Texas Commission on Environmental Quality

Texas State Soil & Water Conservation Board

NONPOINT SOURCE MANAGEMENT IN TEXAS

2015 ANNUAL REPORT

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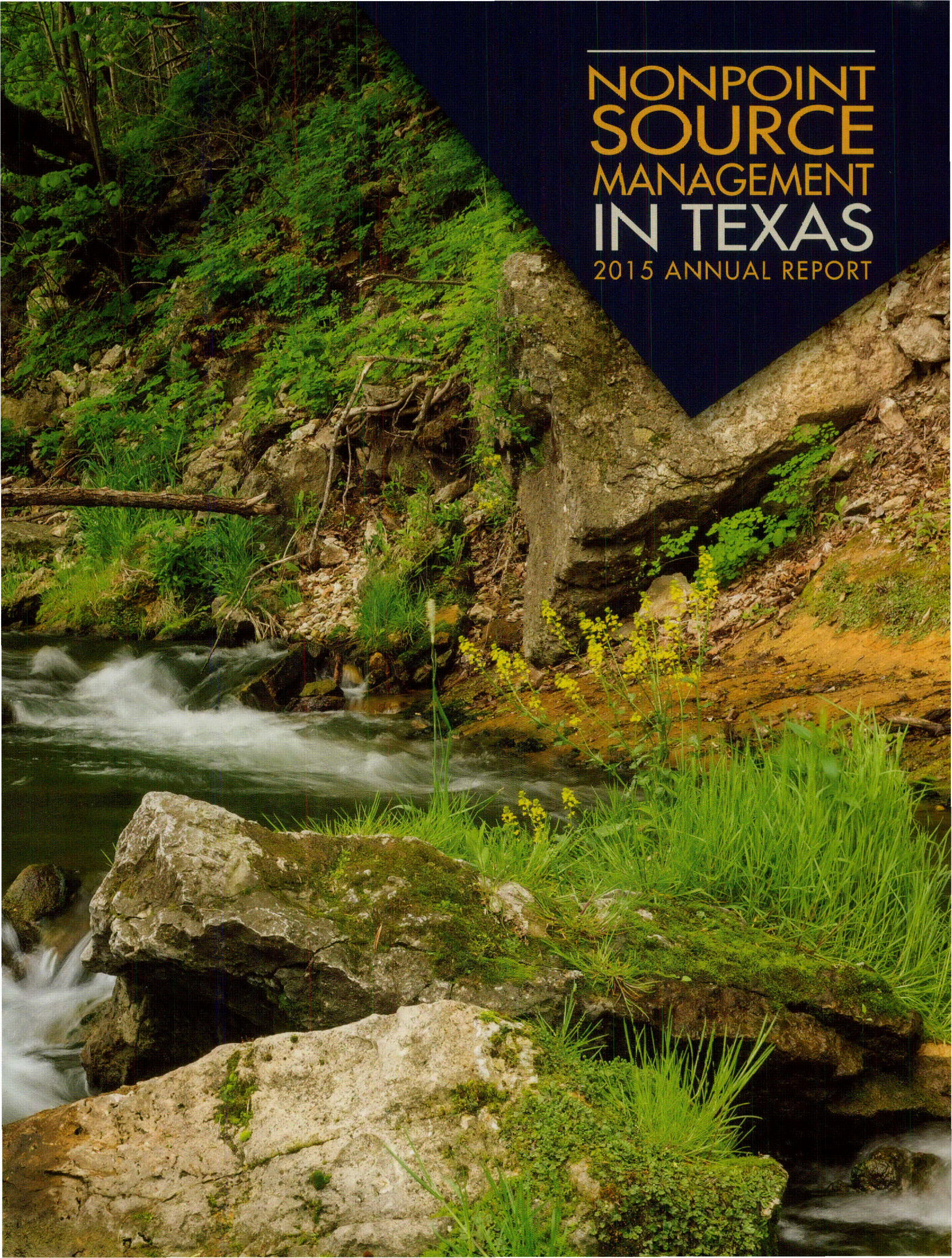

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LETTER FROM THE EXECUTIVE DIRECTORS

The *Nonpoint Source Management Program* outlines Texas' comprehensive strategy to protect and restore waters across the state impacted by nonpoint source pollution. This comprehensive strategy is implemented by utilizing voluntary, regulatory, financial, and technical assistance approaches, while working with a multitude of partners, to achieve a balanced program. The United States Environmental Protection Agency (EPA) provides grant funding to Texas to implement the goals and strategies set forth in the *Texas Nonpoint Source Management Program*. The responsibility for implementing this program is divided between the Texas Commission on Environmental Quality (TCEQ) and the Texas State Soil and Water Conservation Board (TSSWCB).

Texas has consistently worked with partners across the state to develop and implement watershed-based plans to improve water quality. To date, ten watershed-based plans have been accepted by EPA, and more than twenty others are under development across the state. The TSSWCB, the TCEQ, partners, and stakeholders are actively engaged in implementing voluntary management measures identified in the watershed-based plans.

The *Nonpoint Source Management Program* has continued to achieve success over the past year, including recognition by the EPA for restoration efforts and the approval of two "Success Stories." A success story is an EPA featured story about nonpoint source impaired water bodies where efforts have led to documented water quality improvements. The Watershed Action Planning process continues to be integral to the development and implementation of watershed-based plans in Texas by coordinating, documenting, and tracking strategies and activities to protect and improve water quality.

We are pleased to present the *2015 Annual Report* of the state's *Nonpoint Source Management Program*. The report highlights our accomplishments in managing nonpoint source pollution and 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 look forward to the continued implementation of an efficient, accountable, and transparent program.

Sincerely,

Rex Isom
Executive Director
Texas State Soil and
Water Conservation Board

Richard A. Hyde, P.E.
Executive Director
Texas Commission on
Environmental Quality

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Introduction

Defining Nonpoint Source Pollution

Nonpoint source pollution occurs when rainfall or snowmelt flows off the land, roads, buildings, and other features of the landscape. This is unlike point source pollution which results from a discharge at a specific single location. Nonpoint source pollution carries pollutants into drainage ditches, lakes, rivers, wetlands, coastal waters, and even underground sources of water. This also includes the flow of water from sources such as car washing and leaking on-site sewage facilities, commonly known as septic systems. Some nonpoint source 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.

Nonpoint source pollution can also originate as air pollution which is deposited onto the ground and into waterways, through a process called atmospheric deposition. Changes in the flow of waterways due to dams and other hydromodifications can also cause nonpoint source pollution.

What Guides Nonpoint Source Pollution Management in Texas?

Under the federal Clean Water Act (CWA), Texas and other states must adopt water quality standards for waters of 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 Nonpoint Source Management Program* is to protect and restore the quality of the state's water resources from the adverse effects of nonpoint source pollution. This is accomplished through cooperative implementation using the organizational tools and strategies defined below.

Partnerships

The Texas Commission on Environmental Quality (TCEQ) is the lead state agency responsible for establishing the level of water quality to be maintained in Texas. Primary responsibilities include the issuance of permits for point source discharges and abatement of nonpoint source 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 that prevent and abate agricultural and silvicultural nonpoint source pollution. The TCEQ and TSSWCB coordinate closely to jointly administer the *Texas Nonpoint Source Management Program*.

Management of nonpoint source pollution in Texas involves partnerships with many organizations to coordinate, develop, and implement the *Texas Nonpoint Source Management Program*. With the extent and variety of nonpoint source issues across Texas, cooperation across political boundaries is essential. Many local, regional, and state agencies play an integral part in managing nonpoint source pollution. They provide information about local concerns and infrastructure and build support for the management measures that are necessary to prevent and reduce nonpoint source pollution. By coordinating with these partners to share information and resources, the state can more effectively manage its water quality protection and restoration efforts.

The Texas Nonpoint Source Management Program

Nonpoint source pollution contributes to water quality impairments in the water bodies of Texas. In the 2012 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d), nonpoint source pollution was associated with approximately 45% of the water quality impairments for rivers and streams and 42% of the water quality impairments for lakes in Texas. The *Texas Nonpoint Source Management Program* was developed to outline Texas' comprehensive strategy to protect and restore waters impacted by nonpoint source pollution. Nonpoint source pollution is managed through assessment, planning, implementation, and education. The state has established long- and short-term goals and

objectives for guiding and tracking the progress of its nonpoint source management program. This report highlights the success in achieving these goals and objectives.

The Environmental Protection Agency's (EPA's) Nonpoint Source Program provides CWA Section 319(h) federal grant funds to states. The grant funds can support a wide variety of activities including implementation of best management practices (BMPs), technical assistance, financial assistance, education, training, technology transfer, and monitoring to assess the success of specific nonpoint source implementation projects. In fiscal year 2015, Texas received $7,131,800 in CWA Section 319(h) federal grant funds to utilize and award to subgrantees across the state.

Goals for Nonpoint Source Management

Long-Term Goal

The long-term goal of the *Texas Nonpoint Source Management Program* is to protect and restore water quality affected by nonpoint source pollution through implementing the following short-term goals; data collection and assessment, implementation, and education.

Short-Term Goals

Goal One—Data Collection and Assessment

Coordinate with appropriate federal, state, regional, and local entities, and stakeholder groups to target water quality assessment activities in high priority, nonpoint source-impacted watersheds, vulnerable and impacted aquifers, or areas where additional information is needed.

Goal Two—Implementation

Implement watershed protection plans and/or Total Maximum Daily Load (TMDL) implementation plans and other state, regional, and local plans to reduce nonpoint source pollution by targeting activities in the affected areas.

Goal Three—Education

Conduct education and technology transfer activities to increase awareness of nonpoint source pollution and activities that contribute to the degradation of water bodies, including aquifers.

The Watershed Approach

Protecting the state's streams, lakes, bays, and aquifers from the impacts of nonpoint source 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:

- a geographic focus based on hydrology rather than political boundaries;
- water quality objectives based on scientific data;
- coordinated priorities and integrated solutions; and
- 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 for Water Quality Restoration**

Watershed Action Planning

A major element in the *Texas Nonpoint Source Management Program* is the inclusion of the Watershed Action Planning (WAP) process and the Priority Watersheds Report. The WAP process is an initiative of the water quality programs in the state that guides statewide water quality planning. Management strategies to address water quality issues are selected through a collaborative approach and documented in the Priority Watersheds Report. This comprehensive planning fosters relationships and facilitates greater coordination and leveraging of resources.

Funding challenges, new guidelines, increasing populations, and evolving environmental policies create new challenges for the state water quality planning programs. These challenges elevate the importance of incorporating the WAP process in the Nonpoint Source Program to direct funding to watersheds with nine-element watershed-based plans. The WAP process encourages planning of watershed-based plans prior to implementation in order to ensure that nonpoint source funds are spent efficiently and targeted towards well-planned projects.

The WAP process supports the integration of state water quality planning programs by providing a framework and a mechanism for enhanced coordination among state water quality planning programs and stakeholders. Coordination at the local level allows stakeholders the opportunity to provide a local perspective into water quality management strategies and priorities. Interagency coordination at the state and federal level allows for more effective development of projects, leveraging of resources, and the implementation of water quality management strategies with stakeholder support.

The WAP process integrates information from existing planning tools and from the coordination process to develop and track water quality management strategies. As part of the WAP process, water quality management strategies are documented and periodically updated with the cooperation of the WAP partners which include the TSSWCB, the Clean Rivers Program partners (typically river authorities), and the five TCEQ Water Quality Planning Division program areas—Texas Surface Water Quality Standards Group, Surface Water Quality Monitoring Program, Clean Rivers Program, TMDL Program, and the Nonpoint Source Program. Information collected includes the water quality impairment or special interest, activities to address the water quality issue (i.e. which strategy will be applied), the current status of that strategy, and the lead entity responsible for implementing the strategy. The recommended strategies are documented in the WAP Table, a spreadsheet summarizing the water quality management information. The WAP Table is available to the public and located on the TCEQ's website at: <http://www.tceq.texas.gov/waterquality/planning/wap/>. An interactive, web-based application is currently being developed to replace the existing WAP Table spreadsheet and will become available in the next year.

Water quality management strategies identified through the WAP process are implemented on a continuing basis. Since 2012, the WAP process has helped in the prioritization of water bodies for restoration efforts, the collection of water quality data, the adoption of TMDLs, and the completion of watershed protection plans.

CHAPTER 2

Progress in Improving Water Quality

Section 319(h) of the CWA requires that state nonpoint source 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 nonpoint source pollution control actions in order to "...attain or maintain applicable water quality standards or the goals and requirements of the Clean Water Act." The three primary ways of measuring improvement in water quality are through:

- measuring actual results from implementing management measures;
- calculating estimated load reductions with the help of models or other calculations; and
- long-term monitoring of the water body.

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 habitat and reduced use of fertilizers and pesticides.

Reductions in Pollutant Loadings

Arroyo Colorado Low Impact Development Projects

Texas A&M University-Kingsville received CWA Section 319(h) funds through the TCEQ to partner with multiple cities in the Lower Rio Grande Valley (LRGV) to construct Low Impact Development (LID) demonstration projects in strategic locations and monitor the water quality benefits. LID concepts, ideas, and strategies were promoted throughout the LRGV and a template of a municipal ordinance was developed and shared with cities. BMPs which support LID practices were installed at nine different demonstration sites. Table 2.1 provides descriptions of the LID demonstration sites.

Table 2.1 **LID Demonstration Sites in the Arroyo Colorado Watershed**

Project Lead	Site	Description
Valley Nature Center	Valley Nature Center (Weslaco)	A rain water harvesting system, green roof, pervious walking trails, pervious service road, and a treatment wetland with native and riparian plantings were constructed.
City of La Feria	City of La Feria Indoor Recreation Center	A pervious parking lot and bioswale were included in the construction.
City of Brownsville	Monte Bella Trail Park	A pervious parking lot, walking trails, a bioswale, and a rain water collection system were installed.
City of San Juan	Amigos Del Valle Building	A green roof, rain water collection system, rain garden, and bioswale were installed during a building retrofit.
City of Alton	City of Alton Fire Station	A pervious pavement parking lot was included in the construction.
City of Weslaco	City of Weslaco Public Library	A rainwater harvesting system was installed.
Cameron County Drainage District #1	Cascade Park (Brownsville)	Bioretention areas, wetlands for biofiltration, pervious pavement, and a rain water harvesting system were installed.
City of La Joya	City of La Joya Library	A pervious parking lot was installed.
City of Alamo	City of Alamo Sports Complex	A pergola with solar panels, a rainwater harvesting system, a rain garden surrounding a storm drain, and a pervious trail were installed.

The hydrologic and water quality performance of BMPs was monitored from March 2014 to March 2015. The estimated annual load reductions for seven sites are as follows:

Site	Sediment (lbs)	Nitrogen (lbs)	Phosphorus (lbs)	BOD (lbs)	*E. coli* (MPN*)
Valley Nature Center	6,723	1.8	1.4	218	ND
City of La Feria	48	ND	ND	4.3	$2.8x10^9$
City of Brownsville	667	ND	ND	3.7	$8x10^9$
City of San Juan	67	7.3	2.2	ND	$3x10^9$
City of Weslaco Library	5.4	ND	ND	ND	ND
South Texas College	558	ND	ND	573	$1.8x10^9$
Cameron County Drainage District #1	112	ND	1.1	15	$1.1x10^9$

**MPN: Most Probable Number are units used for enumeration of E.coli colonies.*

Additional information on water quality improvement efforts in the Arroyo Colorado watershed can be found at <http://arroyocolorado.org/>.

Retrofitted Valley Nature Center *(Source: Texas A&M University-Kingsville)*

Low Impact Development Practices in League City

The City of League City, through partnerships with the Texas A&M AgriLife Extension Service, Texas Sea Grant, the TCEQ's Galveston Bay Estuary Program (GBEP), and the TCEQ's Nonpoint Source Program created the 3.75 acre Ghirardi Family WaterSmart Park in the Clear Creek watershed. This park has traditional park amenities including a pavilion, walking trails, and a playground. In addition, League City received CWA Section 319(h) funding through the TCEQ to install seven stormwater BMPs which were integrated into the design of the park to demonstrate how LID reduces pollutants entering the creek. Clear Creek is impaired for elevated concentrations of bacteria and low concentrations of dissolved oxygen.

The following stormwater BMPs were installed:

- 270 square foot green roof,
- 125 square feet of rain gardens,
- 560 square feet of pervious paver parking area,
- 500 gallon rain water harvesting cistern,
- 1,120 square foot drainage swale,
- 900 square foot vegetated buffer, and
- 575 square foot compost-on-turf-grass demonstration plot.

These BMPs were selected because they are appropriate for home and commercial landscapes, and can easily be used to treat stormwater in new and existing developments.

The park allows developers, city staff, community officials, and residents to view functioning BMPs, learn how they fit into the landscape, and see how they can work together to form a treatment train. This facility operates as a living laboratory, where all of the practices can be studied throughout their lifecycle. League City Park staff were provided a maintenance handbook and trained in caring for the installations. Citizens and local stakeholders were informed about the project. Presentations were given throughout the watershed during park construction and a community workshop about possible incentives to install BMPs was conducted.

A monitoring program was established to assess the ability of the installed BMPs to reduce bacteria, nitrogen, and phosphorus loads into Clear Creek. Water samples were collected to measure the level of pollutants both before and after passing through each BMP. The results of the monitoring

program suggest that the effectiveness of the BMPs varied significantly. However, the three sampling events which were conducted may not provide a complete evaluation of the BMPs at the site. Nitrogen levels were reduced by the vegetated swale and the green roof; phosphorus levels were reduced by the vegetated swale and rainwater harvesting practices; and suspended solids were reduced by the vegetated swales, the green roof, and the rainwater harvesting practices. Additional information about the Ghirardi WaterSmart Park can be found at <http://leaguecity.com/index.aspx?NID=1701>.

Implementing Best Management Practices in the Plum Creek Watershed

The Plum Creek watershed spreads across Hays and Caldwell counties as well as a small portion of Travis County and drains into the San Marcos River. To address bacteria levels and reduce nonpoint source pollution, a watershed protection plan was developed in 2008.

The Plum Creek Watershed Protection Plan calls for the voluntary adoption of agricultural BMPs. The Caldwell-Travis Soil and Water Conservation District (SWCD) received a CWA Section 319(h) grant through the TSSWCB to provide technical and financial assistance to implement BMPs on agricultural land in the watershed.

Over the last fiscal year, four water quality management plans (WQMPs) were developed and implemented on a total of 602 acres. The BMPs installed include: a water well, pipeline, watering facility, cross fencing, prescribed grazing, herbaceous weed control, nutrient management, and heavy use area protection. Based on the Texas Best Management Practices Evaluation Tool (TBET) these BMPs provided the following load reductions over the past fiscal year:

Sediment	4.9 tons
Nitrogen	1,487 lbs
Phosphorus	463 lbs

Additional information about the water quality improvement efforts in the Plum Creek watershed can be found at <http://plumcreek.tamu.edu/>.

Lower Colorado River Authority's Creekside Conservation Program

The Lower Colorado River Authority (LCRA) received a CWA Section 319(h) grant from the TSSWCB to implement the Creekside Conservation Program. This program is a partnership between LCRA, private landowners, the United States Department of Agriculture - Natural Resources Conservation Service (NRCS), and local SWCDs. The Creekside Conservation Program provides technical and financial assistance to help reduce soil erosion and agricultural nonpoint source pollution on privately owned land. The program was conducted in Bastrop, Blanco, Burnet, Colorado, Fayette, Lampasas, Llano, Matagorda, San Saba, Travis, and Wharton counties.

As a result of this effort 2,014 acres were placed under conservation management and prescribed grazing and upland wildlife habitat management practices. Additional BMPs installed include a grade stabilization structure, 59 acres of range reseeding, and 390 acres of brush management. Additionally, prescribed grazing and upland wildlife habitat management practices were implemented on all 2,014 acres. Based on the TBET, these BMPs achieved the following load reductions:

Sediment	1,009 tons
Nitrogen	3,679 lbs
Phosphorus	574 lbs

In the last year, LCRA published a news article on its website featuring one of the project participants and held a guided ranch tour on another participant's property. LCRA also hosted two field tours and two workshops in the program area with a total of 250 attendees. Additional information regarding LCRA's Creekside Conservation Program may be found at < http://www.lcra.org/community-services/land-conservation>.

Water Quality Improvements

The TSSWCB and the TCEQ work together to identify water quality improvements where the implementation of nonpoint source BMPs is a contributing factor. Once a strong candidate is identified, a "success story" is written and sent to the EPA for approval. Linking instream nonpoint source pollutant reductions to land management practices is challenging. Changes to the land can occur over varying temporal and spatial scales and contributions to the stream are rainfall driven. As a result, changes in water quality often lag behind the implementation of nonpoint source BMPs, and many years of implementation may be needed before significant improvements in a water body are observed. Despite these challenges, Texas continues to see measurable water quality improvements.

Success Story Highlights

Stormwater Best Management Practices Improve Water Quality for Aquatic Life Use in the Concho River

The North Concho River runs through the City of San Angelo, and is impacted by urban runoff. Sedimentation and nutrient

enrichment problems associated with urban runoff along with low flow have had a detrimental effect on the aquatic life in the Concho River. Segment 1421_07, a five mile section of the Concho River, was placed on the state's 2002 303(d) list of impaired waters for failing to meet the water quality standard for macrobenthic communities. This impairment was associated with high nutrient and sediment concentrations coming from Segment 1421_08, which is directly upstream of Segment 1421_07. Macrobenthic organisms are sensitive to changes in water quality and nonpoint source pollutants, making them an indicator species of the overall health of a water body. Sediment loading into the North Concho River impedes macrobenthic habitats downstream and disrupts the organisms' ability to filter feed. The TCEQ, TSSWCB, Upper Colorado River Authority, and City of San Angelo implemented several BMPs and programs in San Angelo to minimize nutrient and sediment loading into the North Concho River.

Best Management Practices

A gabion retention structure, aimed at managing stormwater runoff, was constructed at the Civic League Park in San Angelo in 1998. This was the first of many structural BMPs built using CWA Section 319(h) funding. The construction of two additional BMPs, a "wet" retention pond at Brentwood Park and a "dry" detention pond at Santa Rita Park, was completed in 2001. An innovative BMP was completed in 2007 on the North Concho River in downtown San Angelo. It diverts runoff to a gravity-based stormwater cleaning device. After stormwater is gravity-separated and filtered, high quality effluent from the system is discharged into the river or pumped into nearby "living laboratory" demonstration ponds. A watershed protection plan for the entire Concho River watershed was developed by the Upper Colorado River Authority, and completed in 2008. Components of the plan included a public stakeholder outreach and education program, water quality monitoring, and implementation of BMPs to improve water quality. As part of an expanded public education effort, in 2008 the Concho River Basin Aquatic Research & Education Center was built. The Center has been the site of continuous workshops informing the public on nonpoint source BMPs.

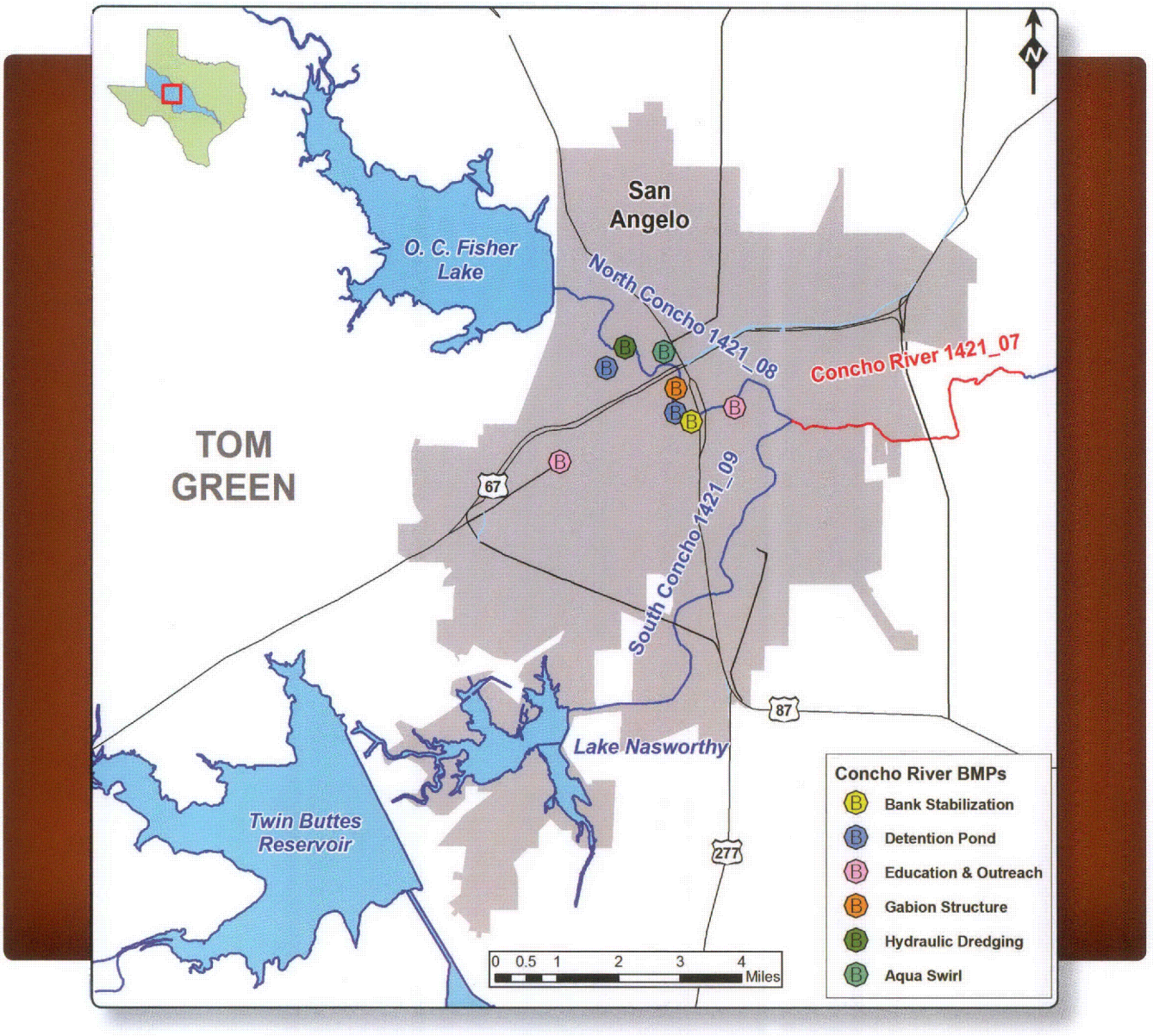
The most recent BMPs implemented are the hydraulic dredging of the North Concho River, completed in 2010, followed by stabilization of select sections of the bank in 2011. These improvements removed silt and sediment from the river and stabilized areas of bank deterioration, thereby mitigating sloughing and erosion that contribute to streambed deposition of sediment.

Water Quality Improvement

Approximately 3,273 tons of sediment and debris have been removed from stormwater through the gravity-based stormwater cleaning device and bank stabilization projects implemented in downtown San Angelo. The gabion structure at Civic League Park removed 36,000 lbs of sediment and organic matter in its first year. Through monitoring, the Brentwood retention pond has been found to remove 99% of total suspended solids, 85% of the biochemical oxygen demand, and 98% of fecal coliform from stormwater entering the river. The hydraulic dredging project removed roughly 1.43 million cubic feet of silt from the river and added over 10 million gallons of storage capacity. Water quality data indicate that concentrations of sediment and phosphorus have

North Concho River with bank stabilizing BMPs

Figure 2.1 **Map of BMP Locations in the Concho River Watershed**



decreased in the North Concho River directly upstream of the segment. The aquatic life integrity of Segment 1421_07 was re-assessed in 2008-2009, and showed that the macrobenthic community was healthy and met water quality standards once again. This resulted in the water body being removed from the 303(d) list in 2012.

Tenaha Creek Arm of Toledo Bend Reservoir

Toledo Bend Reservoir is on the Texas–Louisiana border and was created by impounding the Sabine River. The Tenaha Creek Arm (Segment 0504_06), of the Toledo Bend Reservoir is fed by Tenaha Creek, which extends northwest into Shelby County, Texas. The watershed is dominated by mixed hardwood and softwood forests, known as the Pineywoods of Texas. Agriculture and silviculture are the main land uses in the watershed. The Tenaha Creek Arm of the Toledo Bend Reservoir was added to the 303(d) list of impaired waters in 2000 for not supporting its aquatic life use due to low dissolved oxygen levels.

Low dissolved oxygen levels can be caused by elevated nutrient levels that result in algal blooms and other oxygen-demanding materials decomposing in the water. Agricultural and silvicultural operations in the watershed have the potential to be a source of nutrient loading if they are not properly managed.

To meet the state's water quality standards for dissolved oxygen, Toledo Bend Reservoir must maintain a 24-hour average dissolved oxygen concentration above 5.0 milligrams per liter (mg/L), and a 24-hour minimum dissolved oxygen concentration above 3.0 mg/L in all parts of the reservoir.

BMPs Implemented

Beginning in 2001, the TSSWCB partnered with the Shelby County SWCD and local landowners to voluntarily implement BMPs such as waste utilization, nutrient management, and grazing management on agriculture lands in the Toledo Bend Reservoir watershed.

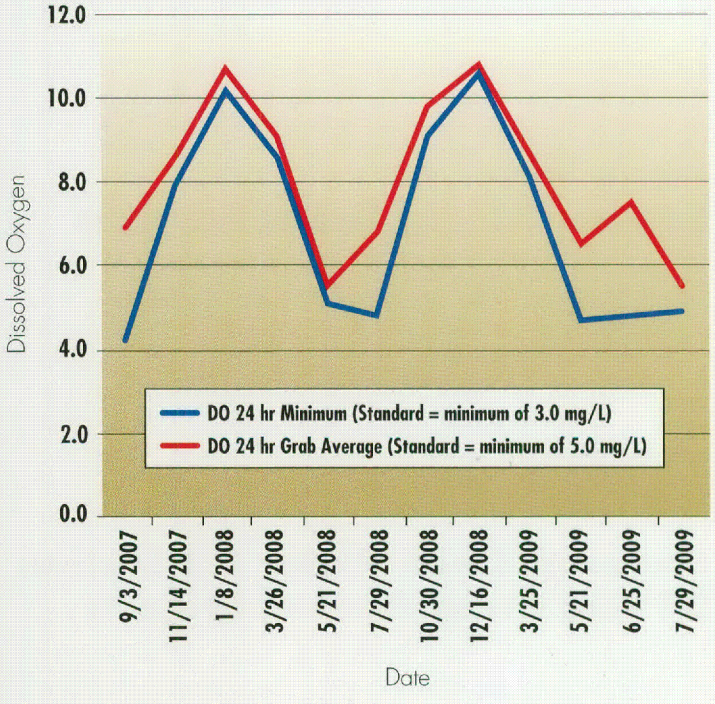
Specifically, in the Tenaha Creek watershed, a total of 26 WQMPs were developed on agricultural operations covering 4,155 acres. The U.S. Department of Agriculture NRCS developed conservation plans on 31,142 acres, with practices consisting of nutrient management, poultry mortality management, forestry practices, and grazing management on agricultural and silvicultural operations in the watershed.

In addition, from 2002 to 2009, the TSSWCB partnered with the Texas A&M Forest Service to administer the Texas Silviculture Nonpoint Source Abatement project. This effort included forestry BMP education and technical assistance for foresters, landowners, and loggers, in coordination with local, state, and federal agencies, as well as forestry BMP effectiveness monitoring.

Water Quality Improvements

Water quality monitoring data from 2007–2009 at station 20283, located on the Tenaha Creek Arm of Toledo Bend Reservoir, showed the 24-hour average and the minimum value for dissolved oxygen levels were above 5.0 mg/L and 3.0 mg/L, respectively, indicating that the water body complied with the state's water quality standards (Figure 2.2). As a result, the TCEQ removed the Tenaha Creek Arm of the Toledo Bend Reservoir from the state's 303(d) list of impaired waters in 2010.

Figure 2.2 **Dissolved Oxygen for the Tenaha Creek Arm of the Toledo Bend Reservoir**



The success of this effort is attributed to the voluntary implementation of BMPs by landowners and the use of education and outreach paired with technical assistance. Landowners have continued to implement agricultural BMPs with assistance from the TSSWCB, Shelby County SWCD, and the NRCS after the segment was delisted. This, along with continued forestry BMP education and implementation, will ensure the continuing success of this restoration effort. The full story and more information can be found on EPA's website at <http://www.epa.gov/sites/production/files/2015-12/documents/tx_toledo.pdf>

CHAPTER 3

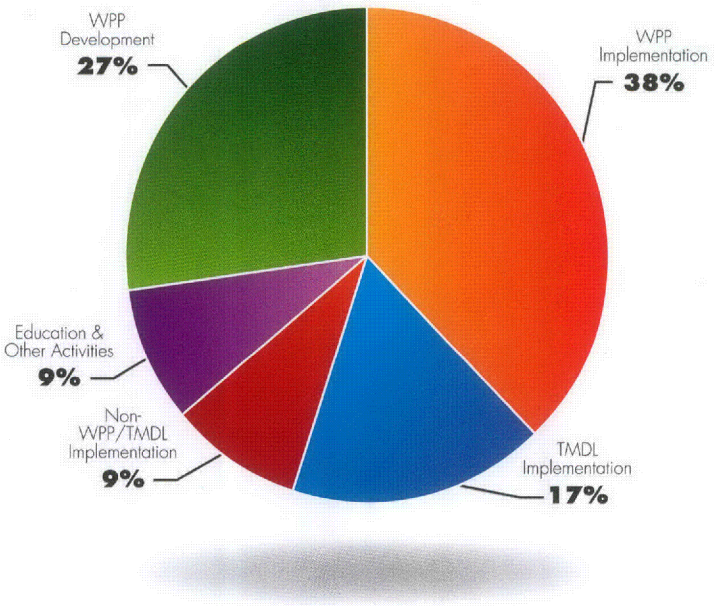
Progress Toward Meeting the Goals and Objectives of the Texas Nonpoint Source Management Program

The TCEQ and the TSSWCB have established goals and objectives for guiding and tracking the progress of nonpoint source management in Texas. The goals describe high-level guiding principles for all activities under the *Texas Nonpoint Source 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 Nonpoint Source 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 nonpoint source activities consistent with the long- and short-term goals defined in the *Texas Nonpoint Source Management Program*.

Figure 3.1 **TCEQ Fiscal Year 2015 Nonpoint Source Grant Funds**



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

In fiscal year 2015, the TCEQ had 33 active CWA Section 319(h) grant-funded projects totaling approximately $10.5 million, which addressed a wide range of nonpoint source issues (Figure 3.1). A primary focus of these projects was the development and implementation of watershed protection plans to address urban nonpoint sources, targeted outreach and education, LID projects, and TMDL implementation activities.

In fiscal year 2015, the TSSWCB had 35 active CWA Section 319(h) grant-funded projects totaling approximately $9 million, which addressed both agricultural and silvicultural nonpoint source pollution (Figure 3.2). Specific projects include developing and implementing watershed protection plans, implementing TMDLs, supporting targeted educational programs, and implementing BMPs to abate nonpoint source pollution from agricultural and silvicultural operations.

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

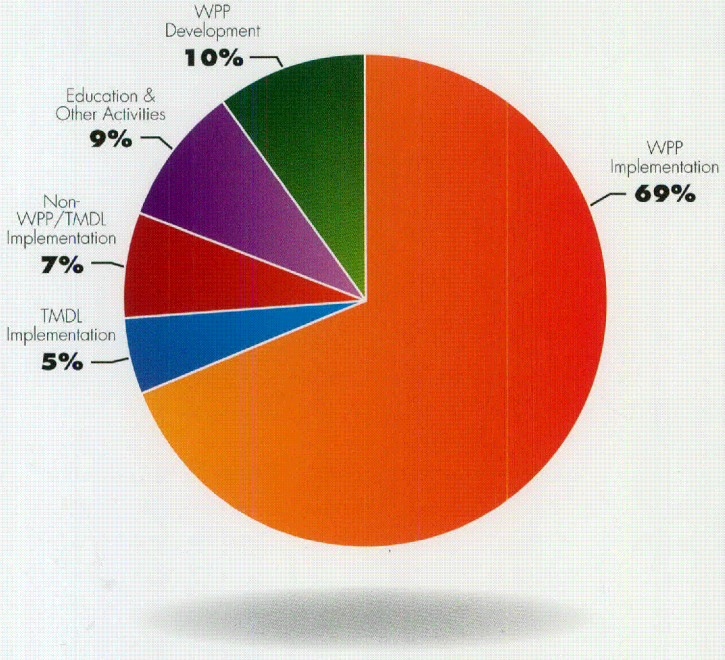
Goal One—Data Collection and Assessment

One of the goals of the *Texas Nonpoint Source 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 Program, operating from the Austin central office and 16 regional offices,

conducts both routine ambient monitoring and special studies. In addition, the Clean Rivers Program, which is 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 uses or if water quality improvement activities are achieving their intended goals. For impaired waters, water quality data can be used in the development of watershed protection plans and TMDLs. Data are also used to determine potential sources of pollution and the adequacy of regulatory measures, watershed improvements, and restoration plans. The data collection guides the distribution of CWA Section 319(h) grant funds toward water quality assessment activities in high priority watersheds, nonpoint source-impacted watersheds, vulnerable and impacted aquifers, or areas where additional information is needed.

Figure 3.2 **TSSWCB Fiscal Year 2015 Nonpoint Source Grant Funds**



Texas Integrated Report

Section 305(b) of the CWA requires all states to assess the quality of surface waters every two years. The TCEQ meets this requirement by producing the Integrated Report every two years in even-numbered years. The Integrated Report describes the status of all surface water bodies of the state evaluated for the given assessment period. The TCEQ uses data collected during the most recent seven to ten year period to assess the quality of surface water bodies of the state. The descriptions of water quality for each assessed water body in the Integrated Report represent a snapshot of conditions during the time period considered in the assessment. Water bodies identified as impaired by nonpoint source pollution are given priority for CWA Section 319(h) grants and other available funding through the WAP process. The assessment guidance includes methods to determine designated use attainment for water quality standards. These methods are developed by the TCEQ with the advice of a diverse group of stakeholders. The 2014 Integrated Report was approved by the TCEQ in June 2015 and by the EPA in November 2015. The assessment methods for the 2014 Integrated Report are detailed in the *2014 Guidance for Assessing and Reporting Surface Water Quality in Texas* (available online at <http://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/14txir/2014_guidance.pdf>).

Water Quality Status Categories

The Integrated Report 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 the 2014 Integrated Report.

The 303(d) list (Category 5 of the Integrated Report) identifies waters that do not meet Texas surface water quality standards. It is an important management tool produced as part of the Integrated Report. The 303(d) list must be approved by the EPA. Water bodies on the 303(d) list are those that require action to restore water quality. An impairment occurs when a water body does not meet a pollutant standard for a specific use. The same assessment unit can have multiple impairments. For example, a water body may not meet the standard for both dissolved oxygen and bacteria; this is considered two impairments. 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. 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.

The Integrated Report further divides Category 5 water bodies into subcategories to reflect additional options for addressing impairments:

- Water bodies in Category 5a have a TMDL underway, scheduled, or to be scheduled.
- Water bodies in Category 5b require a review of the water quality standards for the water body to be conducted before a management strategy is selected.
- Those water bodies in Category 5c require additional data and information to be collected or evaluated before a management strategy is selected.

Table 3.1 Number of Water Bodies Assigned to Each Assessment Category in the 2014 Integrated Report

Category	Definition	Number of Water Bodies
1	Attaining all the water quality standards and no use is threatened.	85
2	Attaining some of the designated uses, no use is threatened, and insufficient or no data and information are available to determine if the remaining uses are attained or threatened.	336
3	Insufficient or no data and information to determine if any designated use is attained. Many of these water bodies are intermittent streams and small reservoirs.	127
4	The standard is not supported or is threatened for one or more designated uses but does not require the development of a TMDL.	104
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. Category 5 is the CWA Section 303(d) List.	401
Total		**1053**

Table 3.2 shows the total number of impairments in the 2014 Integrated Report broken down by the category designation. The categories must be applied to each combination of water body and parameter for determining support.

Table 3.2 Number of Impairments in the 2014 Integrated Report

Category	Definition	Water Body Classification		Total Number of Impairments by Category
		Classified	Unclassified	
5	5a—TMDL scheduled or underway	77	55	132
	5b—Water Quality standards review scheduled or under way or undergoing Use Attainability Analysis	55	118	173
	5c—Need additional monitoring	162	127	289
Total Number of Impairments in Category 5		**294**	**300**	**594**

Summary of the 2014 Integrated Report

The 2014 Integrated Report assessed the water quality of 1,409 water bodies. Sufficient data was available to assess uses for 1,053 water bodies which resulted in 589 impairments (Table 3.3). Of the 1,409 water bodies, 401 were classified as Category 5 water bodies (Table 3.1) with a total of 594 impairments (Table 3.2). The number of impairments by category shown in Table 3.2 is greater than the number of impairments shown in Table 3.3 for 2014 because a segment may have assessment units in different subcategories of Category 5. The number of water bodies classified as Category 5 was a slight decrease from the 2012 CWA Section 303(d) list, which included 410 water bodies, while the total number of impairments increased from 568.

Summary of Impairments on the 2014 Integrated Report

Impairments identified in the 2014 Integrated Report have been grouped by the parameter and the beneficial use of the water body affected (Table 3.3). Elevated levels of bacteria represent the majority of the listed impairments. Many of these bacteria impairments are the result of urban and agricultural nonpoint source pollution. Low dissolved oxygen, impairing many of the same water bodies was also found to be a leading cause of impairments.

Table 3.3 **Summary of Impairments in the 2012 Versus 2014 Integrated Report**

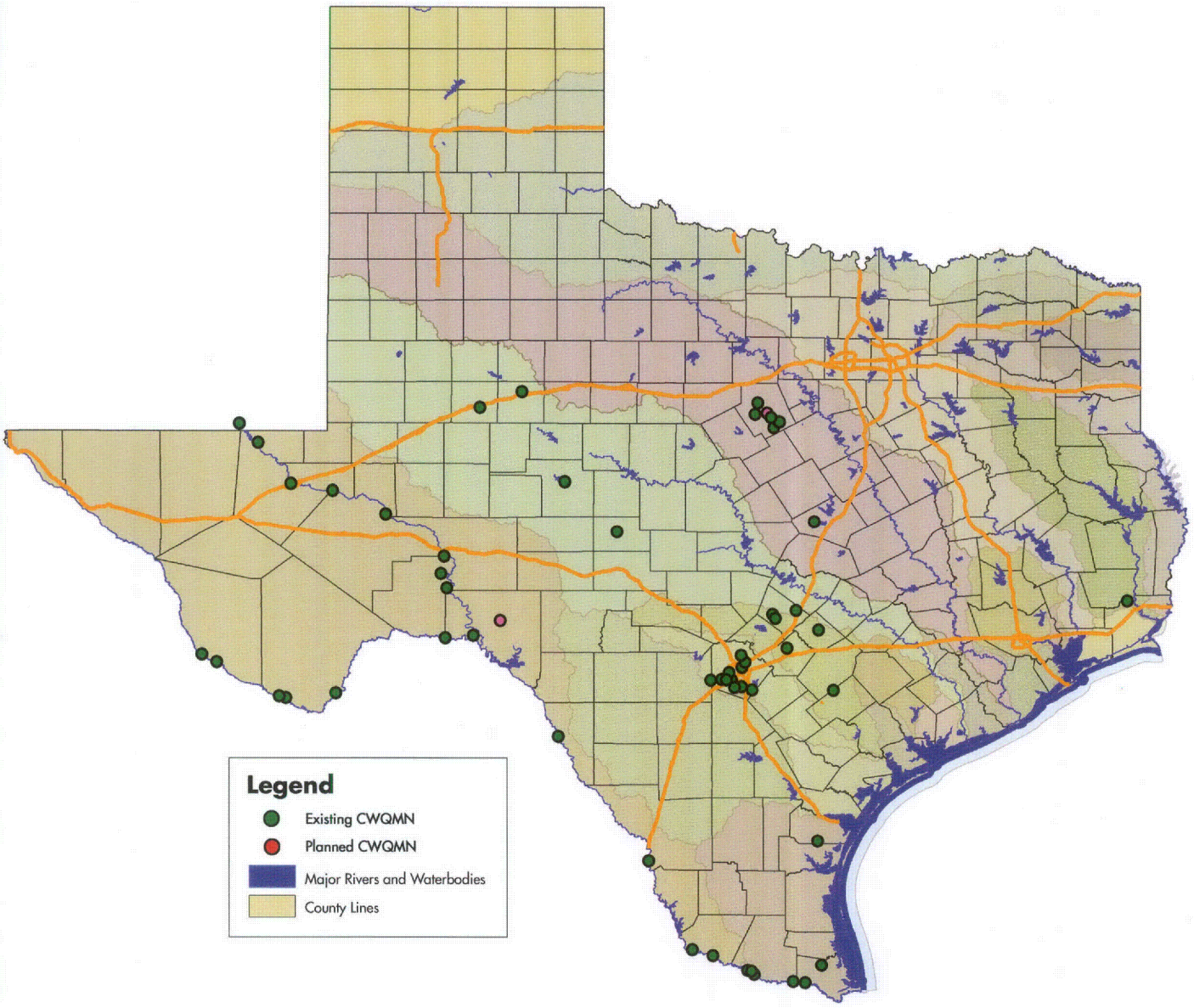
Impairment Group	Media	2012 Number of Impairments	2014 Number of Impairments	Use
Bacteria	in water	257	243	recreation
	in water	0	2	general use
	in shellfish	15	8	oyster waters
	beaches	1	2	beach use
Dissolved oxygen	in water	90	96	aquatic life
Toxicity	in ambient water	2	2	aquatic life
	in ambient sediment	6	6	
Organics	in water	0	0	fish consumption, aquatic life
	in fish or shellfish	99	114	
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	23	24	
Dissolved solids	chloride	11	17	general
	sulfate	9	12	
	total dissolved solids	14	18	
Temperature	in water	0	1	general
pH	in water	17	17	general
Nutrients	nitrogen	0	0	general, public water supply
Biological	habitat, macrobenthic community, or fish community	19	20	aquatic life
Totals		**568**	**589**	

Continuous Water Quality Monitoring

The TCEQ has a network of continuous water quality monitoring sites on priority water bodies. The agency maintains 50-60 sites in its Continuous Water Quality Monitoring Network (CWQMN) as shown in Figure 3.3. The number and locations of sites varies from year to year. In the summer of 2015, the TCEQ had 53 active sites. At these sites, instruments measure basic water quality conditions every 15 minutes. CWQMN monitoring data may be used by the TCEQ or other organizations to make water resource management decisions, target field investigations, evaluate the effectiveness of water quality management programs such as TMDL implementation plans and watershed protection plans, characterize existing conditions, and evaluate spatial and temporal trends. Site information and data are available online at <http://www.texaswaterdata.org>. The monitoring network is used to guide decisions on how to better protect certain rivers and lakes.

In 2015, TCEQ removed four nutrient analyzer sites in the North Bosque River watershed and deployed five Environmental Monitoring and Response System sites. These stations help the TCEQ Stephenville Field Office prioritize field activities. The sites were redeployed with sensors designed to measure electrical conductivity, water temperature, and water levels. Specific conductance (calculated from electrical conductivity and temperature) has been found to correlate well with total nutrient concentrations (nitrate + ammonia + phosphate). As a result, trigger levels for specific conductance have been established, and notifications are sent to the Stephenville Field Office when high readings occur.

Figure 3.3 **Continuous Water Quality Monitoring Stations**



Texas Stream Team Monitoring

Texas Stream Team is a statewide network of citizen scientists, and partner organizations that is dedicated to monitoring water quality through data collection, stakeholder engagement, and watershed education. The program is based out of The Meadows Center for Water and the Environment at Texas State University, and is administered through a cooperative CWA Section 319(h) grant funded partnership with The Meadows Center for Water and the Environment, the TCEQ, and the EPA.

Texas Stream Team citizen scientists are certified under a training process to collect water quality parameters from assigned sites along rivers, lakes, and streams. The water quality parameters include temperature, pH, dissolved oxygen, specific conductance, water turbidity, *E. coli*, nitrate-nitrogen, orthophosphate, and field observations. The data are collected in accordance with an approved Quality Assurance Project Plan. After undergoing a quality assurance check, the data are posted onto Texas Stream Team's Dataviewer, <https://aqua.meadowscenter.txstate.edu/>, an interactive database/map, where visitors can click on a specific site and download the historical water quality data that have been collected.

Watershed-wide data are also compiled and analyzed in summary reports which are available to partner organizations, local water resource managers, local stakeholders, citizen scientists, and the general public in order to give a more complete picture of the quality of local water bodies. In fiscal year 2015, Texas Stream Team published summary reports of citizen scientists' data in the Salado Creek, Geronimo Creek, Carters Creek, and Lake Worth watersheds.

In fiscal year 2015, Texas Stream Team and its partners trained 449 volunteers in water quality monitoring. These citizen scientists volunteered 4,390 hours of their time and conducted 2,313 monitoring events on rivers, lakes, and streams across Texas. Many of these monitoring events took place on water bodies where there is a watershed protection plan such as Geronimo Creek and Cypress Creek, or where a TMDL is being implemented such as Carters Creek. The data collected by citizen scientists helps watershed coordinators and stakeholders to better understand the environmental conditions of their waters.

Texas Stream Team, in conjunction with its partner REI, trains citizen scientists to monitor from kayaks as part of the Texas Stream Team Paddlers Program on Lady Bird Lake in Austin, Texas. *(Source: Texas Stream Team)*

Goal Two—Implementing Programs to Reduce Nonpoint Source Pollution

The second goal of the *Texas Nonpoint Source Management Program* is to implement activities that prevent and reduce nonpoint source pollution in surface water, groundwater, wetlands, and coastal areas. Activities include the implementation of watershed protection plans, TMDL implementation plans, the Texas Groundwater Protection Strategy, the development of TSSWCB-certified WQMPs, implementation of BMPs on agricultural and silvicultural lands, and other identified priorities.

Implementation Project Highlights

LID in an Urban Setting—Dallas

Urban nonpoint source runoff from the Dallas/Fort Worth metropolitan area contributes to pollution in the Upper Trinity River, which is listed as impaired for *E. coli*, and is showing increasing concentrations of nitrate, orthophosphate, and total phosphorus. The metropolitan area is projected to increase in population, from 6.6 million in 2010 to 13 million by 2060. The impervious cover is also likely to increase. This will affect the region's hydrology by causing increased runoff volume, and increased peak runoff flow. These increases could deteriorate water quality. LID practices have been gaining momentum as a possible solution to reduce urban nonpoint source pollution and mimic the natural pre-development hydrology of a site.

Texas A&M AgriLife Research received a CWA Section 319(h) grant from TCEQ to design, construct, and evaluate five LID BMPs at its Research and Extension Center in Dallas, a site typical of commercial development in the Upper Trinity watershed. The five BMPs were a bioretention area, permeable pavement area, rainwater harvesting, green roofs, and meandering detention ponds.

Bioretention systems provide stormwater treatment through fine filtration, extended detention, and biological uptake. A bioretention area was constructed with a gravel drainage layer at the bottom, perforated pipes, and an engineered media layer designed for high infiltration, with a layer of hardwood mulch on top. The area was planted with native and adapted plants suitable for the climatic conditions. The drainage and overflow were monitored for a variety of parameters. The bioretention feature reduced runoff by 49%, nitrate-nitrogen by 42%, orthophosphate by 86%, total suspended solids (sediments) by 86%, and *E. coli* by 33% during the project period.

Permeable pavements are designed with a range of sustainable materials and techniques to allow the movement of stormwater through the surface. In addition to reducing runoff, these pavements are designed to trap sediment and filter pollutants. Four different kinds of permeable pavements were evaluated for effectiveness in reducing runoff and associated pollutants. The types tested were grass pavers, interlocking block pavers, porous concrete, and porous asphalt. The average volume reduction for the grass pavers was 85%, interlocking block pavers 73%, gravel pavers 81%, and the porous concrete 79%.

Rainwater harvesting is a technique used for collecting, storing, and using rainwater for landscape irrigation and other uses. The rainwater is collected from surfaces such as roof tops and can be effective in reducing runoff by capturing stormwater. The rainwater harvesting BMP consisted of four roof shelters with a turf lawn beside each. Flow and water quality samples were collected from each site using a monitoring system. Runoff was reduced by 14-44% at the four sites. Nitrate load reductions ranged from 49-61% and orthophosphate reductions ranged from 53-95%. No significant reductions in total suspended solids or *E. coli* were recorded.

Green roofs are used to reduce the amount of runoff by capturing stormwater. A green roof experiment was conducted which included four roof shelters representative of a residential roof with varying vegetative designs. Each roof was divided into four sections to compare four types of growing media. Runoff volume was reduced by an average of 75% and the

total suspended solids load was reduced by an average of 60%. Nitrate, orthophosphate, and *E. coli* all had mixed results with some treatments reducing the concentrations while others contributed nutrients and bacteria to the runoff.

Green roofs and collection systems *(Source: Texas A&M AgriLife Research)*

Detention ponds are excavated areas installed on, or adjacent to, water bodies to protect against flooding. The Urban Center detention pond was designed with a high length to width ratio to resemble a meandering river. Associated vegetation was included to reduce erosion and act as filter strips. From April 2015 to the end of May 2015, flow was reduced by 62%, nitrate by 91%, total suspended solids by 18%, and *E. coli* by 81%. No orthophosphate was found in the inflow or outflow during that period.

Education and outreach was also integral to this project. Texas A&M AgriLife Research, in collaboration with others such as North Carolina State University and Belgard Hardscapes, conducted several workshops and tours of the green infrastructure practices to educate the public about different options that exist for stormwater control in the metropolitan area. These well attended workshops provided continuing education credits for engineers, landscape architects and other professionals, and provided practitioners with the necessary tools to adopt these techniques elsewhere in the state.

Mission Drive-In Redevelopment LID—Upper San Antonio River

The Upper San Antonio River (Segment 1911) runs through the heart of downtown San Antonio and has been impaired for contact recreation uses since 2000 due to high levels of bacteria. In 2006, local stakeholders completed a watershed protection plan with the intent of removing the impairment for this segment of the river above Loop 410 South. One of the elements of the plan was the use of structural BMPs, including LID, in redevelopment projects to reduce the discharge of bacteria in stormwater.

From 2011 through 2015, TCEQ funded the City of San Antonio to design, install, monitor, and evaluate three BMP systems as part of the initial redevelopment of the abandoned Mission

Meandering detention pond *(Source: Texas A&M AgriLife Research)*

Drive-In Theater property. The redevelopment features the city's new Mission Library. These LID features include a bioswale, a rainwater collection system, and a permeable friction course overlay.

The bioswale runs along the outer edge of the main library parking lot, receiving runoff through curb cuts. The rainwater collection system consists of three cisterns with a total capacity of 30,000 gallons to collect roof runoff. The cisterns connect to an irrigation system, and overflow is directed to a rain garden and a large bioretention area which also treats runoff from other impervious areas. The bioswale, rainwater collection, and bioretention system treats runoff from a total of 4.45 acres and discharges to a common point.

Parking lot bioswale at the redeveloped Mission Drive-In Theater
(Source: San Antonio River Authority)

The permeable friction course overlays most of the ring road and adjacent parking spaces, filtering runoff, and draining it to an adjacent bioswale. A vegetated filter strip alongside the bioswale treats any overflow. This BMP system treats runoff from 2.80 acres.

After installation, the runoff from both BMP systems, the bioswale, rainwater harvesting, and bioretention system and the permeable friction course, was monitored by automatic water quality sampling stations during six storm events over a one year period. The City of San Antonio designed the BMPs to meet a performance goal of treating approximately eight acres and achieving an overall annual reduction of approximately 3.7E+11 MPN of indicator bacteria. The project also provided a cost-benefit analysis of these systems in regard to averting water treatment to remove the nitrogen and phosphorus, compared to the cost to control them via the three BMPs. Over their expected life span of 25 years, the bioswale, rainwater harvesting, and bioretention system had a treatment savings of $103,844 and the permeable friction course had a savings of $59,600. Other benefits include the use of attractive landscaped areas rather than typical detention features to meet runoff treatment requirements, a 76% overall reduction in runoff, directing runoff to groundwater recharge and irrigation of site vegetation, and enhanced aesthetics of the property.

Cisterns in rain garden at redeveloped Mission Drive-In Theater
(Source: San Antonio River Authority)

Cedar Bayou Watershed Protection Plan

The stakeholder facilitation process is a crucial element in the success of developing watershed protection plans that can also lead to collaboration and partnerships beyond the scope of a single project. During the development of the Cedar Bayou Watershed Protection Plan, discussions among local partners led to early implementation of some recommendations. The Galveston Bay Foundation installed polychlorinated biphenal and dioxin fish consumption advisory signage at a watershed park, the City of Baytown increased efforts to address sanitary sewer overflows, and Texas A&M AgriLife Extension held feral hog and riparian and stream ecosystem workshops in the watershed. One successful early implementation project was the removal of 21 abandoned vessels and barges from Cedar Bayou Tidal by a coalition of project stakeholders. The Galveston Bay Foundation, with input by local residents and other organizations, obtained funding from the Texas General Land Office (GLO) to remove the vessels. This effort improved recreational enjoyment, navigational safety, and water quality in the bayou and fostered a sense of combined purpose among the stakeholders involved.

Total Maximum Daily Loads and Implementation Plans

The TMDL Program develops targets for reducing pollution and helps communities build plans to clean up waterways. TMDL implementation plans may be developed concurrently with TMDLs to increase the pace at which Texas improves impaired waterways. Stakeholders provide the local expertise for

identifying site-specific problems, targeting areas for attention, and determining what measures will be most effective. Ultimately, it is stakeholders who implement the plans to clean up the rivers, lakes, and bays.

Several TMDL implementation plans are supported by CWA Section 319(h) grants. These include implementation plans for contact recreation in Carters, Clear, and Gilleland Creeks; the Guadalupe River above Canyon Lake; the Houston–Galveston Region; and the Greater Trinity Region. As of August 2015, stakeholders are implementing 157 TMDLs under 18 approved implementation plans for waterways that are impaired, in part, by nonpoint source pollution (Table 3.4).

Table 3.4 **TMDL Watersheds Impaired by Nonpoint Source Pollution**

Uses of Concern & Watershed Name	Status of Restoration[1]	Links to Project Websites
Aquatic Life		
Lake O' the Pines	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/19-lakepines/19-lakepines.html
Contact Recreation		
Austin Area Watersheds	Underway	www.tceq.texas.gov/waterquality/tmdl/101-austinbacteria
Armand Bayou	Underway	www.tceq.texas.gov/waterquality/tmdl/23-armandbayou.html
Carters Creek	Underway	www.tceq.texas.gov/waterquality/tmdl/85-carterscreek.html
Houston–Galveston Region	Some Improvement	www.tceq.texas.gov/waterquality/tmdl/nav/42-houstonbacteria/42-big-houstonarea
Gilleland Creek	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/69-gillelandcreekbacteria/69-gillelandcreekbacteria.html
Guadalupe River Above Canyon Lake	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/65-guadalupe/65-guadalupebacteria
Greater Trinity Region	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/66-greatertrinitybacteria/66-trinityimplementation
General		
Clear Creek	Restored	www.tceq.texas.gov/waterquality/tmdl/08-ccchlor.html
Colorado River Below E.V. Spence Reservoir	Some Improvement	www.tceq.texas.gov/waterquality/tmdl/nav/32-colorado/32-colorado.html
E.V. Spence Reservoir	Some Improvement	www.tceq.texas.gov/waterquality/tmdl/04-spence.html
North Bosque River	Significant Improvement	www.tceq.texas.gov/waterquality/tmdl/06-bosque.html
Petronila Creek	Underway	www.tceq.texas.gov/waterquality/tmdl/nav/32-petronila/32-petronila-tds
Public Water Supply		
Aquilla Reservoir	Restored	www.tceq.texas.gov/waterquality/tmdl/10-aquilla.html

[1] *Restored only for the parameters addressed in the TMDL implementation plan; the waterway may have other impairments.*

Texas Coastal Management Program

The Texas Coastal Management Program (CMP) was created to improve coastal management and ensure the long-term economic and ecological productivity of the coast. The GLO administers the CMP, and is advised by members of the Coastal Advisory Committee which includes staff from the TCEQ, TSSWCB, Texas Parks and Wildlife, and Texas Department of Transportation.

The Coastal Zone Act Reauthorization Amendments (CZARA), Section 6217 of the Federal Coastal Management Act, requires coastal states with approved CMPs to develop and implement a federally approved program to control nonpoint source pollution in the coastal zone. These nonpoint source management programs are required to implement management measures in accordance with guidance published by EPA. The majority of the Texas Coastal Nonpoint Source Management Program (TXCNPS) has been approved, however, three management measures still need to be addressed. The GLO and members of the Coastal Advisory Committee continue to work in coordination with EPA and the National Oceanic and Atmospheric Association to implement the TXCNPS and address these management measures. The CMP needs approval for programs that aim to reduce nonpoint source pollution from septic systems, urban runoff, and roads, highways, and bridges.

Operating Septic Systems

Texas is implementing several projects to satisfy CZARA requirements to inspect and remediate failing on-site sewage disposal systems, or septic systems, in the coastal zone. Texas continues to provide technical and financial assistance for the inspection of septic systems in the coastal zone. With CWA Section 319(h) funding, Texas implemented a project designed to identify, inspect, and remediate failing septic systems in the coastal zone. Information questionnaires were administered during public outreach meetings to share project information and identify potential sites for evaluations of septic systems. The *Anaerobic On-Site Sewage Facility Inspection Report* form, which includes eight sections and requires photographs, was used to thoroughly evaluate the condition of each system. Results of the report were shared with homeowners for reference and to document any concerns. The project resulted in the development of a comprehensive inspection form, eight public homeowner trainings with a total of 203 participants, 63 inspections, 59 "pump outs," and 19 replaced systems. The results of this project are driving Texas' strategy toward meeting this management measure.

Another important project, locating septic systems in the coastal zone, was implemented. This project uses existing information, "911" emergency response data, wastewater system service areas, and other information to identify, locate, and characterize septic systems in the coastal zone. The inventory of septic systems will identify systems that meet the applicability criteria for upgrading systems near nitrogen-limited surface waters specified in the CZARA guidance. Texas will develop and implement a strategy for replacing or upgrading these systems.

Texas is also implementing a project to inventory the current number of time-of-transfer septic system inspections conducted during real estate transactions in the coastal zone. The project will promote and report the use of time-of-transfer septic system inspections in the coastal zone.

Urban Runoff

Texas has completed an inventory of urban runoff management measures currently used in the coastal zone. Based upon this information, Texas will design and implement a targeted program to promote and document the use of stormwater management practices. The program will include education and outreach, and technical and financial assistance. The program will target community officials, land owners, land developers, engineers, financiers, and other local land development professionals and interest groups to emphasize the goal of institutionalizing the use of sustainable stormwater management practices.

Roads, Highways, and Bridges for non-TxDOT Facilities

Texas has completed an inventory of roadway management practices currently used in the coastal zone. Texas will design and implement a targeted assistance program to promote and document the use of sustainable coastal roadway management practices. Texas Department of Transportation (TxDOT) guidance for roadway planning, design, operation, and maintenance will be promoted for use on non-TxDOT roadways. The program will include education and technical assistance and will target public officials with jurisdictional responsibilities for managing coastal non-TxDOT roadways. The goal of the program is to institutionalize the use of sustainable coastal roadway management practices within each community and jurisdictional area.

Estuary Programs in Texas

Galveston Bay Estuary Program

GBEP is one of 28 National Estuary Programs in the United States and works with local stakeholders to provide comprehensive ecosystem management through collaborative partnerships to ensure preservation of the bay's multiple uses. Specifically, GBEP is charged with implementing *The Galveston Bay Plan*—a Comprehensive Management Plan for Galveston Bay. Through the implementation of *The Galveston Bay Plan*, the GBEP addresses nonpoint source pollution through development and implementation of watershed protection plans, nonpoint source outreach and education, and development and

implementation of structural and nonstructural BMPs through water quality improvement projects.

Cease the Grease Campaign

In fiscal year 2015, the GBEP supported the City of Nassau Bay's Cease the Grease Campaign (see website at http://www.ceasethegrease.net), a public education and outreach campaign which aimed to educate residents in the lower Galveston Bay watershed about proper grease disposal. This campaign was adopted from upstream partner Dallas Water Utilities, which successfully launched a Cease the Grease Campaign in 2005, and has seen a significant reduction in the occurrence of monthly sanitary sewer overflows. Dallas Water Utilities provided campaign and marketing materials free of cost, allowing for significant cost-savings. The Galveston Bay Foundation adapted materials to produce streamlined messaging throughout the Galveston Bay watershed.

Sanitary sewer overflows from fats, oil, and grease are a source of concern for harmful bacteria found in Galveston Bay. Aging infrastructure, combined with the improper disposal of fats, oils, and grease in single and multi-family homes, can lead to costly problems for both local governments and citizens in terms of sewer lines, home plumbing repairs, and environmental remediation. Cease the Grease is directed towards four target audiences: homeowners, apartment dwellers, schools, and restaurants.

The City of Nassau Bay, which subcontracted with the Galveston Bay Foundation for the management of this campaign, also partnered with the cities of Baytown, Friendswood, Pearland, League City, Houston, and La Porte for a consistent message and regional approach to grease management. A partnership with a local NBC affiliate in Houston led to the dissemination of outreach materials during the 2014 holiday season, resulting in over 378,000 impressions via online click-thru and television broadcastings. The Galveston Bay Foundation participated in a number of events in 2015, including Trash Bash, career days, and the Bay Day Festival. The Galveston Bay Foundation provided campaign information, distributed materials, and demonstrated sanitary sewer overflows caused by fats, oils, and grease through educational games. Campaign effectiveness will be measured by a reduction in grease-related sanitary sewer overflows and questionnaire data in outreach programs. Future campaign efforts include the installation of grease recycling stations in the lower Galveston Bay watershed.

Coastal Bend and Bays Estuary Program

The Coastal Bend Bays and Estuaries Program (CBBEP) is another one of the 28 National Estuary Programs that works with local government, stakeholders, conservation groups, industry, and resource managers to improve the health of the bays and restore critical habitats. The CBBEP targets nonpoint source pollution issues by conducting research projects to determine sources of pollution. In addition, the CBBEP participates in the development and implementation of watershed protection plans and TMDL implementation plans. Other CBBEP priority focus areas include land conservation and management and education through the Delta Discovery program.

Nueces Delta Preserve

In 2000, the CBBEP began to acquire land in the Nueces River Delta, now known as the Nueces Delta Preserve, and currently owns approximately 8,500 acres of the delta wetlands, coastal prairie, open water, islands, and river and bay shorelines. In 2015 the CBBEP purchased an additional 2,800 acres of the Nueces River Delta and was awarded funds from the National Resource Damage Assessment process which will be used to purchase an additional 2,000 acres. Preserving habitats, such as the Nueces Delta, will enhance water quality, estuarine habitat for wildlife, and research and educational opportunities for the Coastal Bend region.

Texas Groundwater Protection Committee

Groundwater is a major source of water in Texas, providing about 60% of the 16.1 million acre-feet of water used in the state. Texas' groundwater is used as drinking water for people and livestock, irrigation for crops, and in mining and industrial processes. It also serves as habitat for plants and animals, some of which are endangered species. The Texas Groundwater Protection Committee (TGPC) was established by the Texas Legislature in 1989 as an interagency committee to manage this essential resource. The TGPC consists of nine state entities and an association of groundwater districts. The TGPC strives to improve interagency coordination in the area of groundwater quality protection, and continues developing and updating the comprehensive groundwater protection strategy for the state. The TGPC also identifies areas where new programs could be created, or existing programs could be enhanced, to provide added protection.

Two subcommittees, the recently created Groundwater Issues Subcommittee and the longstanding Public Outreach and Education Subcommittee, execute the majority of the TGPC's responsibilities. Both the Groundwater Issues Subcommittee and the main TGPC have standing agenda items at every meeting for discussion of nonpoint source pollution issues. The Agricultural Chemicals Subcommittee was deactivated in April 2015 and its responsibilities and focus areas were incorporated into the Groundwater Issues Subcommittee. The Groundwater Issues Subcommittee now oversees the cooperative groundwater monitoring program for pesticides in groundwater, which monitors aquifer conditions for select pesticides of interest.

Because contamination of groundwater is easier to prevent than it is to clean up, the TGPC emphasizes groundwater awareness in their outreach and education efforts. Targeting primarily rural Texans, the Public Outreach and Education Subcommittee worked with partner agency Texas A&M AgriLife Extension Service to develop Fact Sheets and Frequently Asked Questions that include nonpoint source pollution information and management practices. Several thousand copies of the Fact Sheets were distributed during visits to the TGPC's traveling display during 12 events in fiscal year 2015. The TGPC supported AgriLife Extension in conducting seven educational events for water well owners, disseminating more literature while screening 203 water well samples for basic groundwater quality data. The TGPC also launched an updated website this year, making it easier to access information about activities, groundwater facts, and publications via tablet and smartphone. The Texas Groundwater Protection Committee's web address is <http://tgpc.state.tx.us/>.

Clean Water State Revolving Fund Loans for Nonpoint Source Projects

Another tool available in Texas for addressing nonpoint source pollution is the Clean Water State Revolving Fund (CWSRF), which is administered by the Texas Water Development Board (TWDB). The CWSRF is a financing program authorized under the federal CWA and is partially capitalized by an annual grant from the EPA. This program provides funding assistance in the form of 20 to 30 year loans at interest rates lower than the market offers, as well as a limited amount of funds which do not have to be repaid, called loan principal forgiveness. The funds are available to disadvantaged communities as well as for green projects. Although the majority of funds finance publicly owned wastewater treatment and collection systems, the TWDB can also provide CWSRF for nonpoint source pollution abatement projects. Funds can be made available to towns, counties, groundwater conservation districts, SWCDs, and other public agencies, as well as to nonprofit organizations, mainly water supply and/or sewer service corporations.

A water quality-based priority system is used to rank potential applicants and fund projects, including nonpoint source projects. To be eligible, a nonpoint source project must be an identified practice within a WQMP, TMDL implementation plan, or watershed protection plan; a nonpoint source management activity that has been identified in the *Texas Groundwater Protection Strategy*; or a BMP identified in the *Texas Nonpoint Source Management Program* or the National Estuary Program. Loans can be used for planning, designing, acquiring, and constructing wastewater treatment facilities, wastewater recycling and reuse facilities, and collection systems. Other activities eligible for funding assistance include agricultural, rural, and urban runoff control; estuary improvement; nonpoint source education; and wet weather flow control, including stormwater management activities that are associated with a Texas Pollutant Discharge Elimination System Municipal Separate Storm Sewer System (MS4) permit or outside of the permit area.

The TWDB has increased its efforts to identify potential applicants for loan projects that would address water quality problems associated with nonpoint source pollution in the state. Staff members from the TWDB, the TCEQ, and the TSSWCB meet regularly to coordinate efforts to identify water bodies that are impacted by nonpoint source pollutants and to identify potential applicants for CWSRF assistance. They also identify potential candidates for Green Project Reserve funding, which can provide some loan forgiveness if LID practices are constructed.

CWSRF Loans Utilized in the Plum Creek Watershed

Local municipalities in the Plum Creek watershed secured a CWSRF loan to reduce pollutant loading from failing septic systems. This loan will be used to connect Hillside Terrace, a 264-home subdivision located along the Interstate 35 corridor near Buda, to central sewer service. Plum Creek watershed stakeholders identified this subdivision as a site with chronically failing septic systems on small lots in a subwatershed with a high likelihood of impacting water quality.

Texas A&M AgriLife Extension and the City of Buda conducted a socioeconomic survey of Hillside Terrace residents while developing an application to the CWSRF Intended Use Plan for 2012. Per the survey's findings, Hillside Terrace qualified for disadvantaged community status with the potential to receive up to 70% loan forgiveness. The TWDB selected the Hillside Terrace septic-to-sewer project to receive a $400,000 CWSRF loan to design a wastewater collection system and to receive 70% loan forgiveness. In a pledge of support for the project and commitment to the Plum Creek Watershed Protection Plan, Hays County and the City of Buda entered into an Interlocal Agreement to cover the 30% or $120,000 of the project cost not covered by loan forgiveness.

The entire Hillside Terrace septic-to-sewer project will require time and financial resources from the City of Buda and Hays County. Additionally, the City of Buda intends to submit an application for construction funding through the CWSRF, once design plans have been approved.

This project was possible as a result of cooperation among member communities, critical funding, and technical assistance from state agencies like the TWDB and the TCEQ. In 2008, the Plum Creek Watershed Protection Plan became the first watershed protection plan accepted by EPA in Texas. The commitment to local control and cooperation empowered the Plum Creek Partnership to engage stakeholders, reduce pollutants, and improve water quality.

Lake O' the Pines National Water Quality Initiative Monitoring

To help implement recommendations in the Lake O' the Pines TMDL Implementation Plan, the NRCS named five sub-watersheds into the National Water Quality Initiative which are part of the Lake O' the Pines watershed. This allowed these sub-watersheds, which contain over 148,000 acres in Camp, Morris, Tutus, and Upshur counties, to receive technical and financial assistance under NRCS's Environmental Quality Incentives Program.

Various conservation practices have been implemented across the subwatersheds. To monitor the environmental outcomes of the conservation practices implemented as part of the initiative, the Texas Water Resources Institute (TWRI), with CWA Section 319(h) funding from the TSSWCB, initiated a long-term monitoring program in the Lake O' the Pines watershed. TWRI with support from Water Monitoring Solutions Inc., has installed instream, edge-of-farm, and edge-of-field water quality monitoring sites to illustrate differences in nutrient, sediment, and bacteria loading coming from fields, farms, and streams with and without planned conservation practices applied.

Two instream monitoring stations have been installed; one on Prairie Creek at FM 557 and the other on Boggy Creek at State Highway 11. The flow recording devices at these locations have been calibrated and sample collection began in the fall of 2015. All edge-of-farm sites and field sites have been constructed and sampling started in the fall of 2015. Collectively, the edge-of-farm and field sites are sampling runoff from agriculture operations that have prescribed grazing, pasture planting, cover crops, waste application, and forest stand improvements.

Goal Three–Education

The third goal of the *Texas Nonpoint Source Management Program* is to conduct education and technology transfer activities to raise awareness of nonpoint source pollution and activities that contribute to the degradation of water bodies by nonpoint source pollution. Education is a critical aspect of managing nonpoint source pollution. Public outreach and technology transfer are integral components of every watershed protection plan, TMDL, and implementation plan. This section highlights some of the nonpoint source education and public outreach activities conducted in fiscal year 2015.

Texas Well Owner Network

The Texas Well Owner Network (TWON) is an educational training program developed by the Texas A&M AgriLife Extension in partnership with the TWRI. Funded by the TSSWCB under CWA Section 319(h), TWON educates well owners about water quality BMPs to protect their wells and surface waters from contaminants. Public drinking water supplies are monitored through requirements of the federal Safe Drinking Water Act. However, private well owners are responsible for monitoring the quality of their wells and are therefore at a greater risk for exposure to compromised water quality. Bacteria is the most common contaminant in private water wells in Texas, as well as the most frequent cause of water quality impairments. TWON works with other project partners to support watershed protection planning and implementation efforts.

There are more than one million private water wells in Texas that provide water to citizens in rural areas and increasingly, to those living on small acreages in the rural-urban interface. TWON training is delivered via "Well Educated," a day-long course, and "Well Informed," an hour-long program. The "Well Educated" training course covers aquifers, household wells, improving and protecting water resources, groundwater

Testing well water samples at a TWON training *(Source: Danielle Kalisek, TWRI)*

resources, septic system maintenance, well maintenance and construction, water quality, and water treatment. The "Well Informed" presentation focuses on wellhead protection and recommendations for remediating well contamination. Through both programs, well owners can bring in water samples to test for fecal coliform bacteria, nitrate-nitrogen, and salinity.

In fiscal year 2015, nine "Well Educated" and seven "Well Informed" training events were conducted. This resulted in educating more than 316 private water well owners, and the screening of more than 700 water samples. Results from pre-test and post-test evaluations indicate that knowledge was increased for the participants. On average, participants increased their program test scores from 54% pre-program to 86% post-program. Most participants indicated that they were satisfied with the trainings, and more than 80% of participants intend to adopt behavioral changes.

Furthermore, results from six-month follow-up evaluations indicated that 89% of well owners needing to remove hazardous material from their well house complied. For participants whose septic tanks needed pumping, 55% had pumped their septic tanks within six months following the program. Also, 95% of participants said they had shared TWON educational materials with other well owners.

Cow Creek Groundwater Conservation District Education Initiative

The Cow Creek Groundwater Conservation District, in partnership with the Greater Edwards Aquifer Alliance, the Upper Cibolo Creek Watershed Partnership, and the City of Boerne, used CWA Section 319(h) grant funds to promote stewardship of limited water resources in a rapidly developing portion of the greater San Antonio area. The message of this project emphasizes the importance of controlling nonpoint source pollution, capturing rain water, and preventing water waste as necessary measures to ensure the health and longevity of the region's drinking water supply.

The first phase of this project generated a water well owner's manual, educational videos, presentations, and literature templates for use by groundwater districts. Although the focus is in Central Texas, all materials are available for download and adaptation by other organizations. A design committee coordinated input from area organizations promoting conservation as well as from stakeholders. Key contributors to the effort included the Cibolo Nature Center and Farm and the Guadalupe-Blanco River Authority.

The second phase involved presentations and workshops for a wide audience including homeowners, students, businesses, developers, and public sector representatives. This phase kicked off with presentations and a booth at the Boerne Rainwater Harvesting Revival. In addition to a documented increase in participant knowledge on groundwater issues, accomplishments of this effort include:

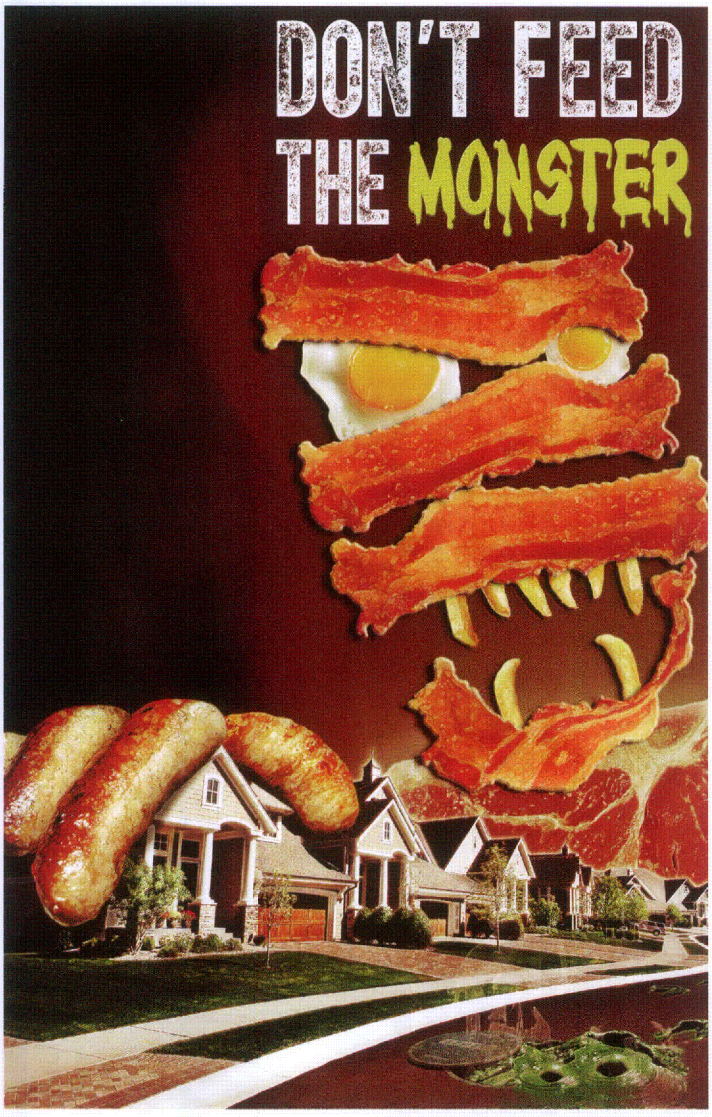
- more than 5,000 water well owner's manuals distributed at presentations, public meetings, and by request;
- more than a dozen presentations using the videos and slide shows, reaching about 500 seventh grade students as well as other audiences;
- two collaborative workshops with a total of about 125 participants;
- 125 landowners conducted, or committed to conduct within three months, various land stewardship practices including water conscious landscaping, protection of caves and sink holes, and reduction of impervious cover.

For more information or to download the educational materials, including the water owner's manual "Water: Yours, Mine and Ours," visit <http://www.ccgcd.org/>.

Trash Bash

For 22 years, the River, Lakes, Bays 'N Bayous Trash Bash®, a volunteer-based waterway cleanup event organized by the Texas Conservation Fund, Houston-Galveston Area Council, and a 42-member coordination committee, has been held in the Houston-Galveston region.

This fiscal year, 4,384 volunteers participated at 15 cleanup sites. Nearly half the volunteers were under 18 years



Poster for Defeat the Grease Monster game *(Source: Trash Bash®)*

of age and 1,375 were scouts. Students across the region are encouraged to get involved with Trash Bash® by entering a contest to design the front of the event t-shirt and scouts receive a commemorative patch for volunteer ng. A total of 37.43 tons of trash, 434 tires, and more than 2,600 pounds of material for recycling were collected, while cleaning 162 miles of shoreline.

TCEQ is providing CWA Sectior 319(h) grant funding to link trash removal activities to education about elevated levels of bacteria in surface waters, the most widespread water quality impairment in the region. Educational displays and materials about water quality issues are used to educate attendees on changes they can make that can improve water quality.

At each site, watershed demonstrations and exhibits are used to increase awareness and understanding of water conservation. Displays are used to provide a visual of the life cycle of common trash items found in marine debris. Pitch the Poop, an interactive game that focuses on bacterial contamination from pet waste, continues to be a popular part of the event.

For the 2015 Trash Bash®, an interactive game, Defeat the Grease Monster, was introduced to educate participants on the negative impacts of fats, oils, and grease on water collection systems. Participants received information about reducing bacterial contamination in water through proper disposal of fats, oils, and grease.

Lone Star Healthy Streams: Feral Hog Component

The Lone Star Healthy Streams (LSHS) Feral Hog program has focused on promoting healthy watersheds through the implementation of watershed-based feral hog educational programming designed to increase citizen awareness, understanding, and knowledge about the biology, impacts, economics, methods of removal, and laws and regulations concerning the management of feral hogs in Texas. Additionally, one-on-one technical assistance on feral hog management increases the effectiveness of feral hog population reduction efforts undertaken by the public. These efforts focus on priority watersheds where feral hogs have the potential to contribute to water quality issues. The LSHS Feral Hog program is funded by a CWA Section 319(h) grant through the TSSWCB. Activities are facilitated by the Texas A&M AgriLife Extension Service's Wildlife and Fisheries Sciences (WFSC) Extension Unit, which employs two Extension Associates centrally housed within priority watersheds.

WFSC Extension Unit staff maintained working relationships with watershed coordinators and related personnel across the state through both face-to-face and online collaborations. WFSC Extension Unit staff also provides expertise in feral hog related educational programming and field-based technical assistance to County Extension Agents associated with the Texas A&M AgriLife Extension Service. Collaborations with multiple federal and state agencies and public organizations increased the effectiveness and outreach of the LSHS Feral Hog program. For instance, organizations such as the NRCS, Texas Parks and Wildlife Department, Texas Animal Health Commission, Texas Wildlife Services, Texas Department of Agriculture, Wildlife Management Associations, and Texas Master Naturalists chapters have helped distribute educational resources.

Educational efforts over the past fiscal year were advanced through multiple outlets including:

- eight one-on-one technical guidance site visits;
- 41 face-to-face presentations (two four-hour and 39 one-hour) with 2,987 attendees;
- statewide online feral hog reporting tool with a total of 676 hogs sighted and 22 hogs removed based on 87 total reports;
- six web videos viewed 3,136 times;
- feral hogs Facebook page with 3,455 "Likes" with 199 posts that reached 93,730 unique users;

Providing technical assistance to landowners *(Source: Mark Tyson, Texas A&M AgriLife Extension)*

- feral hogs Twitter page that has 206 followers with 100 tweets that reached 23,798 unique users;
- six blog articles with 3,177 views; and
- 21 external online articles, five AgriLife Communications news releases, and five magazine articles.

Statewide Riparian and Stream Ecosystem Education Program

The TWRI, a part of Texas A&M AgriLife, has partnered with the TSSWCB, Texas Riparian Association, Texas A&M Forest Service, Texas Parks and Wildlife Department, NRCS, Nueces River Authority, and the Texas Tech University Llano River Field Station to conduct Riparian and Stream Ecosystem Education programs across the state. Riparian degradation is a major threat to water quality, instream habitat, terrestrial wildlife, aquatic species, and overall stream health.

To improve the management of these sensitive and vital ecosystems across Texas, riparian education programs are needed so landowners and land managers can understand the nature and function of riparian zones, the benefits and services they provide, and management measures used to protect them. This program has a website with online tools and education modules (<http://texasriparian.org/> and <http://naturalresourcestraining.tamu.edu/courses/texas-riparian/>) and includes 4,002 subscribers, a listserv with over 200 members, and a Facebook page with 499 followers.

Workshops are being conducted in watersheds where watershed protection plans and TMDL efforts are ongoing. In fiscal year 2015, trainings and workshops were conducted in the following watersheds: Double Bayou, Lower Nueces, Petronilla Creek, Oso Creek/Oso Bay, Eagle Mountain Lake, Pedernales River, Dickinson Bayou, Leon River, Upper San Antonio River, Cypress Creek, Hickory Creek, and Richland Chambers/Trinity River. A total of 495 people have participated in ten workshops. Course evaluations from 350, or 70%, of the participants showed that 99% of the respondents were mostly satisfied or completely satisfied with the program and the course material, 99% of the respondents would recommend the program, and 96% said they plan to adopt BMPs discussed during the workshop. Forty percent of respondents said they believed they might benefit economically from this program in the future. Evaluation responses included 254 people who owned or managed land that totaled more than 145,337.2 acres. Of those 254 people, 32% owned or managed 6 acres or less, 22% managed 10-100 acres, 13.6% managed 101-700 acres and 4.4% managed 1,000-44,800 acres. In addition, two 2-day Riparian Proper Functioning Condition Assessment trainings were held for professionals in Waxahachie and Belton with a total of 56 attendees. Just over half of the participants responded to the online course evaluation and 100% of those respondents were satisfied with the overall course and said that they would refer the course to their colleagues. Another milestone for the program was the first three-day Urban Riparian Symposium held in Austin, which was co-sponsored by the TWRI, Texas Riparian Association, Texas Parks and Wildlife, Texas A&M Forest Service, Austin Watershed Protection Department, and the Upper Trinity Conservation Trust. The symposium included three workshops, two receptions, a keynote speaker and two plenary speakers. The event had 47 presentations during concurrent sessions on a variety of topics dealing with stream and riparian issues. There were more than 213 attendees over the three-day event.

Texas A&M Forest Service

The Texas Silvicultural Best Management Practice Education and Implementation Project, administered by Texas A&M Forest Service through a CWA Section 319(h) grant from the TSSWCB, mitigates silvicultural nonpoint source pollution. The sustained success this program has achieved is directly related to the extensive education, outreach and technical assistance provided by the staff implementing this project. During fiscal year 2015, personnel coordinated landowner workshops, contractor training sessions, professional seminars, public outreach and other educational events, reaching over 5,000 people with the message of sustainable forestry, BMPs and water quality protection.

The effectiveness of this program is primarily measured through BMP implementation monitoring. Results from the most recent round of monitoring indicate a 94% implementation rate. Based on this rate, computer models predict annual sediment load reductions from 747,525 acres of East Texas forestlands

Demonstration of a rain simulator *(Source: Hughes Simpson, Texas Forest Service)*

to be 92,000 tons, 12,000 tons of which would otherwise enter our streams, lakes, and rivers.

Project personnel are always looking for innovative ways to promote BMPs to the forest sector. An online BMP pictorial directory was created, showing examples of properly implemented BMPs, along with technical information on their use and functionality. YouTube videos documenting the construction of road BMPs were also produced and linked from the Forest Service website. Lastly, an updated forest watershed model was developed, demonstrating the water quality and quantity benefits of sustainably managed forests. This new model builds on the tremendous success of the Streamside Management Zone model constructed almost 20 years ago.

Maintaining a proactive approach to addressing water quality issues is one of the foundations of this project. An online GIS based application, Plan My Land Operation, was recently developed to assist landowners, natural resource professionals, and contractors with land operation planning and layout. This system, accessed through <http://texasforestinfo.com>, enables users to map custom areas, identify sensitive features (streams, wet areas, steep slopes), add custom buffers to streams, and generate planning reports with BMP recommendations based on the site characteristics of the mapped area. This tool will help watershed coordinators across to the state plan and implement practices outlined in watershed protection plans.

While this project historically has focused efforts in East Texas, new attention has been given to water resource protection throughout the state. Modeled after the Texas A&M Forest Service traditional Logger BMP training course, the Land Stewardship Workshop for Contractors training course targets land operations outside of East Texas. The Land Stewardship Workshop provides ranchers and contractors that clear vegetation to improve range, aesthetics, and wildlife habitat or to mitigate wildfires with the principles and concepts for use of BMPs. Three workshops were conducted in 2015 in Goliad, Junction, and Meridian, reaching over 75 attendees.

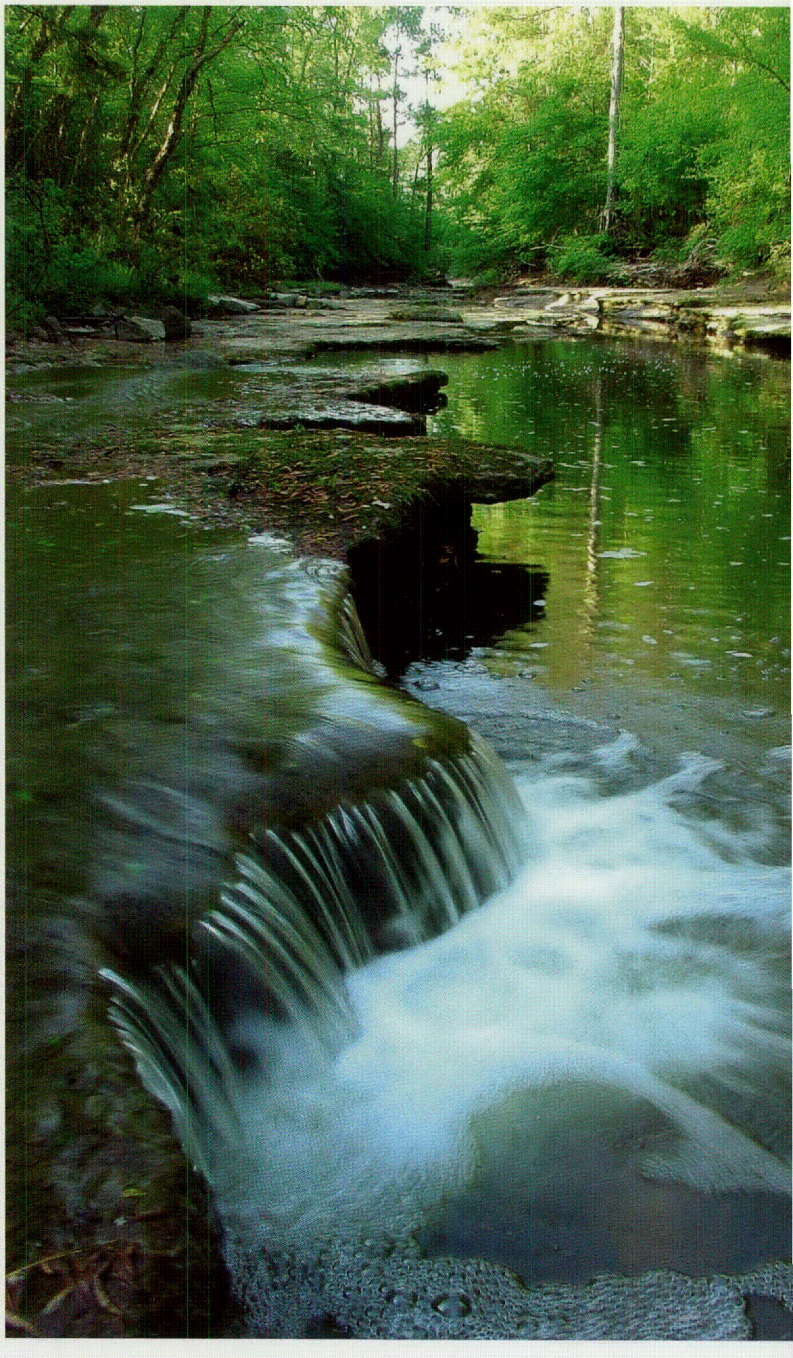
Coordinating project efforts is critical to building cooperation, enhancing outcomes, and achieving results. Project personnel routinely meet with critical stakeholder groups to share information and identify opportunities for collaboration.

CHAPTER 4

Developing and Implementing Watershed Protection Plans

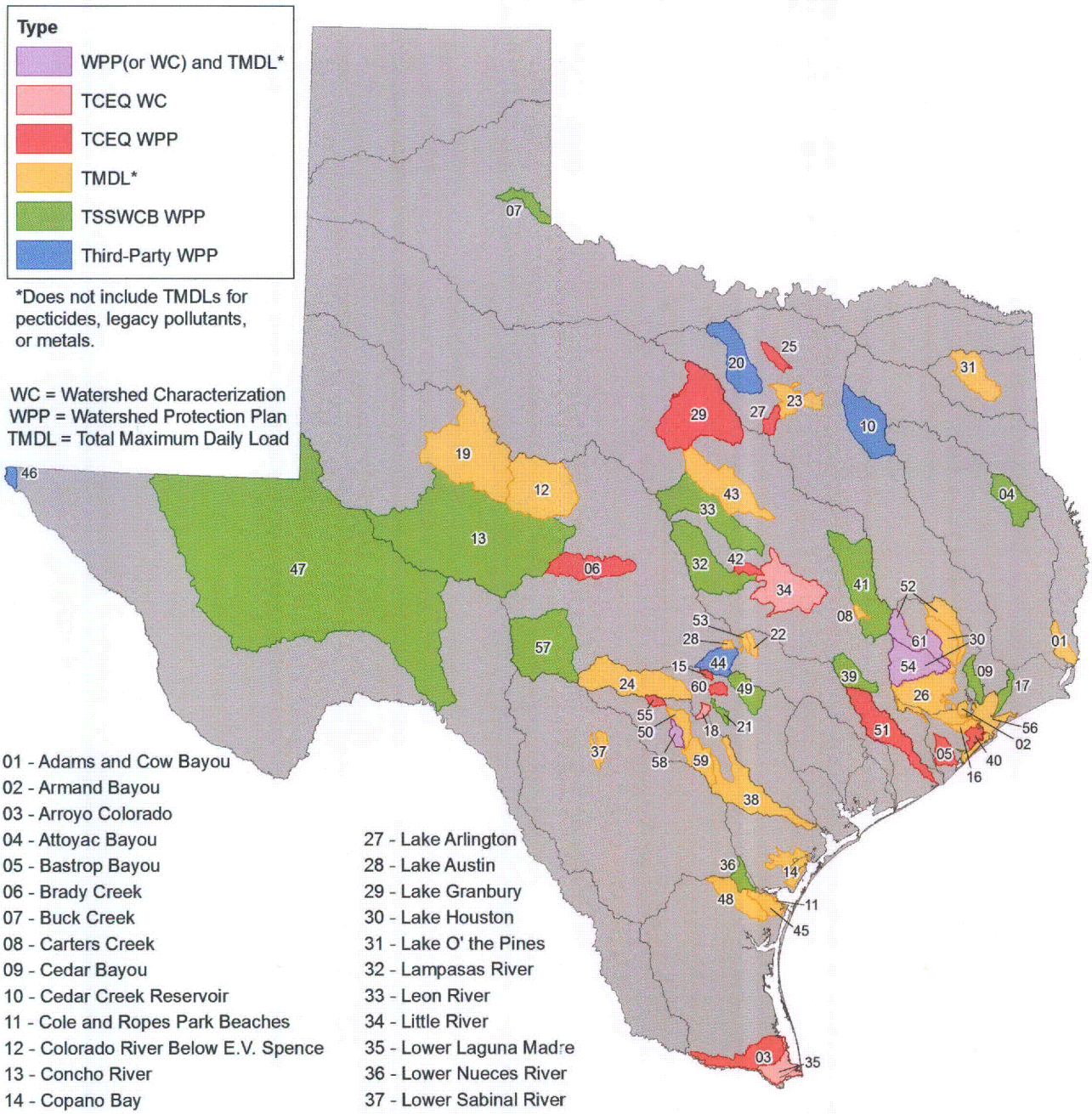
The TCEQ and the TSSWCB apply the Watershed Approach to managing nonpoint source pollution by supporting the development and implementation of watershed protection plans. These plans are developed through local stakeholder groups who coordinate activities and resources to manage water quality. In Texas, watershed protection plans 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 watershed protection plans 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 in the *Nonpoint Source Program and Grants Guidelines for States and Territories*, <http://www.epa.gov/polluted-runoff-nonpoint-source-pollution/319-grant-current-guidance>.

In fiscal year 2015, the TCEQ and the TSSWCB facilitated the development and implementation of watershed protection plans 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 to address nonpoint source pollution under the federal CWA is dedicated to the development and implementation of watershed protection plans in areas where nonpoint source pollution has contributed to the impairment of water quality. In Texas, watershed protection plans are also developed by third parties independent from the TSSWCB and the TCEQ. Figure 4.1 is a map of watershed protection plans and TMDL implementation plans being developed or implemented in Texas at the end of fiscal year 2015. Table 4.1 is a list of the same plans and links to more information. Neither the map nor table is intended to be a comprehensive list of all the watershed planning efforts currently underway in Texas.



West Caney Creek *(Source: Hughes Simpson, Texas Forest Service)*

Figure 4.1 Map of Watersheds with Watershed Protection Plans or TMDL Implementation Plans Being Developed or Implemented



01 - Adams and Cow Bayou
02 - Armand Bayou
03 - Arroyo Colorado
04 - Attoyac Bayou
05 - Bastrop Bayou
06 - Brady Creek
07 - Buck Creek
08 - Carters Creek
09 - Cedar Bayou
10 - Cedar Creek Reservoir
11 - Cole and Ropes Park Beaches
12 - Colorado River Below E.V. Spence
13 - Concho River
14 - Copano Bay
15 - Cypress Creek
16 - Dickinson Bayou
17 - Double Bayou
18 - Dry Comal/Comal
19 - E.V. Spence Reservoir
20 - Eagle Mountain Reservoir
21 - Geronimo Creek
22 - Gilleland Creek
23 - Greater Trinity River Region
24 - Guadalupe River Above Canyon Lake
25 - Hickory Creek
26 - Houston Area TMDLs
27 - Lake Arlington
28 - Lake Austin
29 - Lake Granbury
30 - Lake Houston
31 - Lake O' the Pines
32 - Lampasas River
33 - Leon River
34 - Little River
35 - Lower Laguna Madre
36 - Lower Nueces River
37 - Lower Sabinal River
38 - Lower San Antonio River
39 - Mill Creek
40 - Moses-Karankawa Bayous
41 - Navasota Below Lake Limestone
42 - Nolan Creek
43 - North Bosque River
44 - Onion & Barton Creeks
45 - Oso Bay and Oso Creek
46 - Paso del Norte
47 - Pecos River
48 - Petronila Creek
49 - Plum Creek
50 - Salado Creek
51 - San Bernard
52 - San Jacinto
53 - Spicewood Springs and Walnut Creek
54 - Spring and Cypress Creek
55 - Upper Cibolo Creek
56 - Upper Coast Oyster Waters
57 - Upper Llano River
58 - Upper San Antonio River
59 - Upper San Antonio River
60 - Upper San Marcos
61 - West Fork San Jacinto and Lake Creek

Table 4.1 Watershed Protection Plans Being Implemented or Under Development in Texas

TSSWCB WPPs	Links
Attoyac Bayou	attoyac.tamu.edu/
Buck Creek	http://buckcreek.tamu.edu/
Cedar Bayou	http://www.cedarbayouwatershed.com/Project%20Documents.html
Concho River	www.tsswcb.texas.gov/managementprogram/conchowpp
Double Bayou	http://www.doublebayou.org/wpp-document/
Geronimo Creek	www.geronimocreek.org/Plan.aspx
Lampasas River	www.lampasasriver.org
Leon River	http://leonriver.tamu.edu/publications/
Lower Nueces River	https://nueces-ra.org/NRWP/pubs.php
Mill Creek	millcreek.tamu.edu/
Navasota River	www.tsswcb.texas.gov/en/managementprogram/navasota
Pecos River	pecosbasin.tamu.edu
Plum Creek	plumcreek.tamu.edu/
Upper Llano River	http://southllano.org/projects/upper-llano-watershed-protection-plan/ South Llano Watershed Alliance: Upper Llano Watershed Protection Plan
TCEQ WPPs	**Links**
Armand Bayou	www.h-gac.com/community/water/watershed_protection/armand-bayou.aspx
Arroyo Colorado	http://arroyocolorado.org/watershed-protection-plan/
Bastrop Bayou	www.bastropbayou.org/
Brady Creek	http://www.ucratx.org/brady.html
Cypress Creek	http://cypresscreekproject.squarespace.com/documents/
Hickory Creek	http://www.cityofdenton.com/departments-services/sustainable-denton/water/hickory-creek-319-grant-project/watershed-protection-plan
Lake Granbury	http://lakegranburywatershed.org/watershed-protection-plan/
Highland Bayou & Moses-Karankawa Bayous	mokabayousalliance.org/
Lake Arlington/Village Creek	Not available
Nolan Creek	www.killeentexas.gov/nolancreekwatershed
San Bernard River	www.h-gac.com/community/water/watershed_protection/san-bernard-river.aspx
Upper Cibolo Creek	www.ci.boerne.tx.us/index.aspx?nid=147
Upper San Antonio River	www.bexarfloodfacts.org/watershed_protection_plan/
Upper San Marcos River	www.smwatershedinitiative.org/
West Fork of San Jacinto	Not available
TCEQ Watershed Characterizations	**Links**
Cypress Creek (San Jacinto River Basin)	Not available
Dry Comal/Comal River	Not available
Little River	Not available
Lower Laguna Madre	www.arroyocolorado.org/brownsville-resaca-watershed-characterization/
Spring Creek	Not available
Bridge Documents (Accepted by EPA as WPPs)	**Links**
Colorado River Below EV Spence Reservoir	www.tceq.texas.gov/waterquality/nonpoint-source/mgmt-plan/watershed-pp.html
Dickinson Bayou	http://www.h-gac.com/community/water/watershed_protection/default.aspx
Third-Party WPPs	**Links**
Cedar Creek Reservoir	nctx-water.tamu.edu/meetings
Eagle Mountain Reservoir	nctx-water.tamu.edu/meetings
Onion Creek and Barton Springs	www.waterqualityplan.org
Paso del Norte	www.pdnwc.org/319h.html

Watershed Protection Plan Highlights

Leon River

The Leon River watershed, located in the Brazos River Basin, is bound by Proctor Lake upstream and Belton Lake downstream. In 1996, the Leon River was placed on the 303(d) list for elevated bacteria levels. By 2008, the 303(d) list identified all but two of the segment's assessment units as impaired or having a concern for elevated *E. coli* levels.

In 2006, the Brazos River Authority received a CWA Section 319(h) grant from the TSSWCB to collaborate with local stakeholders to develop a watershed protection plan for the Leon River watershed. Stakeholders established a Steering Committee and worked with the project team to identify potential sources of bacterial pollution in the Leon River watershed, including: wastewater treatment facility discharges; stormwater runoff; failing septic systems; and fecal deposition from wildlife, feral animals, livestock, and pets. Potential source loads were modeled and load duration curves were developed in order to determine load reductions needed to achieve compliance with water quality goals for bacteria. The original draft of the watershed protection plan was submitted to EPA in September 2012. After addressing EPA comments and revising the plan, it was completed and approved by the Steering Committee in February 2015. The Leon River Watershed Protection Plan was accepted by the EPA in May 2015.

The watershed coordinator serves as the primary conduit for interaction with landowners, citizens, and entities to facilitate the implementation of the watershed protection plan. Currently, the watershed coordinator is supported by a CWA Section 319(h) grant from the TSSWCB.

Progress has been made in implementing the education and outreach measures outlined in the watershed protection plan, including workshops focused on both urban BMPs (e.g. rainwater harvesting, low impact development, rain gardens, etc.) and agricultural BMPs (e.g. prescribed grazing, soil testing, cross-fencing, etc.). Over the last year, the Leon River watershed has hosted several TSSWCB CWA Section 319(h) funded workshops including a Texas Watershed Stewards Workshop, Texas Riparian & Stream Ecosystem Workshop, LSHS Beef Cattle and Dairy Workshop, LSHS Feral Hog Workshop, and septic system trainings for homeowners. In addition a variety of other workshops were held in the watershed which were designed to educate landowners on the basics of private land stewardship practices that ultimately lead to a healthy watershed and improved water quality.

As a predominantly rural watershed, many residences and some businesses in the Leon River watershed have a septic system. Failing or malfunctioning septic systems can contribute bacteria and nutrients to receiving waters. To address issues associated with failing septic systems, Coryell and Hamilton counties sought and received CWA Section 319(h) grants to support septic system financial assistance programs. Hamilton County began their TSSWCB-funded septic system financial assistance program in 2012, and since the program's inception, over 70 failing septic systems within the Leon River watershed have been repaired and/or replaced in Hamilton County. Coryell County received funding from the TCEQ in 2014 to start a septic system financial assistance program. Over the first nine months of Coryell County's program, spatially explicit locations of potentially failing systems have been identified and the program was marketed county-wide.

The Hamilton-Coryell SWCD received a CWA Section 319(h) grant from the TSSWCB to provide technical and financial assistance to agricultural producers for the development and implementation of WQMPs in the Leon River watershed. During fiscal year 2015 the SWCD technician developed four WQMPs encompassing 813 acres.

Stakeholders of the Leon River watershed consider the feral hog population to be a major contributor of bacteria. Bacterial source tracking data indicate that between 52-80% of the bacteria load within the watershed in Coryell County is attributed to wild mammals. Feral hogs and deer make up the largest percentage of these animals, but feral hogs are likely to contribute the largest proportion of direct deposition load due to their tendency to migrate along the riparian corridor. Coryell and Hamilton counties have acquired three grants totaling $80,000 to purchase emerging trapping technologies, sponsor bounty programs and landowner co-ops, conduct aerial hunting operations, and fund workshops focused on educating stakeholders on the biology, life history, and abatement techniques for feral hogs. Since 2013, over 5,000 hogs have been removed from the watershed as a result of increased awareness and abatement efforts. For more information on the Leon River watershed and implementation activities, please visit <http://leonriver.tamu.edu/>.

Cypress Creek

Cypress Creek, located in the Central Texas Hill Country, is a tributary to the Blanco River. The creek rises in central west Hays County and flows in an easterly direction, passing through the City of Woodcreek and joining with the Blanco River in the City of Wimberley. For about one-half of its length Cypress Creek is dry except for episodic storm flows. However, the infusion of groundwater into the creek at Jacob's Well creates a perennial stream in the lower portion of the watershed.

Stakeholders from the communities in the watershed, which total over 7,500 residents, sought to develop a management strategy for Cypress Creek. The goal was to develop a plan that would protect water quality and flow. With the assistance of The Meadows Center for Water and the Environment at Texas State University, the community members formed the Cypress Creek Stakeholder Committee in June 2009. This committee developed an application and received CWA

Section 319(h) funding from the TCEQ for the development of a watershed-based plan in accordance with EPA guidance. Participation was solicited from across the watershed communities to produce the Cypress Creek Watershed Protection Plan. Throughout this process, the community has been supported by local governments, including Hays County, the City of Wimberley, the City of Woodcreek, the Guadalupe Blanco River Authority, and the Hays Trinity Groundwater Conservation District. Support from nongovernmental organizations includes contributions from the Wimberley Valley Watershed Association, the Hill Country Alliance, The Nature Conservancy, the Friends of Blue Hole, the Hays County Master Naturalists, and the Wimberley Merchants Association. Financial support has also been provided by the Harry L. Willett Foundation. Stakeholders have approved the plan and the plan was submitted to the EPA in 2015 for review.

The Cypress Creek Watershed Protection Plan prescribes BMPs and other actions to attain, maintain and ultimately improve water quality in the creek and its tributaries. Priorities for the protection of water quality in the Cypress Creek watershed include:

- reduce nonpoint source pollution and improve water quality,
- facilitate stakeholders and encourage citizen participation,
- increase local capacity to implement water quality programs,
- educate stakeholders and the public on water quality issues, and
- monitor and evaluate the effectiveness of water quality management measures.

The historic linkages between the creek and the community have given rise to an outpouring of support for implementing the watershed protection plan. Through a successful outreach campaign, the Cypress Creek Watershed Protection Plan has been, and continues to be, a community-driven effort. Newsletters, educational mail outs, bumper stickers, and decals with the slogan "Let's Keep It Clean, Clear, and Flowing" have been distributed throughout the watershed. Early implementation efforts also included hiring a full-time watershed coordinator. Duties for the watershed coordinator include serving as the primary conduit for interaction with landowners, citizens, and other entities and facilitating and tracking the implementation of the watershed protection plan.

A recently awarded CWA Section 319(h) grant through the TCEQ provides funding for the following implementation activities:

- development of a watershed-wide stormwater management plan to mitigate sources of nonpoint source contaminants entering the creek,
- a review of local ordinances to assist the cities and counties in the watershed in quantifying their effectiveness at mitigating nonpoint source pollution,
- facilitation of a plan for the cities and counties to fast-track development proposals with LID and green infrastructure components,
- installation of highly-visible demonstration projects (rain water cisterns, rain gardens, and onsite nonpoint source pollution control measures),
- continuation of a community outreach and information program, and
- water quality monitoring and BMP effectiveness monitoring.

Good stewardship is a crucial element of the Cypress Creek Watershed Protection Plan. By protecting the creek and its watershed, local communities continue to benefit from the recreational opportunities and natural wonders the creek provides. For more information on the Cypress Creek watershed visit <http://cypresscreekproject.net/>.

Above: Cypress Creek *(Source: Meadows Center for Water and the Environment, Texas State University)*

Abbreviations

BMP	Best Management Practice
CBBEP	TCEQ Coastal Bend and Bays Estuary Program
CMP	Texas Coastal Management Program
CWA	Clean Water Act
CWQMN	TCEQ Continuous Water Quality Monitoring Network
CWSRF	Clean Water State Revolving Fund
CZARA	Coastal Zone Act Reauthorization Amendment
E. coli	*Escherichia coli*
EPA	U.S. Environmental Protection Agency
GBEP	TCEQ Galveston Bay Estuary Program
GLO	Texas General Land Office
GRTS	Grants Reporting and Tracking System
Integrated Report	Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)
lbs	Pounds
LCRA	Lower Colorado River Authority
LID	Low Impact Development
LRGV	Lower Rio Grande Valley
LSHS	Lone Star Healthy Streams
mg/L	milligram per liter
MPN	Most Probable Number
NRCS	Natural Resources Conservation Service
SWCD	Soil and Water Conservation District
TBET	Texas Best Management Practices Evaluation Tool
TCEQ	Texas Commission on Environmental Quality
TXCNPS	Texas Coastal Nonpoint Source Management Program
TGPC	Texas Groundwater Protection Committee
TMDL	Total Maximum Daily Load
TSSWCB	Texas State Soil and Water Conservation Board
TWDB	Texas Water Development Board
TWON	Texas Well Owner Network
TWRI	Texas Water Resources Institute
TxDOT	Texas Department of Transportation
WAP	Watershed Action Planning
WFSC	Texas A&M AgriLife Extension Service Wildlife and Fisheries Sciences Extension Unit
WPP	Watershed Protection Plan
WQMP	Water Quality Management Plan

APPENDIX

Texas Nonpoint Source Management Program Milestones

Goals/ Objectives	Milestone	Milestone Description	Milestone Measurement	2015[1] Estimate	2015 Actual	Comments
ST1/A	Nonpoint Source Assessment Report	The state will produce the Integrated Report in accordance with applicable EPA guidance	Integrated Report	0	0	The EPA approved the 2012 Integrated Report on May 9, 2013. The EPA approved the 2014 Integrated Report on November 19, 2015 in fiscal year 2016.
LT/2	Nonpoint Source Management Program Updates	The state will update the Management Program in accordance with applicable EPA guidance	Management Program updates	0	0	Next update due in 2017
LT/7	Nonpoint Source Annual Report	The state will produce the Nonpoint Source Annual Report in accordance with applicable EPA guidance	Nonpoint Source Annual Report	1	1	Will be printed in January 2016
LT/2-5	Section 319(h) Grant Program Solicitation	The state will conduct individual TCEQ and TSSWCB solicitations for Section 319(h) grant funding	Grant Solicitation documentation	2	2	One from each agency
LT/2-5	Section 319(h) Grant Program Application	The state will prepare individual TCEQ and TSSWCB grant program applications and submit them to EPA for Section 319(h) grant funding	Grant Application documentation	2	2	One from each agency

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Appendix: **Texas Nonpoint Source Management Program Milestones** *(cont'd)*

Goals/ Objectives	Milestone	Milestone Description	Milestone Measurement	2015[1] Estimate	2015 Actual	Comments
LT/2	Section 319(h) Grant Program Reporting	The state will report grant funded activities to the Grants Reporting and Tracking System (GRTS) in accordance with EPA guidance	GRTS updates	4	4	Two from each agency
ST2/A	Priority Watersheds Report Updates	The state will update the Priority Watersheds Report based upon information and recommendations derived through the WAP process as described in the Management Program	Priority Watersheds Report Updates	1	0	
ST3/C,D	Watershed Training	The state will provide training to watershed professionals to ensure quality and consistency in the development and implementation of watershed protection efforts	Texas Watershed Planning Short Course	1	1	
ST3/A,B,F,G	Watershed Education	The state will provide watershed education to help citizens participate in programs designed to address water quality issues	Texas Watershed Steward Program (number of workshops)	10	10	
ST3/C,D	Watershed Training	The state will provide a forum to facilitate the transfer of information between watershed professionals in the state	Texas Watershed Coordinator Roundtable	2	2	
ST3/B,F,G	Volunteer Monitoring	The state will provide support for local volunteer monitoring groups. These groups provide water quality data to the state water quality planning program and gain insight into resolving water quality issues	Texas Stream Team Participation (numbers of stations/sites monitored)	250	433	From Texas Stream Team annual report

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Appendix: Texas Nonpoint Source Management Program Milestones *(cont'd)*

Goals/ Objectives	Milestone	Milestone Description	Milestone Measurement	2015[1] Estimate	2015 Actual	Comments
ST3/C,F,G	Urban BMPs	The state will provide technical and financial assistance to local communities to support the implementation of urban BMPs	Coastal Urban BMP Guidance Manual	1	1	GLO document via contract with University of Texas
ST1/B	Quality Assurance	The state will ensure that monitoring procedures are in compliance with EPA-approved TCEQ and TSSWCB Quality Management Plans	Annual Quality Management Plan updates	2	2	
ST1/C	Watershed Characterization	The state will support the implementation of projects designed to evaluate watershed characteristics and produce the information needed for watershed and water quality models	Watershed characterization projects	1	11	
ST2/A,C	Watershed Coordination	The state will support watershed coordination projects which facilitate the implementation of WPPs	Watershed coordination projects	6	10	
ST1/D	Develop WPPs	The state will support projects which provide for the development of WPPs which satisfy applicable EPA guidance	WPP development projects	5	11	
ST2/D	Implement WPPs	The state will support projects which provide for the implementation of management measures specified in WPPs which satisfy applicable EPA guidance	WPP implementation projects	9	26	

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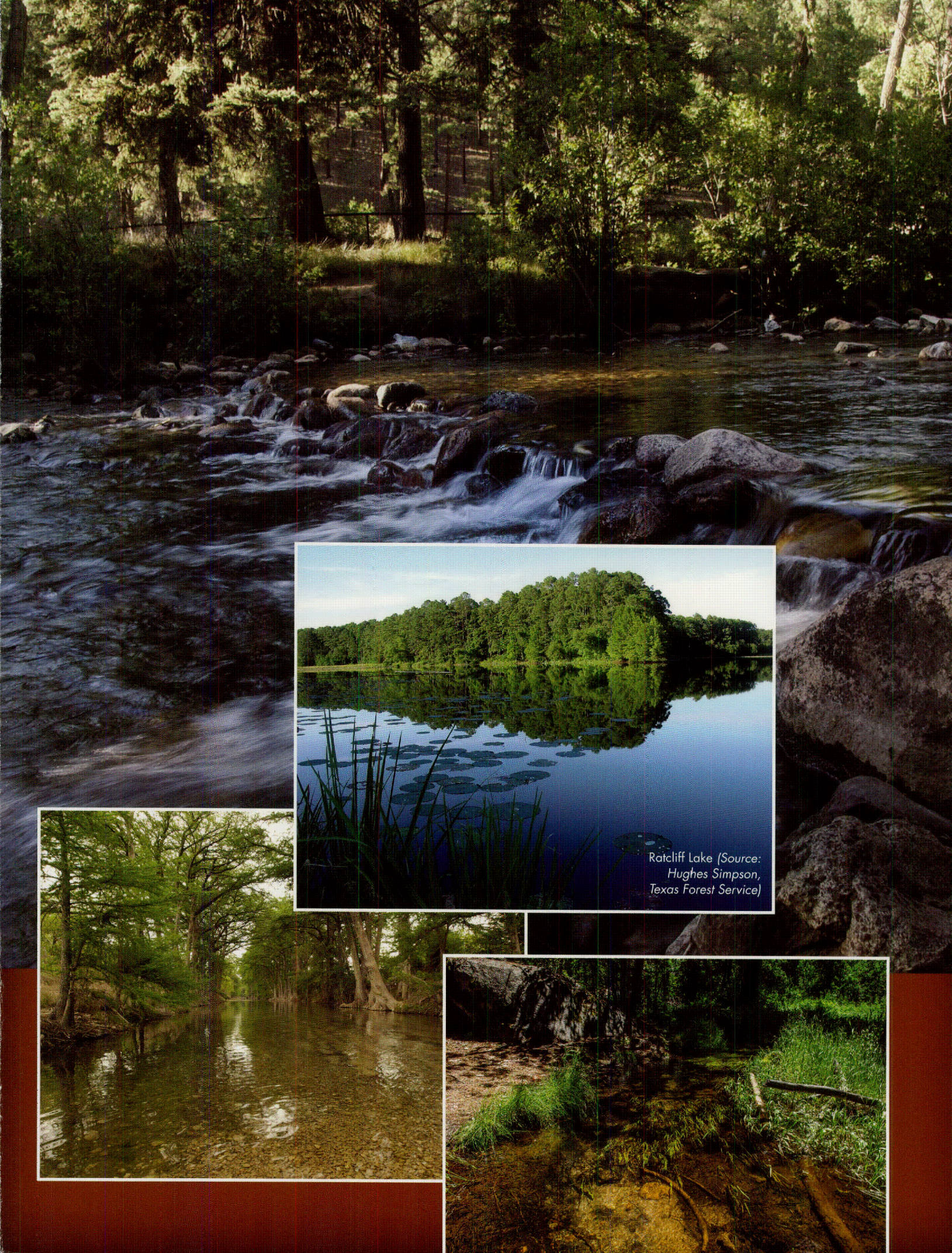
Appendix: **Texas Nonpoint Source Management Program Milestones** *(cont'd)*

Goals/ Objectives	Milestone	Milestone Description	Milestone Measurement	2015[1] Estimate	2015 Actual	Comments
ST1/D	Develop TMDLs and implementation plans	The state will support projects which provide for the development of TMDLs and implementation plans which satisfy applicable state, federal, and program regulations and guidance	TMDL and implementation plan development projects	0	5	One project of 18 TMDLs, Three implementation plans for 26 TMDLs, One TMDL addendum
ST2/D	Implement TMDLs and implementation plans	The state will support projects which provide for the implementation of management measures specified in TMDLs and implementation plans which satisfy applicable state, federal, and program regulations and guidance	TMDL implementation plan implementation projects	5	13	
ST2/B,C	Load Reductions (Nitrogen)	The state will ensure project reductions are reported utilizing GRTS	GRTS Report	RQ[2]	17,979 lbs/yr	Numbers reflect projects with load reductions reported in FY15
ST2/B,C	Load Reductions (Phosphorus)	The state will ensure project reductions are reported utilizing GRTS	GRTS Report	RQ[2]	2,809 lbs/yr	Numbers reflect projects with load reductions reported in FY15
ST2/B,C	Load Reductions (Sediment)	The state will ensure project reductions are reported utilizing GRTS	GRTS Report	RQ[2]	1,654 tons/yr	Numbers reflect projects with load reductions reported in FY15
ST2/E	Effectiveness Monitoring	The state will support projects which provide for the collection and analysis of water quality and other watershed information for the purpose of evaluating the effectiveness of BMPs	Effectiveness monitoring projects	11	15	Numbers reflect active projects

[1] *Estimates are from the 2012 Texas Nonpoint Source Management Program report*

[2] *RQ – Reportable Quantity*



Ratcliff Lake *(Source: Hughes Simpson, Texas Forest Service)*

Cypress Creek (Source: Meadows Center for Water and the Environment, Texas State University)

www.tceq.texas.gov/publications/sfr/sfr-066-15.htm