

January 2011
SFR-047/10

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Texas Department of Licensing and
Regulation

**ACTIVITIES AND
RECOMMENDATIONS OF THE
TEXAS GROUNDWATER
PROTECTION COMMITTEE:**

**REPORT TO THE 82ND
LEGISLATURE**

Prepared by the
Texas Groundwater Protection Committee

**Activities and Recommendations of the
Texas Groundwater Protection
Committee:
A Report to the 82nd Legislature**

Prepared by
Texas Groundwater Protection Committee

SFR-047/10
January 2011



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Published and distributed
by the
Texas Commission on Environmental Quality
PO Box 13087
Austin TX 78711-3087

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Abbreviations Used

ACS	Agricultural Chemicals Subcommittee
BEG	Bureau of Economic Geology at the University of Texas at Austin
BMP	best management practices
EPA	U.S. Environmental Protection Agency
ET	Evapotranspiration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FY	fiscal year
GAM	groundwater availability model
GCD	groundwater conservation district
GDMS	Groundwater Data Management Subcommittee
GIS	geographic information system
Joint Report	Joint Groundwater Monitoring and Contamination Report
MCL	maximum contaminant level
NPS	nonpoint source
OSSF	On-Site Sewage Facility
PCB	polychlorinated biphenyl
PMP	pesticide management plan
POC	pesticides of concern
POES	Public Outreach and Education Subcommittee
POI	pesticides of interest
PWS	public water supply
RCT	Railroad Commission of Texas
RWPG	regional water planning group
SMP	state management plan
Strategy	Texas Groundwater Protection Strategy–2003
SWCD	soil and water conservation district
TAC	Texas Administrative Code
TAGD	Texas Alliance of Groundwater Districts
TCEQ	Texas Commission on Environmental Quality
TDA	Texas Department of Agriculture
TDLR	Texas Department of Licensing and Regulation
TDS	total dissolved solids
TGIC	Texas Geographic Information Council
TGPC	Texas Groundwater Protection Committee
TSSWCB	Texas State Soil and Water Conservation Board
TWC	Texas Water Code
TWDB	Texas Water Development Board
TWRI	Texas Water Resources Institute
USGS	U.S. Geological Survey
WWD/PI/ABW	water well driller/pump installer/abandoned well

Executive Summary

This report was prepared for submission to the 82nd Texas Legislature by the Texas Groundwater Protection Committee (TGPC). The TGPC prepared the report as required by state law [Texas Water Code (TWC) Section 26.405]. The report provides recommendations to improve groundwater protection for legislative consideration and describes the TGPC's activities for the preceding biennium.

Recommendations to the 82nd Texas Legislature

High-quality groundwater resources are of vital importance to the state's economy and the public health and welfare. As required by TWC §26.405, the TGPC submits the following groundwater protection recommendations for legislative consideration. More detailed information is found later in this report.

While the TGPC's recommendations represent the majority opinion of the membership, they do not necessarily reflect the views and policies of each participating organization. The recommendations are not listed in priority order.

Strengthen Groundwater Conservation and Water Quality Protection Efforts

- Fund Brush-Control Projects to Increase Groundwater Yield—Continue to fund the Texas State Soil and Water Conservation Board (TSSWCB) State Brush Control Program and to expand it as funds become available in areas where it is found to be effective and in areas that will increase long-term availability of groundwater by increasing recharge of aquifers.
- Protect Groundwater Quality through Education Programs—Support new groundwater education, demonstration, and outreach efforts administered by the Texas Water Resources Institute (TWRI). The efforts would be coordinated with the TGPC and other entities.
- Develop Education and Training Programs for Groundwater District Management—Support TWRI to work through Texas AgriLife Extension Service to revise, expand, and implement education and training programs for groundwater management district personnel throughout Texas.
- Continued Support and Update of the TEX*A*Syst Program—The program needs to be updated to take advantage of recent technologies, including updating bulletins, internet outreach opportunities, and training locally supported in-community personnel.
- Establish an Abandoned Water Well—Plugging and Education Fund—Provide positive incentives for landowner-initiated closure of

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abandoned and/or deteriorated water wells through the establishment of an abandoned water well–plugging fund.

- Continue to Support the Texas High Plains Evapotranspiration Network—Support the Texas AgriLife Research in the maintenance and scientific upgrading of the Texas High Plains Evapotranspiration (ET) Network.
- Ensure the Brackish/Saline Aquifers Having Potential for Use as Drinking Water are Protected from Contamination—Encourage state regulatory agencies to examine existing, future and proposed policies and rules to ensure that brackish and saline groundwater sources, identified as having potential use as drinking water, are adequately protected from contamination.

Advance Groundwater Management and Protection through Enhanced Data Collection and Availability

- Support Statewide Real-Time Groundwater-Level Monitoring System—Provide continued support to expand the groundwater-monitoring network from coverage in 70 counties to coverage in all 254 counties.
- Continued Support of “Desired Future Conditions” Process—Provide continued support to the Texas Water Development Board (TWDB) to implement House Bill 1763, 79th Texas Legislature.
- Continued Support of Brackish Groundwater Desalination and Source Characterization Studies—Continued support of brackish groundwater desalination, and obtaining, analyzing, and ultimately modeling brackish groundwater data, now being conducted at the TWDB.

Support Groundwater Research

- Characterize Groundwater/Surface Water Interactions—Provide support of investigations to address pathogen residence time; survivability; and rates and methods of transport of viruses, bacteria, protozoa, and other contaminants from surface water to groundwater and from groundwater to surface water.
- Evaluate Groundwater Treatment Methodologies for Removal of Contaminants—Provide support for TWRI to work through Texas AgriLife Extension Service and Texas AgriLife Research to provide private water well screening; to identify high risk water wells; to work with county officials to plan for and implement a maintenance assistance program for homeowners; to develop county-wide educational programs; and to evaluate and demonstrate water treatment technologies.

TGPC Activities 2009-10

The TGPC implements and coordinates projects and administrative requirements that address eight topical areas:

- Implementation of the objectives found in the Texas Groundwater Protection Strategy [2003] (*Strategy*);
- Agricultural Chemical Activities;
- Groundwater Data Management Activities;
- Nonpoint Source Pollution Activities;
- Public Outreach and Education Activities;
- Groundwater Research Activities;
- Intergovernmental Cooperation Activities; and
- TGPC Administrative Activities.

Implementation of the Objectives Found in the Texas Groundwater Protection Strategy [2003]

The legislature charged the TGPC with developing and updating a comprehensive groundwater protection strategy that includes guidelines for the prevention of contamination, the conservation of groundwater, and the coordination of the groundwater protection activities of the agencies and entities represented on the TGPC. In February 2003, the TGPC updated the *Strategy*. Over the last biennium, the TGPC has continued to use existing policy and programmatic direction given by the legislature as the basis for *Strategy* implementation. The *Strategy* also provided recommendations and possible actions that were to be taken over the period of time between 2003 and 2013 to enhance protection of groundwater. Progress in implementing these recommendations is described in this report and in Appendix 2.

Agricultural Chemical Activities

At the request of the Texas Commission on Environmental Quality (TCEQ), in 2001, the TGPC developed the *Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater* (Also known as the Pesticide Management Plan or PMP). This generic management plan for the state serves as a guide for the prevention of pesticide contamination of groundwater. Over the biennium, the Agricultural Chemicals Subcommittee (ACS) of the TGPC has been working on three areas of the PMP: (1) continued cooperative groundwater monitoring; (2) responding to confirmed cases of pesticide contamination of groundwater; and (3) identifying and providing outreach on best management practices (BMPs) in problem areas. These efforts are discussed in the report and more detail is provided on the program in Appendix 3.

Groundwater Data Management Activities

Sound management of groundwater data is fundamental to protecting water quality and ensuring adequate groundwater supplies. The TGPC makes use of

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the expertise of its members and other experts through the Groundwater Data Management Subcommittee (GDMS) to address many of the recommendations found in the *Strategy*. The TGPC also uses the GDMS to make available information on groundwater contamination and water-quality assessments of the state's aquifers to the public through the publication of two reports mandated by both the state and the federal government. The subcommittee coordinates the compilation of data to be assessed by the TGPC and its member agencies and organizations to satisfy direct or indirect state and federal mandates. These efforts are discussed in the report and more detail is provided in Appendix 4 of the *Joint Groundwater Monitoring and Contamination Report (Joint Report)*.

Nonpoint Source Pollution Activities

The committee has changed the former Nonpoint Source (NPS) Task Force to the NPS Management Plan Task Force. The NPS Task Force will be activated for contribution to the development of the *NPS Management Plan*, every five years. Additionally, the TSSWCB representative to the TGPC will serve as liaison between the TGPC and agency NPS programs, and facilitate information exchange on both groundwater and surface water NPS issues.

Public Outreach and Education Activities

Activities during the biennium centered on two overarching themes: the protection of groundwater from contamination, and the protection of human health from contaminated groundwater or water that contains high levels of naturally occurring compounds that could affect human health. The Public Outreach and Education Subcommittee (POES) coordinates many of the TGPC's educational outreach initiatives. Educational efforts over the biennium focused on:

- demonstrations of procedures to plug abandoned wells;
- developing and publishing fact sheets in both English and Spanish on arsenic, perchlorate, nitrate, and radionuclide contamination for private well owners;
- outreach to users of the pesticide atrazine in the Panhandle on BMPs to prevent contamination of groundwater;
- developing two fact sheets about on-site wastewater treatment systems for homeowners; and
- updating the TGPC web site with new information on groundwater protection.

Groundwater Research Activities

The TGPC identifies interagency research needs and provides a forum for a coordinated approach for discussion about funding with federal agencies through the Groundwater Research Subcommittee. During the biennium, the subcommittee developed a template for project-specific white papers and identified a number of research topics.

Intergovernmental Cooperation Activities

The TGPC and its subcommittees undertake intergovernmental efforts to fill gaps in service delivery and information exchange. These include:

- (1) notifying private well owners of groundwater contamination;
- (2) coordination with regional water planning groups (RWPGs); and
- (3) coordination with federal agencies.

TGPC Administrative Activities

The TGPC carries out numerous administrative duties required by state law, such as developing this biennial report to the Texas Legislature, holding required quarterly meetings, and ensuring that documents are maintained in a manner that makes them easily accessible to the public. In addition, the TGPC and its subcommittees are subject to the state's open-meeting laws. Periodically, state laws are enacted that require the TGPC to undertake rulemaking and the TGPC completed its rules review and re-adoption this biennium. Much of the TGPC's work is performed in quarterly meetings and through the efforts of its subcommittees.

Recommendations to the 82nd Texas Legislature

State law (TWC §26.405) requires the TGPC to develop legislative recommendations. Twelve groundwater protection recommendations are presented requesting legislative consideration in three topical areas:

- strengthen groundwater conservation and water quality protection efforts,
- advance groundwater management and protection through enhanced data collection and availability, and
- support groundwater research.

While the TGPC's recommendations represent the majority opinion of the membership, they do not necessarily reflect the views and policies of each participating organization. Recommendations are outlined below and are not listed in priority order. A detailed discussion follows.

Strengthen Groundwater Conservation and Water Quality Protection Efforts

Fund Brush-Control Projects to Increase Groundwater Yield

Issue. The U.S. Department of Agriculture's Natural Resource Conservation Service estimates that brush in Texas uses approximately 10 million acre-feet (over 3 trillion gallons) of water annually. Control of brush potentially offers a cost-effective means for significantly increasing the availability of both groundwater and surface water for the growing needs of Texans.

Recommendation. Continue to fund the TSSWCB State Brush Control Program and to expand it as funds become available in areas where it is found to be effective and increases long-term availability of groundwater by increasing recharge of aquifers.

The TSSWCB is requesting approximately \$4.5 million in its base funding for FY 2011-12 for brush control.

Background. In 1985, the legislature, created the Texas Brush Control Program. The goal of this program is to enhance the state's water resources through selective control of brush species. The TSSWCB is designated as the agency responsible for administering the program and is given authority to delegate responsibility for administering certain portions of the program to local soil and water conservation districts (SWCDs).

In 1986, the TSSWCB prepared and adopted a State Brush Control Plan. The plan includes a comprehensive strategy for managing brush in areas where brush is contributing to a substantial water conservation problem and designates areas of critical need in the state in which to implement the brush control program. It was last revised in January 2005.

The Agriculture Code requires that the TSSWCB submit a report on the activities of the brush control program to the Governor, the Speaker of the House, and the Lieutenant Governor before January 31 of each year. The Agricultural Code created a cost share program for brush control and created the Brush Control Fund. It also limits the cost share rate to 70% of the total cost of a practice, limits the cost share program to critical areas designated by the TSSWCB, limits methods of brush control approved by the TSSWCB, and establishes criteria for approving applications, setting priorities, and contracting for cost sharing.

The North Concho River watershed brush control project began in 1999 and is nearing completion.

TSSWCB conducted feasibility studies on priority watersheds (see Table 1) to estimate the probable water yield and cost of the water resulting from a brush control project. These feasibility studies include extensive hydrologic and economic modeling. Over the next 10 years, a substantial investment will be required to complete the brush control for water yield as recommended in the completed feasibility studies. See Table 1.

Table 1. Watersheds and Costs from the Feasibility Studies

Watershed	Total Cost (\$)	Average Cost (\$/ac-ft)
Lake Brownwood	49,948,000	37.95
Fort Phantom Hill Reservoir	10,189,000	29.45
Lake Arrowhead	17,546,000	14.83
Palo Pinto Reservoir	14,332,000	24.09
Frio River Basin	65,368,000	36.95
Nueces River Basin	250,311,000	46.62
Wichita River Basin	43,395,000	36.59
Canadian River Basin	77,845,000	111.37
<i>Edwards Aquifer watersheds:</i>		
• Hondo watershed	2,176,000	29.92
• Medina watershed	10,658,000	26.68
• Sabinal watershed	5,714,000	42.04
• Seco Creek watershed	1,665,000	35.33
• Upper Frio watershed	8,387,000	51.65
• Upper Nueces watershed	85,889,000	97.51

Protect Groundwater Quality through Education Programs

Issue. To best protect groundwater quality, a variety of education programs are needed to transmit information to the public. These programs will provide resources for water resources managers and agency personnel to demonstrate use of innovative technologies and management strategies.

Recommendation. Support ongoing groundwater education, demonstration, and outreach efforts administered by the Texas AgriLife Extension Service and TWRI. The efforts would be coordinated with the TGPC and other entities.

Background. Several groundwater education programs are already in place, led by the Texas AgriLife Extension Service and several other agencies and entities. Some of the broad topics addressed by these education programs include the following:

- Protection of drinking water wells and areas where wellheads are located;
- Ways to ensure that wellheads are not contaminated and abandoned wells are properly plugged;
- Proper selection, use, and management of on-site wastewater treatment systems;
- Pesticide laws, regulations, and actions agricultural producers can take to reduce pesticide use and limit the risk of degrading groundwater quality; and
- Demonstrations that show how to plug abandoned wells and how individuals can take groundwater quality samples.

These educational programs need continued financial support to achieve long-term results. In addition, new efforts needed to address issues include:

- Preparing individuals and groundwater suppliers to deal with threats to water quality;
- Explaining the economic benefits of protecting groundwater quality;
- Encouraging stakeholders to participate in discussions about current groundwater quality and quantity issues and help identify future water needs;
- Identifying new and emerging technologies that have a significant potential to treat and remove groundwater contaminants; and
- Providing urban, suburban, and rural-fringe education:
 - New urban/suburban homeowners/landowners and pesticide/herbicide and fertilizer application;
 - The application of pesticides, herbicides, and fertilizer by new urban and suburban homeowners;

- New suburban and rural landowners and Groundwater Conservation Districts (GCDs); and
- New rural landowners and oil/gas wells (plugging, conversion into water wells, and groundwater wells supporting oil/gas wells).

Develop Education and Training Programs for Groundwater District Management

Issue: Groundwater district personnel require continuing education to upgrade their knowledge sets and skills related to such rapidly changing issues as groundwater planning and management, conservation, water quality protection, the use of new technologies and management models, and coping with evolving laws, regulations and policies. In addition, there is also a need for educational materials (for example, fact sheets, reports, websites, instructional videos, etc.) to be created and distributed to support district personnel training programs. Developing, updating, and implementing a comprehensive training program that educates as many groundwater district personnel as possible will help ensure that Texas groundwater resources will be used wisely and properly protected by knowledgeable people.

Recommendation: This request asks the Texas Legislature to provide continued support for TWRI to work through Texas AgriLife Extension Service to revise, expand, and implement education and training programs for groundwater management district personnel throughout Texas. Education, demonstration, and outreach efforts will be administered by AgriLife Extension and TWRI. The programs will be coordinated with the TGPC, the Texas Alliance of Groundwater Districts (TAGD), and other appropriate agencies and entities.

Background: For several years, Texas AgriLife Extension Service, working with TWRI, has implemented continuing education programs targeted to groundwater district personnel at locations throughout the state. Topics covered by AgriLife Extension and TWRI training programs have covered several key issues related to groundwater protection and management. Several AgriLife Extension fact sheets, which are made available to the public, have been published as a result of the training. Building on the existing educational base will be cost effective and efficient. Sustaining funding will provide for updates of material to capture legislative actions and regulatory changes.

Continued Support and Update of the TEX*A*Syst Program

Issue: The domestic wells of rural residents are vulnerable to contamination from a number of sources including agricultural activities. The TEX*A*Syst program, developed in the late 1990's, addresses a wide range of potential contaminants and provides remedies in a comprehensive and easy-to-understand way. This program provides rural residents the means to assess how their home site activities are affecting their environmental risks. TEX*A*Syst helps rural residents take decisive actions to preserve the quality of

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their drinking water, prevent water pollution, and protect health. However, TEX*A*Syst is out of date and currently has no support for implementation.

Recommendation. Support renewed implementation of the TEX*A*Syst program by the TSSWCB, AgriLife Extension, and the TWRI by:

- Routine updating of existing informational bulletins.
- Delivering the program, to take advantage of the internet and new technologies.
- Training of locally supported in-community personnel who would be responsible for local implementation of the program.

Background.

TEX*A*Syst is a series of publications developed in 1996 to help rural residents assess the risk of groundwater pollution and to describe BMPs that can help protect groundwater. The TEX*A*Syst publications were developed roughly 15 years ago and require updating to reflect current laws and regulations guiding private well maintenance and management, and development of improved BMPs for protecting groundwater. The two categories of the most common private well pollutants, bacteria and nutrients, are the most frequent cause of stream impairment in Texas. It is likely that in many cases, local release of bacteria and nutrients is not limited to contamination of the property owner's private well and that these contaminants are transported off-site and contribute to pollutant loadings in surface water bodies. This program supports ongoing watershed protection planning efforts being conducted by TSSWCB and others by expanding the reach of these programs to additional audiences and resulting in greater implementation of BMPs for water quality improvement and protection.

Establish an Abandoned Water Well–Plugging and Education Fund

Issue. Numerous state and local programs have identified abandoned and/or deteriorated water wells as having a significant, or potentially significant, negative impact on the quality of groundwater in the state. Abandoned water wells not only serve as conduits or channels for contamination to reach groundwater, but large diameter wells can also be a hazard to human and animal life. Financial resources are not currently available to provide education programs and technical assistance to landowners, GCDs, or local governments to plug abandoned wells.

Recommendation. Provide positive incentives for landowner-initiated closure of abandoned and/or deteriorated water wells through the establishment of an abandoned well–plugging fund.

Fund disbursement would be contingent upon prioritization of potential groundwater quality impacts, hazards, and the landowner's assets. Further, the plugging fund program should be administered by

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the Texas Department of Licensing and Regulation (TDLR), the agency currently responsible for the oversight of water well drillers, well drilling, and well plugging. TDLR would work cooperatively with local GCDs to disburse monies for the plugging of abandoned and/or deteriorated water wells located within GCD jurisdiction.

Furthermore, the funds would be disbursed on a regional geographic model based on the areas of selection for member appointment to the Water Well Driller Advisory Council. Because of the number of abandoned wells and the ability to “scale” the program, a cost estimate cannot be provided and has not been submitted by any member agency in a Legislative Appropriation Request.

To support the abandoned well plugging program, it is recommended that an outreach program be developed by Texas AgriLife Extension through the TWRI. This program would create educational publications, websites, and other resources that could be used by county extension agents and other local and regional agencies in workshops and field days to teach the public how to properly plug and manage abandoned water wells.

Background. Abandoned and deteriorated water wells remain at the top of the list of potential groundwater contamination sources, which landowners can identify and eliminate. Uncapped, uncemented, deteriorated, or uncased wells provide a direct path to groundwater from activities at the surface. Deteriorated wells completed in more than one water-bearing zone may allow poorer-quality water from one zone to commingle with and impact adjacent zone(s). Abandoned domestic, municipal, industrial, irrigation, and livestock wells, and unplugged test-holes pose threats to groundwater quality. Abandoned water wells exist in every county of the state and impact all of the State’s aquifers.

The Abandoned Well Notification and Enforcement Program, administered by the TDLR utilizing the Water Well Driller/Pump Installer Program, investigates, compiles, identifies, and processes abandoned water well notifications and enforcement cases.

Groundwater quality degradation, due in part to abandoned water wells, has also been documented by GCDs, the Bureau of Economic Geology (BEG), the TWDB studies, and the TCEQ’s Source Water Assessment and Protection Program. Furthermore, Senate Bill 279 of the 78th Legislature (TDLR’s Sunset Bill) enhanced the investigatory procedures and referrals of documented abandoned and/or deteriorated wells. A Memorandum of Understanding has been developed to coordinate the efforts of the TDLR, GCDs, and the field offices of the TCEQ relating to investigative procedures for referrals of complaints regarding abandoned and/or deteriorated wells.

The exact number of water wells in the state is unknown. However—based on the TWDB records and the TDLR/TWDB Online Well Report Submission and Retrieval System—between 1965 (the initial date when well reports were recommended to be submitted to the state) and FY 2006, a total of 669,233 State of Texas Well Reports (for water wells drilled) have been submitted (this is not 100% of the wells

drilled since 1965). Submission of water well reports was not required until December 1, 2003 (16 Texas Administrative Code (TAC) §76.700). It is conservatively estimated that there are 150,000 abandoned and/or deteriorated water wells in Texas.

Texas Occupations Code §1901, “Water Well Drillers,” requires landowners or other persons who possess an abandoned and/or deteriorated well to have the well plugged or capped under standards and procedures adopted by the TDLR (16 TAC §76.1004). Texas Occupations Code §1901 also authorizes the TDLR to assess administrative and civil penalties against persons who do not comply with the provisions of the chapter. However, these provisions represent a financial burden and provide little incentive for owners of abandoned wells to voluntarily plug abandoned wells. In addition, consideration should be given to the origin of groundwater contamination in the water well to be plugged, if present.

Educational efforts, such as the TGPC’s *Landowner’s Guide to Plugging Abandoned Water Wells* and the associated video, may initiate some abandoned well plugging. However, a funding source to assist landowners with abandoned well plugging efforts would result in an increase in the number of wells plugged and thus decrease the threats to groundwater quality.

Well-plugging costs to landowners (well owners) could range from approximately \$100 to in excess of \$120,000 per well. Cost is based on well depth, size of casing, and complexity of properly plugging the well in compliance with 16 TAC §76 water well-plugging specifications.

The abandoned well-plugging fund could be a pilot project whereby TDLR, in conjunction with GCDs, would prioritize the abandoned and/or deteriorated water wells with regard to the potential of impacts to groundwater quality and/or human health. Fund disbursement would be contingent upon this prioritization and the landowner’s assets.

The development of the plugging fund would provide criteria for the landowner or person possessing the abandoned and/or deteriorated water well who does not have sufficient assets to plug the well. When making application for an abandoned water well-plugging fund disbursement, the applicant would be required to submit a signed and notarized affidavit stating that they are financially incapable of plugging the well.

The development of the plugging fund would also provide for a disbursement ceiling approved by the TDLR executive director. Requests for amounts above the set ceiling would require Texas Commission of Licensing and Regulation approval.

TWRI requests that \$150,000 annually be designated by the legislature to support the education and outreach program to support efforts to plug and manage abandoned water wells.

Continue to Support the Texas High Plains Evapotranspiration Network

Issue. Water levels in the Ogallala aquifer are declining. The ongoing Ogallala aquifer research funded by the United States Department of Agriculture along with the TWDB funded demonstration project are generating much needed information on water conservation in the Texas High Plains. However, irrigation farmers need spatially and temporally accurate information about crop water requirements in order to conserve the aquifer and cost-effectively irrigate their crops.

Recommendation. Continued support to the Texas AgriLife Research for maintenance and scientific upgrading of the Texas High Plains ET Network.

Background. The Texas High Plains ET Network provides valuable ET data and technical support to farmers, irrigation districts, university research, extension, and industry to foster irrigation water conservation.

The Network's mission is to provide up-to-date information on crop water use to assist in making decisions regarding agricultural irrigation operations.

The Texas High Plains ET Network is a critical component and source of ET information used by farmers throughout the High Plains and much of West Texas. This information is provided electronically to producers to enable them to match irrigation amounts with the changing demands of their crops and the weather. Without this spatially and temporally accurate information, farmers could easily over- or under-irrigate, wasting precious water from the aquifer and/or reducing crop yields and profits.

Cooperative ongoing research currently funded by the states of Texas and Kansas and the federal government, is developing technology and science designed to enhance water use efficiency and promote aquifer sustainability. This scientifically sound data is being provided to water users, planners and policymakers in order to develop effective water management policies that balance the economic, environmental, and social concerns for the Ogallala aquifer. The Texas High Plains ET Network is a critical component and source of ET information used in this cooperative research effort.

The Texas High Plains ET Network is also a critical component and source of ET information for research and demonstrations conducted by Texas Tech University in cooperation with the High Plains Underground Water Conservation District, Texas AgriLife Extension Service, and agricultural producers in Floyd and Hale counties. These cooperators use the Network's ET data to verify and demonstrate environmentally sustainable and economically feasible integrated production systems that will ensure the continued viability of agricultural activities in the Texas High Plains. This demonstration effort is funded by the TWDB and is expected to continue through 2013. The integrated agricultural systems identified through these

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research and demonstration efforts are expected to conserve water and extend the useful life of the Ogallala aquifer; reduce soil erosion; improve air and water quality, wildlife habitat, and recreational opportunities; increase geologic sequestration; promote soil fertility and soil microbial activity; and enhance individual and community well-being.

Ensure that Brackish/Saline Aquifers Having Potential for Use as Drinking Water Are Protected from Contamination

Issue: TWC, §26.401 stipulates that, in order to safeguard usable and potentially usable groundwater, it is the policy of this state that discharges of pollutants, disposal of wastes, or other activities subject to regulation by state agencies be conducted in a manner that will maintain present uses and not impair potential uses of groundwater or pose a public health hazard. Brackish groundwater and certain saline groundwater is gaining importance as a source of drinking water now and in the future. Regulatory programs may not have anticipated the potential use of brackish and certain saline water for human consumption, and therefore may not have provided adequate protection of the resource from pollutant discharge or other contamination.

Recommendation: Encourage state regulatory agencies to examine existing and proposed policies and rules to ensure that brackish and saline groundwater sources, identified as having potential use as drinking water, are adequately protected from contamination.

Background: Brackish groundwater is defined as groundwater containing between 1,000 and 10,000 milligrams per liter (mg/L) total dissolved solids (TDS), while saline water is defined as having a TDS content of greater than 10,000 mg/L. Brackish and saline groundwater can be found throughout all of the regions of the state. As water demands increase and freshwater supplies decrease, more cost-effective desalination technologies are allowing for widespread use of the resource for drinking water supplies.

Currently, there are approximately 100 public water systems in Texas using desalination to treat nearly 80 million gallons of water per day and, according to the 2007 State Water Plan, 3.5 percent of the new water supplies to be developed by 2060 will be provided by desalination. Brackish groundwater sources for desalination were identified in a TWDB report as to location and amount available for desalination. The total estimated volume of brackish groundwater “in place” in Texas aquifers is over 2.8 billion acre-feet.

Current regulatory practices, including risk reduction programs, generally afford slightly less protection to brackish or saline groundwater than they do for fresh groundwater supplies. Rules and policies need to provide protection necessary to maintain suitability of

brackish and saline groundwater that is identified as having potential for use as drinking water, for cost effective desalination treatment.

Advance Groundwater Management and Protection through Enhanced Data Collection and Availability

To ensure the best management of the state's groundwater supply, local and regional planning groups must develop approaches and management methodologies based on high-quality groundwater data; real-time groundwater data; information developed from the completion of groundwater availability models (GAMs) for all of the state's minor aquifers; and sound, defensible determinations of desired future conditions, and calculations of managed available groundwater. Existing data need to be captured into a user friendly database.

Support the Statewide Real-Time Groundwater-Level Monitoring System

Issue. Texans need real-time water-level information to manage their groundwater resources. Such information helps Regional Water Planning Groups (RWPGs) and water suppliers develop drought management plans and individual well owners understand current conditions within an aquifer. GCDs and interested citizens depend on real-time water-level information from automatic recorder wells to monitor day-to-day changes in water levels. More GCDs are using data from these recorder wells to determine different drought management stages, as the Edwards Aquifer Authority has, using data from the San Antonio J-17 index well, for more than a decade in managing pumpage from the Edwards (Balcones Fault Zone) Aquifer in Bexar County.

Real-time water-level information is obtained by equipping a well with automated water-level measuring or recording equipment and a transmitter to send information to a central location for posting on the internet. The TWDB current real-time monitoring network has 150 monitoring stations in 70 counties. The TWDB's interactive map also links to web sites of other agencies with recorders that also publish real-time water-level measurements. However, the current network consisting of recorders from all agencies is inadequate for assessing all of the state's groundwater resources. Although the TWDB strives to add recorders with telemetry equipment to counties in need as the agency's yearly budget allows, currently nearly 50 predominantly single-county groundwater conservation districts and nearly 100 counties with no districts do not have the necessary resources to monitor groundwater levels and host online, real-time water-level information.

Recommendation. Provide continued support to the TWDB's baseline budget which currently allows for a dozen additional sites every two years, or an even greater number of sites when the agency partners with cooperating entities that are able to provide partial funding. An expanded network is needed to achieve parity in the geographic distribution of all real-time monitoring sites and provide all counties with at least one real-time recorder to complete the network. Groundwater districts that are able to partner with the TWDB will benefit from the additional information such recorders can provide in managing their groundwater.

Background. The TWDB has operated recorders throughout the state for several decades. In the past decade, automatic recorder data have become available on a daily basis, on demand, through the installation of dataloggers and telemetry that allow posting of data on the TWDB's web site. The legislature's passage of Senate Bill 1 funded initial TWDB efforts to launch a real-time recorder program and publish water levels online. The agency continues to operate and enhance this program through purchase of additional satellite telemetry and recorder equipment. Other groundwater conservation districts and universities also are publishing their real-time data on the TWDB web site, particularly those districts that have been able to purchase equipment that the TWDB then helps install and maintain. The continued development and maintenance of this program will allow for the purchase, installation, and maintenance of recorders in all areas of Texas and the dissemination of this information to the public in real time.

Continue Support of "Desired Future Conditions" Process

Issue. House Bill 1763, enacted by the 79th Legislature in 2005, requires GCDs to determine the "desired future conditions" of their groundwater resources by September 1, 2010, and the TWDB to provide estimates of managed available groundwater to the districts and the RWPGs. People with defined interests in groundwater can petition the TWDB if they believe that the "desired future conditions" determined by groundwater conservation districts are not reasonable.

Recommendation. Continue to support TWDB's implementation of House Bill 1763.

Background. With House Bill 1763, the 79th Legislature greatly expanded the role of groundwater management areas in managing the groundwater resources of Texas. Groundwater conservation districts in each of the sixteen groundwater management areas now are required to meet to decide the "desired future conditions" of their groundwater resources. The "desired future conditions" then are used to calculate the "managed available groundwater," which is the amount of groundwater available for permitting and the amount of

groundwater available to meet future demands in regional water planning.

The process of deciding “desired future conditions,” calculating “managed available groundwater,” and responding to petitions against desired future conditions requires considerable technical and legal support, especially if the state desires defensible numbers. When House Bill 1763 was being considered, the TWDB submitted a fiscal note, approved by the Legislative Budget Board, which included additional employees to implement the bill. House Bill 1763 was approved toward the end of the session and there was insufficient time to consider appropriations for the fiscal note.

With legislative appropriations in 2009, however, the TWDB was authorized and funded to hire employees to implement the program in fulfillment of support suggested during original House Bill considerations. These three employees are geologists who now provide technical assistance to the districts to help them identify defensible future conditions and to run groundwater availability models.

Continue Support of Brackish Groundwater Desalination and Source Characterization Studies

Issue. Regional water planning groups have been turning to brackish groundwater to address their projected water shortages. The lack of information on the brackish portion of the state’s aquifers is a challenge to developing brackish groundwater desalination projects and, before the full potential of brackish groundwater desalination in the state can be realized, it is vital that the resource be adequately characterized. The TWDB is presently undertaking this effort.

Recommendation. The TGPC recommends continued support of brackish groundwater desalination, and obtaining, analyzing, and ultimately modeling brackish groundwater data by the TWDB.

Background. Desalination of brackish groundwater is gaining importance as a water management strategy in the regional water planning process. In the 2002 State Water Plan, three regional water planning groups recommended brackish groundwater desalination for a total of about 96,000 acre-feet per year by the year 2050. Five years later, in the 2007 State Water Plan, both the number of regions recommending the strategy and the projected volume of desalinated water had doubled to six regions and about 175,000 acre-feet per year.

In response to the growing interest in brackish groundwater desalination, the 79th Texas Legislature, in 2005, considered and approved a TWDB Legislative Appropriations Request for \$3.3 million to continue and expand the state’s efforts at developing new water supplies through water desalination (including seawater desalination).

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The appropriation included \$200,000 for staff costs to oversee the projects, monitor the development of desalination technology, and provide educational outreach and technology transfer. The TWDB also received funding from the legislature in 2007 and 2009 (\$600,000 each session) for brackish groundwater desalination demonstration projects. To date, these appropriations have funded 12 brackish groundwater desalination projects.

The goal of the brackish groundwater desalination demonstration projects is to facilitate the development of brackish groundwater by creating replicable models of projects that may be effectively transferred to other communities with similar profiles. If successful, these projects can be used by other communities as engineering facility roadmaps to characterize source waters, implement desalination technologies, and manage desalination concentrate.

However, one of the more challenging issues and a potential roadblock to the more widespread development of brackish groundwater desalination in Texas is the lack of detailed information about brackish aquifers. While a 2003 TWDB-funded study laid the foundation for estimating brackish groundwater volumes in the aquifers on a regional scale and brought to prominence the enormous volume of brackish groundwater available in the State, it was by design regional in scope, limited in areal extent, and narrow in its assessment of groundwater quality. To help gather more detailed information about the brackish aquifers, the TWDB requested and received funding from the 81st Texas Legislature, 2009, to implement the Brackish Resource Aquifers Characterization System (BRACS) program.

The goals of BRACS are to map and characterize the brackish aquifers of the state in greater detail using existing geophysical well logs and available aquifer data; build replicable numerical groundwater flow models to estimate aquifer productivity; and develop parameter-screening tools to help communities assess the viability of their brackish groundwater supplies.

Initially, for the 2010-2011 biennium, the TWDB is conducting a pilot study in the Pecos Valley. Eventually, depending on the availability of data, all major and minor aquifers in the state will be mapped and characterized. For the pilot study, the TWDB plans to issue a status report by the end of December 2010 and a full project report by the end of August 2011.

Support Groundwater Research

Characterize Groundwater Surface Water Interactions

Issue. The TCEQ 2008 Water Quality Inventory identified numerous stream segments that are impacted by biological contaminants.

Surface water, particularly located in urban streams, is often contaminated by both chemicals and pathogens, disease-causing organisms such as bacteria, which can cause illnesses even at low concentrations. Potential pathogen sources include septic tanks, public wastewater treatment plant effluent, land application of sewage sludge and leaking sewage collection systems. Groundwater is also vulnerable to pathogens from surface sources where rapid infiltration or limited filtration capacity occurs. Groundwater in karst systems is particularly vulnerable to pathogen contamination from surface sources, as a result of rapid infiltration via sinking streams, open fractures or sinkholes. However, the extent of pathogens in groundwater as a result of nonpoint sources, and specifically pathogen persistence, concentrations and modes of transport potentially from surface water to groundwater, has largely not been investigated. Increasing demands on both surface water and groundwater resources will increase the implementation of treated wastewater reuse, recycling, dual water systems and aquifer storage and recovery systems; all of which provide additional opportunities for groundwater and surface water to become adversely impacted by contaminants because of the interrelationships between these interdependent sources of water.

Recommendation. Provide support for investigations to address pathogen residence time, survivability, rate of transport, and methods of transport of viruses, bacteria, protozoa, and other contaminants from surface water to groundwater and from groundwater to surface water.

Background. Groundwater and surface water are intimately related within the hydrologic cycle. Streams receive inflows from groundwater discharge through stream banks and streambeds and groundwater can thereby influence the quality of surface waters. The reverse is also true; discharge from streams during periods of high stream stages result in infiltration via bank storage, and recharge to riparian groundwater aquifers, and potentially can impact groundwater quality.

Drinking water supplies derived from wells have, in general, been assumed to be relatively safe from chemical or pathogen contamination because of the filtration capacity of surface soils and the unsaturated zone above the water table and the ability of aquifers, as porous media, to filter out biological and some chemical contaminants. Where concerns of adverse impacts of surface sources of pathogens on groundwater have arisen, the solution has often been to ensure that surface casings for wells are adequately sealed and of sufficient length to isolate the production zone of the well from direct infiltration of surface water. Regulations governing the required distance of septic tanks and drain fields from water supply wells are an example of this approach. Groundwater is vulnerable to chemical and biological contaminants from surface and subsurface sources where rapid infiltration or limited soil filtration capacity occurs. However, the extent of pathogens in groundwater as a result of nonpoint sources and specifically pathogen persistence,

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concentrations, and modes of transport, has not been investigated in great detail. Where the direct relationship of groundwater impacts resulting from contaminated surface sources has been investigated, it has most commonly been focused on chemical contaminants and not on pathogen movement from sources to groundwater. Much work remains to be done to define the controlling factors that affect pathogen impacts on groundwater quality.

Evaluate Groundwater Treatment Methodologies for Removal of Contaminants

Issue. Many of our groundwaters in Texas currently being used for drinking water for rural private residences contain unacceptable and unhealthy levels of contaminants such as arsenic and nitrates. Studies are needed to determine the most effective and economically viable systems for detecting and treating the water to safe levels.

Recommendation. Provide support for TWRI to work through Texas AgriLife Extension Service and Texas AgriLife Research to (1) provide private water-well screening, (2) identify high risk water wells, (3) as needed, work with county officials to plan for and implement a system upkeep and maintenance assistance program for homeowners, (4) develop county-wide educational programs to enhance the knowledge of well owners and train them on how to protect and improve the quality of water from their private wells and maintain their systems as appropriate, and (5) evaluate and demonstrate water treatment technologies to assess their effectiveness and economy. Additionally, resources need to be identified to assist communities and private well owners with making water quality improvements as some residents and communities may lack financial resources to effectively enhance their water delivery systems.

Background. Groundwater is a major source of drinking water throughout Texas, especially in rural areas. Unfortunately, many counties are at risk from arsenic, radionuclide, chloride, and nitrate contamination. Contamination of the water supply in wells can come from anthropogenic or geological sources that originate from subsurface geology, atmospheric deposition, pesticides, fertilizers, oil production, and/or industrial mining.

County residents in many of these areas have expressed concern over contaminants in their groundwater in recent years. Various types of systems have been installed by a number of water suppliers to remove these contaminants. The problem exists however, in rural communities isolated from populated areas where public water infrastructures are unavailable or incapable of delivering a quality water supply and therefore leaving rural communities isolated from a treated water supply to cope with groundwater quality issues.

To confront groundwater pollution issues, a practical strategy must be developed and implemented to address the challenges facing rural residents and small communities with their groundwater

contamination issues. Rural underdeveloped communities frequently have a high percentage of traditionally underserved clientele and need to assess their groundwater resources, implement BMPs to reduce contaminants, and participate in educational programs to help residents understand their local aquifer issues and properly deal with contaminants to sustain human health.

About the TGPC

Groundwater is vital to the future of Texas. In 2003, Texans used about 16 million acre-feet of water, of which 9.3 million acre-feet was groundwater,¹ or 57 percent of all water used. Approximately 79 percent of groundwater is used for irrigation, with the remainder used for municipal, rural and domestic consumption, livestock, electric utility, and industry. In 2003, approximately 36 percent of municipal water in Texas was obtained from groundwater sources.

Major and minor aquifers underlie approximately 76 percent of the state's 266,807 square mile surface area. Major aquifers are defined as producing large quantities of water in a comparatively large area of the state, whereas minor aquifers produce significant quantities of water within small geographic areas or small quantities in large geographic areas. Minor aquifers are important because they may constitute the only significant source of water in some regions. The TWDB has delineated nine major aquifers and 21 minor aquifers.

Current maps of the aquifers are available on the TWDB's web site at <www.twdb.state.tx.us/mapping/index.asp>.

In some areas of the state, "undifferentiated" local aquifers may represent the only source of groundwater where major or minor aquifers are absent. These local aquifers vary in extent from being very small to encompassing several hundred square miles.

Because of the importance of groundwater resources in the state, the legislature created the TGPC in 1989 to bridge gaps and improve coordination among existing state water and waste regulatory programs. [TWC, §26.401 through 26.407] established the TGPC and outlined its powers, duties, and responsibilities.

Creation and Mandate

The legislature established a policy of nondegradation of the state's groundwater resources as the goal for all state programs. The state's groundwater protection policy recognizes:

- the variability of the state's aquifers in their potential for beneficial use and susceptibility to contamination;
- the value of protecting and maintaining present and potentially usable groundwater supplies;
- the need for keeping present and potential groundwater supplies reasonably free of contaminants for the protection of the environment and public health and welfare; and
- the importance of existing and potential uses of groundwater supplies to the economic health of the state.

The state's groundwater protection policy provides that discharges of pollutants, disposal of wastes, and other regulated activities be

¹An acre-foot is 325,851 gallons and would cover one acre a foot deep.

conducted in a manner that will maintain current uses and not impair potential future uses of groundwater or pose a public health hazard. The use of best professional judgment by the responsible state agencies in attaining the goal and policy is also recognized.

The TGPC implements this policy by identifying opportunities to improve existing groundwater quality programs and promote coordination among agencies. The TGPC identifies areas where new or existing programs can be enhanced to provide additional protection. The major responsibilities of the TGPC are to:

- improve coordination among member agencies and organizations engaged in groundwater protection activities;
- develop, implement, and update a comprehensive groundwater protection strategy for the state;
- study and recommend to the legislature groundwater protection programs for each area in which groundwater is not protected by current regulation;
- file with the Governor, Lieutenant Governor, and Speaker of the House of Representatives a biennial report of the TGPC's activities and any recommendations for legislation for groundwater protection;
- publish an annual groundwater monitoring and contamination report describing the current monitoring programs of each member agency and the status of groundwater contamination cases documented or under enforcement during the calendar year; and
- advise the TCEQ on the development of plans for the protection and enhancement of groundwater quality pursuant to federal statute, regulation, or policy, including management plans for the prevention of water pollution by agricultural chemicals and agents.

TGPC Member Programs

State law designated the TCEQ as the lead agency, with the Executive Director designated as the TGPC's chairman. The Executive Administrator of the TWDB is designated as the TGPC's vice chairman. Members of the TGPC are:

- the executive director of the Texas Commission on Environmental Quality
- the executive administrator of the Texas Water Development Board
- the executive director of the Railroad Commission of Texas
- the commissioner of Health of the Department of State Health Services
- the deputy commissioner of the Texas Department of Agriculture
- the executive director of the Texas State Soil and Water Conservation Board
- a representative selected by the Texas Alliance of Groundwater Districts

- the director of Texas AgriLife Research
- the director of the Bureau of Economic Geology of the University of Texas at Austin
- a representative of the Water Well Drillers and Water Well Pump Installers program at the TDLR

All members may designate a representative to the TGPC. The current members and their designated representative are listed in Appendix 1.

The TCEQ, through the administration of the majority of the state's environmental and water quality regulatory programs, is primarily responsible for protecting groundwater quality. In addition, groundwater quality regulatory programs exist at: the Railroad Commission of Texas (oil and gas production and surface mining); the Texas Department of Agriculture (pesticide use); the Department of State Health Services (water resource protection); the Texas State Soil and Water Conservation Board (agricultural and silvicultural NPS pollution); and the TDLR (water well construction).

The TWDB collects and maintains water resource information; conducts statewide water planning; and administers financial assistance programs for water supply, water quality, flood control, and agricultural water conservation projects. The TAGD, as a non-governmental organization, has no regulatory or enforcement authority. However, GCDs that participate in TAGD have authority over groundwater use and contamination. Texas AgriLife Research and the BEG conduct research activities related to groundwater protection.

Texas Commission on Environmental Quality. The TCEQ has the responsibility for the majority of the state's environmental and water quality regulatory programs. The TCEQ conducts a variety of programs that address groundwater protection and focus on both prevention of contamination and remediation of existing problems. The TCEQ implements these programs through education, voluntary action assistance, permitting, and enforcement.

As the state lead agency for water quality and environmental protection, the TCEQ administers both state and federally mandated programs. Federal programs include:

- the Resource Conservation and Recovery Act for the management of municipal and industrial wastes;
- the Comprehensive Environmental Response, Compensation, and Liability Act or Superfund environmental cleanup program;
- the Clean Water Act for managing pollutant releases to state waters;
- the Safe Drinking Water Act for the protection of public drinking water supplies; and
- the development of a PMP for the protection of groundwater under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

The TCEQ has responsibilities and authorities under state law provided in the TWC and the Texas Health and Safety Code for a number of programs addressing water resource management, waste management, and environmental protection.

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The TCEQ is headed by a three-member commission and organized into major functional program areas. The Office of Permitting and Registration, and the Office of Water are responsible for permitting facility operations that include provisions to prevent groundwater impacts, and for providing support to the TGPC. The Office of Compliance and Enforcement is responsible for assuring that regulated entities comply with permits and agency rules including provisions related to groundwater quality protection through a network of agency regional offices, facility inspections, enforcement proceedings, professional licensing; for remediation and corrective action to address groundwater contamination; and implementation of the Edwards Aquifer Protection Program. The Office of Water is also responsible for developing and implementing plans for achieving clean water. Programs throughout the TCEQ provide outreach and technical assistance to specific stakeholders and regulated communities. The TCEQ also has outreach programs designed to help small businesses and local governments.

Texas Water Development Board. The TWDB, created in 1957, is the state agency responsible for collection and maintenance of water resource information; statewide water planning; and administration of financial assistance programs for water supply, water quality, flood control, and agricultural water conservation projects. The TWDB is responsible for the development of the State Water Plan to provide for the orderly development, management, and conservation of the state's water resources. The TWDB provides support to RWPGs for the development of regional water plans that are used to prepare the State Water Plan.

The TWDB, in support of its water planning and data collection responsibilities, conducts an active groundwater resource assessment program. The TWDB conducts studies to assess the state's aquifers, including occurrence, availability, quality, and quantity of groundwater present. It also identifies major groundwater-using entities and current and projected demands on groundwater resources. The TWDB conducts statewide groundwater level measuring and groundwater quality sampling programs as a part of its assessment effort. The groundwater quality-sampling program permits the TWDB to: (1) monitor changes, if any, in the ambient quality of groundwater over time, and (2) establish the baseline quality of groundwater occurring naturally in the state's aquifers.

As a significant part of the water planning process, the TWDB supports the development of GAMs which are state-of-the-art, publicly available numerical groundwater flow models. GAMs are tools to help in the process of determining groundwater availability in Texas in order to ensure adequacy of supplies or recognition of inadequacy of supplies throughout the State Water Plan's 50-year planning horizon. The TWDB has 20 models covering all nine of the state's major aquifers and several of the minor aquifers, and is now working on developing 12 additional models for the remaining minor aquifers as well as updating existing models to include new aquifer and water use information.

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Furthermore, the TWDB is charged with providing Managed Available Groundwater (MAGs) amounts along with other technical assistance to GMAs in support of the desired future condition process mandated by House Bill 1763 signed into law in 2005. The bill requires the sixteen GMAs around the state to set desired future conditions of the aquifers in their jurisdiction by September 1 of 2010. The groundwater technical assistance and the groundwater modeling areas have been providing assistance in a variety of formats to these planning entities. Once the GMAs determine their desired future conditions, staff from the groundwater division of the TWDB will provide managed available groundwater numbers to the GMAs as well as the regional water planning groups.

Railroad Commission of Texas. The Railroad Commission of Texas' (RCT) regulatory authority includes oil and gas exploration and production, surface mining and mine reclamation, and pipelines. Oil- and gas-related environmental regulations under the RCT include well drilling and completion; well plugging; surface storage, treatment, and disposal of oil and gas wastes; oil spill response; management of hazardous oil and gas wastes; disposal of non-hazardous oil and gas wastes by injection; underground injection of fluids for enhanced recovery of hydrocarbons; underground hydrocarbon storage; solution mining of brine; and remediation associated with the aforementioned activities. The RCT also offers technical guidance through its oil and gas waste minimization program. Environmental activities related to surface mining include surface coal and uranium mine operations, and mine land abandonment. Pipeline regulations primarily are safety regulations, although the routes of new pipelines are reviewed for environmental risk.

Permits to drill oil, gas, and related wells are issued only after the applicant has submitted a letter from the TCEQ that provides information on the depth of usable quality groundwater. The information is used to ensure that the well is constructed and cemented in a manner that protects groundwater. Similarly, the information is used to ensure that plugs are set to isolate and protect groundwater during plugging operations. Knowledge of the presence of shallow groundwater and the recharge areas of aquifers is vital to the regulation of surface storage and disposal of oil and gas wastes. Underground injection including hydrocarbon storage, and brine mining, are primarily groundwater protection regulations federally delegated under the Safe Drinking Water Act. The RCT requires remediation of sites contaminated by oil and gas exploration, production, disposal, and pipeline operations to prevent groundwater contamination or to mitigate groundwater contamination. Remediation projects include operator-initiated cleanup and state-funded cleanup, if no responsible party exists. Oil spills must be reported, managed, and remediated in accordance with state regulations.

The Site Remediation Section of the RCT is responsible for the state funded cleanup of abandoned oil field pollution sites (State-Funded Cleanup Program) and the oversight and monitoring of complex

pollution cleanups conducted by responsible operators (Operator Cleanup Program). In addition, the Site Remediation Section administers a Voluntary Cleanup Program, which is an incentive program for remediation of contaminated property under the RCT's jurisdiction by persons not responsible for the contamination. The goal of these programs is to control or cleanup oil and gas waste or other materials that are causing or likely to cause the pollution of surface or subsurface water, to ensure human health and safety and to protect the environment.

A groundwater impact assessment is performed as part of the surface mining permitting process. Permits contain plans to protect the groundwater resources in the area of the permit. Groundwater may be removed during the mining activities; however, if those activities adversely impact a currently used groundwater resource, then the impacts must be mitigated. Abandoned mines are closed to protect natural resources and the public.

Texas Department of Agriculture. The Texas Department of Agriculture (TDA) is the lead authority for pesticide regulation in Texas. TDA recognizes that certain pesticides, when used or stored improperly, have the potential to contaminate groundwater. TDA shares the responsibility of preventing unreasonable risk to human health and the environment from the use of approved pesticides. The agency conducts a variety of activities designed to reduce the possible groundwater contamination by pesticides:

- TDA has the responsibility and authority under the Texas Agriculture Code to enforce pesticide labels, which include directions and precautions that directly or indirectly prevent possible groundwater contamination
- All pesticide products sold and used in Texas must be registered with TDA. This process will ensure these products meet all United States Environmental Protection Agency (EPA) and state requirements for use.
- Any prospective user of restricted-use or state-limited-use pesticides and regulated herbicides is required to obtain an applicator's license. This process includes education in pesticide laws and regulations, training in the proper and legal use of pesticides, applicator testing, and continuing education.
- TDA routinely evaluates the potential impacts of pesticides on human health and the environment, including groundwater and surface water quality.
- TDA and the TCEQ co-chair the PMP Task Force, under the authority of the Texas Groundwater Protection Committee. TDA staff participate on all interagency subcommittees and task forces charged with various aspects of groundwater protection. The Pesticide Division also addresses other pesticide-related water quality issues.

Additionally, TDA staff participate in statewide, regional, and local regulatory and voluntary programs and committees focusing on water

quality, water supply, and conservation issues. TDA is also involved in drought, brush control, endangered species, and other issues which may impact surface or groundwater use in the state.

TDA does not routinely conduct groundwater monitoring for pesticides. The agency relies on monitoring data generated by the TCEQ, TWDB, USGS, and pesticide industry to identify sites of concern.

These activities ensure compliance with federal and state laws and regulations relating to the use of pesticides and the protection of groundwater resources. In addition, TDA also provides support and assistance in state environmental projects where agricultural pesticide use and regulation are of concern.

Department of State Health Services. The Department of State Health Services (DSHS), formerly the Texas Department of Health, has limited involvement in groundwater protection, although it does provide services that are related to groundwater safety and public health concerns. With regard to groundwater issues, the Community Hygiene Group in the Division of Regulatory Services acts primarily in a nonregulatory manner and serves in an advisory or public service role. When public health is impacted by groundwater contamination, the agency's response would focus on providing advice and assistance to the population affected. Since the DSHS' involvement in groundwater issues is primarily advisory, the agency assists in determining the problem and providing help to the affected public. Regulatory aspects and remediation requirements are the responsibility of other state and federal agencies, as appropriate.

Although they have no direct programs that relate to groundwater protection, the DSHS does have programs that indirectly provide protection to the state's water resources. Under the Regulatory Licensing Unit, the Chemical Reporting Group administers and enforces Tier II reporting of hazardous substances. The Policy Standards and Quality Assurance Unit oversees programs for youth camps, childcare centers, and investigates public health nuisance complaints.

The DSHS Laboratory Services Section performs chemical and microbiological analyses for any program at DSHS that needs water quality testing for its samples. For example, the laboratory routinely performs polychlorinated biphenyl (PCB) analyses of surface water and groundwater samples for the federal PCB program. The Laboratory Services Section also accepts water samples for routine microbiological analysis from the public for a fee and works under contract with other state agencies such as the TCEQ.

Texas State Soil and Water Conservation Board. The Texas State Soil and Water Conservation Board (TSSWCB) was created in 1939 by the Texas Legislature to organize the state into soil and water conservation districts (SWCDs) and to serve as a centralized agency for communicating with other state and federal entities as well as the Texas Legislature. Headquartered in Temple, Texas, the TSSWCB

offers technical assistance to the state's 217 SWCDs and maintains regional offices in strategic locations in the state to help carry out the agency's water quality responsibilities. The TSSWCB is governed by a seven-member board composed of two Governor appointees and five landowners elected throughout Texas by more than 1,000 SWCD directors.

The TSSWCB is the lead agency for the planning, management, and abatement of agricultural, silvicultural, and NPS pollution, and administers the Texas Brush Control Program. The TSSWCB has no statutory authority in the area of point source pollution, including misuse or accidents involving agricultural chemicals that are defined as point source pollution. The Board cooperates with the TDA and TCEQ in instances of point source agricultural chemical pollution. The TSSWCB also works with other state and federal agencies on NPS issues as they relate to Water Quality Standards and Criteria, Total Maximum Daily Loads, and Coastal Zone Protection. The TSSWCB works to ensure SWCDs and local landowners are adequately represented in these matters that could have a significant impact on future conservation and utilization of natural resources.

The TSSWCB has authority to establish water quality management plans in areas that have developed, or have the potential to develop, agricultural or silvicultural NPS water quality problems. This program provides, through local SWCDs, development, supervision and monitoring of individual water quality management plans for agricultural and silvicultural lands.

In addition to their involvement in the abatement of NPS pollution, the Board helps to preserve groundwater resources with its Cost Share Program and Brush Control Program. The Cost Share Program funds up to 75 percent of the implementation costs for a Water Quality Management Plan, which is developed and approved by the Board. This plan represents a commitment by the landowner to use the BMPs, as laid out in the plan, in order to protect their land and water resources from erosion, pesticide contamination, and overuse of the land. The Brush Control Program also protects groundwater resources by controlling invasive brush species that use large amounts of water. By controlling the brush in an area and restoring the native grasses, more water is available to recharge the underlying aquifer.

Texas Alliance of Groundwater Districts. The Texas Alliance of Groundwater Districts (TAGD), formerly the Texas Groundwater Conservation Districts Association, was formed on May 12, 1988. Its core District Membership is restricted to groundwater conservation districts in Texas who have the powers and duties to manage groundwater as defined in Chapter 36 TWC; other organizations with an interest in groundwater management may become Associate Members. TAGD is organized exclusively for charitable, educational, or scientific purposes within the meaning of Section 501 (c) (3) of the Internal Revenue Code. As such it can accept tax-deductible donations and use these donations to educate the public to the growing need for water conservation and groundwater protection.

The purpose of TAGD is to educate the public, further groundwater conservation and protection activities, and to provide a communications vehicle for the exchange of information between individual districts and the general public. TAGD maintains contact with members of the private sector and various local, state, and federal officials and their agencies to obtain, and provide, timely information on activities and issues relevant to groundwater conservation districts. To date, there are 78 district members of the Texas Alliance of Groundwater Districts.

The districts are created by the legislature or by the TCEQ with the purpose and responsibility of preserving and protecting groundwater. Groundwater conservation districts can be created by one of three procedures: (1) special law districts can be established by the legislature; (2) districts can be created through a property-owner petition filed with the TCEQ (Section 36.013 TWC); and (3) districts can be created in priority groundwater management areas through procedures initiated by the TCEQ (Sections 35.012(b) and 36.0151 TWC). Districts are local or regional in their jurisdiction and typically have elected boards of directors. Among other things, groundwater conservation districts have been granted authority to monitor groundwater quality. A number of districts also have the authority to bring civil court proceedings for injunctive relief against an entity causing groundwater contamination.

Texas AgriLife Research. The Texas AgriLife Research is the official agricultural research agency in Texas. AgriLife Research has no regulatory authority. As an agency of the State of Texas, and a component of the Texas A&M University System and headquartered on campus at Texas A&M University, Texas AgriLife Research conducts research to support food, feed, fiber, and bioenergy crop production while emphasizing water conservation and protection of natural resources. AgriLife Research operates a system of 14 research centers that are located in the major land resource regions of Texas. The Texas Water Resources Institute (TWRI) is an administrative unit of Texas AgriLife Research with partial funding through the USGS and has responsibilities for fostering research and educational programs dealing with water issues statewide.

Broad goals of the AgriLife groundwater research program are to protect, preserve, and efficiently use water resources and to develop sustainable agricultural production systems. Groundwater programs of AgriLife Research stress the development of management strategies, technologies, and educational programs to support sustainable agriculture and related natural resources management. AgriLife groundwater quality research focuses on responsible use of chemicals; the control, fate, and transport of agricultural chemicals; and the remediation of contaminated groundwater.

Major efforts are under way to develop strategies to manage brush species on rangelands to increase water yields and protect water quality; to manage solid and liquid wastes from livestock production and processing to prevent water contamination; to develop crop production technologies that produce optimum yields while minimizing the loss of pesticides, chemicals and nutrients into ground

and surface waters; and to manage contaminants produced during industrial and urban activities.

Texas AgriLife Research trains future professionals through undergraduate and graduate education and research programs at Texas A&M University and other System institutions. Many AgriLife researchers at Texas A&M University in College Station hold teaching appointments, thus providing the latest research results to students.

AgriLife Research efforts are complemented by the programs of the Texas AgriLife Extension Service, also a component of the Texas A&M University System. AgriLife Extension conducts educational programs on management strategies and BMPs to protect groundwater resources. AgriLife Extension specialists produce easy-to-read fact sheets and other publications for specific clientele, including agricultural producers. Other activities include field demonstrations and educational programs for youth and adults. Texas AgriLife Extension Service has no regulatory authority.

Bureau of Economic Geology. The Bureau of Economic Geology (BEG), established in 1909, is a research entity of The University of Texas at Austin and functions as the State Geological Survey. The BEG is one of three member institutions within the Jackson School of Geosciences. One of the goals of the Jackson School is to conduct research related to water issues in Texas with some internal funding for these programs. The BEG conducts basic and applied research projects related to water resources and contaminant transport in support of other state and Federal agencies. The BEG is not a regulatory agency and has no groundwater protection regulatory programs but supports the agencies that fulfill these functions.

The BEG serves as a valuable resource for geologic maps and reports that provide the framework for many environmental studies. The state geological mapping program focuses on developing maps of different geologic units and works with other state agencies to identify priority areas related to environmental issues. The core repository at the BEG contains an extensive collection of cores from many of the geologic units in the state. One of the strengths of environmental studies conducted by the BEG is the integration of geology and hydrology.

Groundwater resources are the focus of several studies conducted by the BEG. Groundwater models have been developed by BEG scientists of many of the major aquifers in the state, including the northern Ogallala, Trinity, Carrizo-Wilcox, Edwards (Barton Springs segment), and Gulf Coast aquifers as part of the TWDB Groundwater Availability Model Program.

The BEG also has unique capabilities in unsaturated zone hydrology including physical, chemical, and isotopic analysis and modeling. The unsaturated zone is extremely important because many contaminants originate near the land surface and have to be transported through the unsaturated zone to reach the water table. In addition, groundwater recharge generally occurs through the unsaturated zone and is a critical issue for assessing groundwater availability in the state.

Examples of previous studies in unsaturated zone hydrology include characterization of water fluxes related to proposed low-level radioactive waste disposal sites, quantification of contaminant transport related to the U.S. Department of Energy's Pantex Plant, and estimation of recharge for groundwater modeling studies and for aquifer vulnerability to contamination.

The BEG has conducted many studies evaluating contaminant transport in the state. Examples of the types of studies include evaluation of sources of nitrate contamination in major aquifers for the TCEQ, delineation of salinity contamination related to oil and gas production activities for the RCT, assessment of transport processes at the Department of Energy's Pantex Plant, and evaluation of benzene plumes related to underground fuel tanks. Results of the benzene plume study were extremely valuable for the TCEQ in developing remediation protocols with respect to leaking petroleum storage tanks.

One of the missions of the BEG is public outreach. In its role as the State Geological Survey, the BEG responds to questions and requests for information from other institutions and the public. The BEG participates in many public education programs, including efforts to engage kindergarten through 12th-grade students and teachers in scientific discovery. The BEG has been actively involved in organizing and promoting Earth Science Week, celebrated both nationally and internationally, which highlights the ways the earth sciences affect our daily lives and features an annual career fair.

Texas Department of Licensing and Regulation. The Texas Department of Licensing and Regulation (TDLR) Well Driller/Pump Installer/Abandoned Well Referral Program (WD/PI/ABW Program) maintains the Water Well Drillers Advisory Council; investigates all alleged violations of Chapters 1901 and 1902 of the Texas Occupations Code and 16 TAC Chapter 76 (Water Well Drillers and Pump Installers Rules); investigates consumer complaints filed against regulated well drillers/pump installers; and randomly inspects wells to insure compliance with well construction standards. Investigations also include compliance with rules requiring isolation of zones containing undesirable or poor quality water to prevent commingling with and degradation of fresh water zones. Investigations that involve groundwater contamination are referred to the appropriate state agency with jurisdiction for the activity believed to be the cause of the contamination. In an area where groundwater contamination has been confirmed, the WD/PI/ABW Program notifies licensees of the contamination by letter, including instructions on how to complete wells in the area to avoid further contamination. The WD/PI/ABW Program also works with federal, numerous state and local entities in the area of groundwater protection.

The WD/PI/ABW Program administers the Abandoned Well Notification and Enforcement Program. The Program has created a web site where abandoned or deteriorated wells can be reported online. A person can file a complaint about an abandoned well and

track the status of the complaint. Abandoned or deteriorated wells are reported to the TDLR by drillers, pump installers, and neighbors who discover them. The WD/PI/ABW Program contacts the landowners by letter to notify them of the requirement to plug or bring the wells into compliance no later than 180 days from the time of the notice. Only licensed water well drillers, licensed pump installers, or the landowner whose property contains an abandoned or deteriorated well may plug or bring the well into compliance. A State of Texas Plugging Report must be submitted to the TDLR no later than 30 days after the well is plugged or capped. Information is available, from the TDLR and the TGPC, to landowners wishing to plug their own wells. In addition, a joint memo of understanding has been developed to coordinate the efforts of the TDLR, the field offices of the TCEQ, and GCDs, relating to investigative procedures for referrals of complaints regarding abandoned and/or deteriorated wells.

TGPC Activities 2009-2010

Biennium

The TGPC implements and coordinates projects and administrative requirements by subject area. The following section describes TGPC efforts. In general, TGPC activities are a result of four interrelated requirements. They are:

- state laws specific to TGPC functions;
- state requirements of TGPC member agencies and organizations;
- federal law; and
- the *Texas Groundwater Protection Strategy*.

In order to highlight the links between the *Strategy* implementation and other TGPC activities, relevant *Strategy* recommendations are featured in text boxes.

The following sections discuss the TGPC activities by subject area. These include:

- Implementation of the objectives found in the *Strategy*;
- Agricultural Chemical Activities;
- Groundwater Data Management Activities;
- Nonpoint Source Pollution Activities;
- Public Outreach and Education Activities;
- Groundwater Research Activities;
- Intergovernmental Cooperation Activities; and
- TGPC Administrative Activities.

Implementation of the Texas Groundwater Protection Strategy

Background

The legislature charged the TGPC with developing and updating a comprehensive groundwater protection strategy for the state that includes guidelines for the prevention of contamination and for the conservation of groundwater, and provides for the coordination of the groundwater protection activities of the agencies represented on the TGPC.

With the continuing state focus on the need for assuring a high quality supply of groundwater, and recognizing the programmatic changes that have occurred since the state's first groundwater protection strategy was developed in 1988, the TGPC decided in January 2001 to

update the state's groundwater strategy. The TGPC issued the revised *Strategy* in February 2003.

Overview of the *Groundwater Protection Strategy*

In developing the *Strategy*, the TGPC recognized that the state has numerous successful groundwater programs spread among local and state governmental agencies and research institutions. Therefore, a key part of the *Strategy* documented how the current regulatory, outreach, and research programs work to protect groundwater resources. A second component of the *Strategy* was the identification of protection gaps in program implementation or coordination. TGPC believes that the *Strategy*, grounded firmly within the existing policy and programmatic directions given by the legislature, resulted in a document that sets realistic objectives for success and provides a road map for action over the next five to fifteen years. A detailed discussion of the *Strategy* can be found in Appendix 2.

The *Strategy*:

- details the state's groundwater protection goal as established by the legislature;
- explains the state's efforts to characterize the occurrence, quality, and quantity of groundwater resources and discusses various assessment approaches used in program implementation;
- describes the roles and responsibilities of the various state agencies involved in groundwater protection and discusses the TGPC as a coordinating mechanism;
- provides examples of how the various state agencies implement groundwater protection programs through regulatory and non-regulatory models;
- explains how local, state, and federal agencies coordinate management of groundwater data for the enhancement of groundwater protection;
- discusses the role that research plays in understanding groundwater's importance and the importance of coordinating research efforts;
- provides an overview of groundwater public education efforts in the state;
- discusses public participation in establishing and implementing groundwater policy;
- lays out a planning process for updating the *Strategy*;
- proposes for inclusion in the next *Strategy* an identification and ranking of significant threats to the state's groundwater resources, consideration of the vulnerability of groundwater resources to such threats, and a prioritization of actions to address those threats; and
- provides recommendations and possible actions to protect groundwater.

Summary of *Strategy* Recommendations

Strengthen Communication with the State's Water Planning Efforts.

- The TGPC needs to strengthen the lines of communication and information sharing with the State's RWPG. The lack of communication between these two programs is a gap in the TGPC's ability to coordinate the state's groundwater protection strategy with the state's water supply planning efforts led by the TWDB.

Improve Groundwater Data.

- The existing groundwater quality monitoring programs need more resources to sample additional sites that will provide a better picture of groundwater conditions statewide.
- The parameters that are analyzed need to be expanded to include organic and synthetic chemicals. While site-specific assessment of hazardous wastes in groundwater is covered by a number of state and federal programs, other substances in groundwater, such as nitrate and arsenic that may be deemed naturally occurring, need better assessment.
- The TGPC should develop recommendations on the design of a groundwater monitoring system that will meet the needs of all member agencies and organizations. Any new monitoring of domestic water wells would be on a voluntary basis.
- Data management standards should be periodically reviewed and amended to facilitate information exchange. The TGPC must review and revise its groundwater data management standards and guidelines, and must actively participate in the various data management advisory groups.
- All available data sources should be checked for validity via accepted quality assurance and quality control measures, and once accepted, placed into an electronic format with a spatial data element for indexing in a relational database. The location and geometry of contamination plumes should be placed in a Geographic Information System (GIS) format.
- There is a large number of existing hard-copy water well drillers reports that need to be placed in a digital format and made accessible through the existing digital system.

Coordinate Research.

- The TGPC should form a research subcommittee to identify interagency research needs and to provide a coordinated approach for discussion with federal agencies for funding. The results of this work should be shared with the TCEQ for its consideration under the research model authorized under state law.

Increase Public Outreach.

- More water quality information is needed to develop assessments of water quality and health risk for the domestic/private well owner segment of the population.
- The state should undertake a voluntary program targeted toward private well owners, designed to identify problem areas and assist private well owners in understanding these groundwater quality issues.
- More support needs to be given to educational efforts for targeted geographic areas of concern for high concentrations of naturally occurring groundwater contaminants and on various treatment options available to the domestic/private well owner.
- Support is also needed for educational efforts to develop and deliver effective educational materials that target potential sources of contamination such as abandoned wells.
- Special effort should be made to develop educational programs designed to reach and serve the state's high-growth areas.
- The TGPC recommends that the state continue to support the efforts of the On-Site Wastewater Treatment Research Council, the Texas AgriLife Extension Service, the TCEQ's on-site wastewater program, and local governments in their efforts to develop and deliver effective educational material that addresses on-site sewage facility (OSSF) maintenance in order to prevent failures.
- Government agencies involved in OSSF regulation and outreach may want to consider developing programs specially designed to reach and serve the state's high-growth counties.
- The TGPC should establish links on its web site to key groundwater information residing at state agencies and educational institutions.

Commit to Development of Periodic Updates and Improvements to the State Groundwater Protection Strategy.

- The TGPC should review and update the *Strategy* every 6 years.
- The TGPC should conduct an analysis that will identify and rank threats to groundwater quality (taking into consideration the vulnerability of groundwater resources and using available data), and prioritize possible actions that address those threats.

Agricultural Chemicals Activities

TWC, §26.407 requires the TCEQ to develop any necessary management plans for agricultural chemicals, with the advice of the TGPC. These plans will address agricultural chemicals such as pesticides that may threaten groundwater quality. Specifically, these plans are to be developed for the protection and enhancement of water quality pursuant to federal statute, regulation, or policy, and include management plans for the prevention of water pollution by agricultural chemicals and agents. These management plans were

initially referred to as State Management Plans or SMPs, but more recently are referred to as PMPs.

Pursuant to an EPA proposed rule and policy the TCEQ with participation from the TGPC, in 2001, developed the *Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater*. This plan, as a generic PMP for the state, serves as a guide for the prevention of pesticide contamination of groundwater. The plan was developed as a joint effort of the agency members of the Agricultural Chemicals Subcommittee (ACS). A more detailed discussion of the PMP can be found in Appendix 3.

The PMP explains the general policies and regulatory and non-regulatory approaches the state will use to protect groundwater resources from contamination by pesticides. The document explains a generic coordinating mechanism among all responsible and participating agencies during the implementation of the PMP and provides for specific responses when it is deemed necessary to take actions to protect groundwater. The PMP reflects the state's philosophy toward groundwater protection and recognizes the importance of agriculture to the state's economy.

Ultimately, the EPA did not adopt the proposed rule mentioned above but instead evolved its policy with regard to agricultural chemicals. Starting in FY 2007, EPA moved to a new strategy which consists of a process whereby the states are encouraged to develop a list of pesticides of interest (POIs), from which, after an assessment process, a list of pesticides of concern (POCs) will be selected. Also, the new EPA strategy has been extended to include surface water concerns as well as groundwater. However, even though the POIs and POCs selected will take into consideration the potential pollution of both groundwater and surface water, groundwater will continue to be the focus of the PMP. Reliance will be placed on the appropriate sources for pesticide surface water data. POCs are to be assessed further, and if necessary managed through the Pesticide Management Process outlined in the PMP that was developed under EPA's earlier strategy.

Much of the TGPC's work on agricultural chemicals follows the PMP and is performed by the ACS. The ACS has designated five task forces through which it carries out its work:

- The PMP Task Force, formerly the SMP Task Force, has been charged to revise the PMP, if necessary, and to develop the lists of POIs and POCs.
- The Education Task Force develops PMP-related educational information and materials and coordinates educational outreach including public presentations, displays, applicator certification curriculum development, and brochures.
- The Site Selection Task Force guides in the development of pesticide-specific groundwater monitoring and investigation strategies for determining the extent of contamination.

- The Data Evaluation and Interpretation Task Force reviews and evaluates the available information to determine the probable source and cause of any contamination revealed by monitoring. If monitoring reveals contamination the Task Force coordinates the state's response under the PMP.
- The BMP Task Force is responsible for developing the preventive component of the generic PMP and identifying pesticide-specific and area-specific BMPs that can be used to prevent or curtail pesticide contamination of groundwater.

Currently, the ACS is working on four areas of the PMP: (1) continued cooperative monitoring, (2) responding to confirmed cases of pesticide contamination of groundwater, (3) identifying and providing outreach on BMPs in problem areas, and (4) monitoring for urban pesticides. These efforts are discussed in detail in Appendix 3.

Monitoring efforts have been significantly enhanced through a cooperative sampling effort among the TWDB, a number of GCDs, and the TCEQ. During the most recent round of cooperative monitoring, 218 samples were taken in 2010, with a total of 801 immunoassay analyses for five pesticides. This monitoring continues to indicate atrazine detections in the Panhandle region of Texas, but only occasional low-level detections of atrazine in the rest of the state. All cooperative monitoring atrazine detections have been significantly below the maximum contaminant level (MCL) for drinking water.

Investigative and follow-up monitoring efforts have been conducted at several sites in the central Panhandle. These activities continued throughout the biennium to track and to address atrazine detections in public water supply (PWS) wells. Monitoring reveals that atrazine concentrations have primarily decreased or remained the same over the past five years.

In response to low-level detections of the pesticide atrazine in groundwater in the Panhandle, the TGPC worked with the Texas AgriLife Extension Service staff in Lubbock to develop a "Best Management Practices Training and Curriculum Manual" in 2005. Presentations were given by the AgriLife Extension Service in 2005 and 2006, at eight separate events each year. The TDA also utilized some of this material to train their inspectors in 2008. The curriculum and training are a result of interagency coordination and cooperation in monitoring, education and outreach under the PMP. The TGPC worked with the AgriLife Extension Service staff through the POES to develop BMPs for pesticides tri-fold brochure, and several FAQs that address much of the same subject matter in greater detail than the tri-fold in 2008.

During the biennium, TGPC continued to sponsor a table display at the annual Texas Plant Protection Conference in December. The display explained the PMP program in Texas through the distribution of brochures and the exposition of various pesticide monitoring graphics, including GIS maps of water wells monitored for pesticides in Texas. A presentation on the history and development of this

pesticide program was given at the EPA Mid-Year FIFRA Grant meeting in March 2010.

The ACS, composed of interested TGPC member agencies and organizations, held eight meetings during the biennium. These meetings, along with the cooperative monitoring efforts fulfill FIFRA and 106 Groundwater grant requirements for cooperation and coordination of grant-related activities.

Urban pesticide monitoring was conducted in Austin in 2009, with 26 well and spring samples taken. These samples underwent screening for five pesticides by immunoassay analyses. Another 40 samples were analyzed by laboratory for 47 pesticides. There were no significant detects.

Groundwater Data Management Activities

Sound management of groundwater data is essential to protecting water quality and ensuring adequate groundwater supplies. Because of the importance of scientifically sound data, the TGPC, its member organizations, the federal government, local governments, and regulated entities all place a great premium on ensuring its accuracy and availability. The TGPC uses the expertise of its members and other experts through the Groundwater Data Management Subcommittee (GDMS) to address many of the recommendations found in the *Strategy*.

The GDMS facilitates much of the TGPC's interagency groundwater data communication to ensure that data is more accessible, usable, and valid. The subcommittee encourages uniform groundwater data management practices, the use of spatial data for GIS in groundwater quality/contamination studies, and promotes adherence to state guidelines and standards for data formats. The GDMS met formally three times during the biennium.

The subcommittee maintains and updates the *Texas Groundwater Data Dictionary*, first published in 1995, which serves as the standard reference for encouraging data uniformity.

Reviews of the dictionary contents and data elements in prior years found no need for revision. The GDMS continues working on the formal identification of any outdated data elements, and, based on the ongoing review of this document, will determine whether a revision of the dictionary is necessary.

TGPC member agencies and organizations use the committee as the primary coordination mechanism for exchanging information of various data collection and assessment initiatives. The development of spatial databases for groundwater contamination sites is an example of the type of initiative undertaken by member agencies and organizations. The TCEQ has completed development of spatial

Strategy Recommendation

The TGPC must review and revise its groundwater data management standards and participate in the various data management advisory groups.

datasets for contamination sites under their jurisdiction, and the RCT continues work on spatial datasets for their contamination sites.

The TGPC also uses the GDMS to make available information on groundwater contamination and water-quality assessments of the state aquifers to the public through the publication of several reports mandated by both the state and the federal government. The subcommittee coordinates the compilation of data to be assessed by the TGPC and its member agencies and organizations to satisfy direct or indirect state and federal mandates such as the following reports:

- *Joint Groundwater Monitoring and Contamination Report*—the GDMS compiles and advises the TGPC on possible improvements, and updates and revises the *Joint Report's* enforcement status matrix; and
- *Texas Water Quality Inventory Report [305(b) Report]*—The GDMS advises the TCEQ on, and facilitates data exchange for the biennial assessment of the groundwater quality of the state's aquifers for inclusion in the federally required *305(b) Report*.

Joint Groundwater Monitoring and Contamination Report

The TGPC is required by TWC, 26.406 to publish an annual groundwater monitoring and contamination report. The report:

- describes the current status of groundwater monitoring activities conducted or required by each agency at regulated facilities or associated with regulated activities;
- contains a description of each case of groundwater contamination documented during the previous calendar year;
- provides a description of each case of contamination documented during previous periods for which enforcement action was incomplete at the time of issuance of the preceding report; and
- indicates the status of enforcement action for each case of contamination that is listed.

The TGPC produced and published two monitoring and contamination reports during the previous two years: *Joint Report—2008* (TGPC, 2009) and *Joint Report—2009* (TGPC, 2010). The findings are summarized below; however, a more detailed discussion of the *Joint Reports* and a summary of the report findings can be found in Appendix 4.

Data for the report comes from TGPC members and groundwater districts. Each member agency or organization provides the descriptions of their programs that protect groundwater. Each

Strategy Recommendation:

All available data sources should be checked for validity via accepted quality assurance and quality control measures and, once accepted, placed into an electronic format with a spatial data element for indexing in a relational database. The location and geometry of contamination plumes should be placed in a GIS format.

regulatory agency that requires or conducts groundwater monitoring to assure compliance with guidelines and regulations for the protection of groundwater from contaminants has its own monitoring program requirements and procedures.

The *Joint Report* for 2009 describes 17 regulatory monitoring programs in two state agencies. Monitoring of groundwater quality for permit and operational requirements occurred at approximately 10,619 facilities statewide. Data indicate that an estimated 51,384 monitor and water wells are being used for groundwater monitoring purposes at these facilities. The majority (greater than 99 percent) of the monitored facilities are under the jurisdiction of the TCEQ, with most of the remainder under the jurisdiction of the RCT.

The contamination cases identified in the *Joint Report* are primarily those where contaminants have been discharged to the surface, to the shallow subsurface, or directly to groundwater from activities such as the storage, processing, transport, or disposal of products or waste materials.

There were 4,729 documented groundwater contamination cases in the *Joint Report* for 2008 and 4,503 cases in 2009. Approximately 90.8 percent of the documented cases in 2009 were under the jurisdiction of the TCEQ. The remainder of the cases were under the jurisdiction of the RCT (with approximately 9.1 percent); and GCDs which are members of TAGD (with 1 case, or less than 0.1 percent).

The most common contaminants reported in both 2008 and 2009 were gasoline, diesel fuel, and other petroleum products due to the large number of cases related to petroleum storage tank systems. Less common reported contaminants were organic compounds (such as phenol, trichloroethylene, carbon tetrachloride, dichloroethylene, and naphthalene), pesticides (such as alachlor, atrazine, bromacil, dicamba, and prometon), creosote constituents, solvents, heavy metals, and sodium chloride.

Groundwater Monitoring Strategy

The GDMS has examined the data needs of the state's groundwater quality assessment programs, and is reviewing the adequacy of existing monitoring efforts in order to develop a comprehensive statewide groundwater quality monitoring strategy. For a more detailed discussion of these efforts, see Appendix 2.

The existing groundwater quality monitoring programs need more resources to sample additional sites. The parameters that are analyzed need to be expanded to include organic and synthetic chemicals. Staff from member agencies and organizations worked on refining the first phase of a joint groundwater monitoring strategy. This monitoring strategy is intended to meet present and future needs for groundwater

Strategy Recommendation:

The TGPC should develop recommendations on the design of a groundwater monitoring system that will meet the needs of all member agencies and organizations.

quality and quantity data. This first phase identifies a three-tiered monitoring concept that provides a foundation for building a more detailed monitoring program. The second phase of the monitoring strategy was completed in 2007, and refines the monitoring concepts, and proposes two assessment methodologies, one for data collected under the new monitoring strategy, and another for legacy data.

The development of this monitoring strategy is driven by both the *Strategy* and a need to improve the groundwater portion of the *305(b) Report*. Enhanced monitoring and a new assessment methodology for groundwater quality data will result in a more concise and usable version of the *305(b) Report* when submitted to EPA. While the current *305(b) Report* is prepared through interagency cooperation, primarily between the TWDB and the TCEQ, data gaps that were identified in the *Strategy* will be filled. Additionally, accurate reporting of specific, as opposed to generalized, groundwater quality issues will be possible.

The GDMS has temporarily suspended meetings, and has postponed further development on an enhanced statewide groundwater monitoring plan in order for the co-chair agencies to work together to develop a pilot project for inclusion in a possible national groundwater monitoring program. The TCEQ and the TWDB, respectively, have worked through the biennium to develop a national groundwater monitoring framework document, and pilot project. This work is being coordinated through the Advisory Committee on Water Information's Subcommittee on Ground Water.

Nonpoint Source Pollution Activities

Formerly, NPS Pollution Activities of the committee were coordinated by the NPS Task Force, co-chaired by the TCEQ and the TSSWCB. During the previous biennium, the NPS Task Force was deactivated, however, during this biennium, the Task Force has been re-activated in order to contribute to the NPS management plan that is published once every five years, as well as to address new NPS issues that have developed.

The charge of the NPS Task Force was modified to reflect these changes. NPS Pollution was added to Item 5 of the TGPC quarterly meeting agenda (Information Exchange for Groundwater-Related Activities).

The NPS Task Force has only recently been reactivated, but has held two meetings and is fully functional, currently working on the NPS Management Plan and other efforts to further clarify the role of NPS activities in groundwater protection.

Public Outreach and Education Activities

The TGPC Public Outreach and Education (POE) activities center on two overarching themes: (1) the protection of human health from contaminated groundwater or water that contains high levels of

naturally occurring compounds that could affect human health, and (2) the protection of groundwater from contamination.

The POE Subcommittee coordinates many of the TGPC's educational outreach initiatives. The POE Subcommittee met quarterly during the biennium to coordinate activities with other state and federal organizations involved in public outreach and to develop and implement educational outreach programs on groundwater protection and environmental health issues which are targeted to serve specific groups. The POE Subcommittee developed a formal *Groundwater Educational Outreach Plan* with 10 focus areas in late 2006 and an associated *Implementation Strategy* with specific activities for each focus area in 2007 (both documents are available on the POE Subcommittee's web page). Thirteen specific activities are now considered complete, three are in progress, six are on-going, and 14 still need to be done.

During the last biennium, the TGPC continued its sponsorship of exhibitor booths and displays at 22 Austin-area conferences, seminars, and meetings with 4,394 estimated visitors (10% of registered attendees). From its exhibitor booth, the TGPC distributed its trifold brochure and refrigerator magnets, state maps of various kinds (e.g., major and minor aquifers, river basins, precipitation, geology, TGPC member agency districts, and groundwater organizational areas), fact sheets, booklets, and a listing of groundwater publications available for download from the TGPC and other web sites. In addition, a TGPC-sponsored poster for National Groundwater Awareness Week was displayed in a dozen central Texas locations (including the Texas Capitol) in March 2009 and March 2010.

Strategy Recommendation

The TGPC recommends that the state continue to support the efforts of the Texas On-Site Wastewater Treatment Research Council, the Texas AgriLife Extension Service, the TCEQ's on-site wastewater program, and local governments in their efforts to develop and deliver effective educational material that addresses OSSF maintenance in order to prevent failures.

In addition, the government agencies involved in OSSF regulation and outreach may want to consider developing programs specially designed to reach and serve the state's high-growth counties.

Abandoned water wells provide a direct conduit for pollution occurring at the surface to enter groundwater resources. Recognizing the dangers to human health and groundwater quality that abandoned water wells pose, the POE Subcommittee updated its *Landowner's Guide to Plugging Abandoned Water Wells* (TCEQ RG-347) and worked with the Texas AgriLife Extension Service (TAES) to update the related *Plugging Abandoned Water Wells* (TAES B-6238). In addition, the TAES held two TGPC-supported abandoned water well closure (i.e., well-plugging) demonstrations twice in one county with 47 people in total attendance.

Contamination and naturally occurring compounds in groundwater that can affect human health remain a focus of the TGPC's education and public outreach efforts. The POE Subcommittee continued its coordination efforts with the TAES in expanding a package of educational material for outreach events. A fact sheet for private water well owners on Benzene (L-5513) was developed and published. This fact sheet contains information on the occurrence, health effects, and treatment options for this contaminant.

During the biennium, the TAES conducted a number of TGPC-supported educational events targeting water well owners, and the drinking water fact sheets were used in conjunction with their water well testing program –1,396 well samples were screened from 29 counties at 23 events (more than once in nine of these counties). An Outreach Events Status Report, listing both recent and upcoming TGPC booth displays, abandoned water well closures, and water well screening events, is frequently updated on the POE Subcommittee web page.

The POE Subcommittee drafted a letter of TGPC support for the TWDB's *Major Rivers* school-based water education program. A mail-out package was approved by the TGPC and distributed to 96 GCDs, 12 river authorities, and 12 geological societies in Texas. At least four new GCD sponsors subsequently contacted the TWDB about the *Major Rivers* program.

An effective OSSF system (i.e., septic system) removes wastewater from the home, treats and distributes the wastewater, and protects both public health and water resources from contamination. An OSSF system must be routinely maintained to operate properly. Unlike a centralized sewer system maintained by a city or water district, maintenance of an OSSF system is the responsibility of the homeowner. With a statewide OSSF system failure rate of 13 percent and the growing dependence on OSSF systems in the

Strategy Recommendation

Public educational materials and outreach programs are needed to educate domestic/private well owners on drinking water quality and potential health risks.

More support needs to be given to educational efforts for targeted geographic areas of concern for high concentrations of naturally occurring groundwater contaminants and on various treatment options available to the domestic/private well owner.

Support is also needed for educational efforts to develop and deliver effective educational materials that target potential sources of contamination such as abandoned wells.

Special effort should be made to develop programs designed to reach and serve the state's high-growth areas.

Strategy Recommendation

The state should undertake a voluntary program targeted at private well owners, designed to identify problem areas and assist private well owners in understanding these groundwater quality issues.

suburban fringe, the TGPC will continue to provide information to the public on the proper usage and maintenance of their OSSF system.

Development of educational outreach material related to pesticides and groundwater protection for farmers, ranchers, homeowners, and small acreage landowners will also remain an important focus area for the POE Subcommittee.

Since many of the agencies involved in groundwater protection have several functions, their web sites are not organized around groundwater as a theme, making it difficult for the general public to find information on the state's groundwater protection efforts. The TGPC web site, <www.tgpc.state.tx.us>, was established prior to this biennium and is frequently updated with new information on groundwater protection activities. In addition to providing information about TGPC business to its members and the public, the web site is a clearinghouse for many groundwater-related topics, supplying links to the web sites and publications of TGPC members and other organizations. Addressing one of the focus areas in their *Groundwater Educational Outreach Plan* and its *Implementation Strategy*, the POE Subcommittee now has 29 Frequently Asked Questions (FAQs) posted on the TGPC web site; these FAQs are one- to two-page summaries of topics related to groundwater quantity, groundwater quality, septic systems, water wells, administrative entities, and publications. These popular press articles assist state-wide newsletter editors and webmasters in disseminating groundwater-related information to the public. Additional FAQ topics under development include oil and gas waste disposal wells and radionuclides in groundwater. An email subscription service with 3,415 recipients is used to notify the public of upcoming meetings and new TGPC web site information, and TGPC web site activity for three months in 2010 averaged 41 unique visitors per day.

Groundwater Research Activities

Traditional groundwater research organizations, generally associated with universities, in both the agricultural and natural resource sectors, have developed the experience, infrastructure, and technical expertise needed to address complex research needs. However, there is no formal mechanism to link TGPC members that need research with the organizations that are capable of undertaking the research. The Groundwater Research Subcommittee was formed to identify interagency groundwater research needs and provide a coordinated approach in seeking potential funding sources.

Strategy Recommendation

TGPC should form a research subcommittee to identify interagency research needs and to provide a coordinated approach for discussion with federal agencies for funding. The results of this work should be shared with the TCEQ for its consideration under the research model authorized under TWC 5.1191–5.1193.

The subcommittee continues to identify research topics, and continues to serve as a forum for the exchange of ideas among the various agencies on groundwater research needs and on opportunities for potential sources of funding. As usual research topics exceed funding opportunities. Unfunded research needs considered most urgent are included in the **Recommendations to the 82nd Texas Legislature** Chapter of this document.

The Groundwater Research Subcommittee met eight times during the biennium. Regularly scheduled items on the subcommittee's agenda included discussion of potential research projects and sources of funding. Special participants that were invited to meetings from time to time to discuss special topics included:

- A person from the nonpoint source program to discuss how groundwater projects might receive more funding
- A person from the Water Quality Assessment Team of the Water Quality Assessment Section of the Water Quality Division of the TCEQ to discuss the land application program at TCEQ and how it might be affecting groundwater quality
- Two staff members from the Nonpoint Source Program of the TCEQ to talk about the Nonpoint Source Program

Intergovernmental Cooperation Activities

The TGPC and its subcommittees undertake intergovernmental efforts to fill gaps in service delivery and information exchange. These include: (1) notifying private well owners of groundwater contamination, (2) coordination with RWPGs, and (3) coordination with the federal government.

Private Well Owner Notification of Groundwater Contamination

TWC, 26.408 requires the TCEQ to inform owners of private drinking water wells, within 30 days of the date the TCEQ receives notice of groundwater contamination, that their well may be affected by contamination. GCDs in which the contamination is occurring are also notified.

The TGPC developed the form and content of the notice to the owners of private drinking water wells as required by 31 TAC 601.10. A copy of the rule can be found in Appendix 5.

The TCEQ uses the TGPC as an avenue for interagency communication. Staff has held meetings with the RCT, TWDB, TDA, and TDLR to describe the TCEQ responsibilities and internal protocol. The monitoring programs of these agencies were reviewed, and post-monitoring procedures, which might affect a case referral to the TCEQ, were clarified. Similar discussions are planned with TSSWCB, the Texas AgriLife Extension Service, and Texas AgriLife Research.

Coordination with Regional Water Planning Groups

During the development of the *Strategy*, the TGPC recognized that the State's RWPGs were relying heavily on GAMs and quantity information, but may have been failing to account for groundwater availability issues caused by aquifer impairments. TGPC now provides reports, such as the *Joint Reports*, to RWPGs.

The TWDB representative of the TGPC continues to report quarterly on the status of RWPG activities and the TWDB's GAM efforts.

Strategy Recommendation

The TGPC needs to strengthen the lines of communication and information sharing with the State's RWPGs. The lack of communication between these two groups is a gap in the TGPC's ability to coordinate the state's groundwater protection strategy with the state's water supply planning efforts led by the TWDB.

Coordination with the Federal Government

EPA, through the Clean Water Act, has provided grants to the state since 1985 to: (1) promote the coordination of groundwater protection activities of federal and federally-delegated regulatory programs; and (2) foster a more comprehensive approach to groundwater protection. In addition, starting in 1992, EPA has provided grants to the state under the FIFRA for groundwater protection activities specifically related to pesticide use and effects on groundwater.

The TGPC leads initiatives, in partnership with federal agencies, to develop a state groundwater protection strategy and implement PMP activities to protect groundwater from contamination. Current state and federal cooperative efforts include identifying potential improvements to the state's groundwater quality monitoring effort and ensuring that those efforts are consistent with national monitoring initiatives.

In addition, the TGPC regularly provides input at the national level to federal agencies through the Ground Water Protection Council (an association of state groundwater and underground injection control program directors), the State FIFRA Issues Research Evaluation Group (a group formed by state agricultural regulatory officials and EPA to discuss and evaluate pesticide matters affecting states), the National Water Quality Monitoring Council (an advisory group to the USGS and EPA), and other state and federal stakeholder and regulatory guidance groups.

The TGPC works closely with the USGS, the federal agency with hydrogeologic responsibilities that include national level geologic mapping and hydrologic studies. USGS participates in TGPC-sponsored projects and subcommittees, providing both groundwater expertise and opportunities for state input into federally-sponsored research.

TGPC Administrative Activities

The TGPC carries out numerous administrative duties required by state law, such as developing this biennial report to the legislature, holding required quarterly meetings, and ensuring that documents are maintained in a manner that makes them easily accessible to the public. In addition, the TGPC and its subcommittees are subject to the state's open-meeting laws. Periodically, state laws are enacted that require the TGPC to undertake rulemaking. Much of the TGPC's work is performed in quarterly meetings and through the efforts of its subcommittees.

Legislative Report Development

The Legislative Report Subcommittee met three times during the biennium to coordinate the drafting of the recommendations portion of the *Activities and Recommendations of the TGPC* are required by TWC, 26.405. The subcommittee develops, for full TGPC approval, groundwater protection recommendations for legislative consideration.

Actions on Recommendations to the 81st Legislature

The 81st Legislature addressed five of the 14 recommendations forwarded by the TGPC in January 2009 by:

- continuing funding for brush control in order to enhance the availability of both groundwater and surface water
- continuing support of a Water Conservation Plan Program
- protecting groundwater resources during the development of laws governing the geologic sequestration of carbon dioxide
- protecting brackish/saline aquifers having potential for use as drinking water sources, and
- funding the acquisition and analysis of brackish groundwater data.

Strategy Recommendation

The TGPC should establish, on its web site, links to key groundwater information residing at state agencies and educational institutions.

Meetings and Presentations

The TGPC met quarterly during the biennium, as required by TWC, 26.404. Regularly scheduled items on the TGPC's agenda included subcommittee reports, presentations and roundtable discussions, business, information exchange, announcements, and public comment. In addition, agencies share and discuss current and ongoing rule development relating to the protection of groundwater.

The TGPC regularly receives groundwater-related presentations. Presentations during biennium were:

- TCEQ's Regulation of In Situ Mining in Texas
- TCEQ's Water Well Digitization Project

- TCEQ's Groundwater Source Sampling
- TWDB's Major Rivers Education Program
- BEG's Impacts of Agriculture on Groundwater Quality in the Southern High Plains Aquifer

Subcommittees

The TGPC uses subcommittees and task forces to perform much of its work and to address issue and program development. The TGPC considers subcommittee findings and recommendations at regular meetings. The following subcommittees and task forces were used during the biennium:

- Agricultural Chemicals Subcommittee
 - State Management Plan Task Force
 - Educational Task Force
 - Site Selection Task Force
- Data Management Subcommittee
- Groundwater Research Subcommittee
- Legislative Report Subcommittee
- Nonpoint Source Task Force (deactivated in April 2008; reactivated, and its Charge updated, in April 2010)
- Public Outreach and Education Subcommittee

Rules and Quadrennial Review

The TGPC rules (Appendix 5) define the environmental conditions that constitute groundwater contamination for inclusion of cases in public files of state agencies having groundwater protection responsibilities. The rules describe the contents of the TGPC's Joint Report and specify the form and content of notices of groundwater contamination.

The TGPC is required to develop and implement a rules review plan for the periodic review and re-adoption of its rules in accordance with Government Code §2001.039. The TGPC began a review of its rules in February 2010. At its July 20, 2010, meeting, the TGPC approved the publication of the quadrennial rules review. There were no proposed revisions to the TGPC rules during this review. The TGPC adopted the rules review at its October 20, 2010, meeting.

Public Records and Public Meetings

State law requires the TCEQ to be the TGPC's administrative agent. As such, the TCEQ maintains a mailing list of the TGPC members, designated and alternate members, subcommittee members, and agency staff for correspondence. The TCEQ also uses an e-mail subscription service to notify all TGPC members, agency staff, and interested parties of upcoming meetings. The TCEQ provides meeting information through the *Texas Register* for public notification,

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maintains digital recordings of the TGPC meetings, prepares meeting records, and keeps meeting and correspondence files for the TGPC and subcommittees. In addition, the TGPC publishes documents that are available through the TCEQ's Agency Communications Division. See Appendix 6 for a list of select TGPC publications.

Like other state agencies, the TGPC is subject to the state's open meetings laws. Meeting notices are provided to the *Texas Register*, notices of upcoming meetings are sent to the TGPC e-mail subscription list, and meeting information is also posted on the TGPC web site.

Information is also made available to the public through the TGPC web site at <www.tgpc.state.tx.us>.

Appendix 1. Texas Groundwater Protection Committee Membership

Chairman—Texas Commission on Environmental Quality	
<p>Mark Vickery, Executive Director, MC-109 Texas Commission on Environmental Quality PO Box 13087 Austin TX 78711-3087 Telephone: 512-239-3900 Fax: 512-239-3939</p>	<p><i>Designated Chairman:</i> Cary Betz, Groundwater Technical Specialist Water Supply Division, MC-154 Texas Commission on Environmental Quality PO Box 13087 Austin TX 78711-3087 Telephone: 512-239-4506 Fax: 512-239-6145 E-mail: cbetz@tceq.state.tx.us</p>
Vice-Chairman—Texas Water Development Board	
<p>J. Kevin Ward, Executive Administrator Texas Water Development Board PO Box 13231 Austin TX 78711-3231 Telephone: 512-463-7850 Fax: 512-475-2053</p>	<p><i>Designated Vice-Chairman:</i> Bill Hutchinson, PhD, PG, PE, Director Groundwater Resources Division Texas Water Development Board PO Box 13231 Austin TX 78711-3231 Telephone: 512-463-5067 Fax: 512-936-0816 E-mail: bill.hutchinson@twdb.state.tx.us</p>
Railroad Commission of Texas	
<p>John Tintera, Executive Director Railroad Commission of Texas PO Box 12967 Austin TX 78711-2967 Telephone: 512-463-7068 Fax: 512-463-7000</p>	<p><i>Designated Representative:</i> Leslie Savage, Assistant Director Railroad Commission of Texas PO Box 12967 Austin TX 78711-2967 Telephone: 512-463-7308 Fax: 512-463-7005 E-mail: leslie.savage@rrc.state.tx.us</p>
Texas State Soil and Water Conservation Board	
<p>Rex Isom, Executive Director Texas State Soil and Water Conservation Board PO Box 658 Temple TX 76503-0658 Telephone: 254-773-2250 Fax: 254-773-3311</p>	<p><i>Designated Representative:</i> Donna Long, Water Quality Specialist Texas State Soil and Water Conservation Board PO Box 658 Temple TX 76503-0658 Telephone: 254-773-2250, ext. 228 Fax: 254-773-3311 E-mail: dlong@tsswcb.state.tx.us</p>
Texas Department of Agriculture	
<p>Todd Staples, Commissioner Texas Department of Agriculture PO Box 12847 Austin TX 78711-2847 Telephone: 512-463-1408 Fax: 800-831-3884</p>	<p><i>Designated Representative:</i> Ambrose Charles, PhD Deputy Assistant Commissioner for Pesticides Texas Department of Agriculture PO Box 12847 Austin TX 78711-2847 Telephone: 512-463-7699 Fax: 888-216-9834 E-mail: ambrose.charles@texasagriculture.gov</p>

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Department of State Health Services	
David Lakey, MD, Commissioner Department of State Health Services 1100 West 49th Street Austin TX 78756 Telephone: 512-458-7375 Fax: 512-458-7477	<i>Designated Representative:</i> Ken Ofunrein, Group Manager Compliance Inspections Group South Environmental & Consumer Safety Section Department of State Health Services 1100 West 49th Street Austin TX 78756 Telephone: 512-834-6770, ext. 2451 Fax: 512-834-6644 E-mail: ken.ofunrein@dshs.state.tx.us
Texas Department of Licensing and Regulation	
David Gunn Texas Department of Licensing and Regulation Well Driller/Pump Installer/Abandoned Well Referral Program PO Box 12157 Austin TX 78711 Telephone: 512-463-7880 Fax: 512-463-8616 E-mail: david@license.state.tx.us	<i>Designated Representative:</i> Same
Texas Alliance of Groundwater Districts	
Jim Conkwright, Manager High Plains UWCD #1 President, Texas Alliance of Groundwater Districts 2930 Avenue Q Lubbock TX 79411-2499 Telephone: 806-762-0181 Fax: 806-762-1834	<i>Designated Representative</i> David Van Dresar, General Manager Fayette County GCD 255 Svoboda Lane, Room 115 La Grange TX 78945 Telephone: 979-968-3135 Fax: 979-968-3194 E-mail: david@fayettecountygroudnwater.com
Texas AgriLife Research	
Mark Hussey, PhD, Director Texas AgriLife Research 113 Jack K. Williams Building 2142 TAMU College Station TX 77843-2142 Telephone: 979-862-3746 Fax: 979-862-1637	<i>Designated Representative</i> B.L. Harris, PhD, Acting Director Texas Water Resource Institute 2118 TAMU College Station TX 77843-2118 Telephone: 979-845-1851 Fax: 979-845-8554 E-mail: bl-harris@tamu.edu
Bureau of Economic Geology	
Scott Tinker, PhD, Director Bureau of Economic Geology Jackson School of Geosciences The University of Texas at Austin University Station, Box X Austin TX 78713-8924 Telephone: 512-471-1534 Fax: 512-471-0140	<i>Designated Representative</i> Bridget Scanlon, PhD, Senior Research Scientist Bureau of Economic Geology Jackson School of Geosciences The University of Texas at Austin University Station, Box X Austin TX 78713-8924 Telephone: 512-471-8241 Fax: 512-471-0140 E-mail: bridget.scanlon@beg.utexas.edu

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Appendix 2. Texas Groundwater Protection Strategy

Background

The legislature charged the TGPC with developing and updating a comprehensive groundwater protection strategy for the state that provides guidelines for the prevention of contamination and for the conservation of groundwater and provides for the coordination of the groundwater protection activities of the agencies represented on the TGPC.

With the continuing focus on the need for assuring a high quality supply of groundwater in the state, and recognizing the programmatic changes that have occurred since the state's first groundwater protection strategy was developed in 1988, the TGPC decided in January 2001 to update the state's groundwater strategy. The TGPC issued the revised *Strategy* in February 2003.

State Groundwater Protection Strategy

In developing the *Strategy*, the TGPC recognized that the state has numerous successful groundwater programs spread among local and state governmental agencies and research institutions. Therefore, a key part of the *Strategy* documented how the current regulatory, outreach, and research programs work to protect groundwater resources. A second fundamental component of the *Strategy* was the identification of protection gaps in program implementation or coordination. TGPC believes that this approach to developing the *Strategy*, grounded firmly within the existing policy and programmatic directions given by the legislature, resulted in a document that sets realistic objectives for success and provides a road map for action over the next 5 to 15 years.

The *Strategy* provides recommendations and possible actions to protect groundwater. The following discusses each *Strategy* recommendation that was given in Chapter X: Recommendations for Action and the TGPC and member agency response to the recommendations.

Implementation of Strategy Recommendations

Over the past two years, the Groundwater Research Subcommittee, the POES, and the Data Management Subcommittee were charged with implementing specific recommendations given in the *Strategy*. The charge to the ACS was reviewed and revised to provide assistance and further coordination for addressing recommendations and issues identified in the *Strategy*. The subcommittees were given the ongoing

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responsibility to report quarterly at the TGPC's regularly scheduled meeting on subcommittee activities. A discussion of the progress in implementing the *Strategy's* recommendations follows.

Strengthen Communication with the State's Water Planning Efforts

Strategy Recommendation. *The TGPC needs to strengthen the lines of communication and information sharing with the State's RWPG. The lack of communication between these two programs is a gap in the TGPC's ability to coordinate the state's groundwater protection strategy with the state's water supply planning efforts led by the Texas Water Development Board. (Short-term 5-year Goal)*

Response. The TWDB representative of the TGPC now reports quarterly on the status of RWPG activities and the TWDB's Groundwater Availability Modeling efforts.

Improve Groundwater Data

Strategy Recommendation. *Gaps exist in the data collection and data assessment processes. The existing groundwater quality monitoring programs need more resources to sample additional sites that will provide a better picture of groundwater conditions statewide. The parameters that are analyzed need to be expanded to include organic and synthetic chemicals. While site-specific assessment of hazardous wastes in groundwater is covered by a number of state and federal programs, other substances in groundwater, such as nitrate and arsenic that may be deemed naturally occurring need better assessment. The TGPC should develop recommendations on the design of a groundwater monitoring system that will meet the needs of all member agencies and organizations. Any new monitoring of domestic water wells would be on a voluntary basis. (Short-term 5-year Goal)*

Response. Throughout the biennium, staff from member agencies and organizations worked on refining the second phase of a groundwater monitoring strategy. This monitoring strategy is intended to address current and future needs for groundwater quality and quantity data. While the first phase identified a three-tiered monitoring concept that provides a foundation for building a more detailed monitoring program, the second phase of the monitoring strategy refines the monitoring concepts, and proposes two assessment methodologies, one for the data collected under the new strategy, and another for legacy data.

Once completed, implementing the strategy should improve the groundwater portion of the Texas Water Quality Inventory [305(b) Report]. Enhanced monitoring and new assessment methodologies for groundwater quality data will result in a more concise and usable version of the report when submitted to the EPA. While the current report is prepared by interagency cooperation, primarily between the TWDB and the TCEQ, data gaps that were identified in the *Strategy*

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will be addressed, and accurate reporting of specific, as opposed to generalized, groundwater quality issues will be possible.

The TGPC has also been the primary coordination mechanism for exchanging information of various data collection and assessment initiatives by the member agencies and organizations. The development of spatial databases for groundwater contamination sites is an example of the type of initiative undertaken by member agencies and organizations—the TCEQ and the RCT are both working on spatial datasets for contamination sites under their individual jurisdictions. These spatial datasets are being developed as needed by specific programs within the agencies, and will be able to be utilized by other programs using common data elements. Progress on these efforts is being monitored by TGPC support staff.

Strategy Recommendation *Data management is a dynamic process and, as such, accepted data management standards may become outdated or superseded by a better, newer standard. It is imperative that these data management standards be periodically reviewed and amended to facilitate information exchange. The TGPC must review and revise its groundwater data management standards and guidelines, and must actively participate in the various data management advisory groups. (Short-term 5-year Goal)*

Response. The TGPC published the *Texas Groundwater Data Dictionary* in August 1996. During 2005, the GDMS of the TGPC submitted this document to the Texas Geographic Information Council (TGIC) for review of the spatial data elements for adequacy. TGIC reported that the spatial data elements in the dictionary met the state's requirement for minimum data elements and did not recommend any changes.

Other data elements contained in the dictionary have been informally identified as potentially needing revision. The TGPC is presently working on the formal identification of any outdated data elements, and, based on the results of this identification, will determine whether a revision of the dictionary is necessary.

Data management systems are improving daily. Data storage capacity is much larger today than when the *Strategy* was crafted, and retrieval methods are much easier and faster. Despite these improvements, designing a centralized data management system remains an expensive proposition, in terms of both capital expense and workforce allocation. The TGPC has focused efforts toward developing data management methods that will work with existing databases and/or new databases under construction. Identification of common data elements within these databases is essential to provide access to the widest array of data for all users.

Adding new pesticide sampling data is an ongoing effort of the TGPC. During the biennium, available data was evaluated and a report was prepared describing the status of pesticide occurrence in groundwater. The report is available from the TGPC web site.

Strategy Recommendation *The need for a geographic information systems/relational database for waste site and groundwater contamination site characterizations is critical to any planning process. All available data sources should be checked for validity via accepted quality assurance and quality control measures, and once accepted, placed into an electronic format with a spatial data element for indexing in a relational database. The location and geometry of contamination plumes should be placed in a GIS format. (Medium-term 10-year Goal)*

Response. In 2006, staff preparing the *Joint Groundwater Monitoring and Contamination Report—2005* conducted a trial acquisition of spatial data for groundwater contamination sites in the report. This effort continued and improved during preparation of the 2006 and 2007 reports. Staff were able to provide accurate locations for 99% of the 5,223 sites reported by the TCEQ in 2006, and 4,893 reported in 2007. The RCT continues their current work on developing a spatial database for these sites. Staff remains optimistic about plans to convert the *Joint Report* to a web-based, spatial presentation format within the next few report cycles.

Strategy Recommendation *The TDLR has developed a relational database that includes water well driller information, the water well driller's reports, and reports of encountering undesirable water zones when wells are drilled, in a spatial coordinate (latitude and longitude) database. There is a large number of existing hard-copy water well drillers reports that need to be placed in a digital format and made accessible through the existing system. (Medium-term 10-year Goal)*

Response. During the biennium, the TCEQ undertook conversion of paper Water Well Reports to a digital format. The large number of paper records (800,000+), has been digitally imaged and indexed according to state water well grid number. This system emulates the paper file system that has been in place for years; however, it provides more reliable accessibility and much needed disaster backup. Files may presently be accessed from computer kiosks in the TCEQ Central File Room, with plans to initiate a web-based access system within the next biennium.

Coordinate Research

Strategy Recommendation *Traditional groundwater research organizations, generally associated with universities, in both the agricultural and natural resource sectors, have developed the experience, infrastructure, and technical expertise needed to address complex research needs. However, there is no formal mechanism to link the agencies on the TGPC that need research performed together with the organizations that are capable of performing the research. The TGPC should form a research subcommittee to identify interagency research needs and to provide a coordinated approach for discussion with federal agencies for funding. The results of this work should be shared with the TCEQ for its consideration under the*

*research model authorized under TWC Sections 5.1191–5.1193.
(Short-term 5-year Goal)*

Response. The Groundwater Research Subcommittee was formed to meet a need for a coordinating group to work with state agencies, such as the TCEQ, TWDB, RCT, TDA, DSHS, the TSSWCB, and with traditional research organizations, such as universities and the USGS, to identify interagency groundwater research needs and provide a coordinated approach in seeking potential funding sources.

A document/white paper has been prepared by TWRI entitled “Influences of Natural and Man-Made Sources of Contamination on Water Quality Trends in the Seymour Aquifer: A 2007 Status Report.” The subcommittee has identified a number of research topics, and continues to serve as a forum for the exchange of ideas between the various agencies on groundwater research needs and opportunities for potential sources of funding.

Increase Public Outreach

Strategy Recommendation. *Virtually all water used in rural homes, not connected to a public drinking water system, comes from domestic/private water wells. There are no specific programs that routinely examine the quality of groundwater being consumed by Texans utilizing these wells. More water quality information is needed to develop assessments of water quality and health risk for the domestic/private well owner segment of the population. The state should undertake a voluntary program targeted at private well owners, designed to identify problem areas and assist private well owners in understanding these groundwater quality issues. (Short-term 5-year and Medium-term 10-year Goal)*

Response. The Charges to the TGPC POES and Groundwater Research Subcommittees were updated in 2008 to include a requirement to meet annually with the TCEQ and TSSWCB NPS teams in order to share information, discuss NPS projects, and facilitate NPS grant proposals by TGPC member agencies. In order to provide the public with more educational outreach material related to groundwater and pesticides, the POES also coordinated efforts with the Texas AgriLife Extension Service in developing and publishing a *Best Management Practices to Prevent Pesticide Contamination* tri-fold brochure (L-5500) which discussed the properties of pesticides that can affect the risk of water contamination, the factors that can influence the movement of pesticides in the environment, and special steps that farmers, ranchers, homeowners, and small acreage landowners can take to protect our water from pesticides. In addition, the TGPC supported the reprinting of a Texas AgriLife Extension Service fact sheet which discussed how integrated weed management in lawns can protect the environment (L-5324).

Strategy Recommendation *Public educational materials and outreach programs are needed to educate domestic/private well owners on drinking water quality and potential health risks. More support needs to be given to educational efforts for targeted*

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geographic areas of concern for high concentrations of naturally occurring groundwater contaminants and on various treatment options available to the domestic/private well owner. Support is also needed for educational efforts to develop and deliver effective educational materials that target potential sources of contamination such as abandoned wells. Special effort should be made to develop programs designed to reach and serve the state's high-growth areas. (Short-term 5-year and Medium-term 10-year Goal)

Response. The POES worked with the Texas AgriLife Extension Service to develop and publish a fact sheet that explained how a landowner can cap currently unused water wells for future use (L-5490). In addition, the Texas AgriLife Extension Service held six TGPC-supported abandoned water well closures (i.e., well-plugging demonstrations) in four counties (twice in two counties) with an attendance of over 115 people. The POES continued its coordination efforts with the Texas AgriLife Extension Service in expanding a package of educational material for outreach events. A fact sheet for private water well owners on Methyl Tertiary Butyl Ether (MTBE) (L-5502) was developed and published in English, the radionuclide fact sheet was published in Spanish (B-6192S), and the nitrate fact sheet (B-6184) was reprinted. These fact sheets contain information on the occurrence, health effects, testing options, and treatment options for these contaminants.

During the biennium, the Texas AgriLife Extension Service conducted a number of TGPC-supported educational events targeting water well owners, and the drinking water fact sheets were used in conjunction with their water well testing program through which over 1,700 well samples were screened from over 25 counties at 25 events (more than once in 11 of these counties).

In addition, the TGPC continued its sponsorship of exhibitor booths and displays at 21 Austin-area conferences, seminars, and meetings with over 3,100 estimated visitors (10% of registered attendees) – a TGPC-sponsored poster was even displayed in the Texas Capitol for National Groundwater Awareness Week in both March 2007 and March 2008. From its exhibitor booth, the TGPC distributed its tri-fold brochure and refrigerator magnets, state maps of various kinds (e.g., major and minor aquifers, river basins, precipitation, geology, TGPC member agency districts, and groundwater organizational areas), fact sheets, booklets, and a listing of groundwater publications available for download from the TGPC and other web sites.

Strategy Recommendation *An effective on-site system removes wastewater from the home, treats and distributes the wastewater, and protects our water resources. An on-site wastewater system requires maintenance in order to maintain proper operation and environmental protection. Unlike a centralized sewer system maintained by a city or water district, maintenance of an on-site system is the responsibility of the homeowner. A statewide OSSF failure rate of 13 percent and the growing dependence on these systems in the suburban fringe around urban areas continues to*

create human health and environmental concerns. Therefore, the TGPC recommends that the state continue to support the efforts of the On-Site wastewater Treatment Research Council, the Texas AgriLife Extension Service, the TCEQ's on-site wastewater program, and local governments in their efforts to develop and deliver effective educational material that addresses OSSF maintenance in order to prevent failures. In addition, the government agencies involved in OSSF regulation and outreach may want to consider developing programs specially designed to reach and serve the state's high growth counties. (Short-term 5-year and Medium-term 10-year Goal)

Response. During the last biennium, the POES continued its coordination efforts with the Texas AgriLife Extension Service in expanding a package of educational material for outreach events. A fact sheet for private OSSF system owners regarding the understanding and maintenance of a septic system was developed and published (L-5491) and the graywater (B-6176) fact sheet was reprinted.

Strategy Recommendation *Oftentimes, state agency web pages are not organized around groundwater as a theme, making it difficult for the general public to find information on the state's groundwater protection efforts. To remedy this, the TGPC should establish, on its web page, links to key groundwater information residing at state agencies and educational institutions. (Short-term 5-year Goal)*

Response. The TGPC web site (www.tgpc.state.tx.us) has been frequently updated with new information on groundwater protection activities. In addition to providing information about TGPC activities to its members and the public, the web site serves as a clearinghouse for many groundwater-related topics such as general groundwater information; pesticides; water wells; septic systems; groundwater contamination; oil, gas, and mining; and water conservation. The web site supplies links to other web sites as well as publications of its members and other organizations. Addressing one of the focus areas in their newly developed *Groundwater Educational Outreach Plan* and associated *Implementation Strategy* (available on the POES web page), the POES created a Frequently Asked Questions (FAQs) web page and posted over a dozen one- to two-page summaries of topics related to groundwater quantity and quality, septic systems, water wells, and administrative boundaries. These popular press articles will assist state-wide newsletter editors and webmasters in disseminating groundwater-related information to the public. Additional FAQ topics under development include oil and gas waste disposal wells and the State Water Plan.

Instituted during the last biennium, an email subscription service with almost 1,000 recipients is now used to notify the public of upcoming meetings and new TGPC web site information, driving an increase in TGPC web site activity (the first six months of 2008 averaged 82 unique visitors per day). In addition an Outreach Events Status

Report, listing both recent and upcoming TGPC booth displays, abandoned water well closures, and water well screening events, is now frequently updated on the POES web page.

Commit to Development of Periodic Updates and Improvements to the State Groundwater Protection Strategy

Strategy Recommendation *The first groundwater strategy was developed in 1988 and has not been updated prior to this document. The TGPC should update the Strategy every 6 years. (Short-term 5-year and Medium-term 10-year Goal)*

Response. The TGPC has undertaken review and revision of the Strategy in 2008, and plans for publication in 2011.

Strategy Recommendation. *As part of the ongoing process for developing the next Strategy, the TGPC intends to conduct an analysis that will identify and rank threats to groundwater quality (taking into consideration the vulnerability of groundwater resources and using available data), and prioritize possible actions that address those threats. Such an analysis would provide a valuable tool to both TGPC member agencies and organizations, and state legislators as they go about setting groundwater protection policy. (Short-term 5-year and Medium-term 10-year Goal)*

Response. The compilation of spatial data for cases in the *Joint Report* represents a major step forward in identifying threats to groundwater quality from regulated activities, or conversely, determining where regulatory programs have been effective in maintaining the quality of groundwater. Use of this data with legacy data in the assessment methodology currently under development for the Joint Groundwater Monitoring Strategy, will assist in establishing locations targeted for more intensive or rigorous groundwater monitoring.

Additionally, the most recent format of the Groundwater Assessment portion of the Texas Water Quality Inventory [*305(b) Report*] has been adopted in order to make identification and ranking of threats to groundwater quality possible. In the 2010 version of the report, the data, and the graphical presentation of the data, have been continued to cover all major and minor aquifers in the state.

Concentrations of multiple “constituents of concern” that exceed some generally accepted environmental or health based action levels, are developed using GIS into a graphic format, with symbols showing the locations and relative concentrations of parameters sampled during the most recent round of sampling for each aquifer.

Data from the TWDB’s Database is used for this effort, along with data from the TCEQ’s Public Drinking Water Database and Interagency Pesticide Database.

Appendix 3. State Management Plan for the Prevention of Pesticide Contamination of Groundwater

Plan Development

The TCEQ is charged under TWC §26.407 to develop management plans for agricultural chemicals, with the advice of the TGPC. These plans will address agricultural chemicals such as pesticides that may threaten groundwater quality. Specifically, these plans are developed for the protection and enhancement of water quality pursuant to federal statute, regulation, or policy, and include management plans for the prevention of water pollution by agricultural chemicals and agents.

At the request of the TCEQ, in 2001, the TGPC developed the *Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater*, more commonly known as the PMP. These management plans were initially referred to as SMPs, but eventually came to be referred to as PMPs. The plan, as a generic PMP for the state, serves as a guide that addresses the prevention of pesticide contamination and actions that will be used by the state to respond to contamination when it is found. The plan was developed as a joint effort of the agency members of the ACS. The plan received input from agricultural producers, manufacturers, and environmental interest groups. The TGPC effort considered the guidance provided by the EPA's Ground-Water Protection Strategy and the Final Guidance for Pesticides and Ground-Water SMPs. The effort is an update of the Texas SMP for Agricultural Chemicals in Ground Water, published by the TGPC in 1991.

EPA has decided not to finalize rules, first proposed in 1996, that were originally planned as a part of this initiative. However, EPA continues to advocate their policy on addressing pesticides in groundwater through the PMP process and provides continued grant support for this program.

The goal of the PMP is to protect the existing quality of groundwater and to prevent the degradation of state groundwater resources. This goal does not mean zero-contaminant discharge, but rather that the use of pesticides is conducted according to the label and in a manner that will maintain present groundwater uses and not impair potential uses of groundwater or pose a public health hazard. All usable and potentially usable groundwater resources are subject to the same protection afforded by the state's non-degradation policy goal.

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The PMP describes the general policies and regulatory approaches the state will use to protect groundwater resources from risk of contamination by pesticides. The document describes a generic coordinating mechanism among all responsible and participating agencies during the implementation of the PMP and provides for specific responses when it is deemed necessary to take specific actions to protect groundwater. The PMP reflects the state's philosophy toward groundwater protection and recognizes the importance of agriculture to the state's economy.

Since 2006, EPA began shifting program focus to having the states assess pesticides and identify which pesticides may be POIs or Pesticides of Concern (POCs) in that state. EPA developed a list of 57 pesticides for the states to assess. Many of these pesticides were not being monitored by the state and required a shift in monitoring activities. EPA requires that states annually enter assessment results into an on-line database. EPA is also attempting to integrate surface water into the existing groundwater pesticide program. Since Texas' pesticide program is for groundwater, Texas must rely on the data and information provided by the surface water programs on pesticides, an extra work item for them without any additional budgeted resources. Furthermore, EPA is requiring all pesticide monitoring data be provided in a specific format, which will require some effort and resources to develop and implement. These changes will result in Texas having to be even more creative to stretch resources and provide for these additional tasks without an increase in the program budget.

Groundwater Monitoring Plan for Atrazine and Metolachlor

Monitoring efforts have been significantly enhanced through a cooperative sampling effort among the TWDB, a number of GCDs, and the TCEQ. The TWDB or a GCD obtains an extra groundwater sample, in the course of their regular monitoring activities, and then the TCEQ conducts the screening analyses for atrazine and any other pesticide of interest. Through this cooperative effort over 3000 samples were obtained and analyzed since 2000. Using an immunoassay analytical method, all samples were screened for atrazine and a lesser number for additional pesticides. These include diazinon, 2,4-D, acetochlor, glyphosate, chlorpyrifos, organophosphates/carbamates, and pyrethroids, depending upon available funds for the year.

During the first five years of this cooperative sampling effort, samples from all of the aquifers that the TWDB monitors have been screened for atrazine and metolachlor. The cooperative monitoring program is into the third round of the TWDB's four-year monitoring cycle. Thus far, monitoring continues to reveal atrazine detections in the central Texas Panhandle but only occasional low-level detections of atrazine or one of the other pesticides in the rest of the state. The cooperative monitoring atrazine detections lie in the same region of the Panhandle as previous investigative monitoring detections. All but one (an

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atrazine detection) of the cooperative monitoring detections has been significantly below the MCL for drinking water.

Groundwater Monitoring for Urban Pesticides

Changes in the EPA grant during the past biennium include the assessment of POIs and POCs, from a list of 57 pesticides identified by a national work group put together by EPA. Many of these pesticides are not monitored in Texas, especially those identified as the most commonly used urban pesticides. Since Texas has a relatively minor impact from agricultural pesticides on groundwater, the ACS decided to monitor for as many of the urban pesticides as feasible. The program requires the thorough assessment of these pesticides, fulfills grant requirements, and enables Texas to determine if these pesticides are impacting the groundwater in major metropolitan areas.

TCEQ screened 49 wells and 4 springs for atrazine, diazinon, chlorpyrifos, pyrethroids, and organo-phosphates/carbamates in the Austin and San Antonio metro areas in 2007. The program was expanded in 2008 to include 109 wells and 21 springs in Austin, San Antonio and Houston, while also including 18 laboratory analyses for at least 15 of the 57 pesticides in need of assessment. Another 36 well and spring samples were collected in 2009 in the greater metropolitan Austin area, with 198 immunoassay analyses, and 36 laboratory samples analyzed for 47 pesticides using four analytical methods. The expansion of analyses enabled Texas to provide for a more thorough and defensible assessment of pesticides and to avoid potential problems in the future by monitoring for as many pesticides as practical. The success from the previous year led to greater cooperation by various entities, an increase in not only samples, but the number of immunoassay and lab analyses. The analytical results for the biennium indicate only a few samples with trace amounts (most <0.1 ppb) of atrazine and diazinon. There appear to be no significant impacts by these pesticides on the groundwater in the 3 metro areas monitored. During the most recent round of cooperative monitoring, 218 samples were taken in 2010, with a total of 801 immunoassay analyses for five pesticides. This monitoring continues to indicate atrazine detections in the Panhandle region of Texas, but only occasional low-level detections of atrazine in the rest of the state. All cooperative monitoring atrazine detections have been significantly below the maximum contaminant level (MCL) for drinking water.

Response to Contamination

Response to a confirmed case of pesticide contamination of groundwater is outlined in the PMP. The determination of the appropriate response considers a number of key issues:

- Whether the contamination is from a point or NPS;
- The extent of the contamination; the level of contamination, either above or below the drinking water MCL or Health Advisory Level;

- The expected travel time from the application of the pesticide at or near the soil surface until it reaches the water table; and
- Is the source of contamination the result of present usage of the pesticide or usage under previous labels, which may have allowed greater levels of usage?

Investigative and follow-up monitoring efforts have been conducted at five sites in the central Panhandle and these activities have continued throughout the biennium to annually monitor atrazine detections in PWS wells. Monitoring reveals that atrazine concentrations have primarily decreased or remained the same over the past five years. At present, none of the PWS wells have atrazine concentrations above or even near the MCL. Stability or decline in concentrations has caused a change from annual to biennial monitoring of the impacted wells for the ongoing monitoring program in the Panhandle region.

The investigations of these sites indicate that most of the atrazine contamination cases are due to point sources, such as improperly abandoned water wells that may have served as a migration pathways for atrazine. However, the investigations also found that there is some possibility of NPS contamination where the source of atrazine may be agricultural fields or storm water runoff collection in playa lake basins in the vicinity of public water wells.

In response to a few low-level detections of the herbicide atrazine in groundwater over a broad area, the TGPC worked with the Lubbock staff of the Texas AgriLife Extension Service to develop a tri-fold brochure on pesticide BMPs for private well owners, as well as several related sets of Frequently Asked Questions made available on the TGPC Website in 2008. Presentations were given by the AgriLife Extension Service personnel in 2009 and 2010, at several events each year. The TDA also utilized some of this material to train their inspectors. The curriculum and training are a result of interagency coordination and cooperation in monitoring, education and outreach under the PMP.

In response to trace detections of atrazine and diazinon in urban groundwater, the ACS continued to work with the Extension Service in 2009-2010 to develop FAQs for private well owners.

Scheduled monitoring in 2010 included continued monitoring of the PWSs in the southern end of the Panhandle area where atrazine has been previously detected, as time and resources allow, and groundwater in the cotton-growing counties around Lubbock.

Appendix 4. Annual Joint Groundwater Monitoring and Contamination Reports

The TGPC is required under TWC §26.406 to publish an annual groundwater monitoring and contamination report which:

- describes the current status of groundwater monitoring activities conducted or required by each agency at regulated facilities or associated with regulated activities;
- contains a description of each case of groundwater contamination documented during the previous calendar year;
- contains a description of each case of contamination documented during previous periods for which enforcement action was incomplete at the time of issuance of the preceding report; and
- indicates the status of enforcement action for each case of contamination that is listed.

The TGPC produced and published two monitoring and contamination reports during the previous two years: *Joint Groundwater Monitoring and Contamination Report—2008* (TGPC, 2009) and *Joint Groundwater Monitoring and Contamination Report—2009* (TGPC, 2010). The *Joint Report* describes the status of groundwater monitoring programs and groundwater contamination cases documented or under enforcement by the participating agencies for the calendar year. Each agency or organization includes a description of their programs that protect groundwater. The *Joint Report* contains a brief description of each case of groundwater contamination, listed by county and regulatory agency, and includes the enforcement status for the case.

Groundwater Monitoring

The groundwater protection programs of the members of the TGPC generally fall within one of three categories:

- regulatory agencies requiring or conducting groundwater monitoring to assure compliance with guidelines and regulations for the protection of groundwater from discharges of contaminants;
- agencies or entities conducting groundwater monitoring to assess ambient or existing groundwater quality conditions and to track changes in water quality over time; and
- agencies or entities conducting research activities related to groundwater resources and groundwater conservation.

Each regulatory agency that requires or conducts groundwater monitoring to assure compliance with guidelines and regulations for the protection of groundwater from contaminants has its own monitoring program requirements and procedures. The criteria used to assess the need for groundwater monitoring vary among the regulatory entities. Currently, there are 17 regulatory monitoring programs within two state agencies.

Monitoring of groundwater quality for permit and operational requirements occurred at approximately 10,619 facilities statewide in 2009. Approximately 57,000 monitor wells were used in 2008, and 51,384 in 2009. The majority of the monitored facilities are under the jurisdiction of the TCEQ, with most of the remainder under the jurisdiction of the RCT.

The TWDB, GCDs, and the USGS conduct nonregulatory groundwater monitoring to assess ambient or existing groundwater quality conditions and to track changes in water quality over time. Some monitoring programs are developed for the assessment of water quality that target specific geographic areas, contaminants, constituents, or activities. Contamination cases discovered by these agencies or entities through groundwater studies, or groundwater sampling programs, are referred to the regulatory agency with the appropriate jurisdiction.

The TWDB reported sampling approximately 708 sites in 2008 and 612 sites (wells and springs) in 2009. The TWDB's collection of these samples and analysis of additional samples from cooperative entities comprise the state's ambient groundwater quality-sampling program. The TWDB enters water-quality data collected under this program in its groundwater database.

Groundwater Contamination

Groundwater contamination is defined by the TGPC for inclusion in the *Joint Report* (31 TAC Chapter 601, Appendix 5). Contamination is the detrimental alteration of the naturally occurring physical, thermal, chemical, or biological quality of groundwater reasonably suspected of having been caused by the activities of entities under the jurisdiction of the state agencies. The TGPC recognizes that groundwater contamination may result from many sources, including: agricultural activities; commercial and business endeavors; current and past oil and gas production and related practices; domestic activities; industrial and manufacturing processes; and natural sources that may be influenced by, or may be the result of, human activities.

The contamination cases identified in the *Joint Report* are primarily those where contaminants have been discharged to the surface, to the shallow subsurface, or directly to groundwater from activities such as the storage, processing, transport, or disposal of products or waste materials. The most common contaminants reported in both 2008 and 2009 were gasoline, diesel fuel, and other petroleum products due to the large number of cases related to petroleum storage tank systems. Less common reported contaminants were organic

compounds (such as phenol, trichloroethylene, carbon tetrachloride, dichloroethylene, and naphthalene), pesticides (such as alachlor, atrazine, bromacil, dicamba, and prometon), creosote constituents, solvents, heavy metals, and sodium chloride.

Currently, there are 4,503 cases of documented groundwater contamination. Approximately 90.8 percent of the documented cases in 2009 are under the jurisdiction of the TCEQ. The remainder are under the jurisdiction of the RCT (with approximately 9.1 percent), and GCDs which are members of TAGD (with 1 case, or less than 0.1 percent).

Table 2 lists the documented groundwater contamination cases reported by each agency with enforcement jurisdiction and is further broken down by program within the agency.

Table 2 illustrates the total percentage of documented cases attributable to each agency and program and the net change and percentage change from 2008 to 2009. The *Joint Reports* for both 2008 and 2009 document the large number of groundwater contamination cases attributed to leaking underground storage tanks. As reported by the TCEQ, the number of documented groundwater contamination cases resulting from the failure of storage tank systems declined from 2,344 in 2008 to 2,214 in 2009. This is down from a high of 3,054 cases in 2007. These cases represent 49.5% of the total number of documented contamination cases in 2008 and 49.1% of the total cases in 2009.

While the number of documented contamination cases from underground storage tanks is high compared to other programs, it can be directly linked to the large number of regulated facilities. In 2009, there were 70,529 facilities containing registered storage tanks.

Table 2 also illustrates an increase in the number of active cases reported by the RCT. The RCT case count rose 4.5 percent between 2008 and 2009. Most of these cases are under the jurisdiction of the Oilfield Cleanup Program.

The TCEQ programs with increase in the number of active cases between 2008 and 2009 are the Voluntary Cleanup/ Brownfield Site Assessment (one case), Dry Cleaner Remediation Program (17 cases), Municipal Solid Waste (one case), Public Drinking Water (four cases), and Superfund Cleanup (five cases).

Table 2. Groundwater Contamination Cases by Jurisdictional Agency, 2008–2009

Agency Division Program	Total Cases		Change, 2008-2009		Percent of Total	
	2008	2009	Net	%	2008	2009
Texas Commission on Environmental Quality						
<i>Radioactive Materials Division programs</i>						
Radioactive Materials Licensing	2	2	0	0	0.04	0.04
Uranium and Technical Assessments	1	3	2	0	0.02	0.06
<i>Remediation Division programs:</i>						
Brownfield Site Assessment	4	5	1	25	0.08	0.11
Corrective Action	600	590	-10	-1.6	12.68	13
Dry Cleaner Remediation	151	168	17	11.3	3.19	3.73
Innocent Owner/Operator	264	181	-83	-31.4	5.58	4.01
Petroleum Storage Tank	2,344	2,214	-130	-5.5	49.5	49.16
Superfund Cleanup	80	85	5	6.25	1.69	1.88
Superfund Site Discovery and Assessment	20	17	-3	-15	0.42	0.37
Voluntary Cleanup	771	722	-49	-6.35	16.3	16.03
<i>Waste Permits Division programs:</i>						
Municipal Solid Waste	60	61	1	1.6	1.26	1.35
Industrial and Hazardous Waste	2	2	0	0	0.04	0.04
<i>Water Quality Division</i>						
Water Quality Assessment Program	13	13	0		0.27	0.28
<i>Water Supply Division programs:-</i>						
Public Drinking Water	10	14	4	40	0.21	0.31
Water Rights Permits and Availability	5	5	0	0	0.10	0.11
<i>Enforcement Division</i>	4	4	0	0	0.08	0.08
<i>Regional Offices</i>	2	3	1	50	0.04	0.06
Subtotal, all TCEQ programs	4,333	4,089	-244	-5.6	91.6	90.8
Railroad Commission of Texas						
<i>Oil and Gas Division</i>	395	413	18	4.5	8.35	9.1
Texas Alliance of Groundwater Districts	1	1	0	0	0.02	0.02
Total	4,729	4,503	-226	-4.7	100	100

The *Joint Report* also indicates the status of enforcement action for each instance of groundwater contamination. For purposes of the *Joint Report*, enforcement action includes any agency action that accomplishes or requires the identification, documentation, monitoring, assessing, or remediation of groundwater contamination. In general, regulatory programs are structured to achieve the desired degree of environmental protection and mitigation with the lowest possible level of agency oversight, and while the status of a contamination case may remain at an agency action level for a long period, physical activities related to the assessment and remediation may change often. The comparison of the level of agency action and the status or level of contamination assessment and mitigation allows a one-to-one correspondence between an agency's response (enforcement status) and the completion of the discrete phases in the progression of contamination investigation (activity status).

Table 3 presents the activity status of documented groundwater contamination cases through December 31, 2009. The table indicates the total number of documented cases by the agency (and division or program) with jurisdictional authority and indicates the activity status

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for the cases. Once groundwater contamination has been confirmed, either the regulated entity or the agency will address the groundwater contamination incident following a general sequence of actions until the investigation concludes that no further action is necessary. All of the 4,503 cases listed in the 2009 report had documented groundwater contamination (Table 3). The status of these cases is:

- “No Activity” has occurred on 234 reported cases that are awaiting confirmation of contamination.
- “Contamination Confirmed” (validated) for 525 cases.
- “Ongoing Investigation” is taking place at 1,879 cases.
- “Corrective Action Planning” is being conducted for 208 cases.
- “Corrective Action Implemented” on 685 cases.
- “Monitor Action” for effectiveness is occurring in 323 cases.
- “Action Completed” (No further action is necessary) for 646 cases.
- “No Activity” was provided for three cases.

Historically, the number of new groundwater contamination cases documented each year has been greater than the number of cases in which action was completed during the same year. This trend had held since the TGPC began publishing the *Joint Report* in 1989, but in 2000, the trend reversed. In 2008, 687 cases were listed as action completed, and 492 new cases were reported. In 2009, 646 cases were listed as action completed, with 412 new cases reported. A summary of the changes since 1992 is contained in the 2009 report.

Table 3. Documented Groundwater Contamination Cases by Agency/Activity Status, 2009

Agency Division Program	Cases, 2009		Cases with an Activity Status Code ^{3,4} of ...							
	Total ¹	New ²	0	1	2	3	4	5	6	None
Texas Commission on Environmental Quality										
<i>Enforcement Division</i>	4	0	2	0	2	0	0	0	0	0
<i>Radioactive Materials Division Programs</i>										
Radioactive Materials Licensing	2	0	0	0	2	0	0	0	0	0
Uranium and Technical Assessments	3	0	0	0	0	0	0	0	0	3
<i>Regional Offices</i>	3	1	0	0	1	0	2	0	0	0
<i>Remediation Division programs:</i>										
Brownfield Site Assessment	5	0	4	0	0	0	0	0	1	0
Corrective Action	590	35	4	31	191	138	158	190	44	0
Dry Cleaner Remediation	168	20	5	10	131	14	0	0	8	0
Innocent Owner/Operator	181	24	71	74	5	0	0	0	31	0
Petroleum Storage Tank	2,214	252	0	262	1,174	0	284	0	494	0
Superfund Cleanup	85	1	3	4	19	11	44	34	3	0
Superfund Site Discovery and Assessment	17	2	0	5	12	0	0	0	0	0
Voluntary Cleanup	722	22	145	117	206	27	125	69	33	0
<i>Waste Permits Division programs:</i>										
Municipal Solid Waste	61	6	0	1	37	9	12	0	4	0
Industrial and Hazardous Waste	2	0	0	1	0	0	0	0	1	0
<i>Water Quality Division</i>										
Water Quality Assessment Program	13	0	0	0	6	0	6	1	0	0
<i>Water Supply Division programs:</i>										
Public Drinking Water	14	14	0	0	0	0	0	0	14	0
Water Rights Permits and Availability	5	0	0	2	3	0	0	0	0	0
Subtotal, all TCEQ programs	4,089	377	234	505	1,850	138	536	194	626	3
Railroad Commission of Texas										
<i>Oil and Gas Division</i>	413	35	0	25	29	62	148	129	20	0
Texas Alliance of Groundwater Districts	1	0	0	0	0	0	1	0	0	0
Total	4,503	412	234	525	1,879	208	685	323	646	3

1. Total number of groundwater contamination cases documented or under enforcement during calendar year 2009.
2. Number of new cases documented or under enforcement during calendar year 2009.
3. Key to activity status codes: 0—No Activity; 1—Contamination Confirmed; 2—Ongoing Investigation; 3—Corrective Action Planning; 4—Corrective Action Implementation; 5—Monitoring Action; 6—Action Completed
4. Facilities may have more than one activity status code.

Appendix 5. Texas Groundwater Protection Committee Rules

TAC Title 31. NATURAL RESOURCES AND CONSERVATION Part 18. TEXAS GROUNDWATER PROTECTION COMMITTEE Chapter 601. GROUNDWATER CONTAMINATION REPORT

Subchapter A. GENERAL PROVISIONS RELATING TO PUBLIC FILES AND JOINT REPORT

§601.1 Purposes of Rules

The purposes of this chapter are:

- (1) to implement duties and responsibilities assigned to the committee under Texas Water Code, §26.406, concerning the maintenance by member agencies of public files containing documented cases of groundwater contamination and the publication by the committee, in conjunction with the commission, of annual groundwater monitoring and contamination reports;
- (2) to establish general policies of the committee to guide that implementation; and
- (3) to specify the form and content of the notice of groundwater contamination required under Texas Water Code, §26.408.

§601.2 Applicability

These rules specifically apply to each state agency or organization having membership on the committee. The committee is composed of:

- (1) the Texas Commission on Environmental Quality;
- (2) the Department of State Health Services;
- (3) the Texas Department of Agriculture;
- (4) the Railroad Commission of Texas;
- (5) the Texas Water Development Board;
- (6) the Texas Alliance of Groundwater Districts;
- (7) the Texas AgriLife Research;
- (8) the Bureau of Economic Geology of the University of Texas at Austin;
- (9) the State Soil and Water Conservation Board; and
- (10) the Water Well Drillers and Water Well Pump Installers Program of the Texas Department of Licensing and Regulation.

§601.3 Definitions

The following words and terms, when used in this chapter, have the following meanings.

- (1) Act—House Bill 1458 (71st Legislature, 1989) codified, with amendments, as Texas Water Code, §§26.401–26.408.
- (2) Commission—Texas Commission on Environmental Quality.
- (3) Committee—Texas Groundwater Protection Committee.
- (4) Documented groundwater contamination—A case of groundwater contamination in which a member agency has an established procedure for making a determination based on the quality of groundwater

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and the information pertinent to making the determination is maintained by that member agency under §601.4(b) of this title (relating to Public Files).

- (5) Enforcement action—Any action of the member agencies, identified in §601.2 of this title (relating to Applicability), that accomplishes or requires the identification, documentation, monitoring, assessing, or remediation of groundwater contamination.
- (6) Groundwater—Water below the land surface in a zone of saturation.
- (7) Groundwater contamination—The detrimental alteration of the naturally occurring physical, thermal, chemical, or biological quality of groundwater. Except for an underground source of drinking water granted an aquifer exemption by the commission with concurrence from the United States Environmental Protection Agency in accordance with 40 Code of Federal Regulations Parts 144–146, and 30 TAC Chapter 331 (relating to Underground Injection Control), groundwater contamination, for purposes of inclusion of cases in the public files and the joint groundwater monitoring and contamination report, is limited to contamination reasonably suspected of having been caused by activities or by entities under the jurisdiction of the member agencies identified in §601.2 of this title (relating to Applicability) and affecting groundwater that contains a concentration of:
 - (A) less than or equal to 10,000 milligrams per liter (mg/liter) of dissolved solids; or
 - (B) greater than 10,000 mg/liter of dissolved solids if it is:
 - (i) currently extracted for beneficial use such as domestic, industrial, or agricultural purposes; or
 - (ii) hydrologically connected with, and with the potential for contaminant movement to, a surface water body or another zone of groundwater that has a concentration of less than or equal to 10,000 mg/liter of dissolved solids.
- (8) Member agency—A state agency or organization designated by law under Texas Water Code, §26.403(c), to serve on the committee and be subject to its rules. Member agencies are listed in §601.2 of this title (relating to Applicability). Member agencies having responsibilities related to protection of groundwater include the commission, the Department of Agriculture, the Railroad Commission of Texas, and the State Soil and Water Conservation Board.

§601.4 Public Files

- (a) Subject to the limitations provided by Texas Water Code, §§26.401–26.408 (the Act), and the Texas Public Information Act, Texas Government Code, Chapter 552, information collected, assembled, or maintained by the committee and the member agencies having responsibilities related to protection of groundwater under the Act is a public record open to inspection and copying during regular business hours.
- (b) Each member agency having responsibilities related to the protection of groundwater under the Act shall maintain a public file of all documented cases of groundwater contamination that are reasonably suspected of having been caused by activities regulated by the member agency.

§601.5 Joint Groundwater Monitoring and Contamination Report

In conjunction with the commission, the committee shall publish not later than April 1 of each year a joint groundwater monitoring and contamination report covering the activities and findings of the committee made during the previous calendar year. The report must:

- (1) describe the current status of groundwater monitoring programs conducted by or required by each member agency at regulated facilities or in connection with regulated facilities;
- (2) contain a description of each case of groundwater contamination documented during the previous calendar year and of each case of groundwater contamination documented during previous years for which enforcement action was incomplete at the time of issuance of the preceding report; and
- (3) indicate the status of enforcement action for each case of groundwater contamination that is included in the report.

Subchapter B. NOTICE OF GROUNDWATER CONTAMINATION

§601.10 Form and Content of Groundwater Contamination Notice

When notice of groundwater contamination, as defined in §601.3(7) of this title (relating to Definitions), is provided under Texas Water Code, §26.408 to the owner of a private drinking water well that may be affected by the contamination and to each applicable groundwater conservation district, the notice shall:

- (1) be in writing; and
- (2) contain, at a minimum, the following information:
 - (A) the name of the contaminant or contaminants;
 - (B) the range of analytical results for the contaminant or contaminants measured in the area or well to date;
 - (C) possible health effects of the contaminant or contaminants;
 - (D) possible source or sources for this type of contamination;
 - (E) suggested actions and precautions potentially impacted well owners could take; and
 - (F) who to contact for more information.

Appendix 6. Select Publications of the TGPC

Texas Groundwater Protection Strategy. TCEQ publication AS-188 (February 2003).
<www.tceq.state.tx.us/assets/public/comm_exec/pubs/as/188.pdf>

Joint Groundwater Monitoring and Contamination Report – 2008. TCEQ publication SFR-056/08 (June 2008).
<www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/056_08.pdf>

Joint Groundwater Monitoring and Contamination Report– 2007. TCEQ publication SFR-056/07 (June 2008).
<www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/056_07.pdf>

Texas State Management Plan for Prevention of Pesticide Contamination of Groundwater. TCEQ publication SFR-070 (January 2001).
<www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/070_01.pdf>

Texas Ground-water Data Dictionary. TCEQ publication GI-272 (August 1996).
<www.tgpc.state.tx.us/gi-272.pdf>

Landowner's Guide to Plugging Abandoned Water Wells. TCEQ publication RG-347 (March 2010).
<www.tceq.state.tx.us/publications/rg/rg-347.html>

Drinking Water Problems Fact Sheets

Arsenic. Texas AgriLife Extension Service publication (in English) L-5467 (December 2005) and (in Spanish) L-5467S (June 2006).

Perchlorate. Texas AgriLife Extension Service publication (in English) L-5468 (November 2005) and (in Spanish) L-5468S (February 2006).

Nitrates. Texas AgriLife Extension Service publication (in English) B-6184 (May 2006) and (in Spanish) B-6184S (May 2006).

Radionuclides. Texas AgriLife Extension Service publication (in English) B-6192 (July 2006), and (in Spanish) B-6192S (November 2006).

MTBE. Texas AgriLife Extension Service publication (in English) L-5502 (June 2008).

Benzene. Texas AgriLife Extension Service publication (in English) L-5513 (April 2009).

Note: These publications can be accessed at <<https://agrilifebookstore.org>>.

On-site Wastewater Treatment Systems Fact Sheets

Homeowner's Guide to Evaluating Service Contracts. Texas AgriLife Extension Service publication, (in English) B-6171 (July 2005).

Graywater. Texas AgriLife Extension Service publication, (in English) B-6176 (October 2005).

Understanding and Maintaining Your Septic System. Texas AgriLife Extension Service publication (in English) L-5491 (March 2008).

Note: These publications can be accessed at <<https://agrilifebookstore.org>>.

Water Wells Fact Sheets

Capping of Water Wells for Future Use. Texas AgriLife Extension Service publication (in English) L-5490 (August 2007).

Plugging Abandoned Water Wells. Texas AgriLife Extension Service publication (in English) B-6238 (April 2010).

Note: This publication can be accessed at <<https://agrillifebookstore.org>>.

Pesticides Best Management Practices Trifold Brochure

Keep Pesticides Out of Texas Water Supplies – Best Management Practices to Prevent Pesticide Contamination. Texas AgriLife Extension Service publication (in English) L-5500 (July 2008).

Note: This publication can be accessed at <<https://agrillifebookstore.org>>.

