



In FY08, the TSSWCB had 62 active multi-year CWA Section 319(h) grant-funded projects which had a total budget of approximately $14 million in federal funds addressing a wide array of agricultural and silvicultural NPS issues in Figure 3.2. Specific project actions include development and implementation of WPPs and TMDLs, supporting targeted educational programs, and implementing BMPs to abate NPS pollution from dairy and poultry operations, silvicultural activities, grazing operations, and row crop operations.

Figure 3.2
TSSWCB Current NPS Grant-Funded Projects



Short Term Goals and Milestones of the Texas NPS Management Program

Goal One—Data Collection and Assessment

One of the goals of the Texas NPS Management Program is to collect and assess water quality data. Data collection requires the coordination of appropriate federal, state, regional, and local entities as well as private sector and citizen groups. The TCEQ's Surface Water Quality Monitoring (SWQM) program, operating from the central office and sixteen regional offices, conducts both routine monitoring and special studies. In addition, the Clean Rivers Program (CRP), a collaboration between the TCEQ and fifteen regional water agencies, collects surface water quality data throughout the State in response to both state needs and local stakeholder interests. Furthermore, the TCEQ acquires water quality data from other state and federal agencies after assuring the quality of the data are comparable to that of data collected by the TCEQ's programs.

Data are assessed by the TCEQ to determine if a water body meets its designated use(s) or if water quality improvement activities are achieving their intended goals. For impaired waters, water quality data can be used in the development of WPPs and TMDLs. Data are also used to determine sources of pollution, the adequacy of regulatory measures, watershed improvements, and restoration plans. The data collection primarily guides the distribution of CWA Section 319(h) grant funds toward water quality assessment activities in high priority, NPS-impacted watersheds, vulnerable and impacted aquifers, or areas where additional information is needed.

TCEQ SWQM staff member Bill Harrison uses the Hydrolab water quality monitoring device.

Assessment and Targeting of Bacterial Sources in the South Nolan Creek Watershed

The City of Killeen has taken a proactive approach in addressing water quality problems to improve the quality of life for citizens of Killeen. The City initiated a Water Quality Monitoring Program in the South Nolan Creek watershed to identify priority sub-basins where bacteria concentrations exceed State water quality standards and target these areas for implementation of storm water BMPs. Monitoring within the City of Killeen characterized the water quality in the upper 6.9 miles of the 29 mile long segment (Segment 1218), which extends from its origin in Killeen to its confluence with the Leon River.

Water quality monitoring for the project was initiated in October 2006 and continued through February 2008. The project was completed in August 2008 and the Final Report was submitted in October 2008. Results of routine and wet-weather monitoring were used to identify priority areas in the City for OSSF inspections, sewer conversions through the City's Septic Tank Elimination Program, and targeted public education programs. This assessment project addressed water quality indicators that are typically associated with urban NPSs including: *Escherichia coli* bacteria, nutrients, biochemical oxygen demand (BOD), metals, suspended solids and physical properties such as water temperature, pH, dissolved oxygen (DO), and specific conductance. With the exception of bacteria, ambient monitoring was conducted semi-annually at five main stem stream sites on the South Nolan Creek. Bacteria monitoring was conducted on a monthly basis at nine sites and included six sites on the South Nolan Creek and three tributary sites. Wet-weather monitoring was conducted at a single site where the South Nolan Creek leaves the City of Killeen and enters Harker Heights to characterize pollutant Event Mean Concentrations. Nine storm events were monitored during the study.

The 6.9 mile reach of the South Nolan Creek that was monitored during this study was divided into an Upper Reach (4 miles), a Middle Reach (1.1 miles) and a Lower Reach (1.8 miles) based on the water quality monitoring results.

- The Upper Reach from the beginning of Segment 1218 to a point immediately upstream of the Bell County wastewater treatment plant (WWTP) outfalls was characterized as meeting the designated uses and showed no impairments related to

the TSWQS. DO, pH, temperature, nutrients, metals and bacteria concentrations met the TSWQS criteria and screening levels set by the TCEQ.

- The Middle Reach met TSWQS criteria for DO, pH, temperature, metals and bacteria concentrations. Nutrient concentrations (ammonia, nitrate plus nitrite, orthophosphorus, and total phosphorus) above TCEQ screening levels were observed immediately downstream of the WWTP outfalls. While not conclusive, several water quality parameters as well as flow data suggest that the WWTP discharge may be the source of elevated nutrients. The final report recommends that a special study be conducted by TCEQ to confirm the source of elevated nutrients.
- The Lower Reach met TSWQS criteria for DO, pH, temperature, and metals. Nutrient concentrations generally declined but remained elevated above TCEQ screening levels. Elevated bacteria concentrations were observed and the number of exceedances and the geometric mean confirm impairment of the contact recreation use due to OSSF influences from Long Branch and Little Nolan Creek.

Little Nolan Creek. (photo by City of Killeen)

The results showed a positive correlation between the *Escherichia coli* geometric mean concentration and the number of OSSFs located above the sampling site. Based on the monitoring results and watershed characteristics such as land use, soils, hydrography, and OSSF densities, the City identified 4 priority sub-basins for BMP implementation.

- The Little Nolan Creek and Little Nolan Creek Tributary 1 sub-basins were identified as high priority for implementation of the City's Septic Tank Elimination Program. These sub-basins contain 301 of the 451 OSSFs located in the South Nolan Creek watershed.
- The Long Branch sub-basin was identified as high priority for implementation of targeted public education relating to septic tank maintenance and proper pet waste management.
- The Bermuda Ditch sub-basin contains no known OSSFs but occasional dry weather flows were observed with elevated *Escherichia coli* concentrations. The City will use dry weather screening techniques to identify possible sources, which may include illicit discharges and illegal connections to the storm sewer system.

The City will implement these BMPs through its Phase II Municipal Separate Storm Sewer System (MS4) Storm Water Management Program. The City plans to continue ambient monitoring for *Escherichia coli* concentrations at 3 sites on a quarterly basis to monitor long-term trends and characterize water quality improvements and BMP effectiveness.

Texas Water Quality Inventory

Section 305(b) of the CWA requires all states to assess the quality of surface waters every two years. The TWQI or 305(b) Report describes the status of all surface water bodies of the state evaluated for the given assessment period. To accomplish this, the TCEQ uses data collected during the most recent seven-year period. The quality of waters described represents a snapshot of conditions during the limited time period considered in the assessment. Water bodies identified as impaired or threatened by NPS pollution are given priority for CWA Section 319(h) grants and other available funding.

Guidance for developing the assessment, which includes a description of the CWA Section 303(d) process, is based on a set of methods that apply the surface water quality standards, or goals for water quality. These methods are developed by the TCEQ with the advice of a diverse group of stakeholders, and are detailed in the 2008 Guidance for Assessing and Reporting Surface Water Quality in Texas.

The 303(d) List is an important management tool produced as part of the assessment. It identifies waters for which the existing preventive measures such as permits

that limit discharges of wastewater and the technology used by the dischargers are not sufficient to achieve water quality standards. The TWQI and 303(d) List is subject to review and approval by the EPA.

Categories Indicate Water Quality Status

The TWQI assigns each assessed water body to one of five categories to provide information to the public, the EPA, the TSSWCB, and internal TCEQ programs about water quality status and management activities. These categories indicate the status of a water body, and how the state will approach identified water quality problems. Table 3.1 defines the five categories and summarizes the number of water bodies assigned to each assessment category in 2008.

Table 3.1

Water Bodies Evaluated in the 2008 Texas Water Quality Inventory (305b)

Category	Category Description	Water Body Classification		Number of Water Bodies
		Classified	Unclassified	
1	All uses assessed and attained.	8	0	8
2	Some uses assessed and attained.	187	212	399
3	Insufficient data to assess any use in 2006 and 2008 but previously attaining.	4	99	103
4	Not attaining use or standard and does not need a TMDL.	15	14	29
5	TMDL may be required. Category 5 is the 303(d) list.	160	226	386
Total Number of Water Bodies		**374**	**551**	**925**

Water bodies in Category 1 meet all their uses, and simply require routine monitoring and preventive action. Higher category numbers correspond to higher levels of effort required to manage water quality. Water bodies in Category 5 make up the 303(d) List and are those water bodies that require remedial action by the State to restore water quality. For water bodies in Category 5a, the State must develop a scientific model called a TMDL and a plan to implement it. Water bodies in Category 5b require a water quality standards review and those in Category 5c require additional monitoring to further define the impairment. The number of water bodies in Category 5 requiring remedial action is shown in Table 3.2.

The categories must be applied to each combination of designated use and criteria, or parameter, for determining support. The combination of the use with the pollutant or condition of concern is called an impairment. For example, the concentration of DO is one of the criteria used to determine the support of the aquatic life use. If DO concentrations are too low, the water body being evaluated would have an aquatic life use impairment. Since a water body has multiple uses, it may fall into different categories for different uses. In that case, the overall category for the water body is the one with the highest category number.

Table 3.2

Summary of Impairments by Category from the Draft 2008 Texas Water Quality Inventory and 303(d) List

Category	Sub Category	Water Body Classification		Total Number of Impairments
		Classified	Unclassified	
4	4a- TMDL completed and approved	30	23	53
	4b- Other water quality controls, expected to meet standards soon	8	1	9
	4c- Impaired, but not by a pollutant	4	3	7
Total Number of Impairments in Category 4		**42**	**27**	**69**
5	5a- TMDL scheduled or underway	99	84	183
	5b- Water quality standards review scheduled or underway/use attainability analysis	39	15	54
	5c- Need additional monitoring	111	168	279
Total Number of Impairments in Category 5		**249**	**267**	**516**
Total Number of Impairments		**291**	**294**	**585**

Summary of the 2008 Texas Water Quality Inventory and 303(d) List

In 2007, the TCEQ assessed several specific groups of water bodies for the 2008 TWQI and 303(d) List. These water bodies include classified segments and other segments with a pending regulatory reason for evaluation or the need to initiate or revise planning activities such as a TMDL or standards revision. The TCEQ relied on cooperators, such as local and state water management agencies, to identify additional water bodies for the assessment. The 2008 TWQI included the assessment of 427 (375 classified, 52 unclassified) water bodies. The status of 925 water bodies was reported. A full assessment is planned for 2010. Of the 925 water bodies, 386 were included on the 2008 303(d) List. This was a slight decrease from the 2006 303(d) List which included 399 water bodies. The total number of impairments also decreased from 543 to 516 (see Table 3.3).

Public comment was solicited in January 2008 and the Draft 2008 TWQI and 303(d) List was submitted to the EPA for approval on April 1, 2008. The TCEQ received final approval for the 2008 303(d) List on July 9, 2008.

Summary of 2008 Impairments

Impairments identified in the 2008 TWQI and 303(d) List have been grouped by the cause and the beneficial use of the water body affected (Table 3.3). Elevated levels of bacteria, which impair the contact recreation use of water bodies, cause 53 percent of the listed impairments. Many of these bacteria impairments are the result of urban and agricultural NPS pollution. Low DO, impairing many of the same water bodies, results in an unhealthy environment for aquatic life. DO levels are depressed by both point and nonpoint sources of oxygen-demanding substances and nutrients which over-fertilize aquatic plants and algae. Contaminants in fish tissue originate primarily from the landscape. For example, heavy metals and organic contaminants such as pesticides are often components of runoff from urban and agricultural land.

Table 3.3

Summary of Impairments Identified on the 303(d) List for the 2008 Texas Water Quality Inventory

Impairment Group	Media	2006 Number of Impairments	2008 Number of Impairments	Use
Bacteria	in water	291	274	Recreation
	in shellfish	21	21	Oyster Waters
Dissolved Oxygen		96	84	Aquatic Life
Toxicity	in ambient water	5	5	Aquatic Life
	in ambient sediment	6	6	
Organics	in water	0	0	Fish Consumption, Aquatic Life
	in fish/shellfish	31	34	
Metals (except Mercury)	in water	4	4	Fish Consumption, Oyster Waters, Aquatic Life
	in fish/shellfish	0	0	
Mercury	in water	1	1	Fish Consumption, Oyster Waters, Aquatic Life
	in fish/shellfish	15	17	
Dissolved Solids	chloride	13	16	General
	sulfate	6	6	
	total dissolved solids	11	8	
Temperature		0	0	General
pH		13	16	General
Nutrients	nitrogen	0	0	General, Public Water Supply
Biological	habitat, macrobenthos community, or fish community	30	24	Aquatic Life
Totals		**543**	**516**	

The complete 2008 TWQI and 303(d) List is available on the Web at <www.tceq.state.tx.us/compliance/monitoring/water/quality/data/08twqi/twqi08.html>.

Continuous Water Quality Monitoring Network

The purpose of the TCEQ's Continuous Water Quality Monitoring Network (CWQMN) is to collect and display ambient water quality data in "real-time". "Real-time" means that the data collected in the field are reported almost simultaneously to the TCEQ so that it knows about changes in surface water quality in critical watersheds. The stations are located throughout Texas using a combination of in situ probes and automated analysis instruments and monitor parameters, such as temperature, pH, DO, specific conductance, chlorophyll a, soluble reactive phosphorus, nitrate, and ammonia. Data are transmitted from the stations to the TCEQ using phone modems, wireless modems and satellite telemetry. Once data are trans-

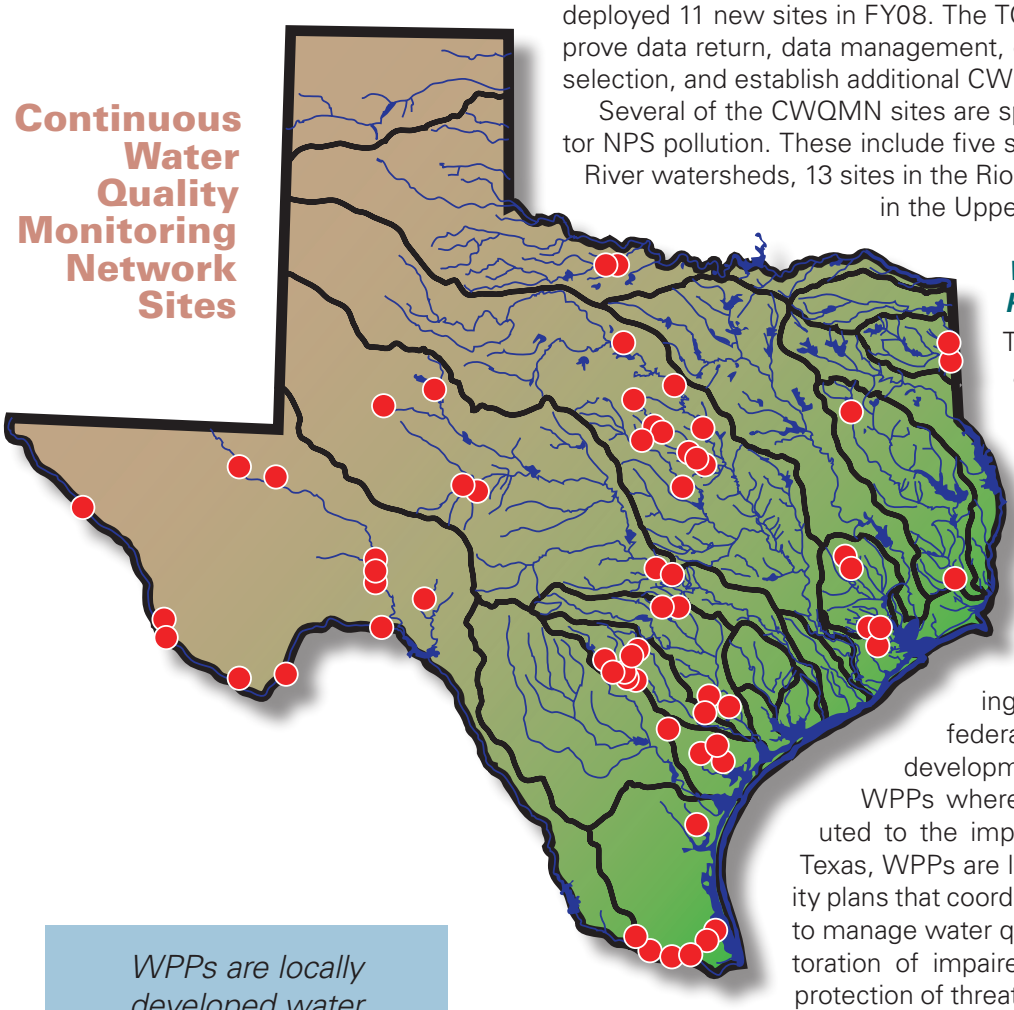
ferred, they are stored in the Leading Environmental Analysis and Display System (LEADS) database.

The data can be accessed by the public via the Web at <www.texaswaterdata.org >.

The CWQMN has 63 sites. TCEQ, cooperators and contractors deployed 11 new sites in FY08. The TCEQ plans to continue to improve data return, data management, operator training, instrument selection, and establish additional CWQMN sites during FY09.

Several of the CWQMN sites are specifically designed to monitor NPS pollution. These include five sites in the Bosque and Leon River watersheds, 13 sites in the Rio Grande Basin, and two sites in the Upper Colorado River watershed.

Continuous Water Quality Monitoring Network Sites



Watershed Protection Plans

The TCEQ and the TSSWCB apply the watershed approach to managing NPS pollution by supporting the development and implementation of WPPs. These plans are developed through local stakeholder groups and a significant portion of the funding for preventing NPS pollution under the federal CWA is dedicated to the development and implementation of WPPs where NPS pollution has contributed to the impairment of water quality. In Texas, WPPs are locally developed water quality plans that coordinate activities and resources to manage water quality. They facilitate the restoration of impaired water bodies and/or the protection of threatened waters before they become impaired. These stakeholder-driven plans give the decision-making power to the local groups most vested in the goals specified in the plans. Bringing groups of people together through watershed planning efforts combines scientific and regulatory water quality factors with social and economic considerations. While WPPs can take many forms, the development of plans funded by CWA Section 319(h) grants must follow guidelines issued by the EPA. These guidelines can be found at: Nonpoint Source Program and Grants Guidelines for States and Territories, <www.epa.gov/fedrgstr/EPA-WATER/2003/October/Day-23/w26755.htm>.

WPPs are locally developed water quality plans that coordinate activities and resources to manage water quality.

In 2008, the TCEQ and the TSSWCB are facilitating the development and implementation of WPPs (Table 3.4) throughout Texas by providing technical assistance and/or funding through grants to local stakeholder groups. There are also WPPs that are being developed or have been developed in Texas independently of those listed in the table. Therefore, the following list is not intended to be comprehensive of all the watershed protection planning efforts currently underway in Texas in 2008.

The following web link provides an overview and summary of WPPs in progress or completed in Texas: the TSSWCB, <www.tsswcb.state.tx.us/en/wpp> and the TCEQ, www.tceq.state.tx.us/compliance/monitoring/nps/mgmt-plan/watershed-pp.html>. Specific WPP activities are described in Chapter 4.

Table 3.4
Texas Watershed Protection Plans

TCEQ Watershed Protection Plans	Links
Armand Bayou Watershed	www.armandbayou.org/
Arroyo Colorado Watershed	www.arroyocolorado.org/
Brady Creek Watershed	www.ucratx.org/NPSBrady.html
Caddo Lake Watershed	www.netmwd.com/Caddo%20Lake%20Protection%20Plan/Caddo_index.html
Dickinson Bayou Watershed	www.dickinsonbayou.org/
Hickory Creek Watershed	http://cityofdenton.com/pages/mygovenvironmentalwater319grant.cfm
Lake Granbury Watershed	www.brazos.org/gbWPP.asp
Upper San Antonio River Watershed	http://sara-tx.org/site/water_quality/water_qual_mon/wpp/wppintro.html
TSSWCB Watershed Protection Plans	**Links**
Buck Creek Watershed	http://twri.tamu.edu/buckcreek/
Concho River Watershed	www.ucratx.org/CRiverRest_UCRA.html
Granger Lake Watershed	www.tsswcb.state.tx.us/managementprogram/granger
Lampasas River Watershed	www.lampasasriver.org/
Leon River Watershed	http://brazos.org/LeonWPP.asp
Pecos River Watershed	http://pecosbasin.tamu.edu/
Plum Creek Watershed	http://plumcreek.tamu.edu/

Goal Two—Implementation

Texas NPS Management Program Implementation

The second goal of the Texas NPS Management Program involves the management of CWA Section 319(h) grant funds and the leveraging of additional funds to efficiently and effectively target implementation activities to areas identified as impacted or at risk for being impacted by NPS pollution. Implementation activities are conducted with the goal of preventing and reducing NPS pollution in surface water groundwater, wetlands, and coastal areas, through the execution of TMDL I-Plans, WPPs, recommendations from the Joint Groundwater Monitoring and Contamination Report, the Texas Groundwater Protection Strategy, and the TSSWCB-certified WQMPs on agricultural and silvicultural lands. The following sections provide an update on various programs and projects that involve NPS implementation activities and are examples of additional funding that target NPS pollution.

Total Maximum Daily Loads and Implementation Plans

The State's TMDL program works to improve water quality in impaired or threatened water bodies in Texas. This program is a major component of the State's strategy for managing the quality of water in Texas streams, lakes, bays, and other surface waters. The federal mandate for state TMDL programs is contained in the Federal Water Pollution Control Act and its amendments, also known as the Clean Water Act. Section 303(d)(1)(C) of the CWA and the EPA's implementing regulations in Title 40 of the Code of Federal Regulations, Part 130, require states to identify waters where effluent limitations alone are not sufficient to meet water quality standards. Every two

years, the identified water bodies are compiled in the CWA Section 303(d) list. The CWA requires that where point source controls are not sufficient to attain water quality standards, a TMDL must be established to account for and allocate loadings from point, nonpoint, and natural sources of pollution.

The TCEQ and TSSWCB are both responsible for developing TMDLs for Texas' water bodies. The TCEQ develops most TMDLs in Texas; however, the TSSWCB is involved in and may take the lead in developing TMDLs in watersheds where agriculture and/or silviculture have significant land uses. The TCEQ and the TSSWCB coordinate closely on all TMDLs in which agricultural or silvicultural NPSs are involved, no matter which agency leads TMDL development. It is also possible for an organization to initiate and develop a TMDL for a water body in the state without invitation or funding support from the State. TMDLs developed by such entities are commonly referred to as "third-party" TMDLs. The State strongly suggests that entities developing third-party TMDLs coordinate closely with the TCEQ and with the TSSWCB as appropriate to their jurisdictions and interests. Regardless of who develops a TMDL, the TCEQ has jurisdiction for managing the overall quality of surface waters in Texas. The TCEQ must adopt all TMDL reports developed for Texas water bodies and is responsible for submitting adopted TMDLs to the EPA for its concurrence.

The TCEQ and TSSWCB believe it is essential to engage residents in the watershed when developing plans to reduce pollution. Residents provide the local expertise needed to identify site-specific problems, target those areas for cleanup, and help determine what measures will be most effective.

Texas TMDLs are developed via a rigorous process of data collection and analysis. The term impairment refers to the combination of the use that is not supported with the parameter of concern for an individual segment. Federal regulations require that the State develop a TMDL for each impairment within a particular body of water. The State is committed to developing TMDLs in a timely manner and implementing all approved TMDLs. Implementation of TMDLs may require the TCEQ to impose new or revised limitations on discharge of some pollutants in the permits it issues under the Texas Pollutant Discharge Elimination System (TPDES). Where nonpoint sources of pollution are identified, the State will work through the NPS management programs at the TSSWCB and TCEQ to encourage local implementation of voluntary actions that reduce the amount of pollutants entering waters. The State leverages existing resources whenever possible to achieve the load reductions identified in TMDLs.

The TCEQ and TSSWCB believe it is essential to engage residents in the watershed when developing plans to reduce pollution. Residents provide the local expertise needed to identify site-specific problems, target those areas for cleanup, and help determine what measures will be most effective. Anyone whose interests may be affected by a TMDL project has a stake in the process. Stakeholders include, among others, permitted wastewater dischargers, municipal and county governments, regional or state governmental agencies, agricultural producers, recreational clubs, homeowners associations, environmental groups, and interested individuals. Experts from local, regional, state, and federal agencies and universities also participate, giving technical and scientific support.

As of August 2008, the TCEQ had approved TMDL I-Plans for the following streams, reservoirs, and estuaries that are impaired in part due to nonpoint sources of pollution (in Table 3.5). Each project is identified by water body, basin and segment number of the impaired water body, the designated use that has been affected, and the geographic extent of the impairment.

Table 3.5

Total Maximum Daily Load Implementation Plan Status

Implementation Plan	Basin & Segment(s)	Use Affected	Year Begun	Status	Area of Impairment
Aquilla Reservoir: atrazine	Brazos River; 1253	Source for drinking water	2002	Goals met	3,943 lake acres
Arroyo Colorado: legacy pollutants and organics	Nueces–Rio Grande Coastal; 2202, 2202A	Safety of fish consumption	2001	Under way	504 stream miles; 333 lake acres
Clear Creek: dissolved solids	San Jacinto-Brazos Coastal; 1102	General (not tied to a specific use)	2006	Under way	60 stream miles
Colorado River below E.V. Spence Reservoir: dissolved solids	Colorado River; 1426	General (not tied to a specific use)	2007	Under way	56 stream miles
Dallas and Tarrant counties waterways: legacy pollutants*	Trinity River; 0805, 0841, 0841A	Safety of fish consumption	2001	Under way	18,970 lake acres; 127 stream miles
E.V. Spence Reservoir: dissolved solids	Colorado River; 1411	General (not tied to a specific use)	2001	Under way	29,000 lake acres
Fort Worth waterways: legacy pollutants*	Trinity River; 0806, 0806A, 0806B, 0829, 0829A	Safety of fish consumption	2001	Under way; some goals met	101 lake acres; 47 stream miles
Lake O' the Pines: low dissolved oxygen	Cypress Creek; 0409	Support of aquatic life	2006	Under way	18,700 lake acres
North Bosque River: soluble reactive phosphorus	Brazos River; 1226, 1255	General (not tied to a specific use)	2002	Under way	121 stream miles
Petronila Creek above tidal: dissolved solids	Nueces–Rio Grande Coastal; 2204	General (not tied to a specific use)	2007	Under way	44 stream miles

**Note:* Legacy pollutants are chemicals that persist in the environment long after their use has been banned or severely restricted.

Coastal Management Program

The Texas Coastal Management Program (CMP) was created to coordinate state, local, and federal programs for the management of Texas coastal resources. The program brings in federal Coastal Zone Management Act (CZMA) funds to Texas to implement projects and program activities for a wide variety of purposes. The Coastal

Coordination Council (CCC) administers the CMP and is chaired by the Commissioner of the Texas General Land Office (GLO). The CCC is comprised of the chair or appointed representatives from the Texas Parks and Wildlife Department (TPWD), the TCEQ, the Texas Water Development Board (TWDB), the Texas Department of Transportation (TxDOT), the TSSWCB, the RRC, the director of the Texas A&M University Sea Grant Program and four gubernatorial appointees. These members are selected to provide fair representation for all aspects concerning coastal issues.

The Coastal Zone Act Reauthorization Amendments (CZARA), Section 6217, requires each State with an approved coastal zone management program to develop a federally approvable program to control coastal NPS pollution.

This program for Texas is the *Texas Coastal Nonpoint Source Pollution Control Program* (Coastal NPS Program) and has been under development since 1997. To facilitate the development of the Coastal NPS Program, the CCC appointed a Coastal NPS Pollution Control Program workgroup comprised of staff from GLO, TCEQ, RRC, TxDOT, TPWD, TSSWCB and a public member from the CCC. This workgroup has addressed comments submitted by the National Oceanic and Atmospheric Administration (NOAA) and EPA regarding Texas' Coastal NPS Program, reviewed and recommended proposed NPS pollution control projects, and researched possible options to enhance the program.

In September 2001, EPA and NOAA notified Texas of their intent to approve the Texas Coastal NPS Program with certain conditions. NOAA and EPA identified the following six areas that Texas must strengthen or correct prior to receiving full approval of the Coastal NPS Program:

1. New Development and Existing Development
2. Site Development
3. Watershed Protection
4. New and Operating Onsite Sewage Disposal Systems
5. Roads, Highways, and Bridges (not under TxDOT jurisdiction)
6. Hydromodification

In July 2008, the CCC sent a letter to NOAA and EPA with supporting documentation that addressed the remaining conditional approval findings in the Coastal NPS Program. The CCC will continue to work with EPA and NOAA in order to obtain full approval of the Coastal NPS Program.

Houston Galveston Area Council

In FY08, TCEQ provided CWA Section 604(b) grant funds to the Houston Galveston Area Council (H-GAC) to implement a portion of the urban runoff management measure identified in the Coastal NPS Program. H-GAC compiled available information and developed new information to assist in planning efforts for coastal areas that are not regulated by storm water permits. H-GAC used aerial photography and Geographic Information System (GIS) to conduct a watershed analysis of several watersheds in the coastal zone. The information H-GAC developed includes: Population growth patterns; location of onsite disposal systems; assessment of ground-water and surface water hydrology; evaluation of soil type and ground cover; identification of areas with water quality impairments; and identification of environmentally sensitive areas, such as wetlands, riparian areas, floodplains, aquifer recharge areas, and drainage ways. The information developed by H-GAC will be used by planning agencies to help guide development and protect water quality. The information can also be used by local stakeholders as a starting point for the development of WPPs.

The Galveston Bay Estuary Program

The Galveston Bay Estuary Program (GBEP), a program of TCEQ, is part of a network of twenty-eight National Estuary Programs in the United States, working with local stakeholders to restore and protect estuaries that are threatened by pollution, development, or overuse. Galveston Bay is classified as an estuary, which is a semi-enclosed body of water where freshwater from rivers, bayous and tributaries mix with salt water from the Gulf of Mexico. This mixing provides an environment that shelters aquatic plants unique to this area and offers a nutrient rich environment that nurtures juvenile marine organisms such as shrimp, oysters, crabs, and numerous fish. Additionally, the bay and its watershed provide important recreation and open space for the region's four million plus residents and visitors.

The GBEP is a partnership of stakeholders, which includes a 41 member advisory committee, the Galveston Bay Council and its six standing subcommittees. The GBEP and its stakeholders implement a Comprehensive Conservation Management Plan, the Galveston Bay Plan. One of the highest priorites of the Plan is controlling or eliminating NPS pollution. The NPS Pollution Action Plan is the portion of the Plan that was developed in order to reduce and eliminate pollutants from nonpoint sources entering Galveston Bay, including toxins, nutrients, pathogens, sediment, and oxygen-depleting substances. The specific goals of this action plan are to reduce NPS pollutant loads from industry, agriculture, construction, sewage, and marinas.

Galveston Bay.

The GBEP provides technical and financial assistance, through workshops, conferences, and grants, on storm water quality issues to Galveston Bay area municipalities. GBEP encourages the use of storm water management program initiatives that provide minimum control measures, often called BMPs, for six areas: public education and outreach; public involvement and participation; illicit discharge detection and elimination; construction site storm water runoff control; post construction storm water management in new developments; and pollution prevention for municipal operations.

As an example, the GBEP is providing financial and technical assistance to locally driven watershed wide management planning efforts to improve water quality, including streams listed as impaired for aquatic life use, contact recreation, and public health. Since 2005, five non-regulatory, watershed management planning efforts have been initiated in the Galveston Bay area: Armand Bayou, Clear Creek, Dickinson Bayou, West Bay and Bastrop Bayou. A major focus of each plan, when completed, will be solutions to NPS pollution problems, including developing BMPs that will be implemented by local governments and citizens. Clear Creek WPP is currently on hold due to the bacteria TMDL currently underway. In West Bay, which includes the watersheds of Highland, Marchand, Halls and Chocolate Bayous is currently being characterized by land uses and initial efforts will focus on agricultural land practices and conservation. A WPP is anticipated to be developed in the year 2010. GBEP is a supporting partner, through match funding and technical assistance, to the development and implementation of the Bastrop Bayou WPP being led by H-GAC and TCEQ's NPS Program.

In addition to developing WPPs, GBEP continues to support the region's annual Rivers, Lakes, Bays 'N Bayous Trash Bash® <www.trashbash.org> through funding and coordinated assistance. Trash Bash® is a litter clean up event on local waterways that encourages citizens to voluntarily cleanup and provides opportunities to educate the public about NPS of pollution. GBEP helped establish a new site in 2008 on Brays Bayou at Mason Park, adjacent to the Brays Bayou Storm Water Treatment Wetland. The Mason Park site had over 100 volunteers who collected 1,200 pounds of trash and

8 tires. Overall, the Trash Bash® event cleaned 17 sites with a total attendance of 4,471 volunteers for 22,449 volunteer hours collecting 87,440 pounds of trash and 643 tires.

In 2008, GBEP supported the Boater Waste Education Campaign. The Boater Waste Education Campaign addressed the issue of illegal boater waste discharge through targeted outreach and education to boaters. The purpose of the campaign is to decrease the incidence of illegal discharge of boater sewage waste to the Galveston Bay Estuary, particularly Clear Lake that has the third highest concentration of privately owned marinas in the U.S. The Clear Lake community showed sincere interest in tackling this environmental issue and played an instrumental role in the development of the campaign. A work group was created that successfully developed campaign messages, created marketing materials, and distributed materials in the Clear Lake community through a variety of methods (flyers, signage, billboards, etc.). Marina owners and managers, involved in the project, helped with all aspects of the campaign and the boaters reached during the events and exhibits have been receptive to the campaign messages.

The Texas Groundwater Protection Committee and Pesticide Management

The TGPC was created by the Texas Legislature in 1989. It was formed as an interagency committee with representatives from nine state agencies and the Texas Alliance of Groundwater Districts. The TGPC strives to identify areas where new groundwater programs can be implemented or where existing programs can be enhanced. It works to protect groundwater as a vital resource by bridging the gaps between existing state groundwater programs and by improving coordination between member agencies. Specific management measures to which the TGPC focuses attention are described in The Texas Groundwater Pesticide Management Plan (PMP) and the Texas NPS Management Program.

The PMP's focus is on the implementation of management practices that prevent groundwater degradation or help to recover groundwater degraded from the use of pesticides. One useful tool for pesticide management is the TCEQ's Inter-agency Pesticide Database (IPD) which is an endeavor at the compilation of all groundwater pesticide monitoring data for the whole state. The IPD, at its last update, included data for more than 173,000 pesticide analytes, or chemical substances from analyses on 8,294 ground water samples collected from 5,204 wells. Data was provided by twelve agencies and other entities.

Measuring groundwater depth in sorghum in the Arroyo Colorado watershed.

Pesticide information is now also being included in the EPA's Pesticide Of Interest Tracking System (POINTS), which is an on-line system for entering information on pesticides assessed by each state and tribe. The assessment process includes pesticide monitoring. During the 2008 monitoring period, a total of 109 wells, 22 springs, and two entry points were sampled in the metropolitan areas of Austin, San Antonio and Houston.

Agricultural Chemicals Subcommittee

The Agricultural Chemicals Subcommittee (ACS) of the TGPC was created to be the primary vehicle for interagency coordination and communication regarding pesticide groundwater issues. The ACS provides guidance for the implementation of the PMP by suggesting avenues of investigation, by reviewing monitoring plans and reports, and by making response recommendations. Groundwater pesticide monitoring, which is a big part of pesticide management, has been carried out in the Texas Panhandle and more recently in some urban areas. Pesticide monitoring has primarily been performed by the TCEQ and by the Cooperative Monitoring Program with the TWDB.

Recently there has been somewhat of a shift in focus by the ACS and TCEQ, supported by a new initiative by EPA, which pursues the management of pesticides by first assessing them and classifying them as pesticides of interest (POIs) or pesticides of concern (POCs). Under this new course the PMP still acts as the foundational guide, and groundwater pesticide monitoring still serves as a primary component in making assessments. The ACS has charged the PMP Task Force to specifically coordinate the assessment activities based on this new EPA initiative.

Public Outreach and Education Subcommittee

The TGPC Public Outreach and Education (POE) Subcommittee develops and implements educational outreach programs for landowners concerned with groundwater protection and environmental health issues as well as facilitating interagency communication and coordination in order to provide support for landowner educational outreach projects related to groundwater. The Charges to the TGPC POE and Groundwater Research Subcommittees were updated in 2008 to include a requirement to meet annually with the TCEQ and TSSWCB NPS teams in order to share information, discuss NPS projects, and facilitate NPS grant proposals by TGPC member agencies. In addition, the POE Subcommittee worked with Texas AgriLife Extension Service to publish *Best Management Practices to Prevent Pesticide Contamination of Water Resources* (L-5500) and reprint *Protecting the Environment Using Integrated Weed Management in Lawns* (L-5324) for distribution from the Texas AgriLife Extension Service online bookstore and the TGPC exhibit booth.

For additional information, please visit the TGPC website at <www.tgpc.state.tx.us>.

Goal Three—Education

The third goal of the Texas NPS Management Program is to conduct education and technology transfer activities to help raise awareness of NPS pollution and prevent activities contributing to the degradation of water bodies, including aquifers, by NPS pollution.

Education is a critical aspect of managing NPS pollution. Public outreach and technology transfer are integral components of every NPS grant project, WPP, TMDL, and I-Plan. This section highlights some of the NPS education and public outreach activities conducted in Texas in FY08.

A water quality lesson is taught by the Texas Stream Team during a field day at Jacobs Well in Wimberly. (photo by Greg Dannheim, Texas Stream Team)

Texas Stream Team Volunteer Monitoring and Environmental Education Program

Texas Stream Team is a statewide organization committed to improving water quality through volunteer water quality monitoring and NPS pollution education. Texas Stream Team is administered through a cooperative partnership between the River Systems Institute (RSI), the TCEQ and the EPA. The program is based at the RSI at Texas State University in San Marcos. In February 2008, Texas Watch unveiled a new name and brand in order to strengthen the program's relationship with stakeholders and to facilitate a growing need for the program to work with private landowners, members of the agricultural community, and watershed stakeholders in general.

Over the last year, Texas Stream Team trained more than 269 new water quality monitors and certified 72 water quality monitors and/or bacteria monitors. Monitors participated in a total of 1,826 monitoring events and submitted data for 246 sites statewide. Texas Stream Team staff hosted 39 NPS presentations, plus 6 summer teacher workshops that covered both monitor training and NPS education methods.

In coordination with the RSI Aquarena Center, the Texas Stream Team conducted presentations and developed educational signs, displays, and an interpretive brochure for the Aquarena Wetlands Walk. Through these efforts, 49,322 people as well as 27,433 group tour participants gained knowledge on NPS pollution. In conjunction with World Water Monitoring Day, the program coordinated an intensive *Escherichia coli* bacteria survey on 110 sites in the San Marcos River watershed. In addition to these core activities, Texas Stream Team also focused efforts on targeted watersheds. In the Gilleland Creek watershed, Texas Stream Team has assisted educational outreach planning and is supporting volunteer monitoring efforts. *Escherichia coli* monitoring and education continue in Orange County, Oso Creek, Oso Bay, Arroyo Colorado, and Guadalupe River State Park. The EPA-funded Border 2012 Dos Laredos project supports volunteer monitoring at 10 sites, NPS education, watershed surveys of 10 neighborhoods, community cleanup events, and public outreach to raise awareness about the connection between activities on the land and their impact on water quality.

Texas Watershed Steward Program

Texas Watershed Stewards (TWS) is a highly successful training program designed to increase citizen understanding of watershed processes and to foster increased local participation in watershed management and watershed protection planning activities across the state.

Texas Watershed Stewards training held for Plum Creek stakeholders

In 2007, the Texas AgriLife Extension Service completed the curriculum for the TWS program. The curriculum is comprised of five different units including a program introduction, an overview of watershed systems, an overview of watershed impairments, watershed management and regulation, and community-driven watershed protection strategies. The curriculum is compiled into a full-color handbook that also includes a comprehensive glossary of terms, and three appendices providing detailed information on federal, state, and local water quality agencies and organizations, important websites pertaining to water quality projects, management, and regulation, and a list of important activities for communities to engage in to help protect their local water resources. In addition, interactive topic modules were developed for each of the five curriculum units to serve as the foundation for the training program.

Texas Watershed Stewards is a highly successful training program designed to increase citizen understanding of watershed processes and to foster increased local participation in watershed management and watershed protection planning activities across the state.

In its inaugural year, 9 workshops were conducted across the state in project watersheds undergoing TMDL or WPP development and/or implementation. In total, over 530 citizens have become trained Texas Watershed Stewards representing small business owners, landowners, cities, agricultural producers, schools, state environmental agencies, universities, and other watershed residents. Preliminary results from pre- and post-test evaluations indicate that knowledge regarding pollutant sources/BMPs and watershed function has increased by 58% and 35%, respectively. Preliminary results from the first round of 6-month delayed post-test evaluations indicate that 80% of workshop attendees have more closely monitored individual actions that could impair water quality, 80% have adopted and/or maintained water quality BMPs on their property, and 65% have encouraged others in their community to attend a TWS workshop. At present, 18 additional TWS training events are being planned across the state. Future training locations are currently being prioritized in collaboration with the TSSWCB and other project partners. For more information on the TWS program, please visit http://tws.tamu.edu.

Plum Creek Outreach and Education

The Guadalupe-Blanco River Authority (GBRA) has completed the first year of a two-year project "Taking Charge of Water Quality" focused on public outreach and education in the Plum Creek Watershed with the use of TCEQ CWA Section 106 funds. The project supports the Plum Creek Watershed Partnership and WPP (See Chapter 4—Progress in Developing and Implementing Watershed Protection Plans). This project funded an assessment and prioritization of illegal dumping sites in the watershed. Six road crossings in Caldwell County were cleaned and restored, producing more than seven tons of illegally dumped trash and debris. GBRA also sponsored a community

cleanup in Lockhart in which over 350 volunteers removed 1,260 pounds of trash from two miles of the Plum Creek waterway. An online wastewater treatment module was developed as a tool to educate citizens on wastewater treatment and disposal. A "Don't be Clueless about the Plum Creek Watershed" brochure was also created. Training events such as two Nonpoint Education for Municipal Officials (NEMO)—Managing Urban Growth and onsite septic system management workshops were attended by Hays and Caldwell County officials, municipal officials, and local citizens. More information on this project is available at www.gbra.org/PlumCreek/.

YardWise Public Outreach Program

In urban areas, residential landscaping practices (particularly those associated with fertilizer and pesticide use) have been identified as a significant concern in preserving surface water quality. Statewide, six metropolitan areas (Dallas/Ft. Worth, Austin, San Antonio, Houston, Corpus Christi, and the Lower Rio Grande Valley) have water bodies with levels of landscape-related pollutants that exceed the TSWQS and require TMDLs. The goal of this project, funded by a CWA Section 319(h) NPS Grant, is to reduce the discharge of landscaping chemicals into streams, lakes and aquifers in major metropolitan areas statewide by changing citizen behavior through a public education and outreach campaign specifically targeting these six areas. In addition to pollution prevention, the landscaping strategies promoted by the program also promote water and energy conservation, both growing concerns in Texas. They are also readily accepted by homeowners and landscape service providers because they offer practical benefits including substantial savings in watering, fertilizer and pesticide costs, ease of maintenance, and increased plant resistance to destructive pests and plant diseases.

Elements of the program included a web site, materials distribution, public service announcements, and public workshops. An integrated YardWise web site, www.yardwise.org, hosted by the Lady Bird Johnson Wildflower Center, includes practical information for residents of TMDL areas and throughout the state, with links to partnering programs and related sites with useful information on environmentally responsible residential landscape management practices. In coordination with TCEQ and its partners, existing successful program materials have been reproduced for distribution through local and regional outlets, including nurseries, Texas AgriLife Extension Service offices, and municipal facilities in targeted TMDL areas. YardWise literature includes the TCEQ's Green Guide to Yard Care, fact sheets from the City of Austin's Grow Green program, and the Texas AgriLife Extension Services' EarthKind series. A total of 13 publications were used in the YardWise campaign. Television and Radio Public Service Announcements (PSAs) were developed and distributed. The PSAs target specific audiences, providing key messages to influence lawn and landscape management behaviors. As of August 31, 2008, the PSAs were broadcast on 88 radio and television stations with a total of 12,590 spots statewide. During summer 2008, six workshops were conducted for community leaders, representatives of the landscaping industry, and interested citizens in targeted urban areas to educate local program participants. Workshops included featured guest speakers, hands-on facility tours, and YardWise literature.

Colorado River Basin Campaign to Eliminate Dumping

Colorado River Basin Campaign to eleminate dumping billboard, LCRA

According to the EPA, the average American household generates waste that includes plastics, wood, fiberglass, paper and metals. Dumping is a harmful option for waste disposal for households located in unincorporated areas or rural areas of the state that do not have an organized waste collection service.

In response to these concerns, the Lower Colorado River Authority (LCRA), applied for

and received Section 319(h) funds in 2002 to enhance public awareness of the problem and to assist law enforcement in combating illegal dumping. In 2004 additional Section 319(h) funds were made available to expand the project to the Lower Colorado River Basin from O.H. Ivie Reservoir to Matagorda Bay.

LCRA conducted an aerial survey using a helicopter equipped with global positioning system (GPS), a video camera, and a digital camera to document dump sites along a 350-foot swath of the Colorado River from below O.H. Ivie Reservoir in McCulloch County to the mouth of the Colorado River in Matagorda Bay. The survey also included the Highland Lakes and the major tributaries to the Colorado, San Saba, Llano and Pedernales rivers. Pecan Bayou and tributaries to Matagorda and East Matagorda bays, the Tres Palacios River, and Caney Creek were also part of the survey. The survey found 324 sites with the potential to affect water quality. Because of that survey, LCRA applied for and received additional funding to conduct a public awareness campaign and educational workshops to educate the public, elected officials, and local decision makers about the problems associated with improper disposal of solid waste. Bastrop County will be the initial focus area due to the proximity and willingness of potential partners such as the Capital Area Council of Government (CAPCOG) and the Central Texas Regional Environmental Task Force.

Through this grant, LCRA will work with counties, COGs, citizens and private companies to educate the public on how to minimize the risk of water contamination due to improperly disposed solid waste. LCRA and CAPCOG currently are working with Bastrop County officials to determine locations for "no dumping" signs and billboards as well as developing other outreach materials. Part of this campaign will include the creation of a Keep Bastrop County Beautiful affiliate to continue the campaign to eliminate illegal dumping and work with local decision makers. This project supports the Texas NPS Management Program's long-term goal of protecting and restoring water quality from NPS pollution by: (1) Supporting the implementation of state, regional, and local programs to prevent NPS pollution through education; (2) Developing partnerships and relationships to facilitate collective, cooperative approaches to manage NPS pollution; and (3) Increasing overall public awareness of NPS issues and prevention activities. Additionally, the project supports Texas NPS Management Program's short-term goal two—implementation by working with regional and local entities to determine priority areas and develop and implement strategies to address NPS pollution in those areas. The project also supports short-term goal three—education by: 1) Enhancing existing outreach programs at the state, regional, and local levels to maximize the effectiveness of NPS education; 2) Administering programs to educate citizens about water quality and their potential role in causing NPS pollution; and 3) Conducting outreach to facilitate broader participation and partnerships.

Texas Watershed Planning Shortcourse in Bandera. From left to right: Pamela Casebolt of TSSWCB, Lucas Gregory of TWRI, Vanessa Escobar of TWDB, Ernest Moran of SARA

Watershed Planning Shortcourse

Comprehensive WPPs that outline ways to preserve or restore watersheds are the accepted approach to protecting Texas surface waters. Using a watershed approach to restore impaired water bodies addresses the problems in a holistic manner and stakeholders in the watershed are actively involved in developing the management strategies and plans. Proper training of watershed coordinators and water professionals is needed to ensure that watershed protection efforts are adequately planned, coordinated and implemented and results are properly assessed and reported. The Texas Watershed Planning Short Course project is a week-long course in Bandera, Texas at the Mayan Dude Ranch that provides information on stakeholder coordination and in-depth analysis of the EPA's nine elements of a WPP. The course also includes infor-

mation and case studies, examples about data collection and analysis and the tools available for plan development, education and outreach related to water quality. The course promotes sustainable proactive approaches to managing water quality throughout the state. There were 43 people in attendance at the first Watershed Planning Shortcourse held in June. The Watershed Planning Shortcourse is a cooperation with Texas Water Resources Institute (TWRI) with the TCEQ, TSSWCB, the Texas AgriLife Extension Service, Texas AgriLife Research, the RSI at Texas State University, Texas Institute of Applied Environmental Research at Tarleton State University (TIAER), and the EPA on the course.

Broadbased Communication and Forecasting for Environmental Quality

If forecasts hold true, the Houston-Galveston metropolitan region will be home to 3.5 million more people in 2035 than live there today. This growth will put tremendous strain on the region's already stressed aquatic ecosystems. To help address environmental concerns associated with the anticipated growth, H-GAC has partnered with the TSSWCB, StormCenter Communications Inc., and KPRC Channel 2's "Going Green" initiative to bring science-based environmental education to the region. Through this unique public/private collaboration, newsworthy and educational environmental facts and stories will be brought to the region through the Envirocast website <http://kprc.envirocast.net> and through broadcast news stories by KPRC Channel 2. H-GAC has developed a strong stakeholder base to identify these facts and stories geared toward increasing the environmental knowledge of the public and providing the opportunity to tell the full environmental story of the region through online access and broadcast news.

Public Awareness and Trash Cleanup Campaign for Petronila Creek, Oso Creek, and Oso Bay

Oso Creek in Nueces County. (photo by Theresa Finch, CBCOG)

Since 2007, the Coastal Bend Council of Governments (CBCOG), in cooperation with a variety of local Nueces watershed entities, the Texas Stream Team and Corpus Christi area stakeholders, have been conducting an education and outreach campaign and an illegal dump and trash cleanup campaign. Petronila Creek Above Tidal, segment 2204, Oso Creek, segment 2485A, and Oso Bay, segment 2485, have been identified on the State's CWA Section 303(d) List. Petronila Creek is listed for nutrients and TDS, Oso Creek is listed for bacteria, and Oso Bay is listed for depressed DO and bacteria. Two TMDL projects are currently underway for these segments. In FY08, the campaign continued, focusing on educating stakeholders about water quality, NPS pollution and solid waste issues. 26 presentations were given reaching 4,321 children and 605 adults, primarily students and teachers. An illegal dumping outreach commercial featuring Senator Hinojosa and two county commissioners appeared on the local Spanish station, Univision 28, for a total of 312 spots during the news hours and telenovelas. Additionally, a trash cleanup event was held November 3, 2007 at Tierra Grande Colonia in Petronila, Texas. Three 40 yard dumpsters were filled with over 20 residents participating.

Texas Silvicultural NPS Pollution Prevention

The Texas Silvicultural NPS Pollution Prevention Project continues to demonstrate its environmental success across East Texas. Computer models have shown, largely through the implementation of this project, the Texas forestry community has been able to prevent over 12,000 tons of sediment from reaching streams and 100,000 tons of sediment from eroding off forestlands annually. Visually, this is enough sediment to cover a football field, endzone to endzone, over thirty five feet high. These tremendous load reductions have been achieved primarily through the education and technical assistance component of this project.

Texas Forest Service (TFS) has been extremely active in promoting BMPs to the forestry community and general public over the past year. Ten BMP training workshops, reaching almost 400 people, were held for foresters, loggers, and landowners, including a newly developed course focusing specifically on stream crossings. Participants have seen the benefits in attending these courses, with over 97% saying they would recommend them to others. Post workshop evaluations have also shown that 100% of attendees now have a good or excellent understanding of BMPs, meaning they are more likely to implement them on their own operations. This compares to just 77% prior to the workshop. A course specifically focusing on forest roads has been developed and will be offered next year. Training was also conducted for agency personnel, providing attendees with information on how to properly implement BMPs on forestry and wildfire operations. This will have a far reaching effect due to the number of landowners they work with on a day to day basis as well as the increased fire activity Texas has experienced lately. This project also supported the efforts of the Teacher's Conservation Institute, a week long continuing education program for teachers. BMPs and environmental stewardship were a main focus of this program, with project staff providing training to over 75 teachers. This has the potential to reach thousands of Texas students annually.

Other educational efforts of this project included the use of the media (highway billboards, radio PSAs, newspapers), BMP newsletters targeting TMDL watersheds, and an interactive display exhibited at numerous events throughout East Texas promoting BMPs. Monitoring is used to measure the success of this project's educational efforts as well as the actual effectiveness of BMPs to protect water quality. Recently harvested sites are evaluated to determine the extent at which BMPs are being implemented on forestry operations. Evaluations conducted over the past year show that 92% of all operations are following the recommended guidelines. This project recently completed an innovative, high-tech biological (benthic macroinvertebrate / fish) and physiochemical (sediment / nutrient) stream monitoring project designed to determine if BMPs actually protect water quality when implemented. Four sites under intensive forest management were monitored before and after forestry operations. Statistical analysis of the results showed no significant differences, indicating that forestry BMPs are effective in protecting water quality and aquatic stream health. To view a copy of the report, go to http://txforestservice.tamu.edu/sustainable/bmp.

Chapter 4

Progress in Developing and Implementing Watershed Protection Plans

In Texas, WPPs are locally developed water quality plans that coordinate activities and resources to manage water quality. They facilitate the restoration of impaired water bodies and/or the protection of threatened waters before they become impaired. These stakeholder-driven plans give the decision-making power to the local groups most vested in the goals specified in the plans. Bringing groups of people together through watershed planning efforts combines scientific and regulatory water quality factors with social and economic considerations.

While WPPs can take many forms, the development of plans funded by CWA Section 319(h) grants must follow guidelines issued by the EPA. These guidelines can be found at: Nonpoint Source Program and Grants Guidelines for States and Territories, <www.epa.gov/fedrgstr/EPA-WATER/2003/October/Day-23/w26755.htm>.

In 2008, the TCEQ and the TSSWCB facilitated the development of WPPs throughout Texas by providing technical assistance and/or funding through grants to local partners. There are also WPPs that are being developed or have been developed in Texas independently of this grant funding.

Lampasas River. (photo by Steve Potter, AgriLife Research)

TSSWCB Watershed Protection Plans

Buck Creek

Buck Creek (Segment 0207A), also known as Spiller Creek, is a small waterbody situated within the Red River Basin and is located within a subwatershed to the Lower Prairie Dog Town Fork of the Red River (Segment 0207). The creek's headwaters originate close to Hedley, TX and flows 68 miles in an east-southeast direction into Oklahoma. Buck Creek is an ephemeral stream that usually ceases to flow in places during the summer months when irrigation and evaporative demand reduce shallow groundwater table levels. In 2000, Buck Creek was listed on the CWA Section 303(d) List due to bacteria levels exceeding TSWQS. In 2003, TWRI and Texas AgriLife Research Vernon received a CWA Section 319(h) grant to collect water quality data and in 2006 received an additional grant to facilitate the development of a WPP.

In FY08, Buck Creek WPP activities mainly consisted of collecting water quality samples and beginning to trap live animals for the positive ID of fecal samples. Water samples were collected on four different dates and were collected at five sites. Trapping has resulted in the collection of many different animal fecal samples in the watershed. On January 24th in Wellington, a TWS workshop was presented to watershed stakeholders and other interested citizens. The workshop provided science-based watershed education to help citizens learn about the nature and function of watersheds, potential impairments, and how to take action in addressing local water quality impairments. A watershed flyover was conducted with over 900 photographs taken and will be evaluated to aid in identifying potential sources of bacteria in the watershed.

The stakeholders participated in a watershed field day in June. Discussions consisted of the final report from the monitoring project, nitrates, wildlife and ranching, brush control, animal behavior, wildlife assistance, and alternate water sources.

Concho River

The Concho River basin lies within 13 West Texas Counties and encompasses a watershed of approximately 4.5 million acres. Four major reservoirs, O.H. Ivie, O.C. Fisher, Twin Buttes, and Lake Nasworthy are located within the watershed boundaries. These reservoirs provide potable water, either wholly or in part, to approximately 500,000 residents. In addition, the streams and reservoirs of the Concho basin are utilized for agriculture. The Concho River itself lies below San Angelo and enters O.H. Ivie Reservoir near Paint Rock, Texas. In the San Angelo area, several major streams converge to form the Concho River. These include the North, South and Middle Concho Rivers, Spring Creek and Dove Creek. Many historical springs feed into the tributaries of the Concho River. It is at these locations that the more environmentally sensitive aquatic habitats are commonly found. In 2002, the Concho River (segment 1421) was placed on the 303(d) List for having impaired macrobenthos communities. The O.C. Fisher Reservoir (segment 1425) was also listed for TDS and chlorides.

South Concho River below Anson Springs in Tom Green County. (photo by Chuck Brown, UCRA)

In 2004, the Upper Colorado River Authority (UCRA) received a grant from the TSSWCB to facilitate the development of a WPP. In the last year they worked with stakeholders to finalize implementation strategies for inclusion in the WPP. In July 2008, they submitted an approved stakeholder plan for state and federal review.

Additionally in 2008, UCRA began implementation of the first BMP listed in the WPP. UCRA completed construction and began designing educational displays for the Concho River Basin Aquatic Research and Education Center. In addition, UCRA engaged in education and outreach activities with a group of junior stakeholders. The middle school and high school aged group, known as Aquasquad, worked with the UCRA, the San Angelo Museum of Fine Arts and the Smithsonian Museum in Washington D.C. to gain ideas for the design of displays and outreach activities for the Center. The Aquasquad will continue designing the Concho Center educational displays and activities in 2009.

Lake Granger

Williamson County has one of the highest rates of population growth in the state. Currently Lake Granger is the sole drinking water supply for approximately 20,000 residents in Williamson County. Demand is expected to increase to approximately 32,000 by 2020 and 65,000 by 2060. While the demand for water on Lake Granger is increasing, its storage capacity is decreasing due to sedimentation. Volumetric surveys suggest that Lake Granger has lost more than 12,000 acre-feet of storage since its initial construction in 1980 and continues to lose between 200 and 300 acre feet of storage per year, on average. Water quality monitoring has also detected elevated levels of nutrients in the lake and high bacteria levels in several of its tributaries.

The TSSWCB partnered with the Brazos River Authority (BRA), Little River-San Gabriel SWCD, and the Texas AgriLife Research to quantify sediment loadings and develop a WPP for Lake Granger and the San Gabriel River. BRA and the Little River-San Gabriel SWCD met with local agricultural producers and landowners to prioritize the most effective BMPs for reducing sediment and nutrient runoff. The BRA also partnered with the Texas AgriLife Extension Service to host a TWS workshop in Georgetown, which had a total of 40 participants.

The project has also provided technical and financial assistance through the Little River-San Gabriel SWCD to local landowners in the watershed to develop WQMPs on agricultural lands. In FY08, nine WQMPs were developed on over 1800 acres. BMPs installed included 202 acres of cropland converted to grass, 25,700 feet of terraces, and 2.8 acres of waterways. Additional BMPs were also installed during the past year on WQMPs that were developed in previous fiscal years. A total of 65 WQMPs have been developed to date in the Lake Granger Watershed.

Lampasas River

The Lampasas River (Segment 1217) rises in western Hamilton County 16 miles west of Hamilton and flows southeast through a rural agricultural landscape in Lampasas, Burnet, and Bell Counties. Above Stillhouse Hollow Lake the river is listed as impaired due to elevated bacteria levels and North Fork Rocky Creek is impaired for DO.

The Lampasas WPP project kicked off its inaugural year in mid 2008. During this time, Texas AgriLife Research at Blackland Research and Extension Center primarily focused on project administration/organization and stakeholder outreach. Thorough literature reviews were performed and outreach materials such as brochures, presentations, and a website were developed to raise awareness of the Lampasas WPP. AgriLife Research conducted listening sessions with landowners, community leaders, university staff, and governmental agencies to identify key stakeholders and gain information and knowledge from those living, working, and recreating in the Lampasas watershed. A draft Quality Assurance Project Plan (QAPP) was developed to model the watershed and develop load duration curves.

Leon River

The Leon River Watershed (Segment 1221) encompasses approximately 1340 square miles in Bell, Coryell, Hamilton, Comanche, and Erath Counties. In 1998 the Leon River was placed on the State's CWA Section 303(d) List for having bacteria concentrations that exceeded TSWQS for contact recreation, prompting the TCEQ to commence a TMDL Project for bacteria in 2002. In an effort to take a more proactive role in developing management strategies to reduce bacteria loadings to the Leon River, local TMDL stakeholders initiated a WPP in 2006. The BRA was asked to take the lead in facilitating this effort.

Over 300 local citizens, city and county officials, and state and federal agencies are involved in the Leon River watershed planning efforts. To ensure that all parties are equally represented in the formulation of the WPP, the BRA established and met independently with seven focus groups, which include farm and ranch, dairy, landowner, and city and county governments, to evaluate BMPs specific to each focus group's area of interest. A draft QAPP has been prepared to model different strategies aimed at determining the level of implementation necessary to achieve estimated load reduction goals.

Pecos River

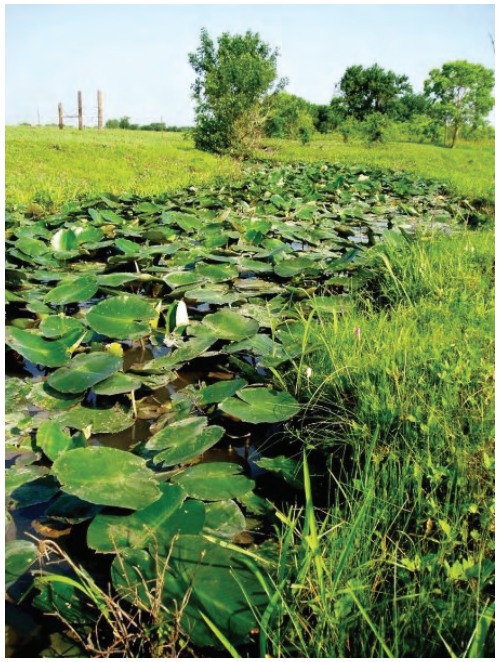
As the Pecos River winds through arid West Texas, it and the landscape undergoes drastic changes. In the eyes of many landowners in the watershed, Interstate 10 is an appropriate dividing line when describing the upper and lower portions of the river and watershed. North of Interstate 10, the watershed consists predominantly of a flat or gently rolling landscape that is dominated by small brush, which are interspersed with limited herbaceous ground cover. South of Interstate 10, the landscape changes to one filled with plateaus and valleys that are dominated by larger brush species that are interspersed with grasses.

The 2nd and 3rd drafts of the WPP were released during this year and one series of public meetings were held throughout the watershed that approximately 75 people attended to voice their concerns about the plan. Oral and written comments were taken and addressed. The project annual report for year three has been completed and is now posted to the project website. Economic modeling of the watershed to

evaluate the impacts of water quality improvements across the watershed is being finalized. The WPP will be finalized and submitted to EPA in FY09.

Plum Creek

The Plum Creek Watershed was selected as the first WPP pilot project by the TSSWCB's Regional Watershed Coordination Steering Committee in December 2006. Plum Creek is a 400 mile watershed whose headwaters are located north of Kyle in Hays County, and which drains much of Caldwell County and a small portion of Travis County.



Lillies on a ranch near Clear Fork in Lockhart, Texas. (photo by Matt Berg, AgriLife Extension)

The creek is listed as an impaired waterbody on the CWA Section 303(d) List due to high levels of bacteria and concerns for nutrient enrichment. A key objective of the project was to demonstrate the most efficient and effective strategies for evaluating, planning, and developing a WPP. However, the ultimate goal of the project is to restore and protect the quality of the water in Plum Creek. The 166 page comprehensive "Plum Creek WPP" was completed in less than 24 months and adopted in February 2008 by the Steering Committee composed of local stakeholders. Even before completion of the Plum Creek WPP, the team was hard at work implementing key components of the overall strategy to begin to improve water quality in the Plum Creek Watershed. Over 39 meetings, workshops, and trainings have been conducted in FY08 totaling about 2,867 participants, 102 hours of training, and over 5,527 contact hours. These meetings, workshops, and trainings included: 6 steering committee meetings; 5 sets of work group meetings; 11 public / local government meetings; and over 16 educational events. Through these efforts, Texas AgriLife Extension Service has engaged staff and officials with each of the municipalities and counties within the watershed and GBRA to build strong cooperative partnerships. Critical education programs in many disciplines have already been conducted including: 2 stormwater management, 2 NEMO—Managing Urban Growth, 2 Onsite Septic System Management, 2 Feral Hog Management, and 2 TWS. The Plum Creek Watershed received an EPA 106 Grant for outreach and education implementation that has helped fund education efforts and an assessment and prioritization of illegal dumping sites in the watershed. For more information, see Chapter 3, Goal 3—Education.

In support of the WPP, the GBRA received and initiated a Section 319(h) funded intensive surface water quality monitoring project on Plum Creek. A QAPP was developed and approved and sampling was initiated in February 2008. GBRA is collecting routine ambient, targeted watershed, stormflow, 24-hour DO, wastewater effluent and springflow sampling at 43 sites throughout the watershed.

With completion of the WPP, the project moved rapidly forward to secure essential resources to enable full implementation of the identified management measures. To date, they have coordinated the development of supplemental project proposals which will secure over $2.1 million in additional funding to support programs and projects targeting improvements in Plum Creek. This includes supporting development of urban stormwater BMPs targeting pet waste management, storm drain stenciling, street sweeping, city park cleanups, retrofitting of two regional stormwater detention facilities, outreach and education programs, developing agriculture WQMPs for farmers and ranchers, promoting feral hog education, and conducting broad based extension educational programs throughout the watershed. Through these efforts, the level of on-the-ground water quality protection will be increased.

TCEQ Watershed Protection Plans

Armand Bayou

Armand Bayou (Segment 1113) has been listed for depressed DO on the CWA Section 303(d) List since 1996 and for bacteria since 2006. In 2007, Texas Sea Grant and the Trust for Public Land developed the first phase of a WPP for Armand Bayou. The WPP for Armand has been slowed due to a lack of sufficient data to complete watershed modeling and load allocations for nutrients and bacteria. Additional bacteria data is being collected to evaluate the need to complete a TMDL for Armand Bayou.

Arroyo Colorado

The Arroyo Colorado (Segment 2201), an ancient distributary channel of the Rio Grande, extends about 90 miles from Mission, Texas to the Laguna Madre in the Lower Rio Grande Valley. Flow in the Arroyo Colorado is sustained by wastewater discharges, agricultural irrigation return flows, urban runoff, and base flows from shallow groundwater. To address the Arroyo Colorado's bacteria and DO impairment as well as nutrient concerns, the Arroyo Colorado Watershed Partnership developed "A Watershed Protection Plan for the Arroyo Colorado—Phase I."

Following the release of the WPP in 2006, the *"Arroyo Colorado Watershed Protection Plan Implementation"* project began putting the strategies and objectives listed within the plan into action. The Arroyo Colorado Watershed Partnership has grown to over 700 members. The physical watershed model was unveiled as an excellent hands-on educational tool for youth and adults. Almost 14,000 individuals in the watershed have viewed the model to learn about their local watershed, their impact on water quality and how they can be better stewards. To secure funding for continuing this effort, this project has submitted or facilitated the submission of 14 grant proposals and leveraged over $400,000 to support implementation of the WPP. In the next year, watershed boundary road signs will be installed, a watershed wide storm drain marking campaign will occur and, with funding, one or more wetlands will be installed.

The *"Arroyo Colorado Watershed: Construction of Wetland Treatment Systems"* provides financial assistance to the Cities of San Juan, San Benito, and La Feria to enhance water quality through the design, construction, maintenance, operation, and monitoring of wetlands that will receive treated effluent from municipal wastewater treatment facilities and stormwater runoff. Recreational appurtenances such as boardwalks, all-weather paths, signage, and kiosks will be developed. San Juan has completed the permitting and design phase of the project and construction should begin in March 2009. The cities of La Feria and San Benito have completed the permitting process and are currently finalizing the design phase of the project. Construction of the wetlands in La Feria began in January 2009, and San Benito should begin in the summer of 2009.

The Arroyo Colorado.

The overall objective of the *"Education of Best Management Practices in the Arroyo Colorado Watershed"* is to educate agricultural producers on how to better produce and manage their acreage and in doing so reduce the potential for NPS pollution. Through the use of trainings and information of BMPs, crop production techniques, pesticide safety, soil testing and WQMPs, programmatic impact has reached over 1,600 producers and citizens across the Valley and South Texas. In addition, more than 80 producers participated in the soil testing campaign, which resulted in the analysis of over 650 soil samples. Over the last 5 years, the soil testing campaign, an essential component of the nutrient management education program in the valley, has helped growers significantly reduce the amount of crop fertilizer (3.3 and 3.8 million pounds of nitrogen and phosphorus, respectively) that might otherwise have ended up in the watershed of the Arroyo Colorado.

The Arroyo Colorado.

The primary focus of the *"Arroyo Colorado Agricultural Nonpoint Source Assessment"* is to better characterize agricultural runoff in the Arroyo Colorado, assess and demonstrate the effects of BMP implementation at the field and sub-watershed level, and measure progress towards meeting WPP goals. The Land Use-Land Cover (LULC) map was updated to reflect land use changes in the rapidly growing watershed and will be used to accurately characterize and model the watershed. It is available at the Arroyo Colorado website. Additionally, scientists monitored water quality in agricultural drainage ditches to assess potential mitigation and attenuation within the drainage way and also are measuring the quality of irrigation return water as it leaves the fields to gain better data on the quality of tailwater leaving the fields. Agricultural BMPs are being mapped to better target education efforts and impacts of BMPs on water quality will be monitored during the next year. The "WQMP Implementation Assistance in the Arroyo Colorado Watershed" provides technical and financial assistance to local watershed landowners to develop WQMPs. This project is featured in Chapter 2—Progress in Water Quality Improvement.

In an effort to increase the sophistication of the TMDL analysis to reduce uncertainty and to better characterize the watershed, the *"SWAT Model Simulation of the Arroyo Colorado Watershed"* will utilize the Soil and Water Assessment Tool (SWAT) model and GIS to simulate the current sediment, BOD, and nutrient loadings in the Arroyo Colorado watershed. Data was collected for input into the SWAT model and with the updated LULC map of the watershed, model calibration and validation began. The model should be released in early 2009.

Brady Creek

Brady Creek (Segments 1416A and B) is an intermittent to perennial flows stream that originates in Concho and Menard Counties, flows through Concho and McCulloch Counties and finally confluences with the San Saba River in San Saba County, east of Brady, Texas. Since construction of Brady Lake in the early 1960s, Brady Creek below the dam has primarily consisted of flows from urban runoff. Since this time, the creek through the City of Brady has experienced significant algae blooms and fish kills. The creek was first identified on the 2004 CWA Section 303(d) List for not supporting the designated aquatic life use due to low DO. Concerns have also been identified for chlorophyll a and nutrients. The WPP is an expansion of the Brady Creek Master Plan, completed in 2004.

In FY08, the UCRA began the watershed planning process for Brady Creek. The WPP will address the entire Brady Creek watershed with a focus on NPSs of pollution in the downtown Brady portion of the watershed and other areas identified by stakeholders. A steering committee was formed and three meetings were held to

inform stakeholders of the WPP process, the water quality status of the watershed, and receive stakeholder input on potential sources of pollution. Additionally, a TWS workshop was held to increase citizen understanding of watershed processes and to foster increased local participation. An initial watershed characterization for Brady Creek was developed as a result of research and the stakeholder meetings. The characterization will provide important background information for the planning phase of the WPP process.

Brady Creek in downtown Brady (photo by UCRA)

Caddo Lake

The Caddo Lake watershed is a rich and unique ecosystem that straddles the Texas-Louisiana border. Historical, current, and possible future stressors on this system may destroy aspects of the lake that make it so valuable to humans and wildlife. The existing stressors have resulted in at least three major areas of concern, which overlap: water quality, water quantity, and aquatic and riparian habitat. In order to encourage the wise use of this ecosystem by those who live in the watershed and those who visit it, stakeholders in the Caddo Lake community have proposed undertaking a comprehensive, watershed-level planning effort. Three stakeholder meetings were held in FY08.

The data inventory task began in the winter of 2007. Based on stakeholder concerns, the CWA Section 303(d) List and the TWQI, data was queried from the State's Surface Water Quality Monitoring Information System (SWQMIS) database. In the spring of 2008, several maps indicating land use, location, topography, soils, major cities/communities, and highways/county roads for the Caddo Lake Watershed were developed for the Caddo Lake Watershed. Photographic surveys were used to document features like the courses of streams, the topography of the land, the extent of forest cover and other land uses, and other natural and human-made features of the watershed. Phase I of the modeling effort began in the summer of 2008. The parameters evaluated in this effort included DO, pH, ammonia, total nitrite-nitrate nitrogen, total phosphorus, orthophosphate, chlorophyll-a, and bacteria (fecal coliform and *Escherichia coli*). A technical memorandum was developed using the information gathered in the data inventory to classify the current land use for the watershed, rank the potential source locations of pollutants, identify data gaps and/or needs, recommend additional data collection or monitoring, and recommend a modeling approach for the next phase of the watershed planning effort.

Dickinson Bayou

The Dickinson Bayou watershed is located within the San Jacinto-Brazos Coastal Basin, to the southeast of Houston and west of Galveston Bay. The bayou begins near the town of Alvin in Brazoria County. The Dickinson Bayou watershed covers a total of approximately 63,830 acres or 99.7 square miles and is elongated in shape, with a length of approximately 24 miles from west to east. The maximum width of the watershed is approximately 7 miles. Water falling within this area eventually makes its way into Dickinson Bay. Dickinson Bay is a secondary bay of Galveston Bay. Cat's Point, April Fool Point, and Shell Island bound the roughly circular bay just over a mile across.

Dickinson Bayou Above Tidal (segment 1104) is currently listed as an impaired body of water for high bacteria levels. Other concerns include low DO and pollutant loading. This section of the bayou runs 7 miles and is freshwater. Dickinson Bayou Tidal (segment 1103) which is the main stem of the bayou is listed as an impaired body of water for low DO occurrence. A special study conducted through the CRP revealed that tidal fluctuations allow surface water to flush and replenish itself with DO, while deep water is forced to remain in the same location and slush back and forth. This section of the bayou runs 15 miles and is brackish, a mix of salt and freshwater creating an estuarine habitat.The entire watershed is listed as impaired for high bacteria levels. Low levels of DO are found in Borden's Gully and Magnolia (Geisler) Bayou.

A Dickinson Bayou Watershed Partnership involving more than fifty stakeholders is nearing completion of a WPP for both Dickinson Bayou Tidal (1103) and Dickinson Bayou Above Tidal (1104) Segments, addressing both DO and bacterial issues. A draft WPP was submitted to watershed stakeholders for approval in fall 2008. The goal is to submit the draft WPP to the TCEQ and EPA in spring 2009.

Hickory Creek

The Hickory Creek arm of Lake Lewisville (Segment 0823) was identified as a water body of concern for ammonia in the 2004 TWQI and CWA Section 303(d) List. Although Lake Lewisville is not currently on the CWA Section 303(d) List, the significant development that is occurring in the area has the potential to threaten designated uses. Monitoring and modeling research indicated that water quality in Lake Lewisville will decline if development is not carefully and strategically managed. The City of Denton held the final stakeholder meeting in December of 2007 and completed the "Hickory Creek Watershed Protection Plan" in August of 2008. The goal of the WPP is to identify sources and causes of pollution, prioritize these sources and causes, and identify management strategies that are best suited to decrease pollutant loads and thus protect water quality in Lake Lewisville. The WPP provides a number of design scenarios and associated costs for implementation, including a design to prevent net increases in sediment and nutrient loading and designs to meet specific loading targets. As a part of these designs, the WPP provides in-depth analyses of the cost of potential BMPs versus the effectiveness of these BMPs at removing pollutant loads at a variety of spatial scales and land uses.

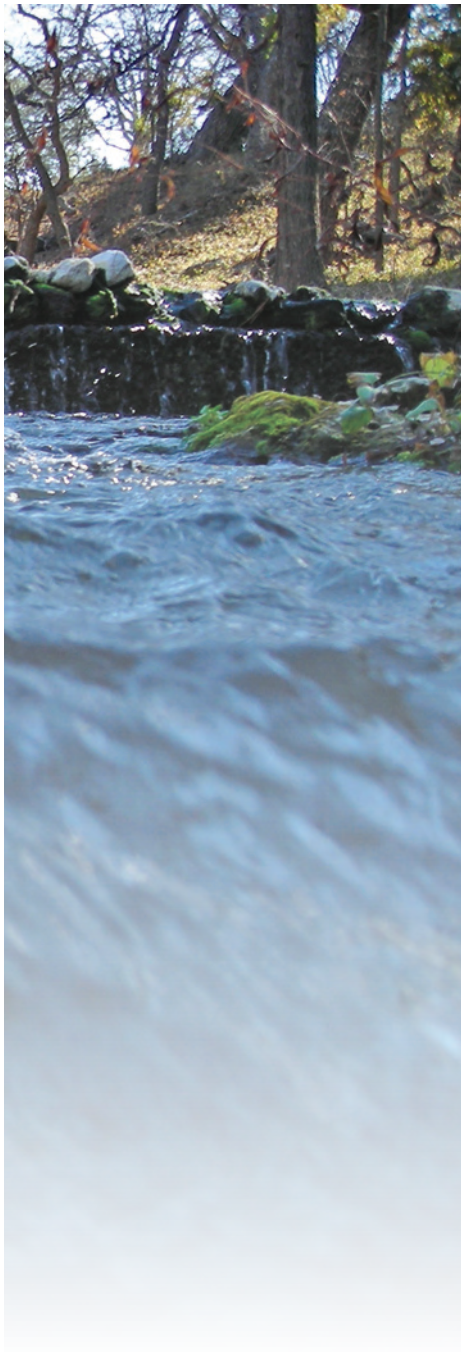
Hickory Creek Fire Station, best management practices in the City of Denton.

Lake Granbury

Lake Granbury (Segment 1205) in Hood County serves as a water supply for more than 250,000 people in North Central Texas. For the last several years, regular water quality testing has found elevated concentrations of *Escherichia coli* in the coves of Lake Granbury resulting in water quality exceeding criteria set for contact recreation use. A substantial portion of the developed area around Lake Granbury, which lies wholly within Hood County, consists of unincorporated subdivisions that do not have sewage collection systems and centralized sewage treatment facilities. The Lake Granbury WPP Project will provide an assessment of existing and potential water quality threats from ongoing NPS pollution within the Lake Granbury watershed. Four stakeholder meetings were held in FY08. Historical data analysis was completed and a water quality characterization report with trend analysis was produced. The bacterial source tracking (BST) data collection phase was completed and the assessment of the BST data is in progress. Data collection for the modeling phase was completed and included dye tracing of septic tanks and defining the circulation/movement of water in representative canals. Monthly sampling of bacteria, conventional laboratory parameters, and field parameters were conducted under various climatic conditions to continue to develop a database of water quality conditions over a long period of time. Stakeholders chose to collect additional data on wastewater to help define an assumption for the model for the concentration of bacteria that may exist in raw wastewater from treatment plant overflows and septic tank seepage. Modeling of eight canal systems are in final draft form.

Upper San Antonio River

The Upper San Antonio River WPP, completed in 2006, addresses elevated fecal bacteria concentrations in the upper reach of the San Antonio River (segment 1911) north of South Loop 410 in the City of San Antonio. The San Antonio River Authority (SARA), coordinating with local governments through the interagency Bexar Regional Watershed Management Group, developed this strategy to restore the river to attaining the standard for contact recreation. Key elements of the strategy include reducing bacterial contributions from the San Antonio Zoo by 99.9%, from general urban runoff sources by 25%, and from wastewater collection system sources by 12%. One focus of this plan is the River Walk area, the number one tourist destination in Texas. In 2008, SARA began implementing a project to improve housekeeping practices along the River Walk area, to expand vacuum power washing of walkways in the same area, and to use social marketing strategies with River Walk patrons to reduce the feeding of birds and other activities that contribute bacteria in the River Walk area. Another focus of the plan is the San Antonio Zoo, which was found to be the primary source of elevated bacteria in the upper reach of the river during normal flow levels. The City of San Antonio initiated design of an ultraviolet disinfection system for the waterway draining the San Antonio Zoo in 2008.



Third Party Watershed Protection Plans

The North Central Texas Water Quality Project

The North Central Texas Water Quality Project is actively engaged in innovative watershed protection planning activities for Cedar Creek, Eagle Mountain, and Richland-Chambers Reservoirs. All three water bodies are owned and operated by Tarrant Regional Water District (TRWD) allowing for a continuity of project personnel, management philosophy, and strategic system-wide planning. The Cedar Creek and Eagle Mountain projects are currently operating under an anticipated October 2009 deadline for submission to the EPA. This project utilizes a combination of SWAT, QUAL2E and Water Quality Analysis Simulation Program (WASP) to model the reservoir and associated watershed. Watershed, stream and reservoir models have been linked together to better determine pollutant loadings and potential sources.

Cedar Creek Reservoir Watershed

The Cedar Creek WPP is currently in draft form awaiting finalization of an economic cost performance model for BMPs designed to assist project managers and stakeholders in maximizing dollars spent for watershed pollutant reduction. To decrease the rising trend of Chlorophyll-a within the reservoir, (caused by increasing levels of phosphorus and nitrogen) the impetus for watershed planning efforts, stakeholders have agreed upon an overall phosphorus reduction goal of 35 percent. This benchmark will drive the selection and location of BMPs within critical sub-basins as determined by water quality models. During the process of the development of the WPP numerous activities took place which include a water quality analysis for the reservoir and the watershed, a study of the loadings of the wastewater treatment plants in the watershed, development and implementation of an education and outreach plan with the assistance of the Texas AgriLife Extension Service and the Environmental Co-op, a local environmental education group. Many research efforts were conducted to study the effects of stream bank erosion on potential phosphorus loadings in the reservoir and as a result of the research conducted a soil sampling campaign for local agricultural producers was performed. The Texas AgriLife Extension Service partnered with the TSSWCB to quantify the effectiveness and demonstrate agricultural BMPs identified by stakeholders and modeling as appropriate for the watershed. TSSWCB provided funds to the Kaufman-Van Zandt SWCD to hire a technician to assist landowners in developing WQMPs and to provide financial assistance to implement BMPs. Texas AgriLife Extension Service also partnered with the TCEQ to conduct educational events and to demonstrate the effectiveness of stormwater BMPs in the watershed.

Eagle Mountain Lake

Stakeholder involvement in the Eagle Mountain Watershed is underway as the first public meetings were held attracting 45 attendees. SWAT, QUAL2E and WASP modeling efforts have been completed and BMP analysis is underway. Like Cedar Creek, Eagle Mountain Lake has demonstrated a rising trend of Chlorophyll-a resulting from excessive nutrient and sediment loadings. It is therefore anticipated that the development of a WPP will proceed quickly following the method established by the Cedar Creek planning process. The Eagle Mountain WPP is currently in outline form with historical and other background information completed, which includes completing a water quality model development and validation, completed analysis of wastewater treatment plants in the watershed, and conducted a sediment survey on the lake in order to determine loadings from the watershed.

Richland-Chambers Watershed

Computer-based water quality modeling for the Richland-Chambers Watershed is currently in progress. Stakeholder meetings are scheduled to begin in early 2009 with development of a complete watershed plan taking place shortly thereafter.

The North Central Texas Water Quality project is a partnership of the TRWD, TWRI and The Texas AgriLife Research and Extension Urban Solutions Center—Dallas. Funding for the project is provided by the United States Department of Agriculture-Natural Resource Conservation Service, EPA, TSSWCB, TCEQ and TRWD.

O.H. Ivie Reservior (photo by UCRA)

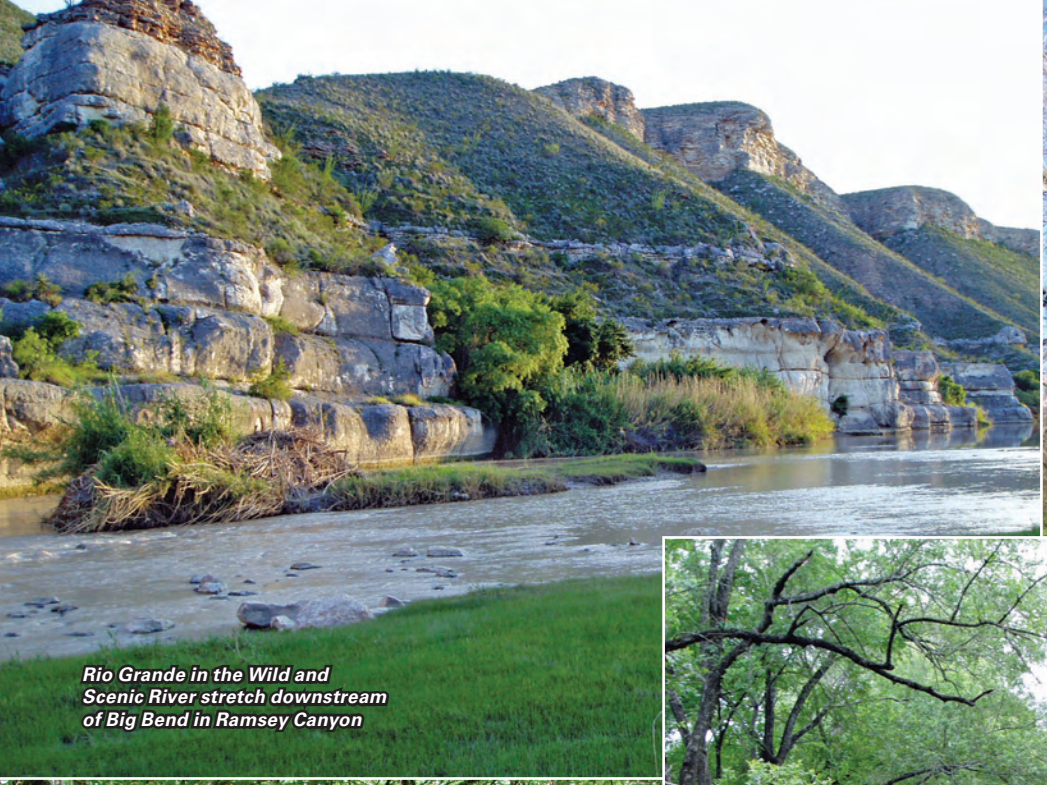
Abbreviations

ACS	Agricultural Chemicals Subcommittee
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BRA	Brazos River Authority
BST	Bacterial Source Tracking
CAPCOG	Capital Area Council of Governments
CBCOG	Coastal Bend Council of Governments
CCC	Coastal Coordination Council
CMP	Coastal Management Plan
COG	Council of Governments
CRMWD	Colorado River Municipal Water District
CRP	Clean Rivers Program
CWA	Clean Water Act
CWQMN	Continuous Water Quality Monitoring Network
CZARA	Coastal Zone Act Reauthorization Amendments
CZMA	Coastal Zone Management Act
DO	Dissolved Oxygen
DSHS	Texas Department of State Health Services
ECC	Erosion Control Compost
EPA	U.S Environmental Protection Agency
FY	Fiscal Year
GBEP	Galveston Bay Estuary Program
GBRA	Guadalupe Blanco River Authority
GIS	Geographic Information System
GLO	General Land Office
GPS	Global Positioning System
H-GAC	Houston Galveston Area Council
IBWC	International Boundary and Water Commission
IPD	Inter-agency Pesticide Database
I-Plan	Implementation Plan for a TMDL
LCRA	Lower Colorado River Authority
LEADS	Leading Environmental Analyss and Display System
LULC	Land Use Land Cover
MS4	Municipal Separate Storm Sewer System
NEMO	Nonpoint Education for Municipal Officials
NOAA	National Oceanic Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service (of the USDA)
PMP	Texas Groundwater Pesticide Management Plan
POC	Pesticide of Concern
POE	Public Outreach and Education
POI	Pesticide of Interest
POINTS	Pesticide of Interest Tracking System
PSA	Public Service Announcement

continued

Abbreviations

QAPP	Quality Assurance Project Plan
OSSF	On Site Sewage Facility
RRC	Railroad Commission of Texas
RSI	River Systems Institute- Texas State University
SARA	San Antonio River Authority
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
SWAT	Surface Water Assessment Tool
SWCD	Soil and Water Conservation District
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TFS	Texas Forest Service
TGPC	Texas Groundwater Protection Committee
TIAER	Texas Institute for Applied Environmental Research
TMDL	Total Maximum Daily Load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TRWD	Tarrant Regional Water District
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
TWDB	Texas Water Development Board
TWQI	Texas Water Quality Inventory
TWRI	Texas Water Resources Institute
TWS	Texas Watershed Stewards Program
TxDot	Texas Department of Transportation
UCRA	Upper Colorado River Authority
USDA	U.S. Department of Agriculture
WASP	Water Quality Analysis Simulation Program
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan
WWTP	Wastewater Treatment Plant



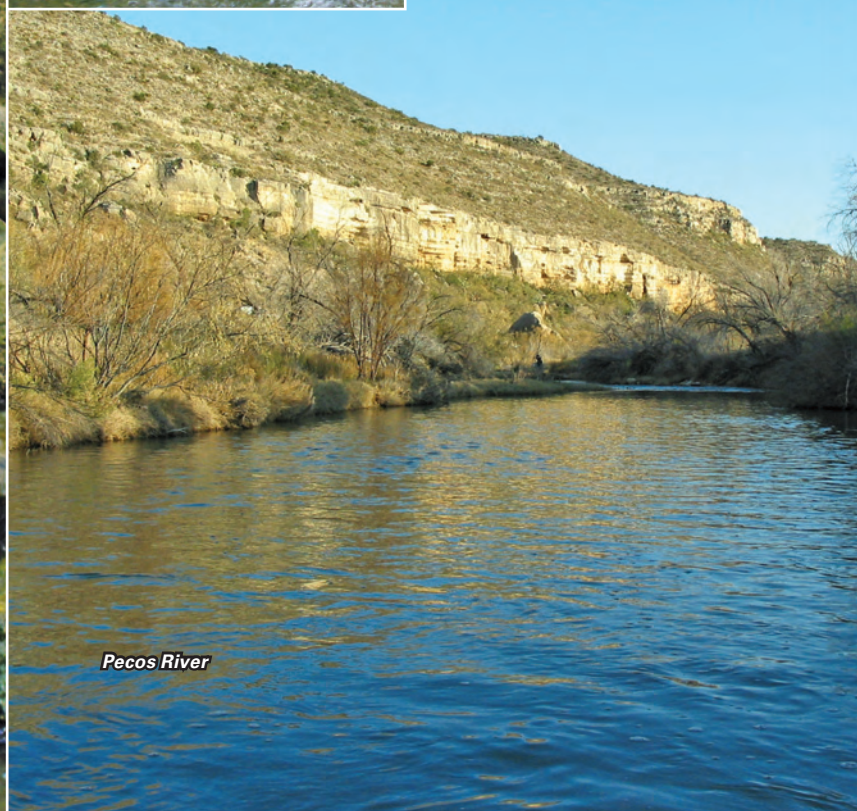
Rio Grande in the Wild and Scenic River stretch downstream of Big Bend in Ramsey Canyon

Black Bayou

Nolan Creek

Geronimo Creek

Upper Cibolo Creek



Pecos River

Medina River in Bandera