INTRODUCTION

The purpose of this chapter is to summarize the local, state, and federal commitment to protect and improve the quality of ground water through identifying problems, prioritizing problems, increasing partnership participation, and developing interest in developing demonstration projects.

DESCRIPTION

According to the U.S. Geological Survey, ground water supplies 45% of the drinking water for Tennessee, while surface water supplies 55%. This means that at least two and a quarter million Tennesseans get their drinking water from below the surface. At least 30% of those people live in Memphis-Shelby County, while 20% of Tennesseans rely on private wells or springs for their drinking water. Ground water, its quantity as well as quality, is a very important issue to Tennesseans.

It is well known in Tennessee that surface and ground water are often one in the same resource. West Tennessee soils can be quite sandy and porous, allowing surface waters to migrate through them to the sand aquifer in a fairly short period of time, while the presence of karstic terrain (i.e. sinkholes and open fractures, please see Appendix G for more information) and extremely thin soils in middle and portions of east Tennessee permit even a more rapid migration of surface water into the subsurface. Any pollutants found on the surface, such as nutrients, pathogens, hydrocarbons, or toxics, can easily migrate into the subsurface and possibly to a nearby receiving stream in a short period of time.

To contend with any pollution that might occur between surface and ground water, the state regulatory agencies of TDA-Regulatory Services Division-Pesticide Management Program, TDEC-Division of Ground Water Protection, TDEC-Division of Water Supply-Wellhead Protection and Source Water Assessment Program, TDEC-Division of Geology-Oil & Gas Board, TDEC-Division of Underground Storage Tanks, and TDEC-Division of Solid Waste Management, have been given, through state law, the capabilities of implementing necessary enforcement actions. TDA-NPS Program is initiating partnerships with these agencies in order to generate projects that will address water quality concerns. Examples of these partnerships would be our role in reviewing both the state's Pesticide Management Program and Source Water Assessment Program, while funding several local and state efforts addressing ground water problems.

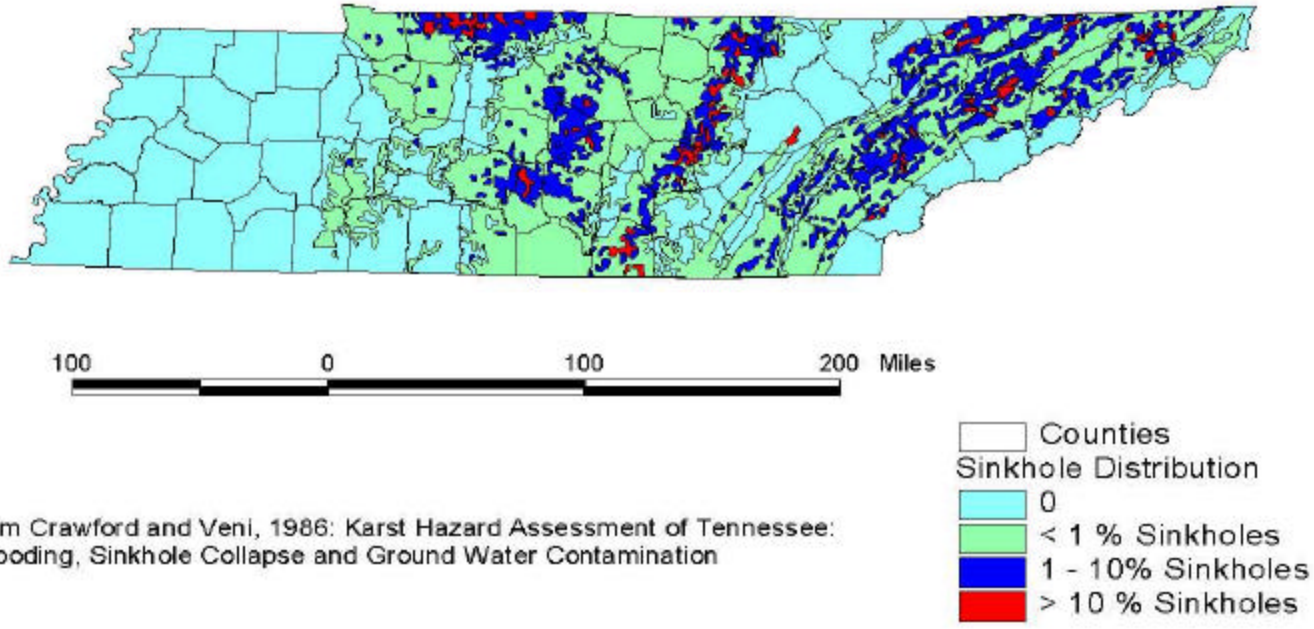
These efforts, in themselves, are insufficient to remediate Tennessee's ground water problems. Stronger partnerships supporting sound, productive water quality remediation and education projects, are the only means in which to address these issues in an effective manner. Through the establishment of the Ground Water Working Group (GWWG), intentional partnering efforts, and more involvement of partners in the project submission and selection process are the means to solve the existing problems.

EXTENT OF PROBLEM

In many locations throughout the state, aquifers are vulnerable to surface activities. There have been cases of highly volatile and dense organic compounds (chlorinated solvents and gasoline components) migrating through the subsurface materials to the aquifers, which serve public water systems. The problems were of such magnitude that the springs or wells were abandoned. Other pollutants such as bacteria and nutrients have also been found to contaminate local subsurface water supplies.

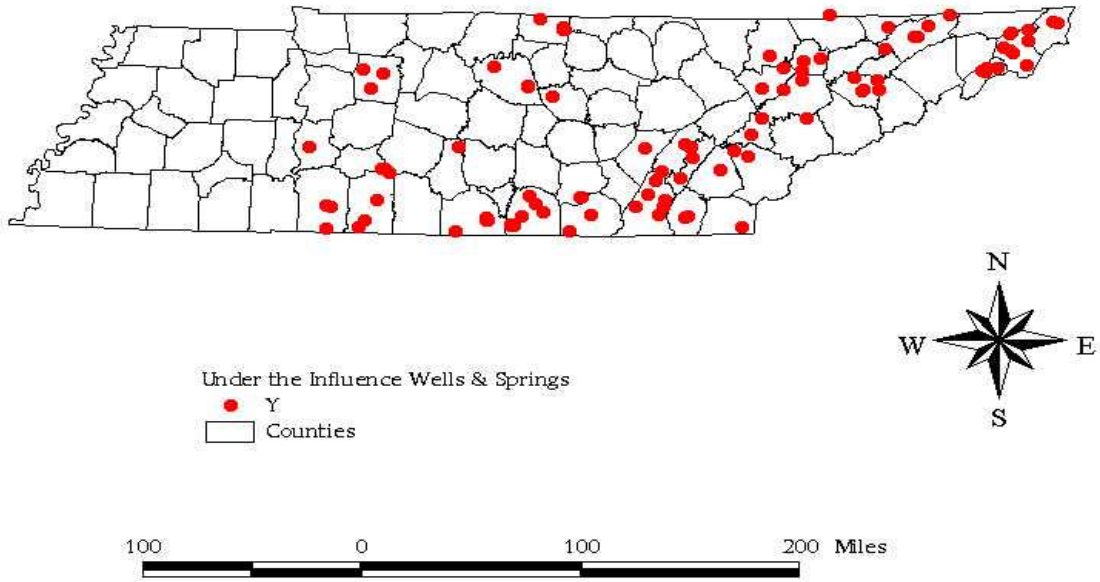
The following graphics demonstrate the statewide prevalence of groundwater pollution problems. Source of information: TDEC-DWS-GWMS.

Sinkhole Distribution in Tennessee

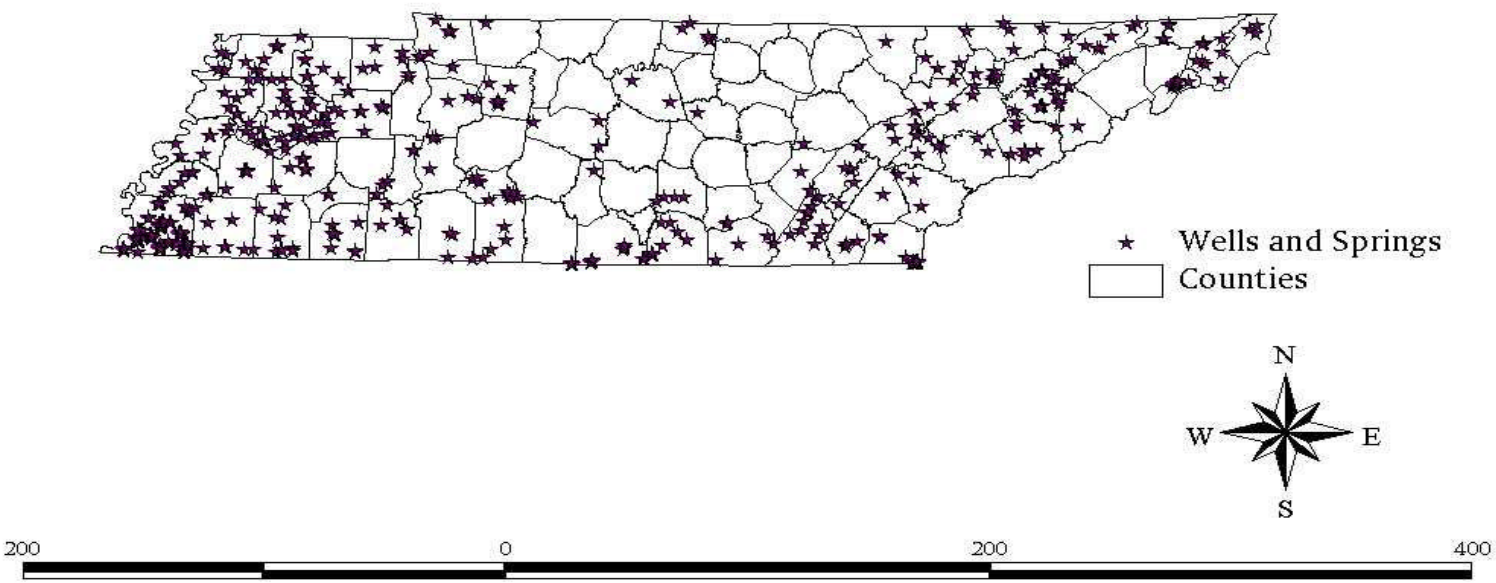


Adapted from Crawford and Veni, 1986: Karst Hazard Assessment of Tennessee: Sinkhole Flooding, Sinkhole Collapse and Ground Water Contamination

Ground Water Systems Under the Influence



Community Public Water Systems Wells and Springs



T

There have been a few ground water monitoring studies completed in Tennessee during the past five to ten years. Two studies were completed in the Loosahatchie River in the southwestern portion of the state while three studies were completed in the Duck River in the south-central portion of the state. The Tennessee Department of Agriculture has completed a 6,809 sample, five year study of pesticide concentrations throughout the state.

Unfortunately, there is no ambient ground water quality monitoring in Tennessee. Private wells and springs are not monitored by any official entity, while public water systems are not required to test their raw water, just their finished water. The local homeowner is left with the responsibility of testing their own well or spring, which could be contaminated by a failing septic system or surface activity.

Additional resources are needed to better understand ground water quality and to initiate needed protection programs. The programs needed are:

- Ambient monitoring and ground water evaluations
- Assistance provided to small community water systems for ground water protection
- Monitoring and assessment of ground water contributing to ecologically vital waters
- Pollution prevention assistance to small businesses

Funding programs, such as 319, have no guidance from monitoring data to indicate what aquifers need remediation. TDA-NPS Program will continue to rely upon partnering efforts with other water quality agencies to address the problem of ground water pollution from both a focused watershed assessment, as well as a statewide public awareness approach.

Thus far, these public awareness programs have included the Pesticide Management Program and the Source Water Assessment Program (SWAP). Both of these programs generate information regarding sites of pollution in addition to being strong educational efforts. By remaining active in these programs, the TDA-NPS Program intends to make all Tennesseans more aware of the problems associated with the pollution of subsurface water supplies.

SOLUTIONS

Proper protection of sinkholes and wellheads:

- established and maintained grassed areas
- maintained throats (i.e. conduits between sinkhole and subsurface)

Established and maintained grassed set-backs for potential pollutants from:

- animal facilities
- septic systems
- machinery service areas
- applied chemicals (i.e. fertilizers and pesticides)

Properly installed septic systems:

- sand filters
- mounds
- artificial wetlands

Proper land management of areas in and around petroleum wellheads:

- properly installed catchment basins around oil wells and storage tanks

Proper land management and implementation of all needed BMPs in recharge areas of aquifers.

Proper storage, containment, mixing, and application of all pesticides and fertilizers.

Annual collection of unused home and farm pesticides and/or containers.

COOPERATING PARTNERS

Partners	**Abbreviations**
Austin Peay State University	APSU
Development Districts	
East Tennessee State University	ETSU
Local landowners	
Local watershed associations	
Tennessee Department of Agriculture	TDA
Ag Resources Conservation Program	-ARC
Regulatory Services Division	-RSD
Tennessee Department of Environment and Conservation	TDEC
Division of Community Assistance	-DCA
Division of Geology	-DG
Division of Ground Water Protection	-GWP
Division of Water Pollution Control	-WPC
Division of Water Supply	-DWS
Environmental Policy Office	-EPO
Tennessee Oil & Gas Board	TO&GB
Tennessee Technological University-The Water Center	TTU
US Department of Agriculture	NRCS
Natural Resources Conservation Service	
U.S. Geological Survey	USGS
University of Tennessee Institute of Agriculture	UTIA

Austin Peay State University (APSU)
The project manager at APSU is addressing ground water protection by implementing BMPs to reduce the sediment, bacterial, and pathogen loadings to the local sinkholes. This will be a demonstration program with the hopes that additional efforts are made by landowners with or without the funding of other sources. Because local streams are recharged by ground water, it is important

to the overall improvement of the water quality in the Red River watershed that these types of pollutant sources are eventually treated.

Development Districts
The Development Districts were established as Tennessee's regional planning and regional development organizations by Chapter 241 of the Public Acts of 1965. They include all of the state's counties and municipalities. Tennessee Code Annotated, Section 12-14-103 states the General Assembly's intent for the districts to be threefold:

- That the various counties and cities of the state be provided the most effective and efficient means of organizing themselves on a regional basis for the purpose of carrying on general and comprehensive planning and development activities such that would provide coordinated, efficient and orderly economic development of the state;
- That local governments through such regional agencies, be guided and assisted in making maximum use of federal, state and local programs designed to stimulate economic development and utilization of resources; and
- That the planning function of governments be separated from the plan implementation function, leaving to county, municipal and state governments the carrying out of all plans for physical, economic and resources development, as provided for under state laws.

ETSU-Department of Geological Sciences (ETSU)
The ETSU-Department of Geological Sciences is currently monitoring water wells and springs in an effort to learn more about subsurface water quality in northeast Tennessee. Presently, this information is not being used by the TDA-NPS Program, but will be used during future Watauga River watershed projects.

Local landowners
Local landowners that have either wells on their property or many sink holes, will be targets in public awareness campaigns.

Local watershed associations
Local watershed associations serve to make local landowners aware of the pollution potential to groundwater from improperly managed sinkholes and well heads.

Tennessee Department of Agriculture-Ag Resources Conservation Program (TDA-ARC)
Many of the BMPs funded by TDA-Ag Resources Conservation (TDA-ARC) program have direct effect on the quality of local ground water resources. Because of the interconnection between surface and ground water resources, TDA-Ag Resources Conservation Program will continue to implement BMPs in the state's many recharge areas to protect and improve ground water quality.

Tennessee Department of Agriculture-Regulatory Services Division (TDA-RSD) Pesticide Management Program
Proper pesticide storage and containment, pesticide collection, and regulatory efforts of TDA-RSD, through the state's Pesticide Management Program, continues to stop pollution of the ground water resources in Tennessee. These programs are supported by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Tennessee Insecticide, Fungicide, and Rodenticide Act (TIFRA) as well as the Tennessee Commercial Fertilizer Law (TCFL).

TDA-NPS Program will continue to financially support the pesticide collection efforts which is comprised of at least ten collection events across the state annually. The TDA-NPS Program will also continue to explore the possibilities of additional projects for remediative and educational activities. TDA-RSD has made progress towards enlisting cooperative efforts, in the form of model site demonstrations at agrichemical retailers, pest control and lawn service companies, golf courses, farms, and nurseries. The continuation of addressing pesticide problems at the rural, suburban, and urban levels is a priority for the TDA-NPS Program.

Tennessee Department Environment and Conservation-Division of Community Assistance (TDEC-DCA)
As the TDA-NPS Program demonstrates new BMPs across the state, it will be endorsing the use of the State Revolving Fund (SRF) Program, a financial assistance program managed by TDEC-Division of Community Assistance (TDEC-DCA). The TDA-NPS Program has had preliminary meetings with TDEC-DCA concerning the use of these funds in an effort to assist in the installation of BMPs across the state.

Tennessee Department of Environment and Conservation-Division of Geology (TDEC-DG)
The TN Oil & Gas Board is housed within TDEC-DG where it monitors the petroleum industry of Tennessee. This effort includes making certain that all wellheads are properly installed to prevent migration of any surface pollutants into subsurface water sources. Proper plugging of inactive or abandoned wells is also monitored and assured by this state agency.

Tennessee Department of Environment and Conservation-Division of Ground Water Protection (TDEC-GWP)
TDEC-GWP and seven contracted county health departments review the installation of all septic systems in Tennessee. By assuring that proper porosities exist in local soils through soil percolation tests and through periodic and final inspection of septic tanks and lines, TDEC-GWP prevents pathogens from reaching the ground water.

In many cases, especially in Middle Tennessee, access to ground water is protected by just a thin veneer of soil which restricts the installation of standard septic systems. The presence of shallow hardpans (shallow layers of impervious material) can also cause problems for subsurface drainage. TDEC-GWP has

the expertise of dealing with these issues on a daily basis, thereby making them ideal partners to assist the TDA-NPS Program in addressing related water quality issues.

Tennessee Department of Environment and Conservation-Division of Water Pollution Control (TDEC-WPC)
Even though TDEC-WPC is principally a surface water regulatory agency, they also have jurisdiction for the first seven inches of the soil/substrate as well as surface flow into sinkholes, open fractures, and direct conveyances to ground water aquifers. The TDA-NPS Program will of partner with TDEC-WPC on all applicable nonpoint source issue for the duration of 319 funding.

Tennessee Department of Environment and Conservation- Division of Water Supply (TDEC-DWS)
The Ground Water Management Section (GWMS) of this state agency protects and improves the ground water quality of Tennessee. It is imperative that these agencies continue to share information while developing and completing ground water remediation and education projects as partners.

TDA-NPS Program provided review of TDEC's Source Water Assessment Program (SWAP) document. Information gathered by the SWAP reconnaissance of watersheds will be useful in directing TDA-NPS Program remediation efforts for years to come. Another partnering effort occurs each year when the TDA-NPS Program, with the assistance of TDEC-WPC, TDEC-DWS-GWMS, and USDA-NRCS, determine the Unified Watershed Assessment (UWA) targeted watersheds. The presence of water intakes, whether they are surface or subsurface, are considered as a strong criteria for the selection of UWA watersheds.

TDEC-DWS is also responsible for the management of the state's Wellhead Protection Program. This effort attempts to limit the accessibility of surface pollutants to wellheads and aquifers used as water supplies.

TDEC-DWS is also responsible for the management of the Underground Injection Control Program, which regulates the introduction of pollutants into deep wells for disposal.

Tennessee Department of Environment and Conservation-Environmental Policy Office (TDEC-EPO)
The TDEC-EPO leads the state's Wetland Strategy effort. The Tennessee Wetlands Conservation Strategy completed in 1999. Although much of this effort addressed surface issues, it is known that wetlands do clean surface waters before they re-enter the subsurface in recharge areas as well as serving as points of surface discharge in association with springs. It is critical that wetlands are protected so they can continue to improve water quality.

Tennessee Technological University-The Water Center (TTU-WC)

The TTU-WC is currently under state contract to TDA to implement BMPs along Pigeon Roost Creek. This is a stream which flows underground for a substantial portion of its length and in so doing collects pollutants from residential and commercial portions of Cookeville.

Even though this project was introduced and will be managed by TTU-WC, the intention of the project is to demonstrate the need for such BMPs to the City of Cookeville and neighboring cities, thereby causing additional installations. Through this project the water quality of Pigeon Roost Creek could improve to the point of being removed from the 303(d) List.

US Department of Agriculture-Natural Resources Conservation Service (NRCS)
The local district conservationist (DC) uses EQIP and CRP funds, as well as funds from the TDA-ARC Fund channeled through the local SCD, to protect/restore springs and wetlands throughout the state. These DCs also implement many BMPs that have a direct effect on ground water quality by improving surface water quality before it percolates into the subsurface. Both of these efforts protect and improve ground water quality.

US Geological Survey (USGS)
All three offices of the USGS, Knoxville, Nashville, and Memphis, are actively involved in ground water monitoring. The Knoxville and Nashville offices are involved in the National Water Quality Assessment (NAWQA) program in the upper and lower Tennessee River watersheds. The USGS monitors ground water to determine how it interacts with local surface waters.

The USGS has also been involved in well water monitoring in the southwestern portion of the state, especially in the Loosahatchie River watershed. Data from this study as well as an equivalent study in the Upper Duck River watershed served as the bases for subsequent ground water monitoring completed by TDA-NPS Program. These types of studies point towards pollutant sources on the surface and assist in determining how surface water resources will be affected by these pollutants.

University of Tennessee Institute of Agriculture (UTIA)
UTIA is determining the ease of transport of pesticides and fertilizers to the ground water resources of West Tennessee. This 319 funded program is still in progress.

UTIA has also assisted with water quality monitoring of several ground water studies across the state. UTIA will likely participate in future monitoring projects and public awareness efforts.

Funding Opportunities

Additional funding sources for environmental projects are listed in the Catalog of Federal Funding, which can be found at: www.aspe.os.dhhs.gov/cfda

CURRENT 319 PROJECTS

Although much of the 319 emphasis has been placed on surface water issues, there has been significant concern for the ground water issues as well. Much of what is done on the surface affects the quality of ground water because of the conveyance between the two resources. This is true in Tennessee where the western division is comprised of highly porous soils with high conveyance into the subsurface, while the middle and eastern divisions are comprised of sinkholes, open fractures, and thin soils which promote a very high conveyance, in both directions, between the two water resources.

Even though the following listing addresses those 319 funded projects that have direct bearing on ground water quality, there have been several 319 funded watershed projects that have incorporated ground water issues within them. The following projects vary in what water quality aspects are addressed. Both the Duck and the Loosahatchie River projects were monitoring and assessments while the vadose zone project addressed the ease of transport of pesticides through the soil column under constant agricultural conditions. The remaining projects are demonstrations of a wide variety of nonpoint source categories that affect ground water quality. Many of the demonstration projects will be performed at least twice in each of the four major geomorphic provinces in Tennessee.

Grant Yr.	Project Title	Location
FY-93	Duck River-North Fork/Fall Cr. monitoring	Bedford County
FY-94	Loosahatchie River-Beaver Cr. monitoring	Shelby County
FY-96	Shallow Vadose Zone: Pest. & Fert. mon.	Henry County
FY-96	Alternative Septic: Wetland Treatment	McNairy County
FY-98	Pesticide Collection Program	statewide
FY-99	Pigeon Roost Cr. GW BMP Demo.	Cookeville
FY-99	Lambert Estates project	near Maryville
FY-00	Pesticide Collection Program	statewide
FY-01	STEP system with sand filter (proposed)	near Gatlinburg

AREAS FOR PROGRAM EXPANSION

- All Tennesseans need to be informed of the importance of clean ground water and its association with surface water quality.
- All county governments need to initiate local programs, which seek out failing septic systems and provide a means for the landowner to fix the problem.
- County governments, with the assistance of TDEC and TDA-NPS Program, need to initiate GIS systems to inventory failing septic systems and polluted water wells as a means of tracking needs and accomplishments.
- Statewide public awareness campaigns need to reach all owners of privately owned wells so they understand the need of wellhead protection.

- Statewide public awareness campaigns need to reach all owners of land with access points to the subsurface (sinkholes, open fractures, etc.), so that they will possess a full understanding of the surface pollutant-subsurface access principle.
- Statewide completion of the Source Water Assessment Program (SWAP), managed by TDEC-DWS, so that the entire st ate is GIS inventoried for remediation needs and these efforts need to be completed
- Statewide ground water monitoring needs to be developed to investigate aquifers, in a manner that is based on importance of the aquifer as a water supply.
- Statewide effort to protect ground water recharge and discharge areas through land acquisitions and permanent/temporary easements.

ENFORCEMENT MECHANISMS

Enforcement of ground water protection mechanisms are supported through several federal and state laws. Through the Tennessee Water Quality Control Act, TDEC-WPC and TDEC-DWS (Underground Injection Control Program only) protect ground water quality through enforcement of runoff to sinkholes, failing septic systems and underground injection of potentially harmful substances.

The state agency that enforces the proper use of pesticides is TDA-Regulatory Services Division-Pesticide Management Program. TDA-RSD has been assigned these responsibilities via FIFRA and TIFRA.

The plugging of wells and the proper installation of surface detention is regulated by the Tennessee Oil & Gas Board. TDEC-DG has staff who inspect these locations for compliance. Both surface and ground water resources are protected through these efforts.

Other potential pollutants of the ground water resources in Tennessee, including unprotected and polluted wellheads, leaking storage tanks, failing septic systems, among others are managed by the following state regulatory agencies:

- TDEC-Division of Ground Water Protection
- TDEC-Division of Water Supply
- TDEC-Division of Underground Storage Tanks
- TDEC-Division of Solid Waste Management

MEASURES OF SUCCESS

- The Source Water Assessment Program (SWAP), managed by TDEC-DWS, has been completed for the entire state GIS inventorying every site needing remediation

- All county governments have initiated locally operated programs, which seek out failing septic systems and provide a means for the landowner to install a remediative system
- All owners of privately owned wells have corrected any wellhead contamination issues
- All owners of land with access points to the subsurface (sinkholes, major fractures) have a full understanding of the surface pollutant-subsurface access principle and practice good stewardship towards protecting the local ground water resources
- Those owners of land which have been cited as needing remediation by the SWAP have completed these remediative efforts

MILESTONES

Long Term Goal 1.

Hold regularly scheduled meetings with stakeholders, to create new partnerships, to strengthen existing partnerships, and to foster greater trust, commitment and accountability.

- **Action 1:** The Ground Water Working Group (GWWG) will meet semi-annually.
  Lead: TDA-NPS Program
  Key partners: TDEC; TDA-RSD; USGS; UTIA; Local governments; local watershed associations
  Year(s): 2001-2005

- **Action 2**: Increase GWWG membership by one member each year.
  Lead: TDA-NPS Program
  Key partners: GWWG
  Year(s): 2001-2005

- **Action 3**: Establish the GWWG mission statement, a list of collective capabilities, and priorities for funding.
  Lead Agencies: URWG and TDA-NPS Program
  Year(s): 2001-2005

- **Action 4**: Develop Memoranda of Agreement with key federal agencies to improve programmatic consistency.
  Lead: TDA-NPS Program
  Key Partners: All federal agency partners
  Year(s): 2001-2005

Long Term Goal 2.

Fully implement all developed TMDLs for nonpoint sources in compliance with existing regulations, policies, or agreements by 2015.

Refer to Chapter 1.11, TMDL Implementation for specific action items related to this Long Term Goal.

Long Term Goal 3.

Restore all waters impaired by nonpoint sources that are listed on the 1998 303(d) List to the condition of fully supporting their designated uses by 2015, in cooperation with local, state and federal partners.

This goal does not apply to this chapter.

Long Term Goal 4.

Beginning in 2006, through regulatory and non-regulatory means, prevent previously unlisted waters from being included on the 303(d) List because of nonpoint source impairments.

- **Action 1**: Provide funding to ground water related projects to abate and prevent pollution in waters not on the 303(d) List.
  Lead: TDA-NPS Program
  Key partners: GWWG
  Year(s): 2001-2005

Long Term Goal 5.

Improve the knowledge of stakeholders and citizens concerning the origins, magnitude, and prevention of nonpoint source pollution, and how to prevent it.

- **Action 1**: Develop and distribute educational material concerning Ground Water issues in increasing amounts each year.
  Lead: TDA-NPS Program
  Key partners: GWWG
  Year(s): 2001-2005

- **Action 2**: Provide funding to ground water related demonstration projects annually.
  Lead: TDA-NPS Program
  Key partners: GWWG
  Year(s): 2001-2005

- **Action 3**: Provide educational information concerning Ground Water on the TDA-NPS web page.
  Lead: TDA-NPS
  Year(s): 2001

- **Action 4**: Develop at least three demonstration projects focusing on importance of ground water quality protection.
  Lead: TDA-NPS Program
  Key Partners: GWWG
  Year(s): 2001-2005

Long Term Goal 6.

Through the process of continuous improvement, routinely assess all programmatic functions of the TDA-NPS Program in order to maximize efficiency, decrease the bureaucratic burden and increase the numbers of participants in the program.

- **Action 1**: Investigate other funding sources such as The Nature Conservancy, Brownfields Program, as well as EPA.
  Lead: TDA-NPS Program
  Key partners: The Nature Conservancy; US EPA
  Year(s): 2001-2005

- **Action 2**: Provide responses to all project related inquiries from grantees within three business days of the request.
  Lead: TDA-NPS Program
  Year(s): 2001-2005

- **Action 3**: Work with grantees to achieve timely submittal of all progress reports 100% of the time.
  Lead: TDA-NPS Program
  Year(s): 2001-2005

- **Action 4**: Develop a Priority Ranking System for project review.
  Lead: TDA-NPS Program
  Key Partner: GWWG
  Year(s): 2001-2005

- **Action 5**: Request feedback from partners annually to assess the quality of the services provided by the TDA-NPS Program.
  Lead: TDA-NPS Program
  Year(s): 2001-2005

Long Term Goal 7.

Use the maximum allowable percentage of funding annually to assist partners with water quality monitoring and assessment, for the duration of the 319 program.

- **Action 1**: Complete source water assessments for the protection of public water systems for both groundwater (wellhead protection plus susceptibility analysis) and surface water systems.
  Lead: TDEC-DWS-GWMS
  Year(s): 2003