Managing NONPOINT SOURCE POLLUTION IN TEXAS

2011 ANNUAL REPORT

Texas Commission on Environmental Quality

Texas State Soil & Water Conservation Board

Funding provided by the Environmental Protection Agency through Clean Water Act Section 319(h) grant funds

SFR-066/11 January 2012

Front & back cover photos:
Smith Spring, Guadalupe Mountains National Park

Managing

NONPOINT SOURCE POLLUTION IN TEXAS

2011 ANNUAL REPORT

Authorization to use or reproduce any original material contained in this publication, not obtained from other sources, is freely granted. The Texas State Soil and Water Conservation Board (TSSWCB) and the Texas Commission on Environmental Quality (TCEQ) would appreciate acknowledgement.

Copies of this publication are available for public use through the Texas State Library, other state depository libraries, and the TCEQ Library, in compliance with state depository law. Copies of this publication are also available on the TCEQ Web site at: <**www.tceq.texas.gov/publications**>.

This document may also be downloaded from the TSSWCB website at:<**www.tsswcb.texas.gov/reports**>.

Published and distributed by the
Texas Commission on
Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

and by the

Texas State Soil and Water
Conservation Board
P.O. Box 658
Temple, TX 76503

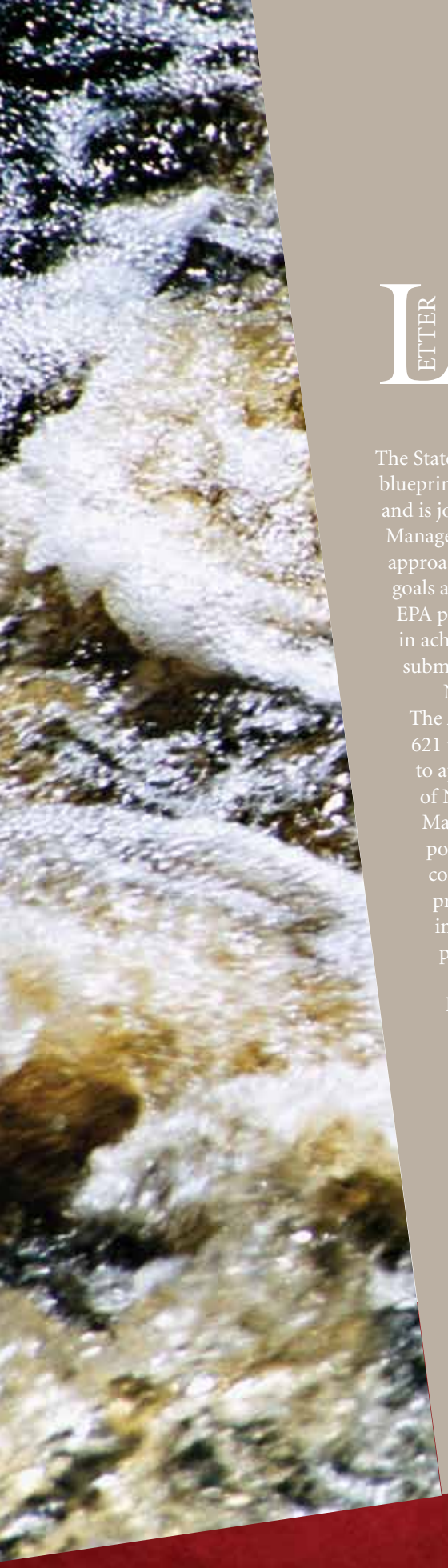
Printed on recycled paper using vegetable-based ink.

The TCEQ is an equal opportunity employer. The agency does not allow discrimination on the basis of race, color, religion, national origin, sex, disability, age, sexual orientation, or veteran status. In compliance with the Americans with Disabilities Act, this document may be requested in alternate formats by contacting the TCEQ at 512-239-0028, Fax 512-239-4488, or 1-800-RELAY-TX (TDD), or by writing P.O. Box 13087, Austin, TX 78711-3087.

How is our customer service?

Fill out our online customer-satisfaction survey at

www.tceq.texas.gov/goto/customersurvey



LETTER

From the Executive Directors

The State of Texas Nonpoint Source (NPS) Management Program is the state's official blueprint to protect and restore water resources impacted by nonpoint sources of pollution and is jointly developed and administered by the TCEQ and the TSSWCB. The NPS Management Program utilizes regulatory, voluntary, financial, and technical assistance approaches to achieve a balanced program. The TCEQ and the TSSWCB have established goals and objectives for guiding and tracking the progress of NPS management in Texas. The EPA provides grant funding to Texas to implement the NPS Management Program. Success in achieving its goals and objectives are reported annually in this document, which is submitted to the EPA in accordance with Section 319(h)(11) of the federal Clean Water Act.

NPS pollution continues to be a major source of water quality impairment in the state. The *2010 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)* identifies 621 water bodies as impaired, and NPS pollution is identified as a source contributing to approximately 75 percent of those impairments. Considering 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 compile information about local concerns and infrastructure and build support for the 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.

We are pleased to present the *2011 Annual Report* of the state's NPS Management Program. The Report documents our progress during fiscal year 2011 in meeting the goals of the program. In partnership with the EPA and other federal, state, regional, and local watershed stakeholders, the TCEQ and the TSSWCB welcome input into the planning and implementation of the program and look forward to its continued growth and success.

Sincerely,

Rex Isom
Executive Director
Texas State Soil and Water
Conservation Board

Mark R. Vickery, P.G.
Executive Director
Texas Commission on
Environmental Quality

Table Contents

From the Executive Directors 3

Contents 4

Chapter 1

Introduction 7

Defining Nonpoint Source Pollution 7

What Guides Nonpoint Source Pollution Management in Texas? 7

Partnerships 8

The Texas Nonpoint Source Management Program 8

Goals for Nonpoint Source Management 8

Long-Term Goal 8

Short-Term Goals 8

The Watershed Approach 9

Watershed Action Planning 9

Chapter 2

Progress in Improving Water Quality 13

Reductions in Pollutant Loadings 13

Assessing Water Quality Management Plan Implementation in the Middle and South Bosque River and Hog Creek Watersheds 14

Lower Colorado River Authority's Creekside Conservation Program 14

Arroyo Colorado Wetlands 14

Dickinson Bayou Watershed Protection Plan Implementation Project 15

Water Quality Improvements 16

Fosdic Lake Success Story 16

Chapter 3

Progress Toward Meeting the Goals and Objectives of the Texas Nonpoint Source Management Program 19

Clean Water Act Section 319(h) Grant Program 19

Status of Clean Water Act Section 319(h) Grant-Funded Projects 19

Short-Term Goals and Milestones of the Texas Nonpoint Source Management Program 20

Goal One—Data Collection and Assessment 20

Texas Integrated Report 20

Categories Indicate Water Quality Status 21

Summary of the 2010 Integrated Report 22

Summary of 2010 Impairments 22

Continuous Water Quality Monitoring Network 23

Rio Grande Watermaster Continuous Water Quality Monitoring Network 25

Guadalupe River Basin Continuous Water Quality Monitoring Network 25

North Bosque River Watershed Assessment 26

Double Bayou Watershed Characterization 27

Highland Bayou Watershed Characterization 28

Statewide Bacterial Source Tracking 28

Goal Two—Implementation 28

Total Maximum Daily Loads and Implementation Plans 29

Bacteria Total Maximum Daily Loads 30

Watershed Protection Plans 31

Texas Coastal Nonpoint Source Control Program 31

Coastal Zone Act Reauthorization Amendments On-Site Sewage Facility Reconnaissance, Training, and Replacement 32

The Galveston Bay Estuary Program 33

The Texas Groundwater Protection Committee and Pesticide Management 34

Agricultural Chemicals Subcommittee 35

Nonpoint Source Task Force 35

Public Outreach and Education Subcommittee 35
Clean Water State Revolving Fund Loans for Nonpoint Source Projects 35
Texas Waterway Cleanup Program 36
Household Hazardous Waste Collection Program 36
Agricultural Waste Pesticide Collection Program 36
Plum Creek Implementation 36
Pet Waste Stations Improve Water Quality 36
City of Kyle 37
City of Lockhart 37
Implementing Agricultural Best Management Practices in the Arroyo Colorado Watershed 38
Goal Three–Education 38
Texas Stream Team 38
City of Austin Lawn and Garden Chemical Education 39
Texas Watershed Planning Training Project 39
Low Impact Development Workshops 40
Texas Watershed Steward Program 41
Interactive Watershed Kiosks Distributed Throughout the State 42
Texas Silvicultural Nonpoint Source Pollution Prevention 42
Feral Hog Management Education in the Plum Creek Watershed 43

Chapter 4
Progress in Developing and Implementing Watershed Protection Plans 45

Texas State Soil and Water Conservation Board Watershed Protection Plans 46
Attoyac Bayou 46
Buck Creek 46
Cedar Bayou 48
Concho River 48
Geronimo and Alligator Creeks 49
Granger Lake 49
Lampasas River 50
Leon River 50
Pecos River 50
Plum Creek 51
Texas Commission on Environmental Quality Watershed Protection Plans 52
Arroyo Colorado 52
Bastrop Bayou 54
Brady Creek 54
Caddo Lake 55
Cypress Creek 55
Dickinson Bayou 56
Hickory Creek 56
Lake Granbury 56
San Bernard River 57
Upper Cibolo Creek 58
Upper San Antonio River 58
Third-Party Watershed Protection Plans 59
Lower Nueces River 59
Paso del Norte portion of the Rio Grande 59

A
Abbreviations 63

Figures

Figure 1-1. Social, Economic, and Environmental Considerations to Achieve Water Quality Restoration 9
Figure 2-1. Fosdic Lake Contaminant Concentrations in Fish Tissue 17
Figure 3-1. TCEQ Fiscal Year 2011 Nonpoint Source Grant-Funded Projects 20
Figure 3-2. TSSWCB Fiscal Year 2011 Nonpoint Source Grant-Funded Projects 20
Figure 3-3. Continuous Water Quality Monitoring Network Stations – Fiscal Year 2011 24
Figure 3-4. Lower Rio Grande Watermaster Continuous Water Quality Monitoring Network Project 25
Figure 3-5. Total Maximum Daily Load and Implementation Plan Watersheds 29
Figure 3-6. Low Impact Development Workshop Attendee Professional Break-down 41
Figure 3-7. Silviculture Best Management Practice Implementation 42
Figure 4-1. Map of Watersheds with Watershed Protection Plans being developed or completed in Texas 46

Tables

Table 1-1. Watershed Action Planning Strategies 11
Table 2-1. Lake Fosdic Fish Tissue Contaminant Levels 16
Table 3-1. Number of Water Bodies Assigned to Each Assessment Category 21
Table 3-2. Number of Impairments in the Draft 2010 Integrated Report Requiring Remedial Action 21
Table 3-3. Summary of Impairments Identified on the CWA Section 303(d) List for the Draft 2010 Integrated Report 22
Table 3-4. Guadalupe Basin Education Kiosks 26
Table 3-5. Total Maximum Daily Load Implementation Status 30
Table 3-6. 2011 Trash Bash Results 34
Table 3-7. City of Austin Lawn and Garden Chemical Education Results 39
Table 3-8. Low Impact Development Workshops 40
Table 4-1. Texas Watershed Protection Plans 47

1 Introduction

Defining Nonpoint Source Pollution

Nonpoint source (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 water. NPS pollution also includes flow of polluted water from sources such as car washing 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
- bacteria and nutrients from livestock, pet waste, and leaking septic systems

Some NPS pollution originates as air pollution deposited onto the ground and into waterways (atmospheric deposition). Changes in the flow of waterways due to dams and other structures (hydromodification) can also cause NPS pollution.

What Guides Nonpoint Source Pollution Management in Texas?

Under the federal Clean Water Act (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 long-term goal of the *Texas NPS Management Program* is to protect and restore the quality of the state's water resources from the adverse effects of NPS pollution. This is accomplished through cooperative implementation using the organizational tools and strategies defined below.

Partnerships

The Texas Commission on Environmental Quality (TCEQ) is designated by law as the lead state agency for water quality in Texas, including the issuance of permits for point source discharges and abatement of NPS pollution from sources other than agricultural or silvicultural. The Texas State Soil and Water Conservation Board (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 and TSSWCB jointly administer the Texas NPS Management Program.

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 integral part in managing NPS pollution, especially at the watershed level. They provide information about local concerns and infrastructure and build support for the 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 and restoration efforts.

The Texas Nonpoint Source Management Program

The *Texas NPS Management Program* is required by Section 319(b) of the federal CWA and prepared jointly by the TCEQ and the TSSWCB. The *Texas NPS Management Program*, approved by both the TCEQ and the TSSWCB in 2005 <www.tceq.texas.gov/goto/nps-report>, is the state's official plan for addressing NPS pollution and presenting the goals, priorities, programs, and milestones for the Program.

The *Texas NPS Management Program* presents goals and objectives for addressing NPS pollution in the state. *The Texas NPS Management Program* utilizes a balanced approach incorporating regulatory, nonregulatory, financial, and technical assistance approaches. The goals describe high-level guiding principles for all activities under the Program. The objectives specify the key methods used to accomplish the goals. The *NPS Annual Report*, which is required by CWA Section 319(h)(11), provides an annual update of progress toward meeting the goals and milestones set forth in the *Texas NPS Management Program*. Additionally, the *NPS Annual Report* briefly summarizes the state's NPS Program and how it is integrated with the state's other water quality programs.

The *Texas NPS Management Program* must be periodically revised and updated. Throughout fiscal year 2011, staff from the TCEQ and the TSSWCB have worked to develop a revised Program document that incorporates new water quality programs and initiatives, provides new milestones for assessing progress to implement the Program, and is more transparent and accountable for the citizens of Texas. During the upcoming fiscal year 2012, the TCEQ and TSSWCB will complete the revision of the Program document and release it for public comment.

Goals for Nonpoint Source Management

Long-Term Goal

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

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 program to support the implementation of Total Maximum Daily Load (TMDL) Implementation Plans (I-Plans) and/or Watershed Protection Plans (WPPs) and other state, regional, and local plans and 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 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 Watershed Approach

Protecting the state's streams, lakes, bays, and aquifers from the impacts of NPS pollution is a complex process. Texas uses the 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. Wherever interactions between surface water and groundwater are identified, management activities will support the quality of both resources.

The Watershed Approach recognizes that to achieve restoration of impaired water bodies, solutions to water quality issues must be socially accepted, economically bearable, and based on environmental goals.

FIGURE 1-1

Social, Economic, and Environmental Considerations to Achieve Water Quality Restoration

Watershed Action Planning

Water quality planning programs in Texas are responding to these challenges of managing NPS pollution by developing new approaches to addressing water quality issues in the state. Watershed Action Planning is an approach that emphasizes the role of partners and stakeholders, relies on sound technical information, and makes available multiple options to provide the flexibility needed to address varied conditions. Watershed Action Planning supports the integration of state water quality planning programs by providing a framework and a mechanism for an enhanced level of coordination. Participants in the Watershed Action Planning (WAP) process consider water quality standards, monitoring data, remedial programs, and other water quality planning programs and how they relate to one another when developing an approach for addressing impaired waters. For example, it is essential to develop meaningful, yet attainable water quality standards. Remedial programs such as TMDLs cannot be successful if the water quality standards on which they are designed are not attainable. Similarly, water quality monitoring plays a critical role in establishing a link between management measures on the landscape and resulting water quality in-stream. This is an important means by which progress toward meeting the state's water quality goals is demonstrated. The goal of Watershed Action Planning is to implement an effective water quality planning program that optimizes resources, has the support of stakeholders, and is accountable and transparent to the citizens of Texas.

The ultimate goal of the WAP process is to achieve restoration of designated uses in impaired water bodies. Water bodies that are not meeting the designated Texas Surface Water Quality Standard (TSWQS) are commonly known as "impaired" and are identified on the CWA Section 303(d) List included in the state's biennial water quality assessment, the *Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)* (*IR*). Additional information about the CWA Section 303(d) List and the *IR* can be found in Chapter 3. Restoration of designated uses can be accomplished by attaining socially accepted and economically bearable solutions based on environmental goals that are grounded in defensible water quality standards and supported by credible water quality data.

Watershed Action Planning is a process to coordinate and track decision-making for the implementation of the state's water quality programs to address water quality issues in specific water bodies. The process, initiated in fiscal year 2011, emphasizes coordination by partners and stakeholders at both the watershed and state levels. An output of the WAP process is a list of impaired and special interest water bodies identifying a recommended approach to addressing the water quality issues. The WAP process involves three levels of coordination:

- Local Watershed Prioritization
- Program Integration
- Statewide Interagency Coordination

There is significant stakeholder participation in the individual state water quality planning programs. The WAP process provides a forum to bring these individual initiatives together. Stakeholder participation in the WAP process will provide opportunities to contribute to the coordination of the individual program resources with the objective of achieving state program goals more effectively and efficiently.

The federal CWA requires that a TMDL be developed for all water bodies on the state's 303(d) List. The state established the TMDL program in 1998 at the TCEQ (formerly Texas Natural Resource Conservation Commission) and at partner agencies to facilitate the fulfillment of the state's obligations under the CWA. TMDL development activity was initiated in watersheds across the state as the primary strategy for addressing water quality impairments. Experience with the TMDL program since that time has shown that TMDLs may not always be the best choice to address water bodies on the state's 303(d) List. This has prompted the state to develop a new approach to addressing surface water quality impairments and other water quality issues.

The strategies identified for addressing surface water quality issues in the WAP process are listed below in Table 1-1. These strategies are implemented at a watershed scale utilizing the Watershed Approach. The Watershed Approach provides a coordinating framework that focuses on the highest priority issues within a hydrologically defined geographic area.

TABLE 1-1

Watershed Action Planning Strategies

Strategy	Strategy Description
Monitoring	More data is needed in order to confirm impairment or delineate the area of the impairment, in order to select and initiate the most appropriate watershed action planning strategy to achieve attainment of WQS. This strategy is limited to the collection or acquisition of more water quality data, either through routine monitoring or specialized monitoring (e.g., special study, targeted monitoring).
Watershed Evaluation	A comprehensive, site-specific analysis that may include one or more of the following: (1) the collection, review and evaluation of existing ancillary watershed data and information; (2) modeling; (3) field surveys to identify pollution sources or significant features of the watershed; (4) trend analysis, (5) an analysis of effectiveness of a best management practice (BMP), (6) a recreational screening survey, or (7) impairment expected to be removed from 303(d) list during next iteration of the IR.
Water Quality Standards Review	Use Attainability Analysis (UAA), which is conducted if the designated use or criterion appears to be inappropriate for a water body. A UAA involves the collection of site-specific information that could result in a use change or the development of a site-specific criterion. To establish or change a designated use or criterion requires a revision to the TSWQS, adoption by TCEQ, and approval by the Environmental Protection Agency (EPA).
Total Maximum Daily Load / ImplementationPlan	A TMDL and I-Plan are planned, scheduled, under development, or being implemented for the water body. A TMDL determines the maximum amount of a pollutant a water body can receive and still achieve its water quality standards and then allocates this amount (load) to point and nonpoint sources in the watershed. A TMDL I-Plan is locally developed and describes the regulatory and voluntary activities necessary to achieve the pollutant reductions identified in the TMDL.
Watershed Protection Plan	A Watershed Protection Plan (WPP) is planned, scheduled, under development, or being implemented. WPPs are a coordinating framework for designing and implementing water quality protection programs and projects. WPPs are locally developed, designed to meet water quality standards, and satisfy EPA guidance and criteria.
Other	Other options available to address water quality issues such as actions taken through Clean Air Act programs, or Superfund, or National Estuary Program Comprehensive Conservation and Management Plans.

The WAP process includes a stakeholder-led evaluation of watershed-specific circumstances and a deliberative and collective decision as to how to address the water quality issues. The process will also be used to evaluate the effectiveness of strategies. Progress in implementing strategies will be reviewed through the process and appropriate actions will be recommended. The goal of this increased flexibility and stakeholder participation in the planning process is more effective and efficient water quality planning programs. In fiscal year 2011, the TCEQ, the TSSWCB, and river authorities began the process of identifying a strategy to address each impairment in the state. The WAP process will be incorporated into the 2012 update to the NPS Management Program. The TCEQ and the TSSWCB anticipate making WAP strategies public in calendar 2012.

Salado Creek/photo courtesy of TIAER

2 Progress in Improving Water Quality

Section 319(h) of the CWA requires that state NPS annual reports include, "…to the extent that appropriate information is available, reductions in nonpoint source pollutant loading and improvements in water quality… resulting from implementation of the management program. This specifically applies to the water bodies 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
- 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 land use 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.

Reductions in Pollutant Loadings

Texas Best Management Practice Evaluation Tool

The Texas BMP Evaluation Tool (TBET) was developed by the U.S. Department of Agriculture (USDA) Agricultural Research Service, to assist in the selection of optimal conservation best management practices (BMPs) and to estimate the resulting pollutant reductions for Water Quality Management Plans (WQMPs). The development of TBET was funded by a State General Revenue NPS grant from TSSWCB.

TBET accounts for local climate, soils, topography, and supports common Natural Resources Conservation Service (NRCS) conservation practices to predict sediment, phosphorus and nitrogen losses from individual fields that comprise a farm or ranch operation. The tool uses the Soil and Water Assessment Tool (SWAT), which is a hydrological model that seeks to replicate the important processes which direct the transport of water, sediment, nutrients and other pollutants. By using the process-based SWAT model, this tool more accurately simulates a wide variety of management options and field characteristics than existing alternatives, such as the Spreadsheet Tool for Estimating Pollutant Loads (STEPL).

During fiscal year 2011, TBET was deployed and beta-tested by staff from TSSWCB, USDA-NRCS, and local Soil and Water Conservation Districts (SWCDs). TSSWCB will utilize TBET beginning in fiscal year 2012 to estimate and report pollutant load reductions achieved through implementing WQMPs. These TBET-generated load reductions will be reported to the U.S. Environmental Protection Agency (EPA) to satisfy CWA Section 319(h) grant requirements and to the Texas Legislative Budget Board to satisfy programmatic changes resulting from the Texas Sunset Advisory Commission's review of the TSSWCB.

Assessing Water Quality Management Plan Implementation in the Middle and South Bosque River and Hog Creek Watersheds

The Middle and South Bosque Rivers, Segment 1246, have concerns for elevated nitrates, as does Lake Waco, the receiving water body for the Middle and South Bosque Rivers and Hog Creek. While nitrogen is an essential nutrient for aquatic life, excessive nitrates can lead to conditions that make it difficult for aquatic insects and fish to survive due to excessive algal growth. High nitrate levels can also lead to human health problems, particularly for infants, if used as drinking water. However, for the Middle and South Bosque Rivers and Hog Creek, aquatic life issues are the concern.

To address this concern, the TSSWCB and McLennan SWCD provided technical assistance and financial incentives to aid landowners in the development and implementation of Water Quality Management Plans (WQMP). A WQMP is a site-specific plan developed through and approved by SWCDs that includes appropriate and essential land treatment practices, production practices, management measures, or technologies applicable to each planned land use (e.g., cropland, rangeland, pastureland) that prevent and abate agricultural NPS pollution.

Water quality monitoring was conducted to evaluate the impact of BMPs implemented along the Middle and South Bosque Rivers and Hog Creek on decreasing NPS contributions of nitrates. This monitoring included routine grab sampling and measurement of storm water runoff for nutrients and total suspended solids (TSS) as well as chlorophyll *a* and bacteria monitoring with routine grab samples only. Chlorophyll *a* was monitored as an indicator of the amount of algae in the water.

While the project is not yet complete, a preliminary review of the data using TBET indicates lower concentrations of nitrates in recent years compared to historical data. These decreases coincide with landowner efforts to implement BMPs in the watersheds.

Sediment	1,560 tons
Phosphorus	4,523 lbs
Nitrogen	7,599 lbs

Lower Colorado River Authority's Creekside Conservation Program

The Creekside Conservation Program, administered by the Lower Colorado River Authority (LCRA), is a partnership between LCRA, private landowners, USDA- NRCS, local SWCDs, and the TSSWCB. The Creekside Conservation Program provides financial incentives to help reduce soil erosion and agricultural NPS pollution on privately owned land. The Creekside Conservation Program is being conducted in Bastrop, Blanco, Burnet, Colorado, Fayette, Lampasas, Llano, Matagorda, San Saba, Travis, and Wharton Counties.

In fiscal year 2011, this effort placed 4,197 acres under conservation plans. BMPs installed in the last year included 15 acres of rangeland reseeding or pasture planting, one pond or grade stabilization structure, 12,732 linear feet of cross fencing to support prescribed grazing, 30 acres of brush management, and a water well for alternative livestock watering. According to the TBET modeling, these BMPs achieved the following load reductions:

Sediment	1,029 tons
Phosphorus	3,166 lbs
Nitrogen	28,595 lbs

In addition to technical assistance and financial incentives, LCRA and project coordinators hosted three BMP effectiveness workshops and field days with a total of approximately 350 attendees.

Arroyo Colorado Wetlands

The Arroyo Colorado in the Lower Rio Grande Valley (LRGV) is impaired for low dissolved oxygen (DO), bacteria, and legacy pollutants. In 2007, *A Watershed Protection Plan for the Arroyo Colorado Phase I* was completed. To implement the habitat and wastewater measures of the WPP, the TCEQ provided CWA Section 319(h) funds to financially assist the cities of San Juan, San Benito, and La Feria to improve water quality through the design, construction, maintenance, operation, and monitoring of wetlands that receive treated effluent from municipal wastewater treatment facilities (WWTF) and storm water runoff. The wetlands are not a requirement of the WWTF permits. Recreational features such as boardwalks, all-weather paths, signage, and kiosks were developed converting the wetlands to educational tools for Arroyo Colorado residents.

The City of La Feria wetland is approximately 11 acres in size, and consists of a series of three wetland cells (or ponds). Each cell consists of a sequence of shallow water

zones with emergent vegetation and deeper open water zones with submergent and floating vegetation.

The City of San Juan wetland is approximately five acres in size, and includes six cells that operate on a parallel basis. The wetland design employs an open water/marsh/open water concept within each of the wetland cells to reduce short circuiting and promote re-aeration of the water column.

The City of San Benito wetland is approximately six acres in size. The wetland was constructed from existing hyacinth ponds previously used to treat municipal wastewater for the city. Four separate cells within the hyacinth pond system were reconfigured to create a wetland with gradients of plant zones.

According to the engineering design reports, these BMPs provide the following load reductions:

La Feria	
Phosphorus	882 lbs
Nitrogen	1,764 lbs

San Benito	
Phosphorus	992 lbs
Nitrogen	6,614 lbs

San Juan	
Phosphorus	1,760 lbs
Nitrogen	7,596 lbs

Dickinson Bayou Watershed Protection Plan Implementation Project

Dickinson Bayou does not meet water quality standards for DO or pathogen indicator bacteria. The Dickinson Bayou Watershed Protection Plan (WPP) outlines a series of actions for improving the overall health of the watershed and reducing the amount of pollutants entering the Bayou. These actions are based on the vision and goals proposed for the watershed by a broad group of stakeholders representing individual citizens, non-profit and commercial interests, and local, state, and federal governmental entities.

For the initial implementation phase of the Dickinson Bayou WPP, the Texas AgriLife Extension Service (AgriLife Extension) proposed short-term implementation measures through a CWA Section 319 grant with the TCEQ. Several on-the-ground demonstrations of site specific BMPs were funded through this grant. This funding helped develop educational workshops for many different groups, NPS-related fact sheets, a pet waste education campaign, lesson plans for teachers, and also provided youth education using watershed models.

Rain garden in the City of Dickinson/photo by AgriLife Extension

For on-the-ground implementation, AgriLife Extension worked with Clear Creek School District and City of League City officials on a storm water wetland (four acres) project at the Education Village on FM 96 in the northeast portion of the Dickinson Bayou watershed. AgriLife Extension staff also worked with the City of Dickinson and Keep Dickinson Beautiful to install a rain garden (0.02 acres) and a roof rain catchment cistern (0.03 acres) at the Dickinson Public Library. In addition, AgriLife Extension staff collaborated with representatives from the City of Dickinson to install a new watersmart landscape (0.23 acres) consisting of native trees and shrubs around the new city hall complex. AgriLife Extension staff also partnered with the Texas Parks and Wildlife Department (TPWD) Dickinson Marine Laboratory to design and install their new watersmart landscape (0.012 acres).

The Simple Method for calculating urban storm water loads from the Center for Watershed Protection was used to determine load reduction from these on-the-ground BMPs. Estimated reductions are:

Phosphorus	356 lbs
Nitrogen	770 lbs

Water Quality Improvements

Fosdic Lake Success Story

Fosdic Lake, Segment 0806A, is a man-made impoundment located along a tributary of the West Fork Trinity River in Tarrant County. The lake was built between 1909 and 1912 and has a surface area of seven acres. The lake is located in east Fort Worth's Oakland Lake Park and drains a 262-acre, residential watershed. The Texas Department of State Health Services (DSHS) issued a ban on the possession of all fish species from Fosdic Lake in 1995 due to elevated levels of several legacy pollutants including chlordane, dichlorodiphenyldichloroethylene (DDE), dieldrin, and polychlorinated biphenyls (PCBs). In 1996, the TCEQ placed the reservoir on its CWA Section 303(d) List as impaired for its designated fish consumption use.

Legacy pollutants are substances that have been banned or restricted, but that remain in the environment. Chemical substances such as chlordane, DDE, dieldrin, and PCBs were widely used beginning in 1946 as pesticides, coolants, and lubricants. Even though these chemicals were restricted between 1972 and 1988, area soils remained contaminated through direct application, leaks, and spills. Extensive urban development in the late 1950's through the early 1990's in the watershed caused contaminated soils to erode and accumulate in Fosdic Lake. The pollutants then entered the food chain and became concentrated in fish tissue.

On November 17, 2000, the TCEQ and the EPA approved a TMDL for Fosdic Lake for legacy pollutants in fish tissue. The endpoint of the TMDL was to restore the fish consumption use by meeting the DSHS' criteria for contaminant levels. With the exception of common carp, which has a limited PCB consumption advisory, the goals of the TMDL were met in 2008. In fiscal year 2011, the EPA recognized the reductions in legacy pollutants in fish tissue from Fosdic Lake as a federally highlighted Success Story of the Texas NPS Program.

The City of Fort Worth Environmental Management Department operates the Environmental Collection Center, a permanent, year-round facility that accepts household hazardous waste from residents of Fort Worth and other areas. In consultation with the TCEQ and the EPA, the Environmental Collection Center modified its record-keeping to track the amounts of legacy pollutants collected at the center. The city used the information as a measure for evaluating its pollution prevention program and targeting its educational efforts.

TABLE 2-1

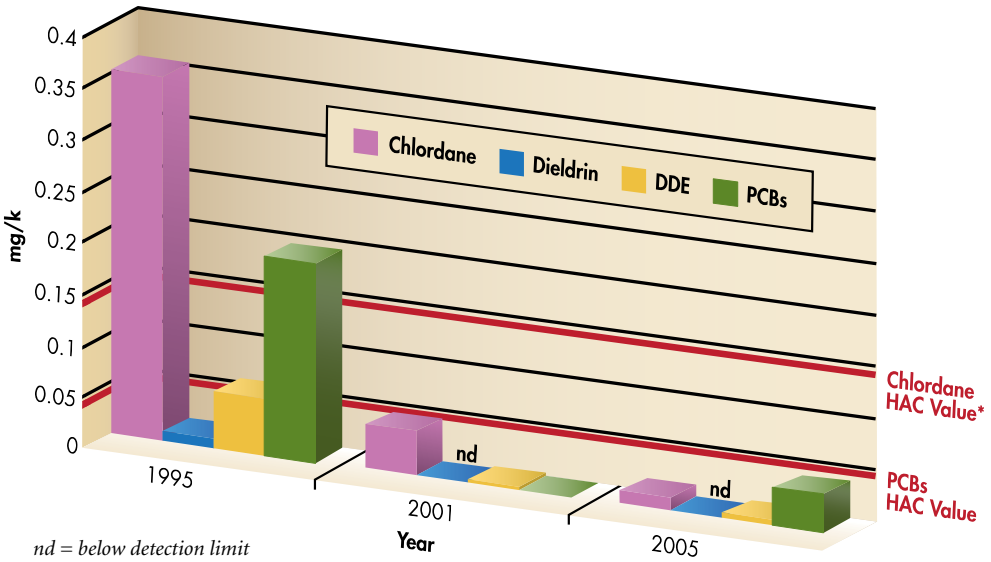
Lake Fosdic Fish Tissue Contaminant Levels

Comparison Value (mg/kg)	Noncarcenogenic Comparison Values (EPA Chronic OralRfD) (mg/kg-day)	Contaminant	Mean Range (Min-Max)		
			1995	2001	2005
0.140*	0.00006	Chlordane	0.350	0.044 (nd-0.083)	0.014 (nd-0.063)
0.117	0.00005	Dieldrin	0.013	nd	nd
1.167	0.0005	DDE	0.054	0.0025 (nd-0.008)	0.01 (nd-0.043)
0.047	0.00002	PCBs	0.190	no data	0.035 (0.021-0.070)
		Number of Fish	7	10	10

As part of the TMDL effort, the TCEQ collaborated with the United States Geological Survey (USGS) to conduct sediment and runoff sampling and analysis to evaluate current loading of legacy pollutants as well as trends, and sources of pollutants. The TMDL collaboration effort also included the collection of fish tissue samples, funded in part by the CWA Section 319 grant. The goal was to develop a quantitative risk characterization that eventually became the basis for the revised health risk assessment adopted by DSHS in 2008.

FIGURE 2-1

Fosdic Lake Contaminant Concentrations in Fish Tissue



nd = below detection limit

HAC = Health-Based Assessment Comparison Value

** The chlordane HAC value was calculated using the 1995 oral RfD value (0.00006 mg/kg-day). The HAC values calculated for Dieldrin, DDE, and PCBs were 0.117, 1.167, and 0.047 mg/kg respectively.*

Pollution prevention and source control practices such as the public education and household hazardous waste collection programs implemented by the City of Fort Worth contributed to the reduction of pollutants to meet the endpoint of the TMDL. These efforts were funded, in part by the EPA. The City of Fort Worth's educational program resulted in an overall 21 percent increase in the use of its permanent household hazardous waste facility. As of 2006, the Environmental Collection Center collected and logged over 8,000 pounds of materials containing legacy pollutants. Participation and feedback initiated with this project were highly successful in informing the public about the quality of urban lakes and the possible public health and environmental risks of potential contaminants.

The combination of these investigations, management activities, and the natural attenuation of the pollutants has proven to be effective for Fosdic Lake. In 2007, the Texas DSHS lifted the ban on possessing fish from Fosdic Lake. However, DSHS continues to advise limiting consumption of common carp. According to a DSHS January 15, 2008 article, fish tissue monitoring showed that, with the exception of PCBs, concentrations of legacy pollutants comply with the endpoint target in the TMDL (Table 2-1, Figure 2-1).

Funding for this project involved multiple in-kind sources and the cooperation of many partners. The City of Fort Worth contributed to the project by conducting public outreach and collecting hazardous household waste. The USGS investigated the status and trends of legacy pollutants in sediments. The TCEQ and the USGS each contributed $39,000, for total cost of $78,000 for the joint investigation. The TCEQ contributed approximately $25,000 of EPA funds granted under CWA Section 319 to cover the DSHS' analytical expenses for the most recent fish tissue analysis. The DSHS matched the grant with salaries and in-kind services to collect the samples and develop the risk characterizations.

The EPA Fosdic Lake Success Story can be found on the EPA NPS Program website at < http://water.epa.gov/polwaste/nps/success319/tx_fosdic.cfm>.

3 Progress Toward Meeting the Goals and Objectives of the Texas Nonpoint Source Management Program

The TCEQ and the 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. Although not comprehensive, this chapter reports on a variety of programs and projects that directly support the goals and objectives of the *Texas NPS Management Program*.

Clean Water Act Section 319(h) Grant Program

Section 319(h) of the CWA established a grant that is appropriated 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 NPS activities consistent with the long- and short-term goals defined in the *Texas NPS Management Program*.

Status of Clean Water Act Section 319(h) Grant-Funded Projects

In fiscal year 2011, the TCEQ had 29 active multi-year CWA Section 319(h) grant-funded projects totaling in a budget of approximately $11.7 million in federal funds, addressing a wide range of NPS issues (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. Other project types include low impact development (LID) projects, support of a state-wide volunteer water quality monitoring program, urban storm water retrofits, on-site sewage facility (OSSF) maintenance and education, and a variety of BMPs chosen on the basis of local water quality priorities.

In fiscal year 2011, the TSSWCB had 56 active multi-year CWA Section 319(h) grant-funded projects totaling in a budget of approximately $14 million in federal funds addressing a wide array of agricultural and silvicultural NPS issues (Figure 3-2). Specific projects include developing and implementing 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 3-1

TCEQ Fiscal Year 2011 Nonpoint Source Grant-Funded Projects

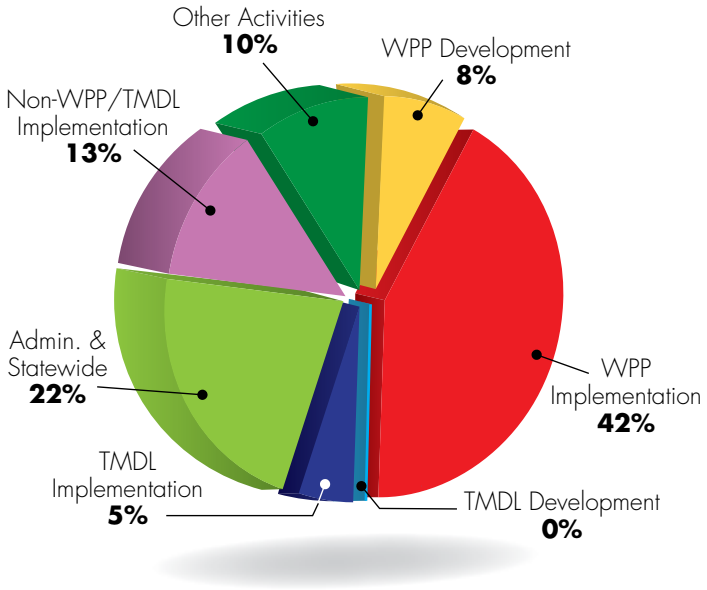
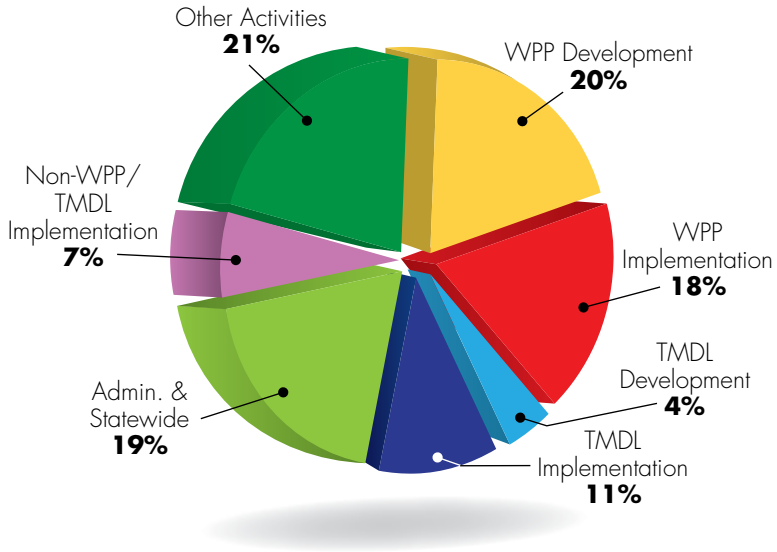


FIGURE 3-2

TSSWCB Fiscal Year 2011 Nonpoint Source Grant-Funded Projects



Short-Term Goals and Milestones of the Texas Nonpoint Source 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 16 regional offices, conducts both routine ambient monitoring and special studies. In addition, the Clean Rivers Program (CRP), a collaboration between the TCEQ and 15 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, river authorities, and municipalities 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 and 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.

Texas Integrated Report

Section 305(b) of the CWA requires all states to assess the quality of surface waters every two years. The *2010 IR* 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 (December 1, 2001-November 30, 2008). The descriptions of water quality present a snapshot of conditions during the limited time period considered in the assessment. Water bodies identified as impaired by NPS pollution are given priority for CWA Section 319(h) grants and other available funding. Guidance for developing the assessment is based on a set of methods that apply the TSWQS, 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 *2010 Guidance for Assessing and Reporting Surface Water Quality in Texas* (available online at <www.tceq.texas.gov/assets/public/compliance/monops/water/10twqi/2010_guidance.pdf>).

The CWA Section 303(d) List is an important management tool produced as part

of the *IR*. It identifies waters for which the existing preventative measures, such as permits that limit discharge of wastewater and the technology used by the dischargers, are not sufficient to meet TSWQS (impairments). The *2010 IR* is subject to review and approval by the EPA.

Categories Indicate Water Quality Status

The *2010 IR* assigns each assessed water body to one of five categories in order to report water quality status and potential management options to the public, the EPA, state agencies, federal agencies, municipalities, and environmental groups. These categories indicate the status of a water body and describe how the state will approach identified water quality problems. Table 3-1 defines the five categories and shows the number of water bodies assigned to each assessment category in 2010.

TABLE 3-1

Number of Water Bodies Assigned to Each Assessment Category in the 2010 Integrated Report

Category	Definition	Number of Water Bodies
1	Attaining all the water quality standards and no use is threatened.	34
2	Attaining some of the designated uses, no use is threatened, and insufficient information, or none, is available to determine if the remaining uses are attained or threatened.	405
3	Insufficient information, or none, to determine if any designated use is attained. Many of these water bodies are intermittent streams and small reservoirs.	282
4	The standard is not supported or is threatened for one or more designated uses but does not require the development of a TMDL.	55
5	The water body does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants (CWA Section 303(d) List).	440
Totals		1216

Water bodies on the CWA Section 303(d) List (Category 5 of the *IR*) are those water bodies that require remedial action by the state to restore water quality. The combination of the water body 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 will 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. This explains why the total number of impairments in Table 3-2 is greater than the number of water bodies in Category 5 in Table 3-1.

The *IR* further divides these water bodies into subcategories to reflect additional options for addressing impairments.

- For water bodies in Category 5a, the state must develop a TMDL and a plan to implement it
- Water bodies in Category 5b require a review of the existing TSWQS
- Those water bodies in Category 5c require additional monitoring to further define the impairment prior to the development of a TMDL of TSWQS change

Table 3-2 shows the total number of impairments in the water bodies requiring remedial action. The categories must be applied to each combination of water body and parameter for determining support.

TABLE 3-2

Number of Impairments in the 2010 Integrated Report Requiring Remedial Action

Category	Definition	Water Body Classification		Total Number of Impairments
		Classified	Unclassified	
5	5a—TMDL scheduled or underway	89	96	185
	5b—Water Quality standards review scheduled or under way or undergoing Use Attainability Analysis	74	174	248
	5c—Need additional monitoring	100	88	188
Total Number of Impairments in Category 5		263	358	621

Summary of the 2010 Integrated Report

The *2010 IR* assessed water quality of 1,216 water bodies. Enough data was available to determine at least one use attainment for 1,066 of these water bodies.

Of the 1,066 water bodies, 440 were included as Category 5 water bodies. This was a slight increase from the 2008 CWA Section 303(d) List which included 386 water bodies. The total number of impairments also increased from 518 to 621 (Table 3-3). Public comment was solicited from February 8 through March 5, 2010 and the 2010 IR was approved for submission to the EPA by the TCEQ on August 25, 2010.

Summary of 2010 Impairments

Impairments identified in the *2010 IR* have been grouped by the parameter and the beneficial use of the water body affected (Table 3-3). Elevated levels of bacteria represent 52 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 can be affected by both point source and NPS oxygen-demanding substances, including nutrients, which over-enrich aquatic plant and algae communities. Contaminants in fish tissue may originate from a variety of sources and typically represent compounds that persist in the environment for long periods of time (such as PCBs and certain pesticides). Some of these contaminants were banned through federal regulation in the 1970s but continue to be present based on recent sampling efforts.

TABLE 3-3

Summary of Impairments Identified on the CWA Section 303(d) List for the 2010 Integrated Report

Impairment Group	Media	2008 Number of Impairments	2010 Number of Impairments	Use
Bacteria	in water	274	303	recreation
	in shellfish	21	15	oyster waters
	beaches	2	1	beach use
dissolved oxygen	in water	84	94	aquatic life
Toxicity	in ambient water	5	2	aquatic life
	in ambient sediment	6	6	
Organics	in water	0	0	fish consumption, aquatic life
	in fish or shellfish	34	94	
metals (except mercury)	in water	4	6	fish consumption, oyster waters, aquatic life
	in fish or shellfish	0	0	
Mercury	in water	1	1	fish consumption, oyster waters, aquatic life
	in fish or shellfish	17	23	
dissolved solids	chloride	16	13	general
	sulfate	6	9	
	total dissolved solids	8	13	
temperature	in water	0	0	general
pH	in water	16	17	general
Nutrients	nitrogen	0	0	general, public water supply
Biological	habitat, macrobenthic community, or fish community	24	24	aquatic life
Totals		518	621	

Continuous Water Quality Monitoring Network

In 2001, the TCEQ established a continuous water quality monitoring network (CWQMN). The purpose of the network is to use advanced technologies to enhance the state's SWQM program. CWQMN sites are designed to meet site-specific data needs. Most sites monitor conventional parameters such as temperature, pH, DO, and specific conductance. Several of the sites can also monitor nutrients, turbidity, and/or chlorophyll.

The CWQMN collects and displays ambient water quality data in real time, meaning that the data collected in the field are reported almost immediately to the TCEQ. The stations, located throughout Texas, use a combination of in situ probes and automated analysis instruments. Data are transmitted from the stations to the TCEQ using phone modems, wireless modems, and satellite telemetry. Once data are transferred, 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>.

Figure 3-3 identifies the locations of the fiscal year 2011 CWQMN sites. During fiscal year 2011, the TCEQ accomplished the following:

- re-established the LRGV CWQMN stations destroyed by flooding associated with Hurricane Alex
- took three (3) stations out of service
- established a new station on the Pecos River near Red Bluff, New Mexico
- established a new station on the Pecos River near Girvin, Texas utilizing CWA Section 319(h) monies from TSSWCB

Additionally, three stations were also deployed in the Guadalupe River Basin by the Guadalupe-Blanco River Authority (GBRA) in fiscal year 2011.

In fiscal year 2011,the TCEQ worked to improve data return, data management, operator training, and instrument selection and continued incorporating measurement of bio-fouling and drift at selected sites; these efforts will be continued in fiscal year 2012. Additional CWQMN sites may be deployed, relocated or removed in fiscal year 2012.

The TCEQ maintains a prioritized list of continuous monitoring proposals for deployment in fiscal year 2012 and beyond. Personnel from water programs throughout the TCEQ, with input from cooperators outside the agency, base the list on the following criteria:

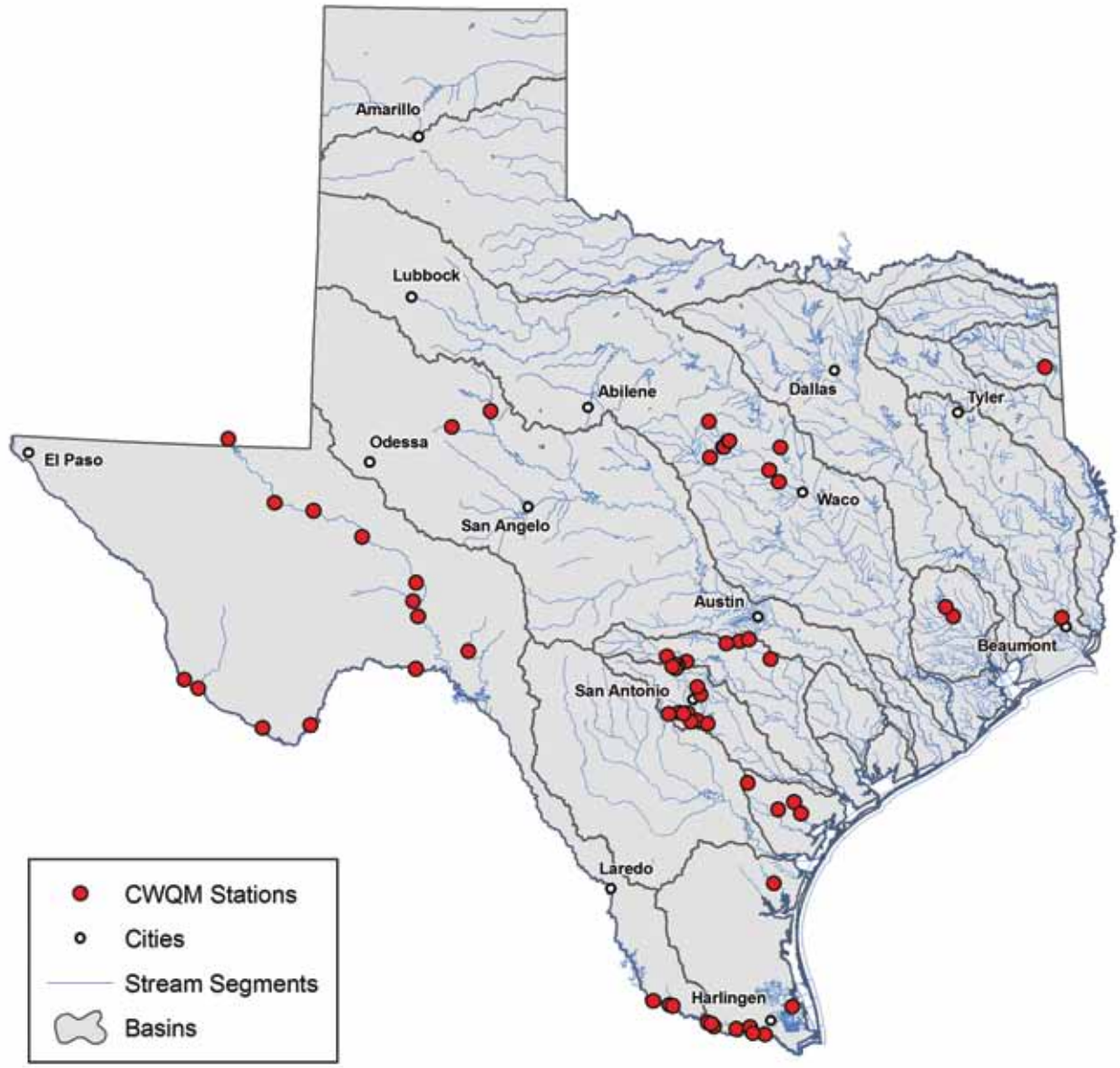
- demonstrated data needs
- availability of monitoring technology to address the specific data needs
- intended use of data
- availability of personnel—internal or external—for operation and maintenance (including data validation)

Numerous organizations cooperate with the TCEQ in the CWQMN by funding operation and maintenance of selected stations and/or operating stations. These organizations include the following:

- Nueces River Authority
- San Antonio River Authority
- Bexar Metropolitan Water Supply
- City of San Antonio—Public Center for Environmental Health

FIGURE 3-3

Continuous Water Quality Monitoring Network Stations – Fiscal Year 2011



- San Antonio Water System
- Toyota
- Waste Management, Inc.
- Colorado River Municipal Water District
- City Public Service Energy of the City of San Antonio
- Water Monitoring Solutions, Inc.
- Guadalupe-Blanco River Authority
- United States Geological Survey
- Cow Creek Groundwater Conservation District
- South Texas Groundwater Alliance
- Barton Springs / Edwards Aquifer Conservation District
- Edwards Aquifer Authority
- International Boundary and Water Commission, U.S. Section

Several of the CWQMN sites have been established based on a need to monitor NPS pollution. The NPS sites include seven sites in the North Bosque and Leon River watersheds, two Edwards Aquifer recharge monitoring sites, sites in the Rio Grande Basin, and two sites in the Upper Colorado River watershed.

Rio Grande Watermaster Continuous Water Quality Monitoring Network

Data from the CWQMN sites on the Rio Grande are used to assist with water use and agricultural production in the Rio Grande region. Agricultural return flows re-enter the Rio Grande at numerous locations between Falcon Dam and Anzalduas Dam. The Anzalduas Reservoir is an important diversion point for irrigation water for both Texas and Mexico. When the agricultural return-flows entering Anzalduas Reservoir from Mexico contain high concentrations of total dissolved solids (TDS) (>1,000 mg/L), Mexico can divert those flows around the Anzalduas Reservoir via a constructed bypass called the El Morillo Drain to a coastal lagoon and then to the Gulf of Mexico.

The TCEQ installed the first CWQMN stations in the Lower Rio Grande on Anzalduas Reservoir at the dam and at Hardwicke Farms in December 2006. The Anzalduas Dam station continues today but the Hardwicke Farms station was destroyed by Hurricane Alex and was subsequently relocated. There are now eight CWQMN stations in the Lower Rio Grande project. The stations monitor temperature and specific conductance, which estimates TDS by multiplying specific conductance by 0.65. Water quality data are collected every 15 minutes and telemetered to the TCEQ database. Electronic notifications are automatically distributed when TDS concentrations are greater than 850 mg/L.

Based on these notifications, the Rio Grande Watermaster can request release of freshwater by the International Boundary and Water Commission, U.S. Section (IBWC). The freshwater is released from upstream storage to dilute TDS to acceptable concentrations for irrigation purposes. The Watermaster also requests that the IBWC verify proper operation of the El Morillo Drain by Mexico. If Mexico does not release flows from the El Morillo Drain as scheduled, the waters released by the IBWC are taken from Mexico's water allocation.

Guadalupe River Basin Continuous Water Quality Monitoring Network

The Guadalupe River Basin Monitoring Network is a collaborative effort between the GBRA, the Guadalupe-Blanco River Trust, and the TCEQ with funding from a CWA Section 319(h) grant. Matching funds are provided by GBRA, the Guadalupe-Blanco River Trust, the Wimberley Valley Watershed Association, and Jacob's Well Natural Area. CWQMN stations have been installed on Cypress Creek at the confluence with the Blanco River, on Geronimo Creek at State Highway 123 in Guadalupe County, and a site is planned on Sandies Creek near Cuero. All three of these segments have impairments or concerns for DO, nutrients, and/or bacteria, and watershed planning efforts have begun on the water bodies. The continuous monitoring sites have become part of the Guadalupe River Water Quality Monitoring Network and the TCEQ CWQMN, producing real-time data for public use.

The goals of the project are to monitor water quality changes that occur in the identified water bodies during and after BMP installation;

FIGURE 3-4

Lower Rio Grande Watermaster Continuous Water Quality Monitoring Network Project

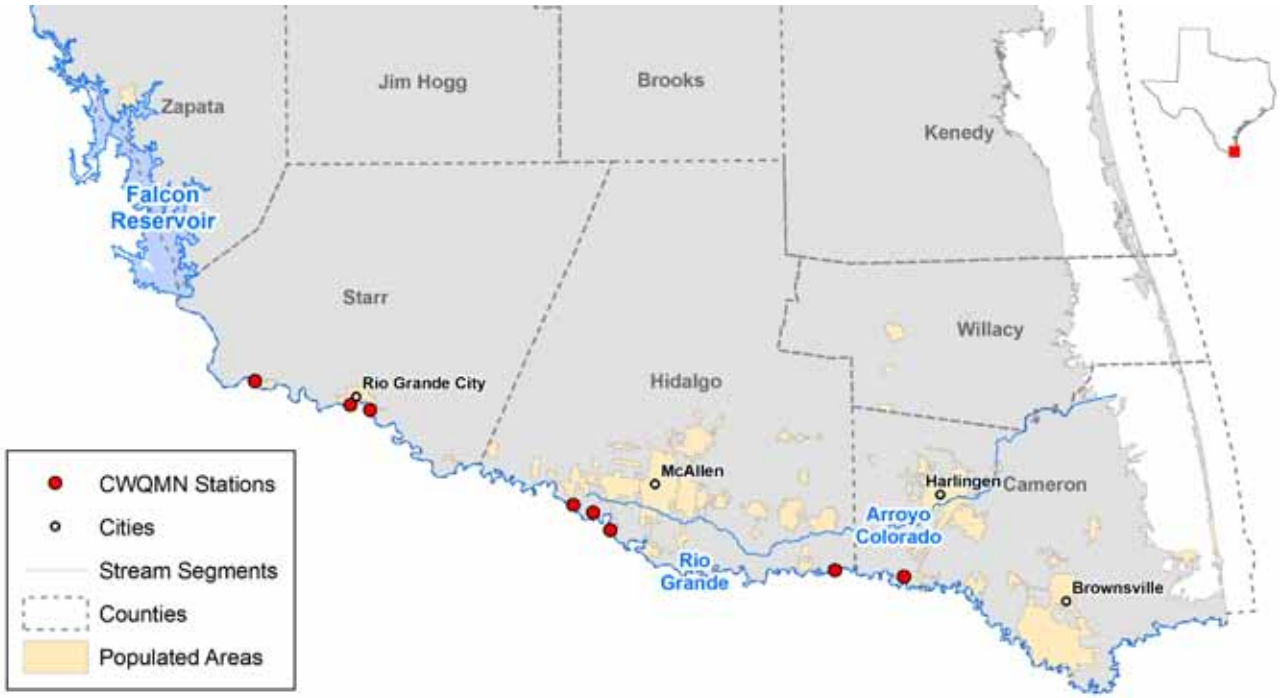


TABLE 3-4

Guadalupe Basin Education Kiosks

Water Body	Kiosk Location	Number of Data Points* Collected in 2011	Number of Kiosk Visits in 2011
Geronimo Creek	Navarro High School	11,507	554
Cypress Creek	Wimberley Community Center	10,941	667

**A data point is defined as one set of parameters collected every fifteen minutes. Reported data is the average over an hour.*

to address stakeholder concerns regarding monthly sampling and short studies; to provide continuous information regarding ambient water quality, particularly temperature variability and the diurnal fluctuations of DO; and to examine links between nitrates and DO. In addition to the continuous monitoring stations, kiosks are being installed in locations within the project watersheds to facilitate the availability of the real-time data as well as providing other education and outreach resources related to water quality and NPS pollution.

In 2011, the continuous monitoring stations located on Geronimo Creek and Cypress Creek were installed, measuring DO, pH, temperature, specific conductance, turbidity, and flow. Data are reported on an hourly basis and is available to the public on the TCEQ CWQMN website. The kiosk linked to Geronimo Creek has been installed in the library at Navarro High School. The kiosk linked to the Cypress Creek monitoring location has been installed in the Wimberley Community Center. Table 3-4 shows the number of kiosk visits and the number of data point collected in 2011.

North Bosque River Watershed Assessment

In 1998, two classified segments along the North Bosque River were included in the CWA Section 303(d) List as impaired under narrative water quality criteria related to nutrients and aquatic plant growth. Excessive nutrients, elevated chlorophyll *a* concentrations, and indicator bacteria levels exceeding TSWQS have been a concern in the North Bosque River watershed for over a decade. In early 2001, the TCEQ approved *Two Total Maximum Daily Loads for Phosphorus in the North Bosque River*, which was subsequently approved by the EPA. By early 2003, a TMDL I-Plan for the North Bosque River

North Bosque River near Valley Mills showing storm runoff from Tropical Storm Hermine/photo by TIAER

was developed and approved by the TCEQ and the TSSWCB. The TMDL I-Plan focuses on phosphorus originating from municipal WWTFs, animal feeding operations (AFO), and animal waste application fields. While not directly addressed, many of the practices outlined to reduce phosphorus loadings should also reduce bacteria loadings to the North Bosque River. Bacteria has been identified on the CWA Section 303(d) List since 2002 within portions of the North Bosque River and several of its tributaries.

The North Bosque River Monitoring project for fiscal year 2011 was funded by the TCEQ. Under this and several predecessor projects, monitoring has occurred that is designed to obtain the water quality and stream flow data needed to assess the effectiveness of management practices and nutrient control activities associated with the TMDL I-Plan. The monitoring activities of this project consisted of two automated storm water sampling sites, continuous stream flow monitoring at seven stream stations, and bi-weekly (once every two weeks) routine grab sampling at eight stream stations, five of which are index stations for the TMDL. Monitoring storm events allows evaluation of nonpoint sources, while routine grab sampling better captures ambient stream conditions. The Texas Institute for Applied Environmental Research (TIAER) at Tarleton State University managed this project and conducted all the water quality monitoring, most laboratory analyses, and all statistical evaluations and data reporting. Continued microwatershed monitoring is also being funded though the TSSWCB.

The project report, "Assessment of Water Quality Trends for the North Bosque River through 2010," was completed August 2011. This report evaluated trends at the eight monitoring stations for data collected from 1993 through 2010 for a variety of parameters, but focusing primarily on phosphorus. Findings showed significant decreasing trends in phosphorus loadings and concentrations at several stations along the North Bosque River. Decreasing trends were also found for nitrogen parameters at several stations, but only the two most downstream stations along the North Bosque River indicated decreasing trends in bacteria. In relating annual average orthophosphate-phosphorus concentrations from grab samples to the log of annual average flow, data for 2010 indicated orthophosphate-phosphorus concentrations meeting the TMDL goal at five of the six mainstem stations monitored. Only the most upstream index station located above Stephenville was not meeting the TMDL goal. According to the report, these evaluated decreases in nutrients are likely related to decreases in the land application of fertilizer (both commercial and manure) supporting the efficacy of NPS management practices. The impacts of point source controls were most apparent at the station directly below Stephenville. The Stephenville WWTF has installed phosphorus controls that have clearly decreased the phosphorus entering the North Bosque River. While improvement has not been as readily apparent due to the location of monitoring stations, phosphorus control practices have also been implemented at the Clifton WWTF contributing to reduced phosphorus concentrations and loadings at the most downstream station.

Though some water quality improvements are indicated, evaluating improvements, particularly from reductions in NPS contributions requires long-term monitoring data. Monitoring within the North Bosque River watershed will continue from September 2011 through August 2014 under a new CWA Section 319 project sponsored by the TCEQ NPS Program in cooperation with EPA Region 6.

Double Bayou Watershed Characterization

The West Fork of Double Bayou has been listed on the CWA Section 303(d) List since 2004 and 2006 due to depressed DO and increased levels of bacteria, respectively. The goal of the project, being carried out by the Houston Advanced Research Center and Shead Conservation Solutions, was to develop a Watershed Characterization Report for the East and West Forks of Double Bayou in Chambers County, with a focus on water quality. The Characterization Report will be used to form the basis of a future WPP for Double Bayou.

The project established a baseline data set for the Double Bayou watershed, identified gaps in the baseline data set, implemented additional monitoring, performed data and model analysis, and conducted a stakeholder process. Water quality data was evaluated to determine if data were adequate for evaluating annual and seasonal trends, spatial patterns, flow analyses and other relationship patterns. Land use-land cover (LULC) analysis of the watershed was also conducted as part of this project to help identify data gaps. A monitoring plan was developed and implemented with the USGS to provide sufficient data for evaluating annual and seasonal trends, spatial patterns, flow analyses, and other relationship patterns. The monitoring plan goals were to define water quality problems, assess critical areas, and analyze data trends.

The initial baseline data inventory was completed in the fall of 2009 and the ensuing data gap analysis in early spring of 2010. Using the data collected from the baseline data set and the resulting gap analysis findings, a monitoring plan was developed in spring of 2010. A total of four sites were selected for this project. Two were located on the West Fork Double Bayou with one of those sites located in an area of tidal influence. The other two sites were located on the East Fork Double Bayou with one site located in an area of tidal influence and the other site located in the northern most part of the watershed. The locations of the sites were determined based on initial land use analysis to optimize representative sampling of both bayous working within the scope of the project. Sampling occurred during two three-month seasonal periods: fall of 2010 and spring 2011.

A list of stakeholders was created and a series of one-on-one meetings were carried out during the project. The meetings will lead up to a public open house in fiscal year 2012 to present project findings and initiate development of a WPP.

Highland Bayou Watershed Characterization

The Highland Bayou Coastal Basin refers to an area of bayous and waterways in southern mainland Galveston County. The basin covers almost 120 square miles and many of its waterways are influenced by tides. Urbanized communities within the basin include Texas City, La Marque, Hitchcock, Santa Fe, Bayou Vista, and Tiki Island. Around these communities are sizeable areas of industrial activity, agriculture, rangeland, and recreational areas, as well as extensive estuaries, marshes, and coastal prairies.

The basin discharges into the Galveston Bay system via several bayous: Highland, Marchand, Moses, Basford, and the Karankawa. Highland Bayou is the largest of these. The receiving waters of Galveston Bay and West Bay are impaired from elevated levels of bacteria in oyster-producing waters. Highland and Marchand Bayous have been listed since 2002 on the state's CWA Section 303(d) List due to decreased levels of DO and for elevated levels of bacteria. Highland Bayou runs 12.5 miles before it flows into the Bay. The Marchand Bayou is a tributary that joins Highland. This project, carried out by the Texas Coastal Watershed Program of AgriLife Extension and the Environmental Institute of Houston of the University of Houston at Clear Lake, was designed to provide a coordinated framework for prioritizing protection and restoration strategies guided by environmental data and public concerns.

The project established a baseline data set for water quality and initiated several elements of a WPP. Project components included conducting additional monitoring, sampling analysis, and evaluation of water quality within the basin. A public participation process was established to work with stakeholders and members of the public from the project area.

The project began in the spring of 2010 and produced the Highland Bayou Coastal Basin Watershed Characterization Report. Water quality data was evaluated against geospatial LULC data to identify possible pollutant sources, pollutant loads, and to determine data gaps. These gaps were used to design and conduct a water quality monitoring program that provided sufficient data for evaluating seasonal trends, spatial patterns, flows, and other relationships around the bayous. A water quality model was identified for future use to examine and evaluate these relationships. Participation from the public was critical to this planning process. Stakeholders were identified and invited to a public open house in August 2011 to share project results and discuss a potential future WPP. The completed Watershed Characterization Report is seen as an important step for restoring the water quality within the coastal basin and the first step towards development of a WPP for the region.

Statewide Bacterial Source Tracking

A key component in effectively implementing a NPS pollution abatement program focused on indicator bacteria is the identification and assessment of sources of fecal pollution. Proper evaluation of these sources is needed to support the development of bacterial TMDLs or WPPs and therefore implementation of BMPs to address those sources. Bacterial source tracking (BST) consists of genetic and phenotypic tests that can identify bacterial strains that are host specific, which allows the type of original host animal and source of fecal contamination to be identified.

BST is a valuable tool for identifying human and animal sources of fecal pollution. In 2007, the TCEQ and TSSWCB adopted the recommendations of a Task Force on Bacteria TMDLs, which recommended the use of specific BST methods. The Task Force recommended using library-independent methods for preliminary qualitative analyses and library-dependent methods if more quantitative data are required.

During fiscal year 2011, TSSWCB continued to provide state General Revenue NPS grants to Texas AgriLife Research to support the operation and maintenance of analytical infrastructure at BST laboratories. According to the Bacteria Total Maximum Daily Load Task Force Final Report, futher characterization of known sources of *Escherichia coli (E. coli)* for library-dependent BST methods is critical. The Texas *E. coli* BST Library currently contains 1,178 *E. coli* isolates obtained from 1,050 different domestic sewage, wildlife, livestock and pet fecal samples. This funding will expand the statewide *E. coli* BST Library to include additional known source isolates and different animal hosts from various watersheds across the state. The utilization of consistent methods across laboratories conducting BST and the use of the growing Texas *E. coli* BST Library will provide significant cost and time savings for the identification of NPS pollution in the development of TMDLs and WPPs.

Goal Two—Implementation

The second goal of the *Texas NPS Management Program* involves the effective management of CWA Section 319(h) grant funds and the leveraging of additional funds. The state implements activities with the goal of preventing and reducing NPS pollution in surface water, groundwater, wetlands, and coastal areas. Activities include the implementation of TMDL I-Plans, WPPs, and the Texas Groundwater Protection Strategy, the development of TSSWCB-certified WQMPs and implementation of BMPs on agricultural and silvicultural lands, and other identified priorities.

Total Maximum Daily Loads and Implementation Plans

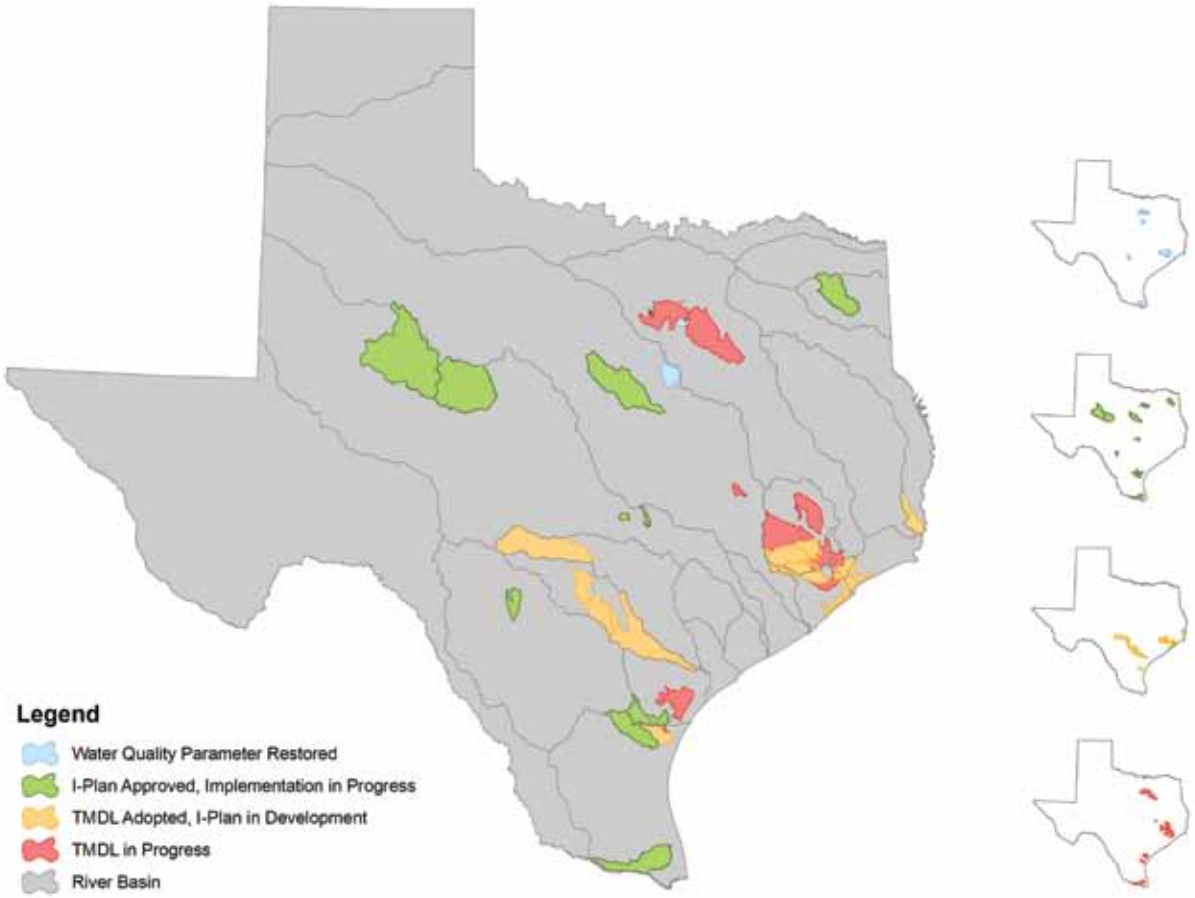
The state's TMDL program works to improve the quality of impaired or threatened water bodies in Texas. This program is a major component of the state's strategy for managing water quality in Texas streams, lakes, bays, and other surface waters. The federal mandate for state TMDL programs is contained in Section 303(d) of the CWA. The EPA's implementing regulations in Title 40, Code of Federal Regulations, Part 130, require states to identify waters where effluent limitations alone are not sufficient to meet surface water quality standards. The CWA further 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 the 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 agricultural or silvicultural nonpoint sources are significant contributing pollutant sources. The TCEQ and the TSSWCB coordinate closely on all TMDLs in which agricultural or silvicultural NPS pollutants are involved, no matter which agency leads TMDL development. Regardless of who develops a TMDL, the TCEQ has jurisdiction for managing the overall quality of surface waters in Texas. The TCEQ must therefore adopt all TMDLs developed for Texas and is responsible for submitting adopted TMDLs to the EPA for concurrency.

The state is committed to developing TMDLs in a timely manner and implementing all approved TMDLs. Figure 3-5 illustrates the status of TMDL and TMDL I-Plan development. Implementation of TMDLs may require the TCEQ to impose new or revised limitations on discharge of some pollutants in the permits issued under the Texas Pollutant Discharge Elimination System (TPDES). Where NPS pollution is identified, the state will work through the *Texas NPS Management Program* to encourage local implementation. Stakeholder groups drive the development of I-Plans for TMDLs. The TCEQ encourages stakeholders to begin work on an I-Plan before the TMDL is completed. This early start means that problems can be addressed more quickly.

FIGURE 3-5

Total Maximum Daily Load and Implementation Plan Watersheds - September 2011



It is essential to engage stakeholders in the watershed when developing plans to reduce pollution. Stakeholders—anyone whose interests may be affected by a TMDL project—provide the local expertise for identifying site-specific problems, targeting those areas for cleanup, and determining what measures will be most effective. Stakeholders include, among others, permitted wastewater dischargers, municipal and county governments, regional or state governmental agencies, agricultural producers, recreational clubs, homeowners associations, environmental groups, industry groups and lobbyists, and interested individuals. Experts from local, regional, state, and federal agencies and universities also participate by giving technical and scientific support.

As of August 31, 2011, the TCEQ had approved TMDL I-Plans for several streams, reservoirs, and estuaries that are impaired in part due to NPS pollution. Table 3-5 lists the I-Plan for each of these TMDLs and progress toward reaching the environmental goals defined in them. The table also shows the project name, basins, and segment numbers, the designated use that has been affected, and the geographic extent of the impairment.

Bacteria Total Maximum Daily Loads

Bacteria from human and animal waste can indicate the presence of disease-causing microorganisms that pose a threat to public health. People who swim or wade in waterways with high concentrations of bacteria

TABLE 3-5

Total Maximum Daily Load Implementation Status

Implementation Plan	Basin and Segment(s)	Use Affected	Implementation Began†	Area of Impairment	Status
Aquilla Reservoir: atrazine	Brazos River; 1253	source for drinking water	2002	3,943 lake acres	Goals met
Arroyo Colorado: legacy pollutants* and organics	Nueces–Rio Grande Coastal; 2202, 2202A	safety of fish consumption	2001	63 stream miles; 333 lake acres	Goals met
Clear Creek: dissolved solids	San Jacinto–Brazos Coastal; 1102	general (not tied to a specific use)	2006	60 stream miles	Goals met
Colorado River below E.V. Spence Reservoir: dissolved solids	Colorado River; 1426	general (not tied to a specific use)	2007	66 stream miles	Some goals met
Dallas and Tarrant counties waterways: legacy pollutants*	Trinity River; 0805, 0841, 0841A	safety of fish consumption	2001	2,710 lake acres; 127 stream miles	Some goals met
E.V. Spence Reservoir: dissolved solids	Colorado River; 1411	general (not tied to a specific use)	2001	14,950 lake acres	Some goals met
Fort Worth waterways: legacy pollutants*	Trinity River; 0806, 0806A, 0806B, 0829, 0829A	safety of fish consumption	2001	15 lake acres; 11 stream miles	Some goals met
Lake O' the Pines: low dissolved oxygen	Cypress Creek; 0409	support of aquatic life	2006	2,102 lake acres	Underway
North Bosque River: soluble reactive phosphorus	Brazos River; 1226, 1255	general (not tied to a specific use)	2002	119 stream miles	Many goals met
Petronila Creek above tidal: dissolved solids	Nueces–Rio Grande Coastal; 2204	general (not tied to a specific use)	2007	35 stream miles	Some goals met

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

† Date I-Plan approved by the commission. In some watersheds, activities to reduce pollutant loads began before completion of the TMDLs or I-Plan.

have an increased risk of contracting gastrointestinal illnesses. High bacteria concentrations can also affect the safety of oyster harvesting and consumption. NPS pollution often contributes some of the bacteria loading to surface waters.

Of the 621 impairments listed in the 2010 303(d) List, about half are for bacteria impairments to recreational water uses. The TCEQ has TMDLs under way, scheduled, or approved for most of the listed segments in urban areas, and for about 43 percent of all bacterial impairments.

Bacterial impairments are widespread in the Houston metropolitan area. By the end of August 2011, the TCEQ had adopted 72 TMDLs in this area, including 41 in fiscal year 2011. All Houston-area TMDLs have been approved by the EPA. These TMDLs address about 40 percent of the state's impairments for contact recreation use.

The board and staff of the Houston-Galveston Area Council (H-GAC) formed the Bacteria Implementation Group (BIG) to develop an I-Plan for the Houston-area TMDLs. The BIG has wide and diverse regional participation, including participation by the TCEQ. It is the largest stakeholder group formed so far to implement TMDLs.

The BIG completed a draft I-Plan for the Houston Metropolitan Area and submitted it to the TCEQ for approval in August 2011. The BIG also worked very closely with the TCEQ in developing the bacteria TMDLs for the Houston Metro area. Because of the size and population of the Houston Metropolitan Area, the I-Plan may affect a significant percentage of the state's residents.

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 who coordinate activities and resources to manage water quality. In Texas, WPPs 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 2011, the TCEQ and the TSSWCB facilitated the development and implementation of WPPs throughout Texas by providing technical assistance and/or funding through grants to regional and local planning agencies and, thereby, to local stakeholder groups. 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. There are also WPPs being developed or that have been developed in Texas by third parties independently of assistance from the TSSWCB and the TCEQ. The following web link provides an overview and summary of WPPs in progress or completed in Texas by the TSSWCB, <www.tsswcb.texas.gov/wpp>, and the TCEQ, <www.tceq.texas.gov/goto/wpp>. Specific WPP activities are described in Chapter 4 of this report.

Texas Coastal Nonpoint Source Control Program

Section 6217 of the federal Coastal Zone Act Reauthorization Amendments (CZARA) of the Coastal Management Act requires coastal states and territories with federally approved Coastal Zone Management

Rockport pier

Programs to develop and implement a Coastal Nonpoint Source Pollution Control Program. At the federal level, Section 6217 is jointly administered by the National Oceanic and Atmospheric Administration (NOAA) and the EPA.

Section 6217 envisions a two-tiered management approach for NPS:

(1.) implementation of management measures to protect coastal waters generally (i.e., technology-based approach)

(2.) implementation of additional management measures needed to attain and maintain applicable surface water quality standards (i.e., water quality-based approach)

State coastal NPS programs must provide for implementation of management measures in conformity with guidance published by the EPA and NOAA. Management measures are defined as economically achievable measures for the control of NPS that reflect the greatest degree of pollutant reduction achievable through the application of the best available NPS pollution control practices.

In 2003, NOAA and the EPA approved most of the management measures in the *Texas Coastal NPS Pollution Control Program*, granting conditional approval to the program. In 2009, NOAA and EPA approved one additional outstanding management measure (hydromodification), leaving only a few measures remaining to be fully addressed. All of the outstanding management measures fall under the urban areas category: operating OSSFs; measures for roads, highways, and bridges; new development; existing development; watershed protection; and site development. States that fail to submit an adequate program and garner full approval face penalties including loss of EPA and NOAA funds, including CWA Section 319(h) grant monies.

Texas has continued to communicate with the federal agencies to further improve its response to achieve full approval of the outstanding conditions. The state has continued to design, fund, and implement programs and projects that address these outstanding measures in an effort to gain full approval of the program. Important funding sources for these efforts are CWA Sections 319(h) and 604(b), the Coastal Management Program, and the Coastal Impact Assistance Program.

In addition, the TCEQ has worked to promote LID projects. While many of these projects are outside the coastal zone, the coastal zone will benefit from the documentation of the costs and benefits of LID practices. The favorable demonstration of the costs and benefits of LID practices will increase implementation of these practices in the state and the coastal zone in particular. Funding will also be provided for educational activities, technical assistance, and legal analyses needed to support the goal of widespread use of LID practices in urban areas of Texas.

Coastal Zone Act Reauthorization Amendments On-Site Sewage Facility Reconnaissance, Training, and Replacement

To address the *Texas Coastal NPS Pollution Control Program* management measures for operating OSSFs, AgriLife Research, with funding from the TCEQ CWA Section 319(h) grant program, is working to conduct reconnaissance, public outreach, inspections, and if needed replace malfunctioning OSSFs in Brazoria and Galveston Counties. OSSFs are a potential contributor of bacteria in Dickinson Bayou, Clear Creek, Clear Lake, Galveston Bay, and other coastal watersheds. Proper operation of these systems is critical to removal of contaminants from wastewater and limiting the transport of contaminants to water resources. Treatment ability is compromised when a system is poorly maintained or installed in a site with limitations such as shallow groundwater, or poor soils. During fiscal year 2011, AgriLife Research coordinated with authorized agents in Brazoria and Galveston Counties to discuss site limitations and complaint histories to identify areas of potential OSSF failure. AgriLife Research performed reconnaissance of these areas to verify the potential for failing OSSFs.

Malfunctioning Septic/photo by AgriLife Research

AgriLife Research coordinated with OSSF professionals to develop a guidance document for evaluating anaerobic OSSFs. A two-day course was developed to deliver the evaluation of anaerobic OSSFs to Designated Representatives in coastal counties. The course consists of classroom instruction and two field inspections.

Two public outreach meetings in April 2011 facilitated a means to share project information and identify potential sites for conducting a visual evaluation of OSSFs. The meetings provided an overview of septic systems, proper maintenance procedures, and discussed how to live with a septic system. The participants received educational materials, a course evaluation, and a septic system survey. Responses to the course evaluations and septic system surveys were extremely positive and indicated the willingness to participate in the OSSF inspection program. System inspections started in summer of

2011 and will continue into the summer of 2012. Contaminant loading will be reduced through public awareness and behavioral change, and through the inspection and replacement of malfunctioning OSSFs in coastal watersheds.

The Galveston Bay Estuary Program

The Galveston Bay Estuary Program (GBEP) is part of a network of 28 National Estuary Programs in the United States working with local stakeholders to restore and protect estuaries that are threatened by pollution, development, and overuse. The GBEP coordinates with the state's Coastal Management Program, administered by the General Land Office (GLO), and TSSWCB on regional NPS issues.

GBEP, which includes a 41 member advisory committee, the Galveston Bay Council, and its six standing subcommittees, implements the *Galveston Bay Plan*, a Comprehensive Conservation Management Plan developed under the auspices of CWA Section 320. One of the highest priorities of the plan is controlling or eliminating NPS pollution. The *Nonpoint Source Pollution Action Plan* is the portion of the plan that was developed in order to reduce and eliminate NPS pollution 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.

GBEP provides technical and financial assistance through workshops, conferences, and grants to Galveston Bay area municipalities, universities, and non-profits. GBEP encourages the use of storm water management initiatives that include illicit discharge detection and elimination, construction site storm water runoff control, post construction storm water management in new developments, pollution prevention for municipal operations, public education and outreach, and public involvement and participation.

As an example, GBEP provides financial and technical support 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. Each plan focuses on solutions to NPS pollution problems, including the development of BMPs that will be implemented by local governments and citizens. Since 2005, non-regulatory, watershed management planning and implementation efforts have been initiated in the Galveston Bay area with support from GBEP for Armand Bayou, Clear Creek, Dickinson Bayou, West Bay, Bastrop Bayou, Double Bayou, Cedar Bayou, and Highland Bayou.

The WPP development for Armand and Clear Creek watersheds is currently pending completion of other monitoring and planning efforts in the watersheds. Additional bacteria data is being collected to evaluate the need to complete a TMDL for Armand Bayou. The Armand Bayou Partnership has recently been reinvigorated and is seeking to become a non-profit organization. The Partnership will seek to complete a nine-element WPP for the watershed. The Clear Creek WPP activities may continue after the completion of the bacteria TMDL and the development of the Houston area Bacteria I-Plan being coordinated by the H-GAC.

Sunrise over Galveston Bay

Projects in the watersheds of Highland and Marchand Bayous in Galveston County and Double Bayou in Chambers County are characterizing land uses, reviewing historic data, collecting new data, and initiating contact with local stakeholders. After this characterization phase is completed in the fall of 2011, stakeholders in these watersheds will determine whether to complete the WPPs. American Recovery and Reinvestment Act (ARRA) funding was used to complete the characterization phase of the projects (these projects are futher described earlier in this Chapter under Goal One).

West Bay is a unique watershed in which stakeholders are looking to protect the water quality of Chocolate Bayou, through preservation by acquisition or conservation easements. The Bastrop Bayou watershed is adjacent to West Bay. GBEP is supporting through match funding and technical assistance, the H-GAC and local stakeholders' development of the Bastrop Bayou WPP. The draft Bastrop Bayou WPP was completed in fiscal year 2010. Though the document is currently under revision, the draft is available on the H-GAC website at <www.h-gac.com/community/water/watershed_protection/bastrop/default.aspx>.

Development of the Cedar Bayou WPP started in fiscal year 2011. The H-GAC received CWA Section 319(h) funding from the TSSWCB to develop the plan. GBEP will be providing non-federal match and technical support to the project. Additional information on the Cedar Bayou WPP can be found in Chapter 4.

Besides WPPs, GBEP supports direct water quality implementation projects to improve water quality and encourage local governments to adopt BMPs. GBEP supported the creation of a storm water treatment wetland, completed August 2011, on the University of Houston at Clear Lake campus. This fully monitored project treats runoff from the university's parking lot and provides valuable quality assured effectiveness data. Additionally the project will test the feasibility of treating ambient water from an adjacent impaired bayou through a solar pump system. Data collection efforts will be conducted through fiscal year 2013.

GBEP will have completed two BMPs in the fall of 2011, a storm water treatment wetland and low water use project, in the cities of League City and Dickinson. A ten-acre storm water treatment wetland was created at a storm water detention facility for a recently constructed Clear Creek Independent School District campus in the City of League City. A one-acre demonstration rain garden was completed at the City of Dickinson library. Additional information about these projects can be found in Chapter 2.

During fiscal year 2012, GBEP will be working with the City of League City to improve water quality and water conservation by providing match and staff support for a recently awarded TCEQ CWA Section 319(h) grant. The results of the project will be a three-acre BMP demonstration park that includes multiple BMPs on display; a community supported NPS control retrofit in an established neighborhood; and a review of city ordinances to develop ordinances that encourage the use of LID concepts and BMPs in future developments.

GBEP continues to support NPS education and public involvement through the region's annual Rivers, Lakes, Bays 'N Bayous Trash Bash® <www.trashbash.org/>, through funding and coordinating assistance. Trash Bash is an annual litter clean up event on local waterways that encourages voluntary public clean up and provides opportunities to educate the public about NPS pollution. For 2011 Trash Bash Results, see Table 3-6.

TABLE 3-6

2011 Trash Bash Results

Number of Cleanup Locations:	17
Total Number of Participants: Number of Participants under 18 years of age:	6,708 3,582
Total Number of Volunteer Hours: (H-GAC planning time not included)	18,927
Total pounds of trash collected: Total tons of trash collected:	132,815 66.41
Number of tires picked up and hauled away for proper disposal:	634
Total pounds of material recycled:	5,737
Miles of Shoreline Cleaned:	176

The Texas Groundwater Protection Committee and Pesticide Management

The Texas Groundwater Protection Committee (TGPC) was established 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 State Management Plan for the Prevention of Pesticide Contamination of Groundwater* (*PMP*, 2001) and the *Texas NPS Management Program*.

The focus of the *PMP* is the implementation of management practices that prevent groundwater degradation by the use of pesticides or help to remediate groundwater degraded by the use of pesticides. One useful tool for pesticide management is the TCEQ's *Interagency Pesticide Database* (*IPD*), which is an endeavor to compile groundwater pesticide monitoring data for the whole state. The *IPD* at its last update included data for more than 195,871 pesticides or other chemical analytes, from analyses on 8,816 groundwater samples, collected from 5,783 wells. Data was provided by 12 agencies and other entities.

During the 2011 monitoring period, a total of 22 wells were sampled in the Panhandle region. Another 16 wells were sampled in South Texas; nine in the LRGV and seven in the Corpus Christi area. Additionally, 192 well samples were collected by the Texas Water Development Board (TWDB) and analyzed for atrazine by the TCEQ by immunoassay analytical method. Immunoassay analyses included only atrazine in 2011, while laboratory analyses included three methods for 44 pesticides. A combined total of 230 groundwater samples were collected, 230 immunoassay analyses, and 28 laboratory analyses were completed for pesticides in 2011.

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, providing assessment materials, and by making response recommendations. Groundwater pesticide monitoring, which is a considerable part of pesticide management, has been carried out in the Texas Panhandle and urban areas. Specific monitoring in these areas included cotton crop areas, public water supply wells with known atrazine detections, general urban wells, and golf course wells. This pesticide monitoring has primarily been performed by the TCEQ. Additional pesticide monitoring has been carried out through the Cooperative Monitoring Program primarily with the TWDB. In this program, immunoassay analytical methods are used to screen for pesticides across the state aquifers for nonpoint sources of pesticides.

The ACS and the TCEQ, supported by a recent EPA initiative, continue to focus on the management of pesticides by first assessing and classifying them as pesticides of interest (POIs) or pesticides of concern (POCs). Under this course the *PMP* still acts as the foundational guide, and groundwater pesticide monitoring still serves as a primary component in making assessments. The remaining five pesticides assessed in fiscal year 2011 have no water quality standard or affordable analytical methods, thus the TCEQ will utilize chemical characteristics, use, and location relative to vulnerable areas to assess these pesticides. The *PMP* Task Force of the ACS continues to coordinate the assessment activities based on the EPA pesticide assessment initiative.

Nonpoint Source Task Force

The TGPC reactivated the Nonpoint Source Task Force in the fourth quarter of fiscal year 2010. The primary goal of the NPS Task Force is "to prevent and abate NPS pollution of groundwater." In order to accomplish this, the Task Force provides recommendations and serves as the primary mechanism for strategizing a coordinated approach for preventing and addressing NPS groundwater pollution in the state. In fiscal year 2011, the Task Force focused on recommending updates to the *Texas NPS Management Program* through four meetings held quarterly.

Public Outreach and Education Subcommittee

The primary goals of the Public Outreach and Education (POE) Subcommittee are to develop and implement educational outreach programs for landowners concerned with groundwater protection and environmental health issues and to facilitate interagency communication and coordination to provide support for landowner educational outreach projects. Activities include developing educational materials, coordination of outreach programs and special projects with a focus on the NPS-related issues of abandoned well closure, OSSF maintenance, domestic drinking well sampling and the TEX*A*Syst groundwater quality protection program. The POE Subcommittee has developed a number of Frequently Asked Questions (FAQs) in order to assist statewide newsletter editors and webmasters in disseminating groundwater-related information to the public. NPS-related FAQ topics include groundwater quality (pesticides and radionuclides) and septic systems. Four FAQ fact sheets were updated in fiscal year 2011. TGPC FAQs can be found at <www.tgpc.state.tx.us/FAQs.htm>.

Clean Water State Revolving Fund Loans for Nonpoint Source Projects

Another tool available in Texas is the Clean Water State Revolving Fund (CWSRF), which is administered by the TWDB. The CWSRF is a loan program authorized under the federal CWA and is capitalized by an annual grant from EPA. This program provides funding assistance in the form of 20-30 year loans at interest rates lower than the market offers. Although the majority of the loans are made to publically owned wastewater treatment and collection systems, the TWDB can also provide loans for NPS pollution abatement projects through the CWSRF. Loans can be made to towns, counties, groundwater conservation

districts, SWCDs, and other public agencies, as well as to private individuals and non-profit organizations.

A water quality based priority system is used to rank potential applicants and fund projects with the greatest environmental benefits. Projects eligible for funding must be an identified practice within a WQMP, TMDL I-Plan or WPP, a NPS management activity that has been identified in the *Texas Groundwater Protection Strategy*, a BMP listed in the *Texas NPS Management Program*, or a plan consistent with the EPA approved *Texas NPS Management Program* or the National Estuary Program. Loans can be used for planning, designing, and constructing WWTFs, wastewater recycling and reuse facilities, and collection systems. Some of the other activities eligible for funding assistance include agricultural, rural, and urban runoff control; estuary improvement; NPS education; and wet weather flow control, including storm water and sewer overflows that are not associated with a TPDES permit.

The TWDB has increased its efforts to identify potential applicants for loan projects that would address NPS-related water quality problems in the state. Staff from the TWDB, the TCEQ, and the TSSWCB meet on a regular basis to coordinate efforts to identify water bodies that are impacted by NPS pollutants and to identify potential applicants for CWSRF assistance to support implementation of management practices to address the problem. The TSSWCB and the TCEQ provide input on funding needs from information gathered during the development of the *IR,* TMDLs, TMDL I-Plans, and WPPs. The TWDB uses this information during the development of the annual Intended Use Plan for the CWSRF program. The TWDB has adjusted its rating criteria to include consideration of the problem areas identified by the TSSWCB and the TCEQ in determining eligibility and priorities for funding assistance.

Texas Waterway Cleanup Program

Since 1993, the Texas Waterway Cleanup Program has assisted communities and organizations with establishing freshwater waterway cleanups and litter-prevention activities to improve and maintain the quality of surface water. As part of a contract partnership with the TCEQ, Keep Texas Beautiful has managed the Texas Waterway Cleanup Program since 1999, providing assistance with event planning and publicity, as well as necessary cleanup materials, to participants at no cost.

A minimum of 120 total cleanups have been held each year throughout the state as part of the Texas Waterway Cleanup Program, with Keep Texas Beautiful actively soliciting cleanups in areas that are part of the TCEQ's TMDL Program. Throughout fiscal year 2011, a total of 224 cleanups were held around the state. During these cleanups, 21,966 volunteers collected more than 414,967 pounds of debris from 891 miles of waterways.

Additionally, the Texas Waterway Cleanup Program provided educational resources to participants that include information on improving water quality through reducing litter and NPS pollution. In fiscal year 2011, Keep Texas Beautiful provided educational information on the Texas Waterway Cleanup Program at more than 19 events, conferences, or trainings.

Household Hazardous Waste Collection Program

The TCEQ Household Hazardous Waste Collection Program gives local governments an opportunity to offer Texans an alternative disposal option for household waste that would otherwise be considered hazardous. Household Hazardous Waste Collections are most commonly funded and organized by municipalities and county governments, with assistance on program requirements provided by the TCEQ.

Results from Household Hazardous Waste Collections, including one-day events as well as permanent collection facilities, are reported annually to the TCEQ. In calendar year 2010, more than 110 collection events were held throughout the state, resulting in the collection of more than 5,818 tons of household hazardous waste.

Agricultural Waste Pesticide Collection Program

To implement the Agricultural Waste Pesticide Collection Program, AgriLife Extension, the Texas Department of Agriculture, and the TCEQ teamed up, organizing regional collections of waste pesticides to give agricultural producers who use pesticides in Texas a free opportunity to properly dispose of unwanted products.

Ten cleanups were held throughout Texas during state fiscal year 2011, resulting in the collection of more than 117 tons of waste.

Plum Creek Implementation

The Plum Creek WPP was completed by the watershed partnership in 2008. Since the plan's completion, multiple implementation activities have been on-going. Three major implementation projects are described here. Additional Plum Creek activities are described in Chapter 4.

Pet Waste Stations Improve Water Quality

Pets are sources of *E. coli* and nutrients, especially in urban areas where improper disposal of dog waste can affect water quality. Pollution concerns arise when animals deposit their waste outdoors and it is not collected. Waste and the bacteria it contains can be washed to the stream or water body during rainfall events or as a result of over-irrigation. The closer the pets and their waste are to a waterway the more likely they are a major contributor of both *E. coli* and nutrients. According to the American Veterinary Medical Association's *U.S. Pet Ownership*

Pet Waste Stations/photo by the City of Buda

and Demographics Sourcebook 2007 edition, 37.2 percent of households own a dog and the average number of dogs owned per household is 1.7 dogs. The Plum Creek WPP estimated over 9,000 dogs in the watershed with the majority of them in the cities of Kyle, Buda, Lockhart, and Luling. The Plum Creek Watershed Partnership worked with the cities to estimate how many pet waste stations would be beneficial at city parks, trails, and other high traffic areas for a total of 64 stations. Kyle and Lockhart already had installed several pet waste stations in previous years and have education programs in place. In fiscal year 2011, TSSWCB CWA Section 319(h) funding was utilized to purchase additional pet waste stations for Kyle (3), Buda (18), Lockhart (10), and Luling (6) for installation in the Plum Creek watershed, as well as four stations for the Upper Guadalupe River Authority to place around Kerrville in support of the *I-Plan for One TMDL for Bacteria in Guadalupe River Above Canyon Lake (Segment 1806)*.

City of Kyle

The City of Kyle received a CWA Section 319(h) grant in partnership with the TCEQ and the EPA to conduct needed improvements as documented in the Plum Creek WPP. Utilizing BMPs, the City of Kyle has actively been involved in improving the overall quality of Plum Creek reducing pollutant loads. The City of Kyle has partnered with agencies such as GBRA to measure the city's progress. BMPs the city has implemented include: mapping and marking of the city's drainage system, monitoring and upgrading of two detention facilities, the installation of dog waste stations, city street sweeping, and the implementation of storm sewer education and awareness throughout the community.

The City of Kyle has continued to lead several initiatives in reducing the pollutant loads in Plum Creek. Activities continued from the previous fiscal year include the maintenance of dog waste stations for public use and the mapping and marking of the city's storm drain system via the use of grant-funded geographic information system (GIS) equipment. Dog waste stations have proven to be an effective way to encourage people pick up pet waste. As of this fiscal year, all storm sewer inlets have been marked within the Kyle city limits, making a total of 1,843 inlets. Throughout fiscal year 2011, the city has also engaged in continued educational fliers and city web resources to provide information to the public on pet waste, automotive care, storm water pollution, and household hazardous waste. In addition, the City of Kyle has completed the retrofit of the Lower Plum Creek detention pond. This retrofit, covering 0.57 acres, is located parallel to Plum Creek and is expected reduce the nutrient load to the Creek using gabion mattresses, rock rubble filter bed, and Indian Grass to achieve this reduction.

City of Lockhart

In fiscal year 2011, City of Lockhart kicked off implementation activities of the Plum Creek WPP with TCEQ CWA Section 319 grant funds. To begin the project, the City of Lockhart stepped up street sweeping activities as part of the BMPs to reduce pollutants entering the creek system. Public Works personnel installed 80 inlet protection devices that have helped in eliminating grass clippings, leaves, and debris from entering the storm sewer systems. To date the City of Lockhart sweeping operations have swept approximately 17.48 lane miles. The combination of sweeping and use of the inlet protection devices has removed approximately 1,040 cubic yards of debris that otherwise would have been deposited in the creek system. Parks personnel have been maintaining existing pet waste stations and installed five new pet waste stations under the TCEQ CWA Section 319 grant project at strategic locations in the Park systems in an effort to reduce *E. coli* generating waste from entering the creeks. With the new and existing pet stations, the City estimates a total of 35 to 40 pounds of pet waste to have been eliminated as a pollution source.

Plum Creek Impl, City of Lockhart storm marker/photo by the City of Lockhart

The City of Lockhart has been actively educating the area residents and children by several means. Quarterly newsletters are being sent out with utility billings for the residents to review. The city website also provides information as to how residents can help and become stewards of Plum Creek in their daily outdoor activities. Existing events put on at the Eugene Clark Library have been increased to include education

classes in proper disposal of kitchen fats, oil, and grease. The classes included the importance of the participation of the residents in reducing the use of fertilizers, and non-biodegradable detergents. Plum Creek literature has been circulated to strategic locations in town in an effort to make residents aware of the goals the Plum Creek Watershed Partnership is trying to attain.

Implementing Agricultural Best Management Practices in the Arroyo Colorado Watershed

The Arroyo Colorado flows through Hidalgo, Cameron, and Willacy Counties in the LRGV 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 DO impairments as well as nutrient concerns, the Arroyo Colorado Watershed Partnership developed *A Watershed Protection Plan for the Arroyo Colorado–Phase I*. For more information regarding the Arroyo Colorado WPP, please see Chapter 4 of this report.

The Arroyo Colorado WPP calls for the voluntary adoption of agricultural BMPs on 33 percent (110,000 acres) of the irrigated cropland within the watershed by 2010 and 50 percent (150,000 acres) by 2015. In response, the Southmost and Hidalgo SWCDs received a CWA Section 319(h) grant through the TSSWCB to provide technical assistance and financial incentives to develop WQMPs and implement BMPs on agricultural land in the Arroyo Colorado.

During fiscal year 2011, 41 WQMPs were developed covering 3,655 acres. This brings the overall acres under conservation plans to 109,000. Some BMPs being implemented include irrigation land leveling, residue management, conservation crop rotation, nutrient management, and pasture planting. The top two most popular BMPs have been irrigation land leveling and irrigation pipeline. With these two practices working together, they have allowed producers to better utilize limited irrigation water.

Goal Three–Education

The third goal of the *Texas NPS Management Program* is to conduct education and technology transfer activities to raise awareness of NPS pollution and prevent the occurrence of activities that contribute 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 WPP, TMDL, and I-Plan. This section highlights some of the NPS education and public outreach activities conducted in Texas in fiscal year 2011.

Texas Stream Team

Texas Stream Team is a statewide organization committed to improving water quality through citizen water quality data collection, stakeholder engagement, and watershed education. The program is based at the River Systems Institute (RSI) at Texas State University - San Marcos, and is administered primarily through a cooperative CWA Section 319(h) grant-funded partnership between RSI, the TCEQ, and the EPA.

Texas Stream Team citizen monitors sample streams, reservoirs, and tidal areas for *E. coli*, DO, specific conductivity, pH, secchi depth, temperature, and various field observations including flow severity. Data are collected utilizing a Quality Assurance Project Plan (QAPP) and a multi-phase training certification process. Intended data uses include problem identification, understanding background conditions, education, research, local decisions, and other uses deemed appropriate by the end user. Data summary reports and a data forum are available for viewing and download at the program website <http://txstreamteam.rivers.txstate.edu/>. The data forum provides water quality data from the last ten years from every major river basin.

Additionally, Texas Stream Team provides outreach to hundreds of teachers and thousands of students each year. By providing customized watershed information and new ways to engage teachers and students, participants can learn about local issues, factors influencing water quality, and ways to improve watershed health.

Multiple new initiatives were undertaken in fiscal year 2011 by the Texas Stream Team. New programmatic developments include the completion and release of new NPS monitoring suite procedures, the development of a new database and dataviewer, the launching the Texas Stream Team iPhone application, the development of a Communication Plan and Field Reference Guide for communicating data about environmental incidents, and increased focus on watershed services.

The newly developed NPS monitoring suite is available for partners' and monitors' use. The NPS monitoring suite includes turbidity, transparency tube, nitrate-nitrogen, orthophosphate phosphorus, and flow. These new parameters were designed to complement other environmental data and aide in better understanding NPS pollution. In fiscal year 2011, two trainers' trainings were held. Additional trainings will be featured for the new NPS suite in 2012 and beyond.

The data forum is being replaced by the newly designed Texas Stream Team database and dataviewer. This on-line resource will serve to aide data users, including monitors, researchers, and program partners, providing easy access to the data, graphs, maps, data entry, and many other capabilities.

Another new tool, the Texas Stream Team iPhone application, is available for monitors to enter and upload their data; view the procedures field reference guide and training

refresher videos; pinpoint their location; send photos; and quickly identify various points of contacts at natural resource agencies. Data, photos, and other information can be sent directly to the database manager before being posted to the on-line dataviewer.

A new Texas Stream Team Communications Plan was recently developed to help stakeholders better understand how and when to communicate concerns about citizen monitoring data. Also included in the Communication Plan is information about data submittal and review processes, as well as the methods in which the Stream Team communicates data information.

The watershed outreach program focuses on teaching participants about watershed functions and how NPS pollution impacts water quality. Watershed services are delivered in myriad ways including water quality monitoring trainings, intensive monitoring surveys such as bacteria snapshots, data summary reports, curriculum distribution, NPS watershed model demonstrations and pollution education, hands-on student scenario investigations, creek-side lessons, community clean-up coordination assistance, hosting booths at special events, and other services identified as beneficial. Texas Stream Team focused efforts in several targeted watersheds in fiscal year 2011. These activities were conducted in support of the following planning and/or implementation efforts: Upper Cibolo Creek WPP, Plum Creek WPP, Gilleland Creek TMDL, Upper Guadalupe River TMDL, Arroyo Colorado WPP, Oso Bay/Oso Creek TMDL, and the Adams and Cow Bayous TMDL.

City of Austin Lawn and Garden Chemical Education

The City of Austin completed a CWA Section 319 project focused on educating homeowners about landscape practices and water quality degradation. The goal of the project was to reduce the use of lawn and garden chemicals by promoting earth-wise landscaping methods. Although many of the grant components such as national award-winning television and radio public service announcements (PSAs) reached the general Austin and Central Texas area, many of the printed educational materials were customized and mailed to targeted, evaluation neighborhoods. These neighborhoods were concentrated in the environmentally-sensitive Edwards Aquifer Recharge Zone. The success of the educational outreach in the pilot neighborhoods was measured with before-and-after education surveys, and pollution reduction was assessed with direct monitoring of groundwater springs and storm water runoff. Monitoring included nutrients, the herbicide atrazine and the pesticide carbaryl near the targeted neighborhoods.

Based on monitoring data, some decreasing temporal trends in atrazine were observed in groundwater. As anticipated, storm water runoff concentrations of atrazine increased in spring months correlating with expected peak landscape chemical use. However, changes in water quality after education were not consistently observed. Additionally, storm water assessment was complicated by a lack of qualifying runoff events in year 2011. Carbaryl was not detected in any sample and was therefore determined to not be a good indicator of landscape chemical runoff at current detection limits.

Behavior change proved to be the primary measure of success for the education campaign. Homeowners in the 2011 pilot neighborhoods were surveyed to determine if they had changed behavior as a result of the educational information. Improvement in use of earth-wise landscape practices was shown in each of the four neighborhoods – Alta Mira, Bauerle Ranch, LaCross, and Sendera. Both Bauerle Ranch and Sendera homeowners indicated more than a 50 percent increase in use of earth-wise practices as a result of the educational efforts.

TABLE 3-7

City of Austin Lawn and Garden Chemical Education Results 2011 respondents by neighborhood adopting earth-wise landscaping practices

Have you adopted new earth-wise practices?	Alta Mira	Bauerle Ranch	La Crosse	Sendera
Yes, many	7%	21%	14%	23%
Yes, a few	28%	34%	21%	35%
No	7%	6%	0%	10%
No, already practiced earth-wise	57%	38%	64%	32%

All materials and television spots can be viewed on the Grow Green website by clicking on "The Big 3" at <www.growgreen.org>.

Texas Watershed Planning Training Project

Watershed planning efforts continue to expand across Texas supported by the TCEQ, the TSSWCB, the EPA, and a growing network of watershed coordinators and water professionals. To support those efforts, a successful training program and set of forums organized by the Texas Water Resources Institute (TWRI) are held in the state providing information to watershed planners where needs have been identified.

As a part of this program, water professionals assemble biannually to meet and share knowledge at the Texas Watershed Coordinator Roundtables. Texas Watershed Coordinator Roundtables provide a forum for establishing and maintaining dialogue between watershed coordinators and facilitate interactive solutions to common watershed issues faced throughout the state. Nearly 200 water professionals attended the two Texas Watershed Coordinator Roundtables held in Temple and Austin

in 2011. Topics discussed included stakeholder involvement and facilitation; and bacteria dynamics, assessment methods, and BMPs.

To further support watershed efforts in the state, a variety of training opportunities were made available to watershed coordinators and other water professionals. In July 2011, a Stakeholder Facilitation Training was held in conjunction with the Texas Watershed Coordinator Roundtable in Austin. The Stakeholder Facilitation Training highlighted tools used to effectively identify, engage, and involve stakeholders throughout a watershed to restore and maintain healthy environmental conditions. More than 40 watershed coordinators and water resource professionals attended the Stakeholder Facilitation Training.

Other training opportunities to be offered in fiscal year 2012 include the week-long Texas Watershed Planning Short Course and an additional Stakeholder Facilitation Training. Courses being developed include an Introduction to Modeling training, training on the use of Load Duration Curves (LDC) and the Spatially Explicit Load Enrichment Calculation Tool (SELECT), and instruction on water quality monitoring.

These efforts are supported by a collaborative project between the TWRI, AgriLife Extension, AgriLife Research, the TCEQ, TIAER, the TSSWCB, and the EPA. Through funding from the TCEQ and the EPA, it is the goal of this project to provide tools, training, and coordination opportunities for watershed planners and coordinators throughout Texas to ensure consistent, high quality WPPs are developed and implemented and water quality improvements are achieved and sustained.

For more information on Texas Watershed Coordinator Roundtables and upcoming training opportunities for watershed planners and water professionals, as well as guidance on watershed planning, see the Texas Watershed Planning website <http://watershedplanning.tamu.edu/>.

Low Impact Development Workshops

The University of Texas at Austin's Center for Research in Water Resources and the Lady Bird Johnson Wildflower Center, in cooperation with, and funded by a grant from the TCEQ and the EPA, created a series of LID workshops and consultations for seven medium to large communities with water quality impairments and concerns in Texas (see Table 3-8). LID is a comprehensive approach to site planning, design, and pollution prevention strategies that, when combined, create a more economically sustainable and ecologically functional urban landscape. The goal of this project was to help eliminate the water quality impairments and reduce sediment and nutrient pollution by identifying and addressing obstacles to the implementation of LID in these communities.

Among the most important obstacles to implementation of LID practices are local

TABLE 3-8

Low Impact Development Workshops

Region (Target Community)	Water Body	Impairment	Initial CWA Section 303(d) Listing	Workshop Held	Workshop Attendance
Houston	Buffalo and Whiteoak Bayous	Bacteria & dissolved oxygen	1996	November 8-9, 2010	185
Waco	Bosque River	Bacteria Dissolved Oxygen	1996	March 3-4, 2011	31
San Antonio	Upper San Antonio River, Salado Creek	Bacteria fish exclusion; macrobenthic community; dissolved oxygen	Impaired fish community: 2004, impaired benthic community: 2006	March 17-18, 2011	150
Corpus Christi	Oso Bay	Bacteria & dissolved oxygen, DSHS shellfish harvesting exclusion.	1996 for dissolved oxygen; 2006 for bacteria	March 28-29, 2011	68
Lower Rio Grande Valley (McAllen)	Arroyo Colorado	Bacteria	1996 for bacteria, 2008 for PCBs & Mercury	March 31-April 1, 2011	54
Austin (Pflugerville)	Gilleland Creek	Bacteria	1999	April 25-26, 2011	370
Dallas/ Fort Worth (Arlington)	Upper Trinity River & West Fork Trinity River below Lake Worth.	Legacy pollutants; Bacteria	Upper Trinity: 1996 for bacteria; 2002 for PCBs. West Fork: 1996	May 11-12, 2011	280

codes and ordinances for land development that limit the use of these practices. The project team catalogued each region's regulations for storm water management and provided recommendations on how LID approaches could be substituted for conventional practices. The project team supported and consulted with key local government officials and staff to evaluate local policies and practices as they relate to LID, to adjust policies and practices as needed to allow and encourage LID practices, and to apply the LID practices most effective for addressing local water quality issues.

Much of the success of this project came from the regional initiatives and efforts following the workshops. The San Antonio workshop reconvened the local Low Impact Development Task Force. The Corpus Christi workshop provided the impetus to include LID practices in the new land development code, including volume targets for on-site storm water retention. The LRGV workshop and follow-up assistance provided guidance to help move green roof and other LID demonstration projects forward. The City of San Marcos is now developing a Low Impact Development Guidance Manual to be adopted and implemented in tandem with their new Smart Code. The project team has also developed a design guide for statewide use identifying region-specific issues.

Texas Watershed Steward Program

Developed by AgriLife Extension, the Texas Watershed Steward Program is a highly successful one-day training program designed to increase citizen understanding of watershed processes and foster increased local participation in watershed management and watershed planning activities across the state. Funded by the TSSWCB under CWA Section 319(h), the program is tailored to, and delivered in, target watersheds undergoing TMDL or WPP development or implementation.

The program curriculum is comprised of five units including a program introduction, an overview of watershed systems, identification 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. The program is delivered through interactive training events conducted by a team of professionals using high quality visual aids and hands-on teaching stations.

In fiscal year 2011, 10 workshops were conducted in watersheds across the state. In all, more than 430 citizens including landowners, agricultural producers, city personnel, business owners, state environmental agency staff, public schools and universities' staff, and other watershed residents have become trained Texas Watershed Stewards.

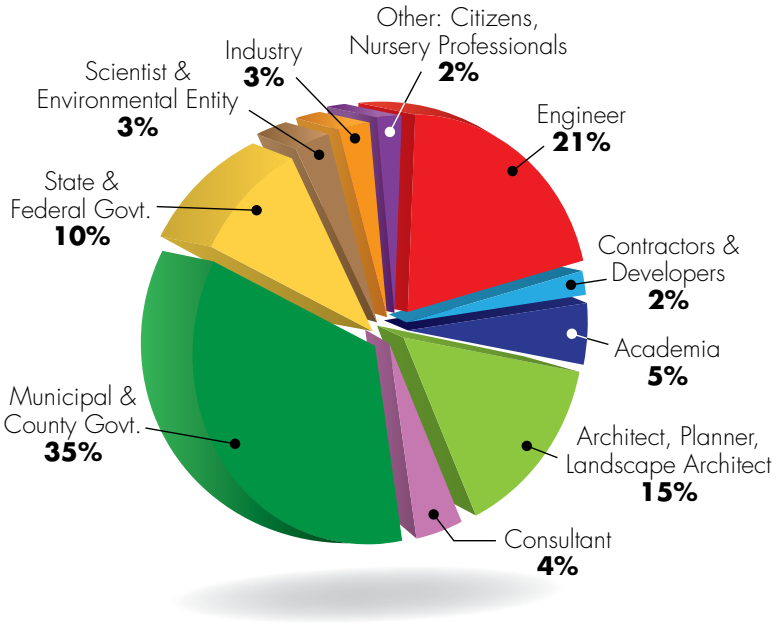
Results from pre- and post-test evaluations indicate that knowledge of the attendees regarding watershed function, pollutant sources/BMPs, water quality, and regulatory agency responsibilities has increased by 20 percent. More than 96 percent of participants report the program has enabled them to be better stewards of their water resources. Furthermore, results from six-month delayed post-test evaluations indicate that 86 percent of workshop attendees have more closely monitored individual actions that could impair water quality, 67 percent have adopted and/or maintained water quality BMPs on their property, and 73 percent have encouraged others in their community to attend a Texas Watershed Steward workshop.

Future training locations are currently being prioritized in collaboration with the TSSWCB and other project partners. A current list of upcoming Texas Watershed Steward workshops can be found on the program website. In addition, the Texas Watershed Steward training course is available as an on-line course on the program website. Participants now have more flexible and widespread access to the training program.

For more information on the Texas Watershed Steward Program, online course, or to pre-register for an upcoming Texas Watershed Stewards event, please visit <tws.tamu.edu>.

FIGURE 3-6

Low Impact Development Workshop Attendee Professional Break-down



Interactive Watershed Kiosks Distributed Throughout the State

Utilizing a CWA Section 319(h) grant, the TSSWCB and the GBRA have worked with water resource agencies across the state to install new interactive kiosks in priority watersheds and communities in order to help the public learn more about water.

The kiosks display educational learning modules by touch screen, and users can listen to mini-lessons on various water subjects such as: watersheds and NPS pollution, the wastewater treatment process, and the operation/maintenance of aerobic and conventional septic systems. The kiosks also include real-time water quality data for each specific watershed, which means having current information with the touch of a finger. Previously installed kiosks in the Plum Creek, Upper Cibolo Creek, and Cypress Creek watersheds have proved to be successful educational tools.

In fiscal year 2011, the TSSWCB and the GBRA purchased twenty kiosks for installation throughout the state. The towns of Pflugerville, Junction, San Marcos, San Antonio, Goliad, El Paso, Corpus Christi, Waco, Stephenville, Victoria, San Angelo, Bastrop, Karnack, Houston, Harlingen, and Weslaco are home to the interactive kiosks.

Texas Silvicultural Nonpoint Source Pollution Prevention

The Texas Forest Service (TFS), through a CWA Section 319(h) grant from the TSSWCB, continues to work diligently to mitigate silvicultural NPS pollution.

The effectiveness of this program is primarily measured through BMP implementation monitoring. Results from the eighth round of monitoring, which occurred in 2011 as shown in Figure 3-7, indicate a 94.1 percent implementation rating, the highest ever in the history of the program. This represents a 24 percent improvement since the monitoring program began in the early 1990s.

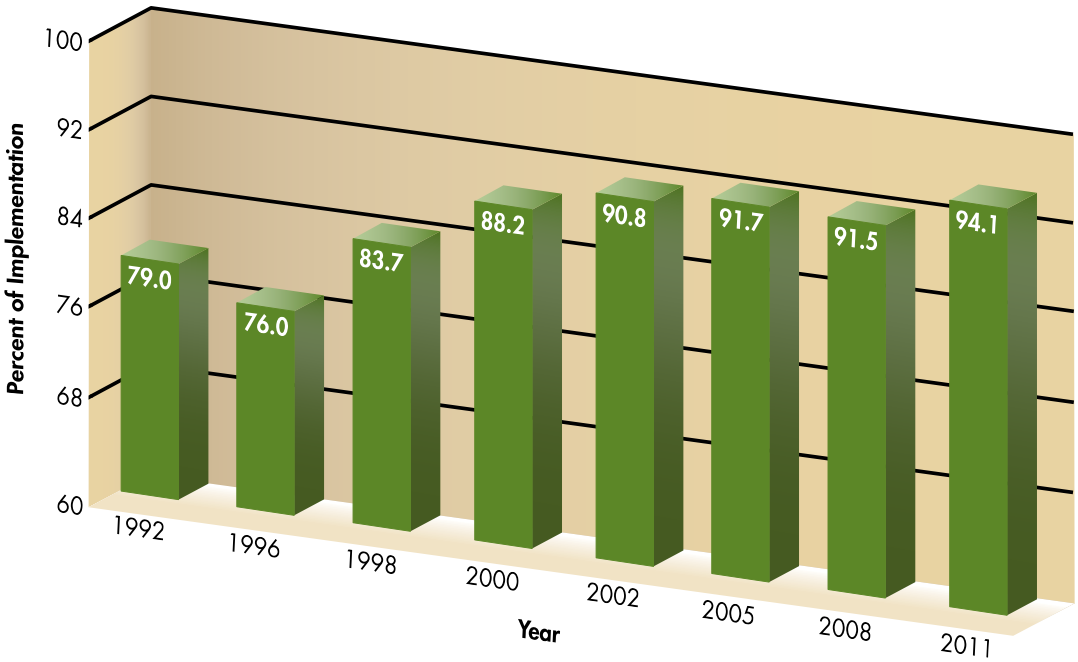
The tremendous improvement is a direct result of the extensive education and technical assistance efforts conducted over the past 20 years. During fiscal year 2011, personnel coordinated numerous landowner workshops and educational outreach events, reaching over 5,000 people with the message of sustainable forestry and water quality protection. Continued participation in the Texas Woodland and Wildlife Expo, Texas Forest Landowner Tailgate Rally, and Texas Logging Council State Convention are just a few of the events that allowed TFS to connect with many new cooperators. Outreach to absentee, out of state forest landowners was also delivered on the importance of BMPs and sustainable forestry through a new targeted newsletter, Forest Landowner Briefings.

Forestry personnel are always looking for innovative ways to promote BMPs to the forest sector. One of these new approaches is logger tailgate sessions, in which concise, focused on-site BMP training is provided to contractors during active operations. A new and improved online BMP demonstration tour was also released, allowing landowners the opportunity to easily view properly implemented BMPs.

The TFS is an active participant in many of the WPP efforts currently underway in East Texas. Information was developed

FIGURE 3-7

Silviculture Best Management Practice Implementation, 1992 - 2011



regarding silvicultural BMPs to include in AgriLife Extension's Texas Watershed Steward Program, having the potential to reach thousands of landowners in priority watersheds across the state each year.

In total, computer models have shown annual sediment load reductions of 92,000 tons across East Texas. Sediment reductions have occurred largely through the implementation of this project.

Feral Hog Management Education in the Plum Creek Watershed

During development of the Plum Creek WPP, feral hogs were identified as a key potential contributor of bacteria and nutrients. Landowner participation in management of feral hogs is critical to reduce environmental and agricultural impacts from this invasive species. Utilizing CWA Section 319(h) grants from TSSWCB, AgriLife Extension has developed tools to engage and assist landowners in feral hog management across the watershed.

A new Extension assistant was hired in September 2010 to lead the feral hog education efforts in the Plum Creek watershed. The annual Feral Hog Management Workshop was held in Luling in February 2011 and had nearly 300 people were in attendance. This workshop was a great success with an all day schedule of speakers on topics pertaining to feral hogs and their management. Problems posed by feral hogs with water quality in the Plum Creek watershed were discussed.

Over 1,540 individual contacts with landowners in the watershed were made in fiscal year 2011 for over 878 contact hours including 12 presentations (not including the Feral Hog Management Workshop in Luling). In addition, 24 landowner site visits were made providing management recommendations and technical assistance in trap construction.

On the Plum Creek Watershed Partnership Feral Hog website (http://plumcreek.tamu.edu/feralhogs) over 1,217 unique visitors had 3,823 page views. This website provides fact sheets, technical guides and other information pertaining to feral hogs and their management, as well as a feral hog reporting website. The feral hog reporting website has two parts, general public and landowner reports. The general public reports are for sightings of feral hogs and damage. The landowner reports are for reporting negative impacts, estimated economic losses, and numbers of feral hogs removed. From the public reporting website there were 12 reports made by nine individuals. There were a total of 13 cooperating landowners making 24 reports totaling 260 feral hogs removed from the watershed this year.

There were five new Feral Hog Factsheets created in fiscal year 2011: *Feral Hog Laws and Regulations in Texas; Feral Hog Transportation Regulations; Feral Hogs and Disease Concerns; Feral Hogs Impact Ground-nesting Birds; Feral Hogs and Water Quality in Plum Creek*. These publications are available on the Plum Creek Watershed Partnership website and the AgriLife Extension Bookstore website.

Seven news releases were distributed throughout the watershed and the state pertaining to feral hogs. AgriLife Extension participated in two radio interviews with the Texas Farm Bureau Radio network; these interviews covered feral hog laws and regulations and the problems they pose to water quality. Also nine blogs about feral hogs were posted on the Wild Wonderings blog of the AgriLife Extension Wildlife and Fisheries Sciences Department (http://wild-wonderings.blogspot.com/). The Wild Wonderings blog had 11,468 unique visitors and 19,426 page views during this year.

For more information about the Plum Creek WPP see Chapter 4 of this report.

North Bosque River near Hico/photo by TIAER

4 Progress in Developing and Implementing Watershed Protection Plans

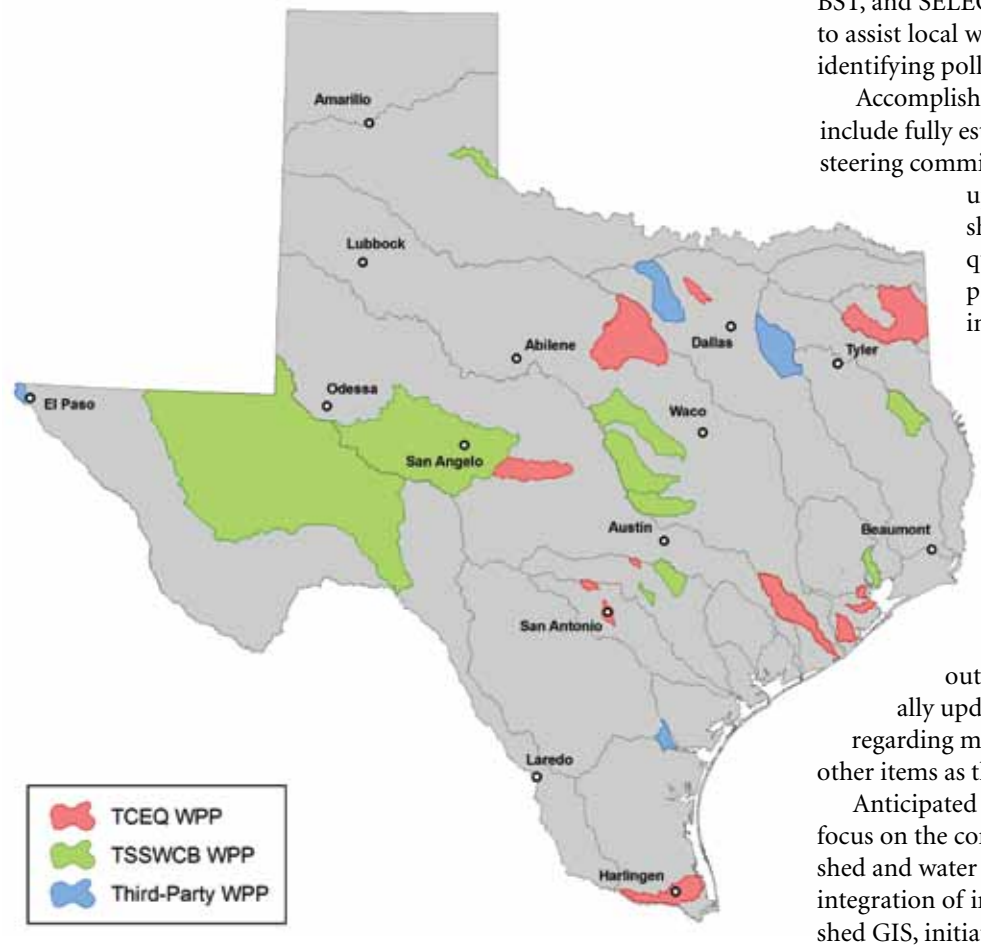
In Texas, WPPs are locally developed water quality plans that coordinate activities and resources to manage water quality. They facilitate the restoration of impaired water bodies and/or the protection of threatened waters before they become impaired. These stakeholder-driven plans give the decision-making 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 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 fiscal year 2011, the TCEQ and the TSSWCB facilitated the development and implementation 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. The following list is not intended to be a comprehensive list of all the WPP efforts currently underway in Texas.

FIGURE 4-1

Map of Watersheds with Watershed Protection Plans being developed or completed in Texas



Texas State Soil and Water Conservation Board Watershed Protection Plans

Attoyac Bayou

Attoyac Bayou is within the Upper Neches River Basin and extends approximately 82 miles through Rusk, Nacogdoches, San Augustine, and Shelby counties before emptying into Sam Rayburn Reservoir. Several rural communities lie in the watershed and the majority of the watershed is used for cattle and poultry operations, forestry, or recreational/wildlife uses.

The Attoyac Bayou is one of many rural watersheds listed as an impaired water body on the *IR* due to high levels of *E. coli*. Attoyac Bayou was first included on the CWA Section 303(d) List in 2004. Data collected at three monitoring stations provided water quality data that illustrated excessive levels of *E. coli* concentrations in the water body along with elevated levels of ammonia at two of the three monitoring sites.

To address these water quality concerns, a WPP for the Attoyac Bayou is being developed. The project team, TWRI, Angelina and Neches River Authority, Stephen F. Austin State University, and AgriLife Research, began working with local entities in November 2009 to conduct water quality monitoring at ten stream sites and four WWTFs throughout the watershed, develop an up-to-date GIS of the watershed, and update LULC classification. Additionally, LDC analysis, BST, and SELECT modeling are being used to assist local watershed stakeholders in identifying pollutant sources.

Accomplishments during fiscal year 2011 include fully establishing the watershed steering committee, completing the LULC update, developing the watershed GIS, and initiating water quality monitoring in the expanded network of monitoring stations. Extreme drought has gripped the watershed causing the bayou and its tributaries to dry up thus preventing water quality monitoring at many locations. The project website (<http://attoyac.tamu.edu/>) continues to serve as the project's primary avenue for education and outreach efforts and is continually updated with recent information regarding meetings, reports, maps, and other items as they become available.

Anticipated work in fiscal year 2012 will focus on the continued collection of watershed and water quality data, the continual integration of information into the watershed GIS, initiation of computer based modeling, and continued BST analysis. Conducting a recreational use attainability analysis, as well as continuing to engage watershed stakeholders and beginning the development of the WPP document are critical steps that will also be taken.

Buck Creek

Buck Creek is a small intermittent water body in the southeastern corner of the Texas Panhandle. The creek flows 68 miles in an east-southeast direction before entering Oklahoma and joining the Lower Prairie Dog Town Fork of the Red River to form the Red River. The creek is encompassed by a rural watershed. Weather cycles and connection to underlying groundwater greatly influence the flow in the creek and result in significant variations in flow across spatial and temporal scales.

In 2000, water quality data collected from Buck Creek resulted in its listing on

TABLE 4-1

Texas Watershed Protection Plans

TSSWCB WPPs	LINKS
Attoyac Bayou	attoyac.tamu.edu
Buck Creek	buckcreek.tamu.edu
Cedar Bayou	www.cedarbayouwatershed.com
Concho River	www.tsswcb.texas.gov/managementprogram/conchowpp
Geronimo Creek	geronimocreek.org
Granger Lake	www.tsswcb.texas.gov/managementprogram/granger
Lampasas River	www.lampasasriver.org
Leon River	www.brazos.org/LeonRiverWPP.asp
Pecos River	pecosbasin.tamu.edu
Plum Creek	plumcreek.tamu.edu
TCEQ WPPs	**LINKS**
Armand Bayou	www.armandbayou.org
Arroyo Colorado	www.arroyocolorado.org
Bastrop Bayou	www.h-gac.com/community/water/watershed_protection/bastrop/default.aspx
Brady Creek	www.ucratx.org/NPSBrady.html
Caddo Lake	www.netmwd.com/Caddo%20Lake%20Protection%20Plan/Caddo_index.html
Cypress Creek	www.cypresscreekproject.org
Dickinson Bayou	www.dickinsonbayou.org
Halls Bayou-Westfield Estates	www.h-gac.com/community/water/watershed_protection/westfield/default.aspx
Hickory Creek	www.cityofdenton.com/index.aspx?page=172
Lake Granbury	www.brazos.org/gbWPP.asp
San Bernard River	www.h-gac.com/go/sanbernard/
Upper Cibolo Creek	www.ci.boerne.tx.us/index.aspx?nid=147
Upper San Antonio River	www.sara-tx.org/public_resources/library.php#enviro_monitoring
Third-Party WPPs	**LINKS**
Cedar Creek Reservoir	nctx-water.tamu.edu/meetings
Eagle Mountain Reservoir	nctx-water.tamu.edu/meetings
Lower Nueces River	www.nuecesriverpartnership.org
Paso del Norte	www.pdnwc.org/319h.html

the CWA Section 303(d) List for *E. coli* levels exceeding TSWQS. As a result of this listing, AgriLife Research and TWRI received a CWA Section 319(h) grant from the TSSWCB to collect additional water quality data and further evaluate the impairment. Data indicated that periodically elevated *E. coli* levels exist in portions of the creek and warrant further investigation. The TSSWCB provided further CWA Section 319(h) funding to explore these variations and facilitate the development of a WPP for Buck Creek that collectively approaches the management of water quality concerns in the watershed.

Increased awareness and educational programming delivered through this project have led to changes in practices applied by watershed landowners and has resulted in *E. coli* loading reductions in the watershed. The implementation of these practices by local landowners and the subsequent reductions in measured *E. coli* concentrations resulted in the removal of Buck Creek from the 2010 303(d) List. Implementing the WPP will ensure the long-term health of Buck Creek and its watershed.

Work in fiscal year 2011 focused on working toward the completion of watershed modeling and the development of the Buck Creek WPP.

Additionally, a new monitoring project was initiated to provide continued data collection and illustrate improvements in water quality.

Work on developing the WPP document will conclude early in fiscal year 2012 and water quality monitoring will continue weather permitting. Upon approval of the WPP by watershed stakeholders and acceptance by the EPA, efforts to implement the plan will begin in earnest. Primary areas of focus will include the continued management of bacteria loading into the creek, addressing nitrate loading in the watershed, and continuing education and outreach at the watershed level.

Cedar Bayou

Cedar Bayou extends approximately 45 miles through Liberty, Chambers, and Harris Counties, before emptying into the Galveston Bay system. The 173 square miles of the watershed comprise the majority of the area within the Trinity-San Jacinto Coastal Basin. The agricultural land uses of its northern reaches, east of Lake Houston, gradually transition through suburban and industrial uses in the mid-watershed, ending in the relatively dense urban/industrial centers in its southernmost reach. While much of the watershed is sparsely developed, population projections indicate that its position at the eastern edge of the rapidly growing Houston-Galveston region makes it a candidate for appreciable future growth.

Cedar Bayou is listed as an impaired water body on the CWA Section 303(d) List for elevated levels of bacteria, PCBs, dioxins in edible fish tissue, and impaired macrobenthic communities. These impairments and local stakeholder concerns about the impact of future development in the area provided the impetus for the development of a WPP for Cedar Bayou. The watershed planning process started in 2010 as a collaboration between local residents, the H-GAC, and the TSSWCB with funding through a CWA Section 319(h) grant. A comprehensive array of ambient and targeted monitoring efforts will help project partners assess the status of the waterway, while several integrated modeling efforts will serve as the basis for a more precise targeting of BMPs to address impairments. These efforts will include over two years of assessing ambient water quality, storm flow runoff contributions, biological communities in the Bayou, WWTF effluent, and the loading and transport mechanisms of this coastal system and its complex hydrology. Throughout the project, the objective will be to facilitate and foster strong local involvement and leadership within the watershed communities.

Cedar Bayou/photo by Justin Bower of the H-GAC

Work in fiscal year 2011 has focused on the initiation of the project, initial characterization of the watershed, and laying the groundwork for an integrated public participation and outreach infrastructure. A project website (<www.cedarbayouwatershed.com>), and Facebook page were created to emphasize a transparent, inclusive process and harness the power of social media as an outreach tool. A GIS database was established and updated, and initial field reconnaissance visits were conducted, including a watershed road tour and a stakeholder aerial watershed tour. A greatly enhanced network of monitoring stations was selected and quality assurance groundwork for future monitoring was put in motion. Project staff have been actively and aggressively working to meet and involve a variety of strategic partners in the watershed, including local industry groups, existing community environmental organizations, and local governments. Project staff have assisted with stakeholder watershed cleanup events and provided a keynote speaker for the Baytown Conservation Fair and other events. Following a successful Texas Watershed Stewards training in August 2011 in the watershed, a first public meeting was held in September 2011 to kick off the next phase of the watershed planning process.

Concho River

The Concho River watershed lies within 13 West Texas counties and encompasses an area 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. These reservoirs provide potable water, either wholly or in part, to approximately 500,000 residents. In addition, the streams and reservoirs of the Concho River watershed are utilized for agriculture. The Concho River itself lies below San Angelo

and enters O.H. Ivie Reservoir near Paint Rock. 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. In 2002, the Concho River was placed on the CWA Section 303(d) List for having impaired macrobenthic communities. The O.C. Fisher Reservoir was also listed for TDS and chlorides affecting general uses of the water body.

In 2004, the Upper Colorado River Authority (UCRA) received a CWA Section 319(h) grant from the TSSWCB to facilitate the development of a WPP. In July 2008, the UCRA submitted a stakeholder-approved WPP for state and federal review. The Concho WPP was submitted to the EPA in August 2011.

Geronimo and Alligator Creeks

In 2008, the GBRA received a CWA Section 319(h) grant from the TSSWCB to develop a WPP for the Geronimo and Alligator Creeks watershed. GBRA subcontracted with AgriLife Extension to aid in development of the WPP. After holding two successful public meetings and a Texas Watershed Steward training in the fall of 2009, the first Geronimo and Alligator Creeks Watershed Partnership meeting was held in January 2010. The Partnership formed a Steering Committee and an Urban NPS Workgroup, a Wastewater Workgroup, and an Agricultural NPS Workgroup, to address the impairment.

After substantial stakeholder input, potential source loads were modeled using SELECT. LDCs were developed in order to determine the load reductions needed to bring the creeks into compliance with water quality goals for bacteria and nitrate-nitrogen. It is estimated that a reduction of 26 percent of the *E. coli* loading during mid-range flows would be necessary to bring the stream into compliance with contact recreation standards. Nitrate-nitrogen loading would need to be reduced over 80 percent under all flow conditions in order to bring the stream concentrations into compliance with the state screening level for nitrate-nitrogen.

The work groups met a total of nine times since January 2009 to evaluate and recommend BMPs to address potential agricultural, urban, and wastewater sources of the pollutants. The Partnership attended presentations on watershed issues including: impacts to water quality from feral hogs and how implementation of approved BMPs for farming practices will protect water quality. The Partnership also toured the upper watershed to observe retention structures that are in place in that highly-urbanizing area.

Granger Lake

Lake Granger is located on the San Gabriel River in Williamson County, about 7.1 miles east of Granger. Originally constructed for flood control and recreation, Lake Granger serves as a drinking water supply reservoir for residents of Williamson County, which has one of the highest rates of population growth in the state. While the demand for water from Lake Granger is increasing, its storage capacity is decreasing due to sedimentation. Volumetric surveys suggest that Granger Lake 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.

The Brazos River Authority (BRA), Little River-San Gabriel SWCD, and AgriLife Research have partnered together to quantify sediment loadings and develop a WPP for Lake Granger and the San Gabriel River utilizing a CWA Section 319(h) grant from TSSWCB. Over fiscal year 2011, the BRA has developed the draft Lake Granger and San Gabriel River WPP. The WPP identifies strategies that will reduce sediment contributions across the watershed.

Concurrent with the development of the WPP, the Little River-San Gabriel SWCD provided technical assistance and financial incentives to agricultural producers in the watershed for the development

Geronimo Creek/photo by Brian Koch of the TSSWCB

and implementation of WQMPs to reduce sedimentation. BMPs implemented included grassed waterways, pastureland planting, terracing, contour farming, critical area planting, livestock ponds, nutrient management, pest management, and prescribed grazing. In 2011, 6 WQMPs were developed and installed on 34.4 acres.

Lampasas River

The Lampasas River watershed encompasses 1,250 square miles and lies within Bell, Burnet, Coryell, Hamilton, Lampasas, Mills, and Williamson Counties. The Lampasas River rises in western Hamilton County and flows southeast for 76 miles through a primarily rural landscape before it drains into Stillhouse Hollow Lake in Bell County. Above Stillhouse Hollow Lake, the Lampasas River is listed as impaired due to elevated bacteria levels. As a result of this impairment, the TSSWCB partnered with AgriLife Research, using CWA Section 319(h) monies, to collaborate with local watershed stakeholders to develop a WPP for the Lampasas River watershed to improve and protect water quality within the basin.

The Lampasas River Watershed Partnership was formed in November 2009. The Partnership includes a Steering Committee, Work Groups that discuss specific issues facing the watershed, and general partners that are interested in protecting the watershed. To date there has been over 250 local stakeholders, city and county officials, and state and federal agency representatives actively involved in the watershed planning efforts. Stakeholders participate in monthly Steering Committee or Work Group meetings to discuss various needs of the WPP.

LDCs were developed for seven monitoring stations within the watershed to aid in determining pollutant sources and needed load reductions. The water quality analysis, along with an updated LULC classification and a stakeholder approved SELECT analysis was utilized to help stakeholders choose BMPs to address pollutant sources of concern. The stakeholders have outlined a ten-year implementation plan that prioritizes both subwatersheds of concern and targets specific BMPs for specific areas. This implementation plan also identifies potential funding sources and existing education and outreach programs that can be adapted to fit the needs of the Lampasas River watershed as well as detailing a recommended long-term monitoring plan for the Lampasas River and its tributaries.

Leon River

The Leon River watershed, between Lake Proctor and Belton Lake, encompasses approximately 1,340 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. To take a more proactive role in developing management strategies to reduce bacteria loadings to the Leon River, stakeholders initiated development of a WPP in 2006 utilized a CWA Section 319(h) grant from TSSWC to BRA.

The Leon River WPP Working Committee and project team met in Hamilton, Texas on August 4, 2011 to review proposed responses to public comments received on the plan. At this meeting, Working Committee members provided their input, and the draft WPP was revised accordingly. In January 2011, a draft of the Leon River WPP was released for public comment. BRA and the Working Committee worked through the remainder of fiscal year 2011 to address comments received and finalize the draft WPP.

Pecos River

The Pecos River meanders 418 miles through one of the driest regions of west Texas in a south-southeast direction before joining the Rio Grande at the International Amistad Reservoir. Along the river's journey southward, the surrounding watershed changes from a relatively flat, short-brush dominated rangeland interspersed with short grasses to one that is filled with plateaus, valleys, steep cliffs and is dominated by larger brush species and sparse short grasses.

During fiscal year 2011, work implementing the Pecos River WPP got fully underway. Work conducted has focused on further cultivating landowner relationships and establishing agreements for implementation of BMPs throughout the watershed. In spreading the word about upcoming implementation programs, the watershed coordinator, employed by TWRI, and two field technicians, employed by the Upper Pecos SWCD and the Crockett SWCD, have attended numerous meetings to present information on program availability, project timelines, and providing general information on the implementation programs.

Implementation activities completed during fiscal year 2011 include the additional treatment of invasive saltcedar through the expansion of the saltcedar leaf beetle release program at multiple sites along the river and throughout the watershed. Despite the harsh winter and damage to the existing beetle population, more than 14,000 acres were defoliated. Development of WQMPs has also been a high priority this year with seven WQMPs being developed and certified and another 12 in the process of being developed. Saltcedar debris burning was scheduled to begin in the past year; however, exceptional drought conditions and the excessive fire danger in Texas this year have precluded any controlled burns. Ground work was completed

to begin chemical saltcedar control and a contractor has been hired. Additionally, the development and application of a DO model for the river that will aid in identifying the source(s) of the river's DO impairment and the construction and installation of another CWQMN station on the river near Girvin (discussed earlier in Chapter 3) are also underway.

Planned activities in fiscal year 2012 include the continued efforts to implement activities initiated in the past fiscal year. The watershed coordinator and field technicians will continue to facilitate relationships with local watershed landowners, work cooperatively with them to implement BMPs recommended in the Pecos River WPP, and help secure additional funding for future watershed management activities.

Plum Creek

Plum Creek flows for 52 miles from its headwaters north of Kyle downstream towards Lockhart and Luling. The 400 square mile watershed drains Caldwell and Hays Counties and a small portion of Travis County. The creek has been included on the CWA Section 303(d) List due to high levels of bacteria since 2002 and on the *IR* for concerns for nutrient enrichment since 1998. The Plum Creek WPP was completed in 2008 and is in its third year of implementation.

During the past year, significant progress toward achieving a number of WPP components has been made. Public involvement and education continues to be a key focus of implementation. Over 41 meetings, workshops, and trainings have been conducted in fiscal year 2011 including: four steering committee meetings, three work group meetings, 23 public and local-government meetings, and nine educational events that included the annual Feral Hog Management Workshop, Luling Foundation Water Field Day, and two riparian workshops. The 2010 Soil Testing Campaign resulted in 128 samples from landowners in Caldwell and Hays Counties. More information about implementation activities is detailed in Chapter 2 under Goal Two - Implementation.

The Partnership has conducted meetings to discuss and plan for the long-term sustainability of the Partnership. AgriLife Extension in collaboration with the GBRA has engaged officials and staff with each of the municipalities and counties within the watershed to build strong cooperative partnerships. This effort has led to the development and signing of an interlocal agreement with 12 local partner entities providing cash and in-kind services to support 40 percent of the cost of a local watershed coordinator. The 12 entities include Caldwell and Hays Counties, the City of Lockhart, the City of Luling, the City of Kyle, the City of Uhland, the City of Buda, GBRA, Plum Creek Conservation District, Polonia Water Supply Corporation, Hays County SWCD, and the Caldwell-Travis SWCD.

Proper management of riparian zones is critical for protection of water quality and aquatic habitat. AgriLife Extension, in cooperation with the Plum Creek Watershed Partnership conducted a workshop in November 2010 to help landowners better manage and protect riparian areas on their property. Personnel from AgriLife Extension, Nueces River Authority, NRCS, and TPWD provided training on indicators for riparian health, causes of degradation, and techniques for restoration of degraded areas. Fifty-four individuals participated in the workshop, and survey results indicated that 80 percent of respondents plan to take action or make changes to better protect riparian areas based on information gained during the workshop. Twenty-six percent of respondents anticipate benefitting economically as a direct result of what they learned. Educated and informed landowners are more likely and able to use practices that improve and/or maintain the integrity of riparian areas adjacent to creeks and streams and by so doing, help protect water resources on their property and downstream.

AgriLife Extension, Plum Creek Watershed Partnership, and San Marcos River Foundation partnered to conduct a second Riparian

Plum Creek/photo by the City of Lockhart

Workshop in fiscal year 2011 for landowners and decision makers in the Plum Creek and San Marcos River watersheds. The workshop, which was held in San Marcos, had 118 participants. The workshop consisted of presentations in the morning at the San Marcos Community Center followed by stream tours and outdoor presentations at the TPWD Fish Hatchery in San Marcos. Participants learned the basic dynamics of hydrology, rivers and drought, key riparian vegetation, erosion/deposition, and water quality issues to promote cooperative riparian management among landowners.

Utilizing CWA Section 319(h) grants from TSSWCB, the Caldwell-Travis SWCD continues to provide technical assistance and financial incentives to agricultural producers for the development and implementation of WQMPs in the Plum Creek watershed. In fiscal year 2011, two WQMP plans were developed with producers in the watershed. BMPs being installed in the Plum Creek watershed include grass planting, cross-fencing, pipelines, water wells, grassed waterways, and watering facilities.

Implementation efforts also continued in the urban sector in the City of Kyle, where a TCEQ CWA Section 319(h) grant is being used to implement a variety of pollution prevention strategies. In addition to structural modifications such as the reengineering of regional detention facilities, Kyle has implemented a few key outreach measures that have engaged local stakeholders to play a role in water resource protection. Five additional pet waste stations were purchased in 2011 using TCEQ grant funds and installed in public parks. More than 180 volunteers participated in the annual Plum Creek Watershed Clean-Up event that removed an estimated 400 pounds of trash and debris from inside the park area and Plum Creek.

The City of Lockhart began implementation of a TCEQ CWA Section 319(h) grant to clean storm drains and install inlet filters; expand household hazardous waste disposal service to include fats, oils, and grease; maintain pet waste collection stations; mark storm sewers; and implement a storm water education program. The City of Lockhart hosted the Annual Town Branch Cleanup in City Park in September 2010. This event continues to be successful with a total of 300 volunteers participating, totaling 900 volunteer hours, this year. Over 1,340 pounds of trash were removed, 460 pounds of materials were recycled, and park beautification projects were completed. The project cleaned up over 4 miles of lake and river banks in the 6 pocket parks that make up City Park.

Hays County, City of Buda, and the Plum Creek Watershed Partnership have joined together to improve wastewater conditions in the Hillside Terrace Subdivision. An application was submitted for the TWDB CWSRF for financial assistance for engineering costs and the connection of the 262 home subdivision to the Buda WWTF. The project qualified for 70 percent loan forgiveness. Buda and Hays County were sent a letter inviting them to participate in the CWSRF.

Additionally, with CWA Section 319(h) funding from the TSSWCB, kiosks have been installed within the Plum Creek watershed. These kiosks, located in the public libraries in Lockhart and Luling and in the Kyle City Hall, are the latest tools in the campaign to bring the message of water quality protection to the public. Residents of the watershed can learn about Plum Creek, view real-time water quality data, as well as how a WWTF operates, how to operate and maintain OSSFs, and the best way to dispose of fats, oils and grease. More information on the educational kiosks can be found in Chapter 3 under Goal Three - Education.

In support of the WPP, the GBRA continued to conduct intensive surface water quality monitoring on Plum Creek and its tributaries through CWA Section 319(h) funding from the TSSWCB. Sampling included targeted routine ambient, wastewater effluent, and spring flow samples that were collected at 51 sites throughout the watershed.

Texas Commission on Environmental Quality Watershed Protection Plans

Arroyo Colorado

The Arroyo Colorado, an ancient distributary channel of the Rio Grande, extends about 90 miles from Mission to the Laguna Madre in the LRGV. Flow in the Arroyo is sustained by wastewater discharges, agricultural irrigation return flows, urban runoff, and base flows from shallow groundwater. To address the Arroyo Colorado's water quality impairments for depressed DO, as well as nutrient concerns, the Arroyo Colorado Watershed Partnership developed a WPP for the Arroyo Colorado in 2007. Following completion of the WPP, TWRI received a CWA Section 319(h) grant from the TCEQ to support/facilitate the Partnership and coordinate implementation efforts. The Partnership has continued to function through fiscal year 2011 and funding to support Partnership efforts has been extended through 2014. Over the next three years, the Partnership will implement a plan to become less reliant on federal funding and move toward local support. The newly formed Arroyo Colorado Conservancy is a 501(c)(3) nonprofit organization that will function as the Partnership's financial development work group and help guide the Partnership's transition to being locally supported. As the conservancy grows and funding is brought in, the conservancy will support a variety of new and ongoing educational, research, and agricultural incentive programs.

Much progress has been made in meeting many of the milestones outlined in the WPP. Upgrading the area's wastewater infrastructure was another major component of the milestone schedule. So far, ten WWTFs have either upgraded or constructed new

above top: Arroyo Colorado Watershed sign
above: The Arroyo Colorado/photo by the TWRI

facilities and 22 colonias have been connected to WWTFs. Also, three wetlands were constructed for the San Juan, La Feria, and San Benito WWTFs and provide wildlife habitat and wastewater treatment. Implementation of BMPs to reduce pollutant loadings from irrigated cropland is discussed earlier in Chapter 3.

Progress has also been made implementing the education and outreach measures outlined in the WPP. The Partnership was instrumental in obtaining a permit from the Texas Department of Transportation for the installation of roadway signage that indicates the location of the Arroyo Colorado watershed and significant crossing areas. A total of 24 signs have been installed with another 30 to be installed by the spring of 2012. The Arroyo Colorado Watershed Coordinator has continued educating the public about the impacts they have on the watershed through presentations at schools and other venues. The Partnership has two watershed models on permanent loan from the Nueces River Authority. The models are used as an educational tool at various educational events and fairs throughout the watershed. Over 30,000 watershed residents have been educated about the Arroyo Colorado through the various outreach activities.

During fiscal year 2011, the TSSWCB continued to fund monitoring to better characterize agricultural runoff, and assess and demonstrate the effects of BMP implementation at the field and subwatershed level. Scientists from Texas A&M University-Kingsville (TAMU-K) and AgriLife Research have monitored water quality in agricultural drainage ditches to assess potential mitigation and attenuation within the drainage way and also collected irrigation return water to gain better data on the quality of tailwater leaving fields currently using BMPs. Agricultural BMPs installed throughout the watershed were inventoried and mapped to better target future education efforts and financial incentive programs. This and other information is being entered into the SWAT model that is being used to simulate the current sediment, biochemical oxygen demand (BOD), and nutrient loadings in the Arroyo Colorado watershed. By December 2011, scientists will simulate future load reduction scenarios based on projected management BMPs identified in the WPP.

The TSSWCB also provided funding through a CWA Section 319(h) grant to AgriLife Extension to educate agricultural producers on the water quality benefits of utilizing BMPs and to inform them of available incentive programs. An educational program was developed and is currently being delivered throughout the Arroyo Colorado watershed. It encourages producers to adopt BMPs to abate NPS pollution and informs them about financial incentive programs for doing so.

During fiscal year 2011, funds were leveraged to assist in the implementation of the WPP. The GLO funded multiple projects including, "Pesticide Education in the Coastal Zone of the Arroyo Colorado Watershed." During this project, agricultural producers were educated on water quality issues and the proper application of pesticides. The project included a soil testing campaign where approximately 330 samples were submitted for analysis. The GLO also funded the development of two PSAs to educate residents about urban storm water pollution and the importance of soil testing. The PSAs were broadcast via television in both English and Spanish. The EPA, as part of the Strategic Agricultural Initiative Program, funded the project, "Integrated Farm Management Education Program." Demonstration projects were utilized to increase the adoption of reduced risk Integrated Pest Management (IPM) practices. AgriLife Extension also hosted programs promoting the adoption of an integrated farm management system where producers learned how to better manage their lands and resources through the adoption of IPM practices.

The LRGV is one of the fastest growing regions in the United States. It is important that future development and redevelopment incorporate practices that will reduce polluted runoff to protect water quality in the Arroyo Colorado. In fiscal year 2011, TAMU-K continued a TCEQ CWA Section 319(h) funded project to improve the performance of several regional storm water detention facilities in the McAllen area. The project is developing and testing several enhancements of existing regional detention facilities to determine their performance in the LRGV's hot and dry climate. TAMU-K has also recently received CWA Section 319(h) funding from the TCEQ to work with LRGV cities over the next four years to construct LID demonstration projects. These projects will

evaluate the potential use of LID practices in the LRGV region and provide LID education with the intent of institutionalizing LID practices throughout the LRGV. TAMU-K will work with LRGV cities to calculate pollutant load reductions from the urban BMPs being implemented and incorporate them into the SWAT model.

Bastrop Bayou

The Bastrop Bayou watershed is located entirely within Brazoria County. Ambient water quality monitoring began for the watershed in August 2004 under the Clean Rivers Program (CRP). A risk assessment was completed for the watershed in June 2006. The assessment revealed that although the watershed is not currently on the CWA Section 303(d) List, rapid population growth in the area is a significant risk to water quality. By 2025, the watershed is expected to have a 50 percent growth in households. Because of the risk assessment, the TCEQ, GBEP, and the H-GAC began the WPP in 2006. In 2011, the H-GAC submitted a draft WPP and will respond to the TCEQ comments with a final WPP in 2012. The project website is <www.h-gac.com/community/water/watershed_protection/bastrop/default.aspx>.

Brady Creek

The Brady Creek watershed encompasses almost 513,000 acres and includes the cities of Brady, Eden, and Melvin. The majority of the watershed is utilized for agricultural production. Brady Creek is currently impaired for DO within the urbanized Brady segment. Other concerns throughout the watershed are increased salinity in Brady Lake, brush infestation, and maintenance of flood control structures. The purpose of the project is to complete a WPP to include refining the Brady Creek Watershed Characterization by conducting additional monitoring and modeling; further identifying and quantifying pollutant loading sources; prioritizing BMPs identified in the Master Plan for the City of Brady; identifying additional BMPs for the watershed, along with associated costs and load reductions to be achieved; creating a schedule of implementation with measurable milestones; and involving stakeholders throughout the WPP process. The goal of the project is to create a locally driven plan that will protect and improve water quality. Funding for the project was awarded to UCRA by TCEQ in 2010.

In fiscal year 2011, the UCRA drafted a Public Participation Plan for the project and focused efforts on creating a cohesive and engaged stakeholder group. The stakeholder group met several times throughout the year providing valuable input to the project. An Urban Advisory Group was also formed in late summer 2011.

Monitoring and modeling commenced in 2011. UCRA is currently conducting ambient monitoring with sites sampled for field,

Brady Creek at the confluence with the San Saba /photo by Chuck Brown of UCRA

flow, bacteria and conventional parameters. The modeling QAPP was approved in 2011 to include the Stream Water Quality Model (QUAL2K) and Storm Water Management Model (SWMM) addressing DO and nutrients for the Brady urban area; the development of a Brady Lake Spreadsheet Model for salinity in the lake; and SWAT for sediment, nitrogen, and phosphorus in the greater Brady watershed.

Caddo Lake

Stakeholders within the Caddo Lake/Cypress Creek Basin have expressed concern over issues that include NPS pollution affecting water quality. To address some of these issues related to NPS pollution, stakeholders have embarked on the development of a WPP. The WPP project encompasses not only Caddo Lake but also the contributing Cypress Creek Basin excluding above Lake O' the Pines. Specific water quality issues addressed in the WPP project include bacteria and nutrient loading.

Modeling activities were performed to predict pollutant loadings. The modeling efforts focused on understanding the processes involved in pollution generation, migration, and kinetics from the Cypress Creek Basin into Caddo Lake. Four models, including SELECT, SWAT, the Environmental Fluid Dynamics Computer Code (EFDC), and Water Quality Analysis Simulation Program (WASP) were used to each characterize different issues evident within the basin. SELECT and SWAT were used to model the watershed while EFDC and WASP were used to model Caddo Lake itself. The SELECT watershed tool was used to evaluate bacteria and what sources of bacteria contribute the highest potential bacteria load in different areas within the basin. The SWAT watershed model was used to evaluate nutrient and sediment loads contributed by watershed sources to receiving streams. The Caddo Lake model consists of two linked models: the EFDC hydrodynamic model and the WASP water quality model. The combined lake model was used to evaluate changes to lake water quality resulting from changes in watershed loading (i.e., SWAT model outputs).

A draft technical memorandum has been produced presenting the results of the analyses. The major sources of bacteria and nutrients in the watershed were preliminarily determined to be livestock, wildlife, pets, OSSFs, poultry (lagoon wastes and dry litter), and WWTFs. Protocols used to characterize sources were consistent with other WPP projects in Texas. Watershed stakeholders are reviewing the draft technical memorandum. The contactor will review, discuss, and incorporate stakeholder comments into a final technical memorandum. The technical memorandum will identify and evaluate the existing assumptions used in the source identification and watershed water quality modeling. These assumptions will be prioritized according to their relative significance in the modeling exercises and other criteria identified by stakeholders. The technical memorandum will describe an analytical approach (including activity descriptions, estimated costs, and proposed schedule) for verifying the accuracy of priority modeling assumptions. Additional work such as field verification of modeling assumptions is required before the WPP can be finalized.

Cypress Creek

Cypress Creek originates in western Hays County and flows into the Blanco River. This perennial stream is 15 miles long and emanates from the middle Trinity Aquifer at a place known as Jacob's Well near Wimberley. The Cypress Creek watershed is home to a unique set of rural and urban communities and distinctive ecosystems. The area has a long-standing reliance on groundwater as a source of water for drinking water supply, recreational activity, and in maintaining aquatic life uses. Stakeholders have determined that a WPP is one of the many tools they will use to keep Cypress Creek clean, clear, and flowing. RSI is helping to guide the development of the WPP.

Cypress Creek/photo by Vanessa Lavendar

Issues of concern include excess sediment in the creek, high bacteria concentrations, and occasionally very high nutrient levels. Characterization results show that flow is a critical factor for maintaining adequate DO levels and a highly functioning aquatic community. Analysis indicates the upper portions of the watershed tend to be highly influenced by inflow of groundwater in terms of the water chemistry, while downstream sites show more of an influence by local stream conditions and runoff from contributing subwatersheds.

Through a series of 58 meetings, stakeholders worked to help identify concerns, set priorities, and to answer many pressing questions associated

with the watershed characterization process. Their efforts are documented within the *Cypress Creek Characterization Report* located at <www.cypresscreekproject.org>. Through the development and delivery of a decision support system, scientifically based information will aid decision makers in determining how land use decisions impact water resources.

A new CWA Section 319 grant contract with the TCEQ was initiated in July 2011 to complete Phase II of the Cypress Creek WPP. A new Cypress Creek Project Coordinator was hired with key staff from the Watershed Characterization project phase continuing to support the WPP. In 2011 stakeholders will be reengaged to complete the WPP.

Dickinson Bayou

AgriLife Extension, with funding from the TCEQ CWA Section 319(h) grant program, is working to implement BMPs identified as necessary in the Dickinson Bayou WPP. The primary goal of this project is to implement and demonstrate effective BMPs through the Dickinson Bayou Watershed Partnership. Dickinson Bayou is on the CWA Section 303(d) List for DO and bacteria affecting aquatic life and contact recreation uses. AgriLife Extension and the TCEQ facilitated the formation of a watershed partnership and a WPP was completed in the spring of 2009.

This plan is under revision to incorporate information from a draft bacteria TMDL I-Plan. Currently the I-Plan is under review by the TCEQ and the additional information is expected to be incorporated into the WPP in 2012. During fiscal year 2011, many aspects of this project were completed. AgriLife Extension staff reached out to city and county officials with a three part series on constructed storm water wetlands. The series included showing a webinar put on the by the Center for Watershed Protection; a technical presentation by AgriLife Extension; and a tour of local wetland sites. Representatives from seven organizations attended. AgriLife Extension staff also continued working with the Clear Creek Independent School District and the City of League City on a storm water detention basin retrofit project. This project is retrofitting an existing detention basin into a storm water wetland at the district' s Education Village, a site with an elementary school, middle school, and high school all on one campus. A wetland dedication event was held in the fall of 2011 to celebrate the completed project.

AgriLife Extension staff worked with the City of Dickinson and Keep Dickinson Beautiful to install a rain garden at the Dickinson Public Library. This garden captures roof runoff from four down spouts. Over 40 community volunteers came out to help plant this garden that is visible from Highway 3, a main thoroughfare in Galveston County. A garden dedication event was held in the fall of 2011.

Finally, another task was added to the project, an OSSF feasibility study. AgriLife Extension staff in conjunction with Texas A&M University at Galveston professors are compiling geospatial data for OSSFs in the watershed, financial data on OSSF upgrades, and options for connecting homes to existing WWTFs. This information is being used to create optimization scenarios and determine the most cost effective and feasible options for fixing the OSSF problems faced in the Dickinson Bayou watershed.

Hickory Creek

The Hickory Creek arm of Lake Lewisville has been identified as a water body of concern for ammonia nitrogen. Lake Lewisville is not currently identified on the CWA Section 303(d) List as impaired. However, significant development is anticipated for the area within the next several years. This growth has the potential to threaten designated uses of the creek. In fiscal year 2009, the City of Denton completed the Hickory Creek WPP. The goals of the WPP are to identify sources and causes of pollution and to determine which management strategies are best suited to maintain water quality in the watershed. These strategies are being targeted with the goal of being compliant with current and anticipated future TSWQS, along with protecting the city's drinking water supply. The WPP is designed to prevent net increases in sediment and nutrient loading. The WPP provides an in-depth cost analysis of the BMPs versus their effectiveness at removing pollutant loads. The WPP also proposes a pilot program that can be used for trading nutrient and sediment loads.

During fiscal year 2010, a new project was initiated by the City of Denton and the TCEQ utilizing CWA Section 319(h) funding. This project will implement BMPs as recommended in the WPP and prioritized by stakeholders, and expands the goals of the earlier grant for the Hickory Creek watershed across the entire Lake Lewisville watershed, also under intense development pressure. During the fiscal year 2011, the project team had three project partner meetings and three stakeholder meetings along with several individual stakeholder meetings looking at sites for BMP implementation. Two sites have been selected for BMP implementation: the City of Denton Cross Timbers Park and the City of Denton South Lake Park.

Additional information can be found at the website <www.cityofdenton.com/watershed>.

Lake Granbury

Lake Granbury 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 *E. coli* in the coves of Lake Granbury.

A long-term concern for water quality, specifically a bacteria concern, has existed at Lake Granbury due to the high incidence of historical man-made cove development and reliance on OSSFs for wastewater

disposal. A substantial portion of the developed area around Lake Granbury does not have sewage collection and treatment facilities. Development in areas without collection and treatment systems currently relies on either holding tanks or OSSFs and absorption fields. There are an estimated 9,000 septic systems located around Lake Granbury. Most of the inhabited areas around the lake are on man-made coves. The man-made coves are shallow, dead-end bodies of water with little mixing or interaction with the main body of the reservoir. Many historical studies of Lake Granbury have been conducted and all indicate that poor soil conditions, age of OSSFs, small lot sizes, and growing lakeside population will lead to more severe water quality concerns unless action is taken.

In response to stakeholder concerns, the BRA began a large-scale monitoring initiative in the canals of Lake Granbury to assess the water quality of the coves. The data generated from this effort indicates that many of the canals on Lake Granbury are impacted by *E. coli* issues and indicate a concern for public health and contact recreation. Declining water quality in some of the canals has begun to negatively affect the contact recreation use of the canals. Lake Granbury is the lifeblood of Hood County, with the majority of the county's communities relying on the lake for drinking water, irrigation, industry, and recreation. The economy in Hood County is closely tied to Lake Granbury and the environmental condition of the lake is crucial to the county's residents.

In 2006, the TCEQ and the BRA initiated an effort to develop the Lake Granbury WPP to reduce bacteria levels in the lake and its canals. The WPP was completed and accepted by the TCEQ and the EPA in 2011. The Lake Granbury WPP is a "community-driven" plan that reflects the local stakeholders' concerns, water quality data, and stakeholder selected management measures. The overall objective of the Lake Granbury WPP is to reduce bacterial contamination in the coves to ensure safe contact recreation use and to adopt a bacteria concentration goal for the canals that will be protective of contact recreation use in Lake Granbury and its canals into the future.

The Lake Granbury Watershed Stakeholders Group selected three types of NPS management measures for inclusion in the WPP, local orders/ordinances and homeowner's association regulations, physical management measures, and a broad educational program. The recommended local orders/ordinances include, but are not limited to: a County Order requiring residents whose properties are in the 100-year floodplain to submit proof annually of routine maintenance of holding tanks to the Hood County Health Department, and restrictions on feeding wildlife and waterfowl. Recommended Homeowner's Association regulations include requiring consultation on property expansions prior to the Homeowner Association (HOA) approving the property expansion. The physical management measures include storm water retention ponds, alteration of drainage patterns in specified areas, and alteration of cove dynamics in specified areas. The education plan includes development and delivery of education and outreach programs on the following topics: OSSF maintenance, gray water, septic tank verification and testing for home inspectors, pet waste management, wildlife/waterfowl feeding, feral hog control, livestock and range management, small acreage land management, and fertilizer application.

The first phase in implementing the WPP provides for supporting staff to perform Watershed Coordinator duties in the watershed. This position will assist stakeholders and local governments in implementing the NPS management measures identified in the Lake Granbury WPP. The Watershed Coordinator will help stakeholders and local governments conduct the following:

- prepare grant and low-interest loan applications for stakeholders
- help local governments write local orders and ordinances
- help homeowner's associations write HOA regulations
- assess milestones, loading reduction, and progress towards achievement of the Lake Granbury WPP goals
- implement the education plan requested by the stakeholders

San Bernard River

The H-GAC is guiding the watershed planning process for the rural and developing watershed of the San Bernard River. The San Bernard River watershed includes portions of Austin, Colorado, Fort Bend, Wharton, and Brazoria Counties. The watershed is approximately 900 square miles and the river flows about 125 miles from the headwaters near New Ulm in Austin County to the Gulf of Mexico.

The San Bernard River was placed on the CWA Section 303(d) List in 2002 for contact recreation due to bacteria. The tidally influenced portion of the river has also experienced low levels of DO. Recently however, the DO levels have returned to normal due to the reopening of the mouth of the river. The TCEQ funded the H-GAC under an ARRA grant for three major tasks to maintain and improve the river's water quality: a WPP, incorporation of BMPs in local jurisdictions, and an analysis of NPS pollution through the use of GIS.

A project with the TCEQ was initiated in September 2009. Three kickoff meetings and watershed tours were conducted in fall 2009. In 2011, stakeholders reviewed several sets of modeling results and watershed maps, and provided comments on the modeling assumptions and data. Water quality testing continues at eight locations on the river and its tributaries. A draft WPP was presented to stakeholders and posted

for comment. A revised draft WPP was presented to the TCEQ and will be finalized in response to comments in 2012. The project website is <www.h-gac.com/go/sanbernard/>.

Upper Cibolo Creek

Upper Cibolo Creek originates in southern Kendall County and flows for 23 miles from the headwater springs to the confluence of Balcones Creek near the Comal and Kendall County line. The Upper Cibolo Creek watershed contains 76 square miles and lies within the San Antonio River Basin. The majority of Upper Cibolo Creek is perennial with the lower reach supplemented by the City of Boerne WWTF discharge. Despite its perennial nature, the extreme lower reach of the creek remains dry throughout most of the year due to groundwater recharge.

Upper Cibolo Creek was initially placed on the 1999 CWA Section 303(d) List for aquatic life and recreational uses due to depressed DO and bacteria exceedences. From 2002-2004 the creek was impaired for low DO and from 2006 to 2010 the creek has been listed as impaired for elevated bacterial levels. A push for action occurred after the TCEQ completed aquatic life monitoring in 2008 on the lower reach of the creek and determined it contained borderline exceptional aquatic life use.

The City of Boerne received a CWA Section 319(h) grant from the TCEQ to develop a WPP in August 2009. Despite ongoing drought conditions, the project team is conducting a monitoring program to characterize water quality conditions. Storm water sampling events have not occurred due to the relatively small events that have occurred during the drought. SWAT modeling will be used to determine load reductions needed to address the existing bacteria impairment and proactively look at ways to reduce nutrient loads within the watershed.

Extensive education and outreach efforts have continued throughout the watershed. The Texas Stream Team hosted a volunteer monitor training and with the help of local stakeholders conducted an intensive bacteria survey within the watershed. The Upper Cibolo Creek project team has worked closely with the Boerne Independent School District to conduct in-class education programs and teacher in-service trainings. The GBRA partnered with the City of Boerne to conduct an Aerobic System Training for homeowners and recently unveiled a digital watershed kiosk at the Patrick Heath Public Library in Boerne. In addition to an Earth Day riparian clean up event, the City of Boerne hosted the Upper Cibolo Watershed Festival and Green Living Fair. The watershed festival promoted watershed protection, water conservation, land stewardship, and green living techniques that can impact the use of natural resources.

right: Upper Cibolo Creek, May 2011/photo by Ryan Bass of the City of Boerne

below: Upper Cibolo Creek, August 2011/ photo by Ryan Bass of the City of Boerne

Upper San Antonio River

In 2006, the San Antonio River Authority (SARA) along with the Bexar Regional Watershed Management partnership completed a WPP for the Upper San Antonio River, which was identified on the 1996 CWA Section 303(d) List for contact recreation due to elevated levels of bacteria. One of the BMPs identified in this document was the need to reduce wildlife (mainly birds) in the Upper San Antonio River, particularly along the historic River Walk commonly known as Paseo Del Rio. The river walk district in the heart of San Antonio consists of restaurants, shops, and hotels that are frequented by tourists and residents.

Implementation activities have been ongoing since the completion of the plan. In

2010, the City of San Antonio was awarded a CWA 319(h) grant from the TCEQ to implement several LID features at a major redevelopment site. In 2011, the SARA was awarded a CWA 319(h) grant from the TCEQ to update and revise the WPP in 2012-2013. In fiscal year 2012, major efforts of both projects will begin.

Nueces River/photo courtesy of Rocky Freund of the Nueces River Authority

Third-Party Watershed Protection Plans

Lower Nueces River

The Nueces River Authority, with funding from the City of Corpus Christi Water Department, is developing a WPP for the Lower Nueces River below Lake Corpus Christi. The primary drinking water source for nearly half a million people in the Coastal Bend area is delivered via the river from Lake Corpus Christi to water treatment plants at the downstream end of the river. The initial catalyst for the development of a WPP was an incident in November 2009 that caused a turbidity violation at the City of Corpus Christi's O.N. Stevens Water Treatment Plant. Additional threats to water quality that have been identified are: chlorophyll *a*, which has been listed since 2008 as a concern in the *IR*; TDS, the levels of which are nearing the screening criteria; bacteria from malfunctioning septic systems; and illegal dumping.

Nueces County Road 73, just west of the Corpus Christi city limits, parallels the river for approximately two and one-half miles and for years has been a popular site for illegal dumping. The area is subject to flooding and large amounts of trash and debris wash into the river during flood events. In May 2010, the City of Corpus Christi Water Department staff spent several days on boats removing trash and small debris from the river between the upstream end of Nueces County Road 73 and Hazel Bazemore Park in Corpus Christi. In June 2010, the City of Corpus Christi Water Department, with help from Nueces County and several local recycling companies, conducted a three-day cleanup along the road. A total of 840 cubic yards of trash and debris, over 100 tires, and a trailer load of scrap metal were removed. The City of Corpus Christi led these activities to begin addressing the problem prior to the contract with the Nueces River Authority.

The Nueces River Authority officially began work on developing the WPP in August 2010. The Nueces River Watershed Partnership, <www.nuecesriverpartnership.org> was formed and had their first meeting in January 2011. There have been two additional stakeholder meetings and the group plans to meet three to four times per year. Five workgroups (education and outreach, water quality, utilities, agriculture, and recreation) have held meetings and will continue to meet as needed. In fiscal year 2011, the TSSWCB funded a preliminary inventory of permitted OSSFs through a CWA Section 319(h) grant to the Nueces River Authority. The City of Corpus Christi has installed three real-time monitoring systems in the river. The education and outreach and the water quality workgroups are working with the GBRA to install educational kiosks in the Nueces River watershed.

Paso del Norte portion of the Rio Grande

The Paso del Norte watershed is in the El Paso-Las Cruces area within the Rio Grande Basin located in South-Central New Mexico and West Texas. Here, the Rio Grande flows from below the dam at Caballo Reservoir in New Mexico, a main stem impoundment of the Rio Grande, and extends south to the American Dam in El Paso near the Texas-New Mexico border and the international border with Mexico. The watershed encompasses approximately 2,405 square miles. The Rio Grande in this reach is confined within levees and has a channel width ranging from 110 to 500 feet with a floodplain width ranging from 50 to 2,100 feet. In the lower 15 miles, the Rio Grande flows back and forth from New Mexico to Texas several times before becoming a shared border between Texas and Mexico.

In 2004, the Rio Grande from one mile below Caballo Dam to the international border with Mexico was listed as impaired for fecal coliform in part based on data collected by the IBWC, the City of Las Cruces, and El Paso Community College. Following an intensive water quality survey conducted by the New Mexico Environment Department, and a change in New Mexico water quality standards, the reach was listed for *E. coli* in 2006. A draft TMDL was released in February 2007 by the New Mexico Environment Department and approved by EPA in June 2007.

In the spring of 2006, the Paso del Norte Watershed Council was awarded a CWA Section 319(h) grant through the New Mexico Environment Department to form a watershed group to address the *E. coli* impairment on the Rio Grande in this area. The primary effort was to review existing data to determine the sources of impairment. Although a draft watershed plan was completed in 2007, the primary conclusion was that there was insufficient data to determine the sources of impairment. In 2010, the Paso del Norte Watershed Council received a second CWA Section 319(h) grant from New Mexico to identify the sources of impairment and produce a viable WPP. Project partners include the Paso del Norte Watershed Council, the New Mexico Environment Department, the New Mexico Department of Agriculture, New Mexico State University, and the Elephant Butte Irrigation District, with additional assistance from the IBWC, the Texas CRP, the City of Las Cruces, Doña Ana County, New Mexico State Parks, and the U.S. Bureau of Land Management.

above: Rio Grande at Leasburg State Park, New Mexico/photo courtesy of Chris Canavan of the New Mexico Environmental Department

right: Daniel Borunda with the IBWC discusses a future wetland project to mitigate stormwater during the November 2010 watershed tour/photo courtesy of Brian Hanson of the New Mexico Department of Agriculture

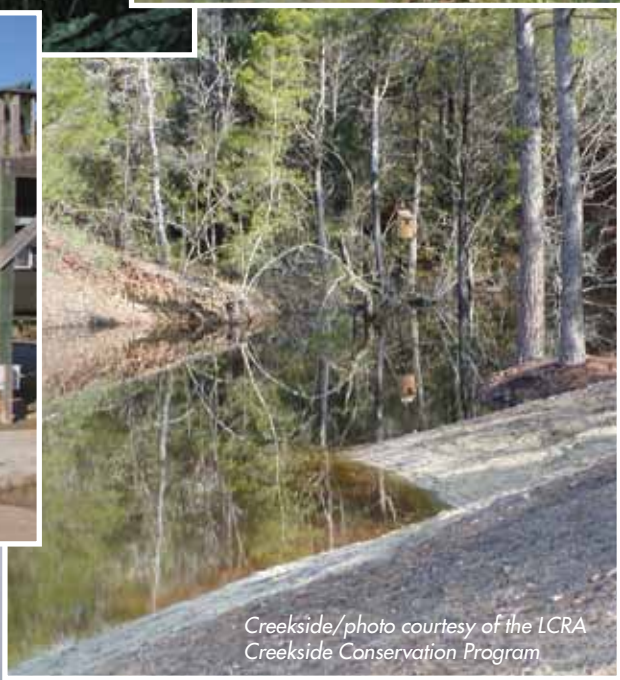
The Elephant Butte Irrigation District began sampling the agricultural return drains and the Rio Grande for *E. coli* in 2008. Following receipt of 319(h) grant funding in 2010, the sampling effort was refined to include identifying localized elevated *E. coli* "hot spots" and conducting further sampling of these areas to include microbial source tracking. Preliminary examination of the *E. coli* data in conjunction with examination of flow data suggest elevated *E. coli* levels in the Rio Grande in the upper portion of the watershed are predominately associated with storm water runoff, while the data in the lower portion of the watershed indicate chronic problems not directly related to storm flows. In the past year four sites were identified for microbial source tracking and sampling was initiated and completed; the results of the analysis are expected by early 2012.

Numerous stakeholder activities occurred over the last year beginning with a watershed tour in November 2010. The tour visited potential problem sites, a completed restoration project, and a potential restoration project site, and was attended by federal, state, and local representatives from both Texas and New Mexico as well as three SWCDs, the Elephant Butte Irrigation District, private landowners and concerned citizens. Stakeholder meetings were convened in early 2011 and are ongoing. After presenting the nature of the pollution problem and the watershed planning process in the initial meeting, topics have included: stakeholder goals and concerns, review of the *E. coli* sampling data, and a review of the draft WPP. In late summer the stakeholders began working on reviewing, updating and submitting comments to be incorporated into the WPP. Outreach activities have included participation in numerous community events including: Earth Day, the Franklin Mountains Poppy Celebration, Dia del Rio, Raft the Rio, the New Mexico State Fair, and the Whole Enchilada Fiesta. A public information factsheet entitled Bacteria in the Rio Grande was also produced; this effort was spearheaded by the IBWC with funding from the TCEQ CRP, but was a cooperative effort with the Paso del Norte Watershed Council. The Paso del Norte Watershed Council's website was also expanded and improved over the past year to include information on this watershed planning effort and can be found at <www.pdnwc.org>.

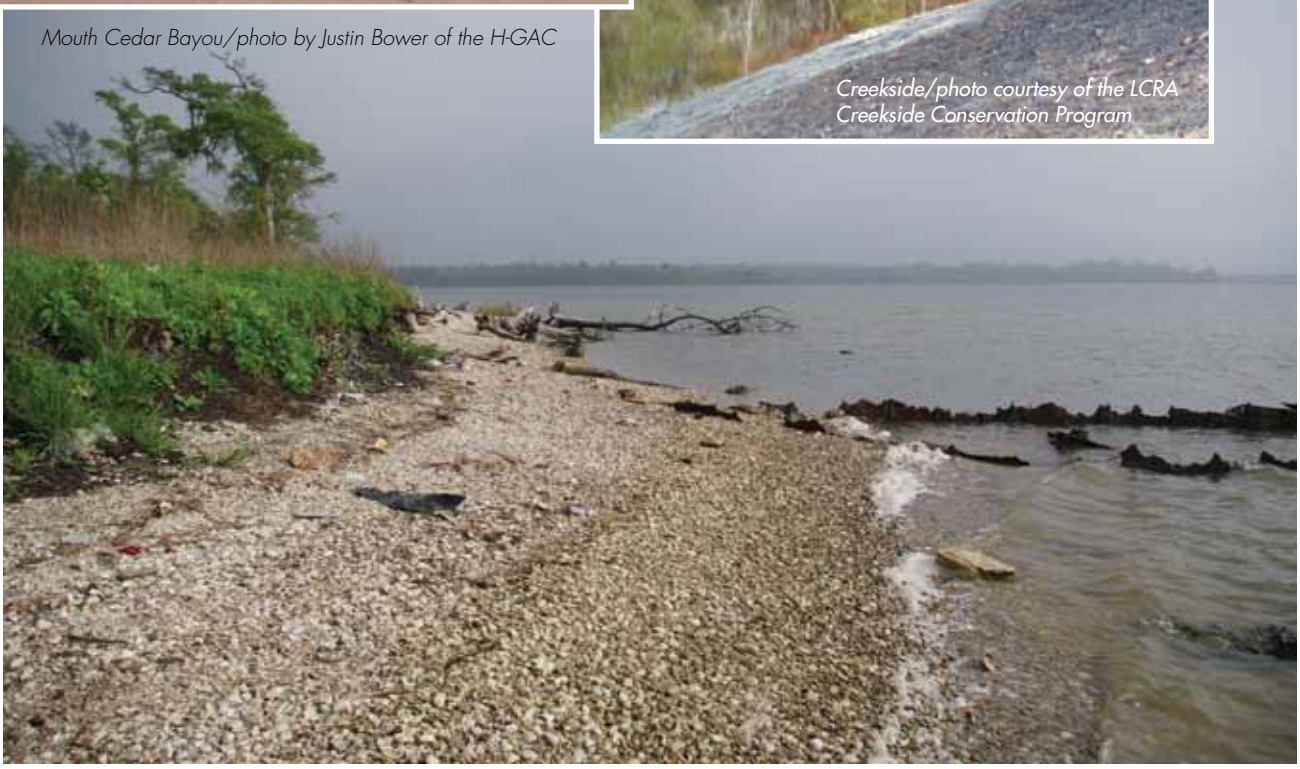
San Saba/photo by Chuck Brown of UCRA

Brady Creek/photo by Chuck Brown of UCRA

Galveston County/photo courtesy of AgriLife Research



Creekside/photo courtesy of the LCRA Creekside Conservation Program



Mouth Cedar Bayou/photo by Justin Bower of the H-GAC

Salado Creek/photo courtesy of TIAER

A Abbreviations

ACS	Agricultural Chemicals Subcommittee of the TGPC
AFO	Animal Feeding Operation
ARRA	American Recovery and Reinvestment Act
BIG	Houston Bacteria Implementation Group
BMP	Best Management Practice
BRA	Brazos River Authority
BOD	Biochemical Oxygen Demand
BST	Bacterial Source Tracking
CRP	Clean Rivers Program
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund (of the TWDB)
CWQMN	Continuous Water Quality Monitoring Network
CZARA	Coastal Zone Act Reauthorization Amendments
DDE	Dichlorodiphenyldichloroethylene
DO	Dissolved Oxygen
DSHS	Texas Department of State Health Services
E. coli	Escherichia coli
EFDC	Environmental Fluid Dynamics Computer Code
EPA	U.S Environmental Protection Agency
FAQ	Frequently Asked Questions
GBEP	Galveston Bay Estuary Program
GBRA	Guadalupe-Blanco River Authority
GIS	Geographic Information System
GLO	General Land Office
HOA	Homeowner Association
H-GAC	Houston-Galveston Area Council
IBWC	International Boundary and Water Commission, U.S. Section
IPD	Interagency Pesticide Database

continued next page

IPM	Integrated Pest Management
I-Plan	Implementation Plan for a TMDL
IR	Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)
lbs	Pounds
LCRA	Lower Colorado River Authority
LDC	Load Duration Curve
LEADS	Leading Environmental Analysis and Display System
LID	Low Impact Development
LRGV	Lower Rio Grande Valley
LULC	Land Use–Land Cover
mg/L	milligram per liter
NOAA	National Oceanic and Atmospheric Administration
NPS	Nonpoint Source
NRCS	USDA – Natural Resources Conservation Service
OSSF	On-Site Sewage Facility
PCBs	Polychlorinated biphenyls
PMP	Texas Groundwater Pesticide Management Plan
POC	Pesticide of Concern
POI	Pesticide of Interest
POE	Public Outreach and Education Subcommittee of the TGPC
PSA	Public Service Announcement
QAPP	Quality Assurance Project Plan
QUAL2K	Stream Water Quality Model
RSI	River Systems Institute at Texas State University-San Marcos
SARA	San Antonio River Authority
SELECT	Spatially Explicit Load Enrichment Calculation Tool
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
SWAT	Soil and Water Assessment Tool
SWCD	Soil and Water Conservation District
SWMM	Storm Water Management Model
SWQM	Surface Water Quality Monitoring
TAMU-K	Texas A&M University-Kingsville
TBET	Texas BMP Evaluation Tool
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 at Tarleton State University
TMDL	Total Maximum Daily Load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSS	Total Suspended Solids
TSSWCB	Texas State Soil and Water Conservation Board
TSWQS	Texas Surface Water Quality Standards
TWDB	Texas Water Development Board
TWRI	Texas Water Resources Institute
UCRA	Upper Colorado River Authority
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WAP	Watershed Action Planning
WASP	Water Quality Analysis Simulation Program
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan
WWTF	Wastewater Treatment Facility

nonprofit