Appendix F: Response from TDEC

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
NASHVILLE, TENNESSEE 37243-0435

DON SUNDQUIST
GOVERNOR

MILTON H. HAMILTON, JR.
COMMISSIONER

MEMORANDUM

DATE: February 28, 2002

TO: The Honorable John Morgan, Comptroller

FROM: Milton H. Hamilton, Jr.

RE: **Comment on Draft Report "Water Supply and Long Term Water Policy in Tennessee**

This is in response to your request to review and comment on the above draft report dated February 14, 2002. You, along with Ms. Ethel Detch, Dr. Dan Cohen-Vogel, and Mr. Greg Spradley, should be congratulated for recognizing the importance of this critical policy issue to the State of Tennessee.

The department finds this report to be an effective and fair summary of future water supply policy needs in our state. Your report reflects both a vision and retrospective view of state water policy that is reasonable and appropriate from a public policy perspective. Your references to the efforts of the Sundquist Administration documents key elements of an extensive water supply policy effort that we have initiated. This level of effort has not been achieved in prior administrations. Your report also documents the greater challenge that lies ahead for a comprehensive policy solution.

The Sundquist Administration recognizes the linkage between land-use, growth and water needs. Proper coordination and consideration of these factors will yield a more complete solution. In the interim, we will continue to pursue a comprehensive vision for water supply policy while recognizing the current fiscal and political constraints on policy development in our state. We have attempted to add new tools in law that collectively, if properly coordinated with a longer-term vision, will lead to a comprehensive solution. If the General Assembly can make quicker progress to achieve more comprehensive water supply policy, including some appropriate linkage of land-use factors and growth with water supply, it should do so. I urge the General Assembly to seriously consider and act on these and other research findings for the benefit of our citizens and our prosperity.

Thank you for helping us to bring additional public and legislative attention to this important issue.

Offices of Research and Education Accountability Staff

Director
◆Ethel Detch

Assistant Director (Research)
◆Douglas Wright

Assistant Director (Education Accountability)
Katie Cour

Principal Legislative Research Analyst
◆Dan Cohen-Vogel
Kim Potts

Senior Legislative Research Analysts
Denise Denton
Phil Doss
Margaret Rose
◆Greg Spradley

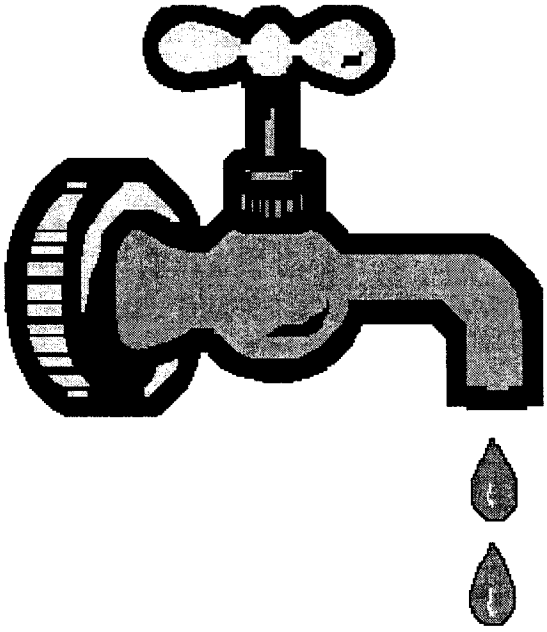
Associate Legislative Research Analysts
Bonnie Adamson
Brian Doss
Richard Gurley
Emily Ogden
Melissa Jo Smith
Karen Tolbert
Emily Wilson

Executive Secretary
◆Sherrill Murrell

◆indicates staff who assisted with this project

Special Report

Tennessee's Water Supply:



Toward A Long-Term Water Policy for Tennessee

John G. Morgan
Comptroller of the Treasury
Office of Research
State of Tennessee

March 2002

STATE OF TENNESSEE
COMPTROLLER OF THE TREASURY
State Capitol
Nashville, Tennessee 37243-0260
(615) 741-2501

March 5, 2002

The Honorable John S. Wilder
Speaker of the Senate
The Honorable Jimmy Naifeh
Speaker of the House of Representatives
and
Members of the General Assembly
State Capitol
Nashville, Tennessee 37243

Ladies and Gentlemen:

Transmitted herewith is a study prepared by the Office of Research in response to multiple media reports over the last two years describing concerns about Tennessee's water supply. The study examines several aspects of water supply policy in Tennessee. It analyzes and makes recommendations in several areas, including water supply legislation, planning, funding, data needs and uses, intergovernmental cooperation, public awareness, registration and permitting, and interstate compacts to deal with shared water resources.

Sincerely,

John G. Morgan
Comptroller of the Treasury

Special Report

Tennessee's Water Supply:

Toward A Long-Term Water Policy for Tennessee

Dan Cohen-Vogel, Ph.D.
Principal Research Analyst
and
Greg Spradley
Senior Research Analyst

Ethel Detch, Director
Douglas W. Wright, Assistant Director
Office of Research
505 Deaderick Street, Suite 1700
Nashville, TN 37243
615/401-7911
www.comptroller.state.tn.us/orea/reports

John G. Morgan
Comptroller of the Treasury

March 2002

Executive Summary

The General Assembly has made at least two attempts in the last 50 years to address the need for a long-term water policy in Tennessee, first through Public Chapter 19 of 1957 and subsequently through Public Chapter 303 of 1981. Neither law resulted in a sustained effort or a long-term strategy for balancing Tennessee's water supplies with ever growing demands. The Department of Environment and Conservation (TDEC) has recently revisited the issue of a long-term plan for Tennessee's water resources, broadly through its organization of the commissioner's Tennessee Water Supply Policy Panel and more narrowly through its promotion of the Interbasin Transfer Act, which the General Assembly passed in 2000. This report reviews the condition of Tennessee's water resources, examines recent state actions concerning water supply, and suggests issues and alternatives that TDEC and the General Assembly may wish to consider to develop and effectively implement a long-term water policy for Tennessee. (See pages 1-12.)

The Report Concludes:

Despite nearly five decades of recurring drought conditions and other water supply problems and despite a statutory requirement for a long-term water policy, Tennessee's long-term policy is still in its beginning stages. As the number of real and potential shortages and conflicts grows, the need for a long-term water policy becomes increasingly apparent. (See page 13.)

State law provides some foundation for a comprehensive, long-term water policy. Laws specifically addressing water supply in Tennessee have provided limited authority to monitor and regulate water use. However, state statutes relating to water have had purposes other than water supply per se, lack important planning and regulatory elements, and have not all been implemented or applied. For example, TDEC has never fully implemented the provisions of the Water Resources Act of 1957, including planning and data gathering functions recommended by this and previous reports. The legal framework on which current Tennessee water law is based becomes less effective at allocating water as scarcity (or competition) increases. Current water withdrawal registration and permitting requirements do not adequately support water and land use planning. (See pages 13-14.)

Water supply and land use are closely related, yet Tennessee laws and regulations do not recognize this relationship. Population growth and economic growth mean increased demand for water and other utilities. Moreover, land use decisions generally do not account for their impacts on shared water supplies. None of the permits required for land use or development considers the impact on water quantity, competing demands, or future development. Land and water use also impact ground water resources, but the effects of development on ground water are generally not regulated. Furthermore, Tennessee's comprehensive growth plan law does not include water supply planning requirements. (See pages 15-16.)

Tennessee presently lacks elements of an effective, comprehensive, long-term water policy. Elements of such a policy include:

- Tools for modeling and analyzing water supply data: Many water-use data sources necessary for formulating water policy are available; however, the data often are based on estimates or self-reporting by individual users, and Tennessee lacks some tools for analysis. (See pages 17-18.)

- Regionally focused water- and land-use policies: Tennessee's current approach to water use and development is inefficient, because it is not based on such policies. Tennessee lacks governance structures and regional water use and development policies that are key components of regional water planning. (See pages 18-20.)

- A system of institutional arrangements among its agencies or with other levels of government to help facilitate a consistent, long-term water policy: Different gubernatorial administrations have orchestrated water-related activities among state agencies to varying degrees. For example, Governor Sundquist transferred the State Planning Office's water-related functions to a new TDEC Policy Office in March 1995. However, in law or rule, Tennessee has no such arrangements. (See page 20.)

- Additional interstate agreements: Tennessee shares water resources with border states, and water conflicts appear increasingly likely unless Tennessee and its neighbors take additional steps to prevent them. (See pages 20-21.)

Legislative Recommendations

The General Assembly may wish to provide a statutory framework within which the Department of Environment and Conservation may regulate the impacts of land use and development on water supplies. Such a framework may include

- a long-term water supply planning component in the comprehensive growth plan statute (TCA § 6-58-101, *et seq.*);
- broader water use registration and permitting authority;
- authority to create incentives for appropriate and responsible land use. (See page 23.)

The General Assembly may wish to appropriate funds to the Utility District Revitalization Fund (TCA § 7-82-704) or develop some other mechanism to promote broader regional water supply planning. (See page 23.)

The General Assembly may wish to amend the Water Resources Act (TCA § 69-8-101, *et seq.*) to include rule-making authority for the Division of Water Resources such as registration, permitting, fees, and civil penalties sufficient to deter violations, and to provide funding for that Division to collect and analyze water-use data necessary to formulate water policy. (See page 23.)

The General Assembly may wish to enact fees, taxes, subsidies, pricing structures, or other tools as incentives to use water efficiently. (See page 23.)

Administrative Recommendations

The Department of Environment and Conservation should seek the necessary funding and implement the provisions of the Water Resources Act (TCA § 69-8-101, *et seq.*). Three provisions of that act of particular value to a long-term water policy are:

- establishing, maintaining and publishing an accurate inventory of the state's water resources;
- determining, maintaining and establishing estimates of existing and future water use in the state; and
- defining and proposing water control districts in the state and making engineering plans and surveys for improving the quantity of the water supply in these districts. (See page 23.)

The Department of Environment and Conservation should develop formal institutional arrangements in rule or law among state agencies and between the state and other levels of government in order to facilitate a consistent, long-term water policy. Placing such arrangements in rule or law would help ensure that they remain in effect from one administration to the next. (See page 23-24.)

The Department of Environment and Conservation should continue use of available media and use educational outlets to heighten public awareness of water supply issues. (See page 24.)

The Department of Environment and Conservation should seek the necessary funding and develop a database and data analysis tools on which water and development policy decisions may be based. These may include:

- analysis tools based on existing data in digital form, as part of geographic information systems (GIS);
- an interagency water supply data clearinghouse to facilitate the gathering and compilation of reliable water supply data. (See page 24.)

The Department of Environment and Conservation should develop a regional approach to managing the state's water resources, such as creation of regional water authorities defined along natural as opposed to political boundaries. Although the Department of Environment and Conservation has encouraged utility district consolidation and local government cooperation, a regional water policy may include a broader set of planning and enforcement tools through such structures as regional water authorities or water control districts. (See page 24.)

The Department of Environment and Conservation should investigate and propose a comprehensive approach to land and water use. Possible tools that may be used to implement such an expanded policy include:

- broader water use registration;
- comprehensive permitting;

- expanded statutory and regulatory requirements that explicitly link land use planning and water use planning;
- financial incentives within communities or between state and local governments. (See page 24.)

The Governor and the Commissioner of Environment and Conservation should continue to evaluate the need for additional interstate compacts or other agreements to protect Tennessee's shared water resources. (See page 24.)

Table of Contents

Introduction.....1

Methodology.....2

Background: Water Resources.....2

Background: Water Law.....8

Analysis and Conclusions.....13

Law and Regulation.....13

Land and Water Policies Are Inseparable.....15

Data Needs and Uses.....17

Regionalization of Water Policy.....18

Interagency Coordination.....20

Interstate and Interbasin Water Management.....20

Incentives for Efficient Use.....21

Public Awareness.....22

Recommendations.....23

Legislative Recommendations.....23

Administrative Recommendations.....23

Appendices.....25

Appendix A: Useful References.....25

Appendix B: Maps.....27

Appendix C: Water-Related Permit Requirements in Tennessee.....31

Appendix D: Relevant Chapters of Tennessee Code Annotated.....33

Appendix E: People Contacted for This Report.....34

Appendix F: Response from TDEC.....35

Introduction

Severe drought in Tennessee in the 1950s led to the creation of a Water Policy Commission. Responding to that Commission's recommendations, Public Chapter 19 of 1957 stated:

> It is hereby found and declared that because of expanding water utilization and actual or threatened shortages in natural water supply, as disclosed by the recent report of the Commission created to study water resources and water uses pursuant to the provisions of Chapter 82 of the 1955 Public Acts of Tennessee, the general welfare of the people of the State requires that immediate steps be taken to continue and expand the study of water resources and water uses in Tennessee *in order to facilitate the creation and development of a basic, long range water resource policy for the state.* [emphasis added]

Also apparently motivated by drought conditions, Public Chapter 303 of 1981 mandated a report to study water laws and policies. The special joint committee of the General Assembly created for that purpose determined that "although Tennessee is richly blessed with water resources, the patterns of use, reliance on English common law riparian rights, and urban growth in the state are placing a severe strain on these resources." Two reports in 1983 by the Water Resources Research Center at the University of Tennessee reviewed Tennessee water law and policy and made a number of specific recommendations for changes. Apparently in reference to these reports and the legislation that motivated them, the fiscal year 1983 budget document, in summarizing the functions of the Division of Water Resources, stated: "Work is in progress toward a long-range water resources policy."[1]

Also in 1983, the Comptroller's Division of State Audit noted, in a program evaluation of the state's river basin agencies, "the absence of an overall state plan for river basin development."[2] A 1991 report by the Comptroller's Office of Local Government, *Special Report: Planning and Service Delivery in Tennessee*, reiterated this finding. The latter report also pointed to the need for "a long-term strategy for providing water and sewer services across the state," observing that such a strategy should be developed with the coordination and cooperation of state and federal agencies.

As a result of its growing population and economy and recent drought conditions, Tennessee again finds its water resources constrained in various areas of the state. As the General Assembly and previous gubernatorial administrations did in the 1950s and 1980s, the Sundquist Administration recognized the need to enhance state water law and to develop a more comprehensive, long-term state water policy. In 1995, Governor Sundquist created an Environmental Policy Office within the Tennessee Department of Environment and Conservation (TDEC), and one of that office's duties is to develop a strategic plan for water supply and waste water services.[3] In 2000, TDEC organized a water supply policy panel to share information and form a consensus among a broad set of stakeholders regarding water policy

---

[1] State of Tennessee, *The Budget: 1982-83*, p. 279.
[2] *Program Evaluation on the River Basin Agencies and Authorities* (Nashville, TN: Division of State Audit, 1983), p. 40.
[3] Memorandum from Governor Don Sundquist to Commissioner Don Dills, March 13, 1995.

directions. TDEC has also recently funded studies of Tennessee water supply and water policy and has promoted its present policy objectives through the media, intergovernmental relationships, and legislation. This report reviews the current condition of Tennessee's water resources, examines actions recently taken by the state with respect to water supply, and suggests a number of issues and alternatives that TDEC and the General Assembly may wish to consider with regard to development and effective implementation of a long-term water policy for Tennessee.

Methodology

To complete this report, Office of Research staff:

- reviewed various primary and secondary sources concerning technical issues, water policy and law, and economics.
- reviewed federal and state statutes and rules related to water supply.
- reviewed other states' studies and actions to date with respect to long-term water policy.
- interviewed persons with expertise in water law and water policy. People contacted as part of this study are listed in Appendix E.
- attended the Commissioner of Environment and Conservation's Tennessee Water Supply Policy Panel meetings.

Background: Water Resources

Overview of Tennessee Water Issues

In Tennessee, whether a domestic water supply comes from ground or surface water depends on topography, geology, and historical development patterns. On the coastal plain of West Tennessee, bounded by the Mississippi River on the West, ground water is the principal source of domestic water supply. A combination of surface and ground water in the rest of the state supports hydroelectric power generation, transportation, aquatic habitat, domestic and commercial consumption, and assimilation of wastewater discharge into the river system. In 1995, 9,640 million gallons of surface water per day and 436 million gallons of ground water per day sustained 5.3 million Tennesseans.[4] The chart on the following page details the relative magnitude of the various uses of Tennessee's water resources.

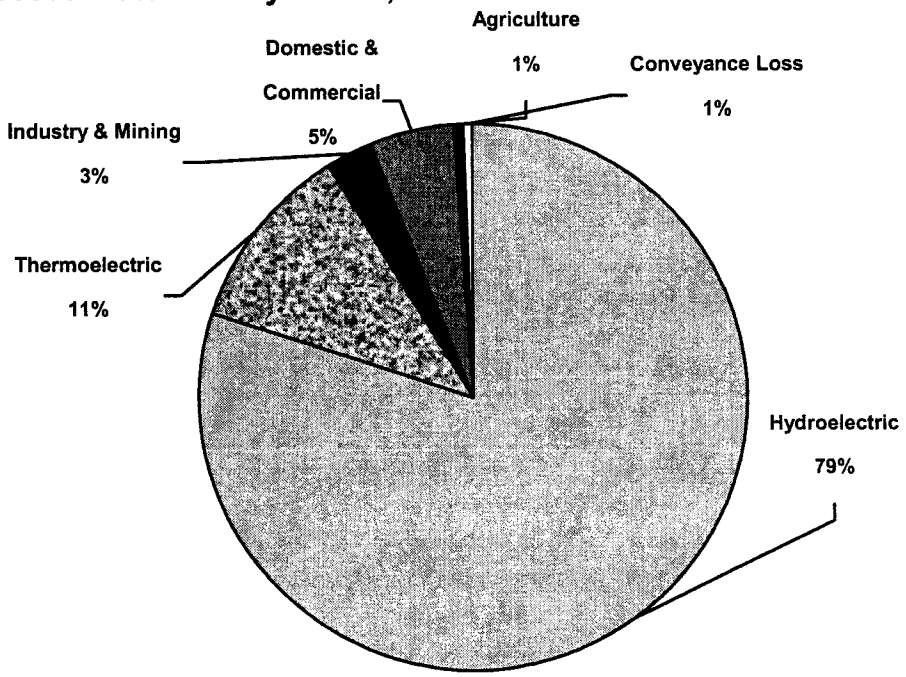
Generally, naturally accessible sources of water are less available at higher elevations in the state, resulting in greater reliance on man-made alterations of surface water resources (dams, diversions) for domestic water supply. (Map 1 in Appendix B shows Tennessee's major surface water resources.) However, these alterations of natural hydrologic systems impact areas both

[4] Susan Hutson, "Public Water-Supply Systems and Associated Water Use in Tennessee: Water Resources Investigations Report 99-4052," U.S. Geological Survey in cooperation with the Tennessee Department of Environment and Conservation, Division of Water Supply, 1995, p. 3; U.S. Department of the Interior, U.S. Geological Survey, USGS Fact Sheet FS-087-98, September 1998; U.S. Census Bureau, Population Division, "State Population Rankings Summary: Population Paper Listing #47, Population Electronic Product #45," http://www.census.gov/population/projections/state/9525rank/tnprsrel.txt (accessed February 13, 2002).

upstream and downstream, affecting domestic and industrial water supplies, waste assimilation, aquatic life, recreation, and agriculture. As the impacts (mainly environmental) from these types of alterations have been studied over time, regulators have become less inclined to approve permits for projects that would alter ecosystems, pushing local officials to consider alternative sources of water.

Areas of the state that rely on ground water must also make difficult water supply decisions. Long-term pumping of ground water from aquifers underlying West Tennessee and surrounding states has brought a realization that this resource is also finite and that the actions of one user can affect availability to others. (Map 2 in Appendix B shows the major aquifers from which Tennesseans draw their ground water.) Legal, economic, and social factors make it essential that decisions on water supply issues involve a broad set of stakeholders.

Tennessee Water Use by Sector, 1995



Source: US Department of the Interior, USGS, "Water Use in Tennessee, 1995."

Water Scarcity and Potential Conflict in and around Tennessee

Since 1998, TDEC has conducted an annual assessment of existing and potential water supply problems in Tennessee. While the results of that assessment do not necessarily indicate all water-stressed counties or incorporate all possible assessment criteria, the list of counties illustrates the widespread potential for scarcity in the state. Map 4 in Appendix B shows the results of the most recent TDEC assessment, in which six counties are identified as having "priority need for additional water supplies" but are not engaged in any study or regionalization efforts.

Similarly, a recent article in the *Tennessee County News* discussed counties that are studying and attempting to address future water needs and others that face interstate competition for scarce water resources. Those counties mentioned include: Wayne, Lewis, Lawrence, Hawkins, Sumner, Montgomery, and Shelby. The article also implied potential conflicts or shortages in other counties that share water resources or borders with Arkansas, Georgia, and Kentucky.[5] Tennessee's water resources are particularly valuable to Georgia as a result of its population growth pressures. The following table lists the population growth rates in all states that share water resources with Tennessee, illustrating the extent to which Tennessee's water supply future is tied to surrounding regions' natural, demographic, and political conditions.

Population Change in States Sharing Hydrologic Units with Tennessee	
State	Estimated (%) Percent Change 1990-2000
United States	**13.2**
Alabama	10.1
Arkansas	13.7
Georgia	26.4
Illinois*	8.6
Indiana*	9.7
Kentucky	9.7
Louisiana*	5.9
Mississippi	10.5
Missouri	9.3
North Carolina	21.4
Ohio*	4.7
Pennsylvania*	3.4
South Carolina*	15.1
Tennessee	**16.7**
Virginia	14.4
West Virginia*	0.8

Source: US Census Bureau.
*States not bordering Tennessee.

Water Scarcity Cases in Tennessee

Case 1: Cumberland Plateau

Despite having a limited water supply because of its elevation, Crossville, Tennessee has become a popular retirement community with a population of about 8,575 residents. In the past, officials have sought to satisfy water needs with small, isolated impoundments (reservoirs). In Fall 2000, the City Council of Crossville approved the expenditure of $350,000 to pursue a permit to construct a 40-foot dam on the Caney Fork River near the borders of Cumberland and White Counties. In addition to providing its own water, the city of Crossville provides water to four

[5] Doug Goddard, "Growing Needs Exist for County Water Resources Study," *Tennessee County News*, May/June, 2001, p. 4.

rural utility districts serving about 80 percent of Cumberland County. Crossville meets current water needs by drawing from two reservoirs that each cover about 250 acres, while the new reservoir would cover about 1,200 acres. Engineers estimate that the new water source could produce another 20 million gallons of water per day, supplying the county's water needs for another 50 to 75 years. City officials report that before proposing this project, they looked at several alternatives, including water harvesting from Watts Bar Lake, impoundments in other areas, and ground water wells, but they concluded that damming the Caney Fork makes more sense economically.

Conservation and environmental interest groups raised objections to the proposal even before the city council approved the funding to pursue a permit. These groups have a number of concerns with the project, including the 10,000-acre Bridgestone-Firestone Centennial Wilderness Area, which lies approximately 3 ½ miles downstream of the proposed dam. This area, recently donated to the state by the Bridgestone-Firestone Corporation, is managed for hunting, fishing, and other outdoor recreation by the Tennessee Wildlife Resources Agency (TWRA). Whitewater enthusiasts are concerned that impounding the Caney Fork upstream of the wilderness area would eliminate opportunities for some of the most isolated and challenging whitewater rafting in the Southeast. If dammed, the river could be used for whitewater sports for only a few days each year during the typically rainy spring season, when the city would need to store water for use during the dryer winter months. Whitewater boaters fear that this would virtually eliminate whitewater boating. State and federal government biologists point out that the outflow from impoundments typically does not meet water quality standards for iron, suspended solids, and dissolved oxygen. Consequently, aquatic life could suffer. Other groups say that the dam would cut off the "very life blood" of the wilderness area and claim that Crossville needs to explore alternatives before moving forward with the dam.[6] The permit to build the dam must be approved both by the U.S. Army Corps of Engineers and TDEC.

Case 2: Duck River

TDEC officials report that water conflicts are common along the Duck River as a result of the number of local users along its route. One example of such a conflict is the area around Normandy Lake and Dam. Officials explained that users upstream of the dam wish to maintain lake levels sufficient to supply municipal needs. Downstream of the Normandy Dam, there are other concerns. Municipal water suppliers downstream of the dam impact the river by withdrawing water, as do municipal sewage treatment plants that discharge treated wastewater. To maintain water quality at levels that support the river's designated uses, dam operators must maintain a minimum flow that will allow treated sewage released into the river to be safely assimilated. Also, the tailwaters of Normandy Lake are one of the state's most popular trout fishing areas, stocked by TWRA to benefit the state's fishermen. Again, to support this fishery, minimum flows require dam operators to release a fairly constant volume of water from the reservoir.[7] The Duck River supports many other species of aquatic life, including endangered species susceptible to poor water quality, which contributed to the cancellation of the Columbia Dam project further downstream. The proposed dam would have provided a major water supply

[6] Morgan Simmons, "Crossville Mulling Dam on Caney Fork River," *Knoxville News-Sentinel,* December 17, 2000.
[7] Interview with Paul Davis, Director, Water Pollution Control Division, Tennessee Department ofEnvironment and Conservation, January 8, 2001.

source to the Columbia region.[8] This situation requires regulators, local governments and utility districts, and TDEC to carefully examine the potential effects of proposed activities both upstream and downstream of the dam and to work together to maintain the hydrologic system to support everyone's needs.

Case 3: Memphis Sand Aquifer

The city of Memphis, through Memphis Light, Gas and Water (MLGW), is one of the largest cities in the world to rely solely on ground water for its water supply. The city's wells tap into the Memphis Sand Aquifer, an underground reservoir that underlies nearly 7,400 square miles in West Tennessee, Northern Mississippi, Southwestern Kentucky, and Eastern Arkansas. The largest user of the aquifer, MLGW pumped an average of 208 million gallons per day in 1995, with an estimated 20 to 40 million gallons per day thought to be coming from beneath DeSoto County, Mississippi. This area of Mississippi has experienced rapid economic and population growth, in part due to the "suburbanization" of Memphis, and views the aquifer as a potential future water source, adding an interstate dimension to this case of water scarcity.[9]

The aquifer's recharge area appears to begin just inside southeast Shelby County, Tennessee (an area of intense development) and to extend east into Fayette County. Balancing local growth against the need to protect the recharge area remains a major challenge and has sparked local efforts to require "open space" and limit development to permit natural "ponding" of standing water and allow aquifer recharge. Memphis Light, Gas and Water and DeSoto County, Mississippi, officials note that as a result of long-term pumping, a cone of depression has developed in the Memphis area. Observation wells showed a decline in water levels of 77 feet between 1928 and 1985; water levels away from the cone in Memphis have also shown a decline. There are smaller cones around a major well field in Memphis, and DeSoto County has reported declines of one foot or more per year, apparently because of pumping locally and in Memphis. It is not clear whether water levels could return to normal if pumping ceased, nor has it been proven that there has been a significant decline in water levels or a measurable effect on well yields in Northern Mississippi or other areas. Also, traces of contaminants such as arsenic, lead, and mercury have been found in water from the aquifer. Though well below EPA's maximum allowable concentrations for drinking water supplies, this discovery is troubling to those who use water from the aquifer, because it demonstrates the aquifer's susceptibility to contamination in the vicinity of waste disposal sites and abandoned dump sites. This evidence of susceptibility is also contrary to previously held beliefs that a layer of clay overlying the aquifer protected it from such contamination.[10]

Officials in both Mississippi and Tennessee have called for a comprehensive study of ground water use, the movement of ground water between Mississippi and Tennessee, and the causes of declines in ground water levels. In response, the Sundquist Administration helped create the Mississippi, Arkansas, and Tennessee Regional Aquifer Study (MATRAS) to study shared

---

[8] Tennessee Valley Authority, "Use of Land Acquired for the Columbia Dam Component of the Duck River Project," http://www.tva.gov/environment/reports/columbiaeis/index.htm (accessed February 13, 2002).
[9] David Lewis Feldman and Julia O. Elmendorf, *Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for Long-Term Planning* (Knoxville, TN: Energy, Environment and Resources Center, 2000), pp. 50-53.
[10] *Ibid.*

ground water issues.[11] While common law pertaining to ground water has not been extensively tested by litigation in Tennessee, legal scholars generally view rights to ground water as held by overlying landowners with some limitations. An appellate court in Tennessee has concluded that the rights of a landowner are restricted to activities that do not interfere with the rights of other landowners overlying the same aquifer.[12] However, Memphis has been pumping water from the aquifer for so long that MLGW may have acquired rights to the water through *prescription*.[13] A number of other legal issues surround this case, including each state's liability to the other and the ability to prove damage. It appears better for parties in the three states to work together toward a mutually acceptable solution than to resolve the issue through litigation. Such a solution would probably include reducing MLGW's reliance on the aquifer.

Case 4: Lake Levels in East Tennessee

In December 2000, Congress agreed to fund a study by the University of Tennessee examining the economic impact on East Tennessee counties if the Tennessee Valley Authority (TVA) were to delay the annual drawdown of its reservoirs there. Current TVA policy lowers, or "draws down," water levels in TVA lakes beginning in August. TVA rationale for the drawdowns include hydroelectric power generation, flood control, navigation, and environmental demands.[14] These reservoirs have a significant financial impact on the surrounding communities because of the tourist and recreation dollars they attract. Drawing the lakes down in August renders them unusable or unattractive to recreational users during months when the weather supports recreational uses, reducing local business revenues, state and local sales taxes, and property values.

An October 1998 report by the UT Center for Business and Economic Research examined the economic impact of keeping water levels in two East Tennessee Lakes constant during the months of August and September rather than beginning the drawdown in August. The table at the top of the next page summarizes the findings of that study and comparisons with other similar studies.

---

[11] Tennessee Department ofEnvironment and Conservation, "Report from Multi-State Water Supply Research Project," http://www.state.tn.us/environment/epo/hotlist.htm#WaterResearch (accessed February 8, 2002).
[12] David Lewis Feldman and Julia O. Elmendorf, *Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for Long-Term Planning* (Knoxville, TN: Energy, Environment and Resources Center, 2000), pp. 52-53.
[13] Acquiring ground water rights through "prescription" means acquiring the rights through long-term pumping without the other users taking any action, though it may affect yields of other users of the same aquifer.
[14] Richard Powelson, "Congress funding study of TVA lake levels," *Knoxville News-Sentinel*, December 17, 2000.

Comparison of Economic Impacts Resulting from Higher Lake Levels in August and September for Douglas and Cherokee Lakes

	Lake Level Survey			
	NSRE*	TVA	Retail Sales Analysis	Commercial Survey
Increased Expenditures	$1,038,500	$1,816,900	$1,646,100	$7,097,090
Income Impact	$588,194	$976,580	$707,823	$5,743,464
Employment Impact**	205	357	259	2,106
Local Sales Tax Revenue	$48,117	$84,185	$38,868	$239,187

* National Survey of Recreation and the Environment (1996)
** Assumes all employment gains accrue in August and September. Numbers represent full-time equivalent jobs.

Source: Center for Business and Economic Research, University of Tennessee, Knoxville, *Economic and Fiscal Consequences of TVA's Draw-Down of Cherokee and Douglas Lakes* (October, 1998).

Background: Water Law

What Body of Law Guides Tennessee Water Policy?

The Eastern United States derived its water law from the colonial period, during which the English common law theory of *riparian rights* was imported to the colonies. "Riparian" means "situated on" (a body of water). Thus, riparian rights are acquired by owning land adjacent to a body of water and specifically authorize the land owner to withdraw and use that water.

In the last century, riparian law developed into a "reasonable use" approach, a concept not always clearly defined. Under the reasonable use doctrine, the quantity and quality of water may be affected, as long as the impact does not cause damage to other users (or "harm without injury").[15] One riparian user's "reasonable use" of a water source is defined relative to other riparian users of that source. The doctrine does not prioritize water uses, and cumulative impacts of multiple users are not taken into account.

Although both ground and surface water rights are based on ownership of land overlying or adjacent to the body of water, ground water rights differ. "Reasonable use" is defined more broadly in the case of ground water to allow a riparian to degrade the quantity and quality of the aquifer, as long as the ground water is not being exported to a non-riparian. Whereas use by

[15] James E. Kundell and Diana Tetens, *Whose Water Is It?: Major Water Allocation Issues Facing Georgia*, Carl Vinson Institute of Government, Public Policy Research Series (Athens, GA: Carl Vinson Institute of Government, 1998), 4. The phrase "harm without injury" (or *damnum absoque injuria*) is taken from *Harris v. Brooks*, 225 Ark. 436, 283 S.W.2d 129 (1955).

other riparians is taken into account under the reasonable use doctrine of surface water law, it is not under ground water law. Furthermore, the common law riparian doctrine does not recognize the hydrologic relationship between surface and ground water.[16]

Recent Developments in Water Law and Regulation

Increasingly, states are moving toward "regulated riparianism" to address the deficiencies of the common law riparian doctrine in dealing with growing competition for water resources. Regulated riparianism entails a set of approaches Tennessee has used to some degree in its water management. Broadly, the phrase refers to registration and/or permitting as tools to monitor water use and induce behavior that accounts for the uncertainties and interrelated impacts that characterize a riparian system.[17] Registration involves the monitoring of water use, at least by certain users, but does not go further than this data collection. Permitting transfers the basis of water rights from ownership of associated land to ownership of a permit that more clearly defines the user's water rights.

Permit programs vary in scope. Many states employ targeted permitting, which applies only to specific geographic areas, specific time periods (e.g., drought), or specific water resources (e.g., ground water). However, some states have implemented more comprehensive permitting programs. While comprehensive permitting constitutes a much larger shift away from riparian rights to regulatory and statutory control of water, it does not mean riparian rights are rejected entirely. In addition to defining the place, time, and/or specific resources, permitting programs may also include:

- permit durations;
- exemptions for certain uses;
- volume thresholds;
- priorities during shortages;
- application to actual use versus capacity for use;
- interbasin and interstate water transfers.[18]

A permitting program is one option the state may consider applying in specific regions or statewide, as is the case in the state of Georgia. Shelby County offers one example of how permitting is used in Tennessee in addition to interbasin transfer permits. That county is the only local government in Tennessee that requires a permit for every well dug in the county.

Tennessee Water Laws

Until the year 2000, Tennessee had no law that specifically authorized the regulation of withdrawals from the state's surface waters. Since 1963, Tennessee law has required that all water withdrawals of 50,000 gallons per day or more be registered with the Division of Water

---

[16] *Ibid.*, pp. 5-6.
[17] The American Society of Civil Engineers (ASCE) published its Regulated Riparian Model Water Code in 1996.
[18] Kundell and Tetens, pp. 5-10.

Resources within TDEC.[19] However, the law contains no limitations and no regulatory authority beyond the standard of 50,000 gallons per day.[20]

The Tennessee Water Quality Control Act of 1977, however, potentially applies to nearly all uses of surface water. It requires anyone that changes the character of the water to obtain a permit from TDEC. Statute defines pollution as:

> ...alteration of the physical, chemical, biological, bacteriological, or radiological properties of the waters of this state including, but not limited to, changes in temperature, taste, color, turbidity, or odor of the waters that will: result or will likely result in harm, potential harm or detriment of the public health, safety, or welfare; result or will likely result in harm, potential harm or detriment to the health of animals, birds, fish, or aquatic life; render or will likely render the waters substantially less useful for domestic, municipal, industrial, agricultural, recreational, or other reasonable uses; or leave or likely leave the waters in such condition as to violate any standards of water quality established by the board.[21]

While these laws do not specifically address the withdrawal of surface water, removing quantities of water from rivers and streams may alter the downstream properties of a body of water by reducing the amount of water available to dilute pollutants, or by altering the flow characteristics of a body of water. Also, withdrawing surface water, especially in large quantities, often involves impounding or diverting streams with dams or other structures, similarly altering the natural flow (physical properties) of those bodies of water. Tennessee rules in support of these laws require permits for any activities not requiring a federal permit that alter state waters.[22] (Appendix C lists the activities for which water-related permits are required.)

Under the statute, the Water Quality Control Board has the power to set water quality standards for all state waters and to promulgate rules for permitting and monitoring. The Commissioner of TDEC has the power to enforce statutes and rules relating to water quality by issuing permits that prescribe limits on polluting activities and enforcement orders based on violations of the law or rules. Such enforcement orders may include the imposition of civil monetary penalties, further restrictions on polluting activities, cessation orders, planning or upgrade requirements, and increased monitoring.[23]

Until 2000, laws and regulations in Tennessee dealing with water withdrawals had been grounded in general riparian law's reasonable use doctrine. In 2000, the Sundquist Administration and the General Assembly began to address surface water withdrawals, primarily in response to an inquiry by the city of Atlanta to purchase water from the Tennessee River near Chattanooga from a private water company. The Interbasin Water Transfer Act of 2000[24] states that as the population and demand for water resources grow, it is prudent to engage in planning

---

[19] That responsibility is actually in the Division of Water Supply, since the Division of Water Resources ceased to exist prior to the creation TDEC.
[20] *Tennessee Code Annotated,* § 69-8-105.
[21] *Tennessee Code Annotated,* § 69-3-103(22).
[22] *Rules of the Tennessee Department of Environment and Conservation,* § 1200-4-7-.01.
[23] *Tennessee Code Annotated,* § 69-3-105 and 69-3-107.
[24] *Tennessee Code Annotated,* § 69-8-201, *et seq.*

for the future and to have an explicit mechanism in place to regulate the diversion of water from one river basin to another. The law says that transferring water from one river basin to another raises issues of the protection of the public health, safety, welfare, and the environment, as the water is no longer available for use in the original stream.

The primary purpose of the law is to regulate interbasin transfers based on the quantity of water in the river basins. The law also states, "Although the common law addresses some of these concerns, it relies on after-the-fact litigation rather than a modern regulatory system,"[25] and it seeks a framework in which the courts are not the primary determinants of water transfers. The law defines ten river basins within the state and lays the groundwork for the regulation of withdrawals that would transfer surface water from one river basin to another.

Previously, in recognition of water supply planning needs, the Water Resources Act of 1957[26] created a Water Resources Division in the Department of Conservation (now TDEC) with various duties and powers relating to water supply. The statute directs and empowers the director of the division to:

1) Establish, maintain, and publish an accurate inventory of the state's water resources;
2) Determine, maintain, and establish estimates of existing and future water use in the state;
3) Define and propose water control districts in the state and make engineering plans and surveys for improving the quantity of the water supply in such proposed districts;
4) Implement the basic water resource policy of the state by creating and defining the rights of competing water users;
5) Perform duties relating to the determination of waters that should be reserved for general public purposes including navigation, sanitation, recreation, maintenance of fish and aquatic life, the maintenance of unusual scenic features and other public purposes;
6) Determine the feasibility of proposed dams and water diversion structures to conserve the basic water resources of the state and review and recommend plans for any such proposed dams and diversion structures in any proposed water control districts; and
7) Perform any other duties required by the terms of this part, the commissioner, or the Water Resources Commission.[27]

In 1983, a University of Tennessee Water Resources Research Center report recommended that the state give the Water Resources Division or other agency "sufficient authority and implementation responsibility to carry out its assigned functions." The report goes on to note that "the Water Resources Division has been assigned numerous responsibilities for which it has lacked both the funding and implementation authority to carry out."[28] The Comptroller's

---

[25] *Tennessee Code Annotated,* § 69-8-202.
[26] *Tennessee Code Annotated,* § 69-8-101, *et seq.*
[27] *Tennessee Code Annotated,* § 69-8-103 (paraphrased). The 1957 act also created a water resources commission, which was subsequently repealed and its functions moved to the conservation commission.
[28] Jack D. Jones, Vincent A. Sikora, and Jane Woodward, *Study of Tennessee Water Resources Law: Legal Considerations for Effective Water Management under Conditions of Shortage* (Knoxville, TN: Water Resources Research Center, 1983), p. 14.

Division of State Audit published audit findings in March 1982 that pointed out inadequacies in the division's regulation of dams and of well drilling as well as its unreliable estimates of the state's water use and availability.[29]

When the Department of Conservation became part of the Department of Health and Environment in 1983, the Water Resources Division was phased out. While the executive order[30] making that departmental transfer specifically moved all of the Water Resources Division's positions and other resources to the Department of Health and Environment, those positions were distributed among various water-related programs. The Division of Water Supply currently carries out some of the provisions of the Water Resources Act, but it does not define and propose water control districts, implement the basic water resource policy of the state, or maintain an accurate inventory of water resources or estimates of existing and future water use. The latter could be compiled by combining data maintained by the divisions mentioned above and that collected by the U.S. Geological Survey (USGS), but neither TDEC nor the USGS currently compiles the data in this manner.[31]

---

[29] *Program Evaluation on the Department of Conservation* (Nashville, TN: Division of State Audit, 1982), pp. 22-23, 44-45.

[30] "An Order Transferring the Water Resources Division in the Department of Conservation and its Functions to the Department of Public Health," Executive Order by the Governor, No. 44, February 11, 1983.

[31] The history of the Division of Water Resources and the implementation of the Water Resources Act was pieced together through examination of successive budget documents, the 1983 executive order transferring the division to the Department of Public Health, the 1983 reports of the University of Tennessee's Water Resources Center, past audits of the Comptroller's Division of State Audit, and conversations with both active and retired officials of TDEC.

Analysis and Conclusions

Despite nearly five decades of recurring drought conditions and other water supply problems and despite a statutory requirement for a long-term water policy, Tennessee's long-term policy is still in its beginning stages. As the number of real and potential shortages and conflicts grows, the need for a long-term water policy becomes increasingly apparent. Growing water supply distress on the Cumberland Plateau, the Duck River, and the Memphis Sand Aquifer highlight the need for farsighted and coordinated planning efforts.

TDEC has begun to build on past and present research efforts and to promote certain policy goals. However, to be effective, a comprehensive, long-term water policy considers a number of issues. Planning for growth and development will need to address water needs and available supplies. The regulatory framework used to secure adequate water and evaluate the effect of one set of users on another should also recognize that the natural properties and boundaries of water resources do not adhere to political boundaries, and it should apply to both land and water use planning. This regulatory framework may require prioritization of water uses in places and times of scarcity, such as during a drought. Where water sources and users reside in states adjoining Tennessee, interstate compacts and/or cooperative agreements may be necessary. The state may utilize a number of tools, enumerated in the following sections, to implement its policy. Such tools should: encourage the pursuit of a regional (as opposed to local) policy framework; help to clarify, change, or create water law and property rights with respect to water; and provide incentives for water users and suppliers to behave in a socially (as opposed to privately) efficient manner.

Law and Regulation

State law provides some foundation for a comprehensive, long-term water policy. However, these laws have had purposes other than water supply per se, lack important planning and regulatory elements, and have not all been implemented or applied. Laws specifically addressing water supply in Tennessee have provided limited authority to monitor and regulate water use. However, current water withdrawal registration and permitting requirements do not adequately support water and land use planning, and TDEC has not implemented current applicable provisions of the law. In particular, the provisions of the Water Resources Act of 1957 have never been fully implemented, including the planning and data gathering functions recommended by this and previous reports. Additional or revised legislation, exercise of existing regulatory powers, and higher state appropriations to support these activities may be necessary to develop and implement a long-term water policy.

Current Tennessee water law is based on the common law riparian doctrine, but that legal framework becomes less effective at allocating water as scarcity (or competition) increases. The major reasons for its ineffectiveness are:

- Inadequate knowledge of amounts of water used creates uncertainty and limits the ability to manage water resources.
- No provisions exist in law or rule to prioritize various water uses.
- Since one user's "reasonable use" is defined relative to that of other users, riparian water rights are uncertain and unpredictable.

- The lack of clear definition of "reasonable use" leads to costly, unpredictable, and often only temporarily resolves conflicts and litigation.
- The doctrine does not account for cumulative uses, so that a number of reasonable uses may result in damage with no one user clearly to blame for the damage.
- The doctrine does not recognize the hydrologic relationship between ground and surface water.[32]

A more extensive system of registration and permitting of water use may remedy some of the deficiencies of the common law doctrine and the current structure of state water policy. A broader permitting system may base the permit on the place, time, water source, and water use, among other factors. Tennessee has already begun moving in this direction with respect to interbasin transfers, through the Interbasin Water Transfer Act of 2000.[33] This law, in addition to the 1963 law[34] requiring the registration of all withdrawals of 50,000 gallons per day or more, appears to provide a framework on which to base a broader set of water policy tools. Additional requirements for reporting withdrawals of smaller amounts of water (under 50,000 gallons per day) and monitoring how and where water is returned to surface water may be necessary. Powers given to the Water Resources Division by the 1957 act and ostensibly assumed by the Division of Water Supply and other divisions could facilitate implementation of these additional requirements. However, the act does not provide the division with rule-making authority, which appears necessary for broader regulatory efforts such as expanded permitting and registration. Effective implementation of the act may also require additional funding or re-prioritization of this particular function of TDEC over others.

A more extensive permitting system, similar to that employed in Shelby County, is another option for regulating the use of scarce water. Within that context, TDEC could use the existing water quality permits to address a broader set of activities that impact water supply. (See Appendix C.) The General Assembly could also modify water use and land use and planning laws to address intrabasin and interbasin water allocation concerns or to define and refine property rights with respect to water in Tennessee.

Such a change in policy implies setting priorities for water uses and users to some degree. For example, to what extent do policy makers wish to protect private development rights, provide a fair distribution of income derived from water use, or ensure that the policy is adaptable to future environmental and other changes? Are industrial, agricultural, and residential growth and uses of water comparable, or should one rank above another? How should hydroelectric uses and inexpensive power be balanced with recreational uses and "existence value," the value that non-users of a water source place on the wildlife and natural beauty that source supports.

---

[32] James E. Kundell and Diana Tetens, *Whose Water Is It?: Major Water Allocation Issues Facing Georgia*, Carl Vinson Institute of Government, Public Policy Research Series (Athens, GA: Carl Vinson Institute of Government, 1998), 6.
[33] *Tennessee Code Annotated,* § 69-8-201, *et seq.*
[34] *Tennessee Code Annotated,* § 69-8-105.

Land and Water Policies Are Inseparable

Water supply and land use are closely related, yet Tennessee laws and regulations do not recognize this relationship. Population growth and economic growth mean increased demand for water and other utilities. Furthermore, economic and social motivations for location decisions generally do not reflect the environmental or other social costs of those decisions, including stress on water supplies.

In addition to the direct impacts of development on water resources, other services required to meet the needs of a growing population also consume considerable quantities of water. In particular, gas-powered electric generators designed to meet electricity needs during periods of peak demand require large quantities of water for cooling purposes. Peak demand often occurs during the hottest part of the year, when water flows are low and water sources are already more likely to be stressed. Therefore, growing reliance on gas-powered generation during those times creates additional competition for scarce water resources. The Sundquist Administration recently recognized this particular issue and suspended new power plant permits.[35]

Surface activities can affect the quantity and quality of ground water, but there is almost no regulation of the effects of proposed developments on ground water.[36] For example, when planning an industrial or housing development, developers and government planners should consider whether or not adequate water will be available to meet residential or commercial needs once the development is complete. To address this question in most cases, they need only to determine whether current or planned water systems have the capacity to meet the needs of the development, or whether they can increase capacity to meet those needs before the development is complete.

None of the permits currently required for land use or development relates to the impact of the development on water quantity, competing demands, or future development. The (hypothetical) example of the permits required for a new residential or commercial development illustrates this point. If the development diverted water or required a culvert, it would have to apply for an Aquatic Resource Alteration Permit (ARAP) through TDEC's Division of Water Pollution Control. If it built a sewage system, it would have to apply for a permit from the Division of Ground Water Protection. Since construction of the project would likely cause storm water run-off carrying sediments that impact natural surface water, the developers would have to apply for a National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge permit as well. However, these permits are all limited to the project's water *quality* impacts, and relate only marginally to water *quantity*. (See Appendix C for further description of water-related permits.)

The comprehensive growth plan law does not include water supply planning requirements. The General Assembly instituted a local land-use planning process in 1998 through Public Chapter 1101, which established the requirement that cities and counties develop "comprehensive growth plans." Public Chapter 1101 made no mention of water with the exception of an incentive, through state revolving fund loans for water and sewer systems, for counties and municipalities

[35] Letter from Deputy Governor Justin Wilson to Commissioner Milton Hamilton, August 9, 2001.
[36] Regulating underground injection wells for waste disposal is an exception to this statement.

to complete their growth plans.[37] However, the law did specify one of its purposes as establishing a growth policy that "[m]ore closely matches the timing of development and the provision of public services," a statement that implicitly recognizes the need to assess the ability of water and other resources to keep up with growth pressures.[38]

Private land use decisions generally do not reflect the consequences of land use for regional water supplies. In addition to regulation, the state may be able to create or promote incentives for land use and development so that these consequences are considered in individual land use. For example, one county recently considered imposing a flat fee on the development of new homes, a measure that may be used to address population growth issues.[39] Location-specific taxes reflecting the varying costs that developments in different locations impose on a community may be more economically efficient.

As mentioned in the discussion of the Memphis Sand Aquifer, excessive pumping of ground water can affect other users overlying the same aquifer by reducing the amount of water available to them and lowering ground water levels to the point that wells must be deeper to access an adequate supply. Also, many abandoned wells in Tennessee have never been properly capped, creating a conduit through which contaminants from the surface may directly impact the quality and usability of ground water.[40] Natural fractures, fissures, and other pathways also may allow contaminants to impact ground water.

A concern related to land use and ground water is the natural replenishment of ground water sources through the hydrologic cycle. When land is developed, much of it is covered with surfaces that do not allow water to soak slowly into the ground. Houses and other buildings, asphalt streets and parking lots, concrete driveways and patios, and municipal storm sewer systems all result in rainfall flowing quickly over the ground's surface (or through underground sewer lines) where the largest portion is assimilated into surface water and continues to flow away from the area where the rain originally fell. This situation can cause a number of problems with both surface and ground water resources. First, when a significant portion of the rainfall runs over the surface rather than being allowed to soak through the ground, the amount of water that eventually makes its way to ground water may not be enough to maintain adequate water levels to meet users' needs. Second, the process of soaking through the ground allows contaminants to be filtered out by dirt, sand, and other materials, while other contaminants are absorbed and can be beneficial to the vegetation in the area. When rain falls on an impervious surface and flows quickly to other surface waters, however, contaminants such as petroleum products from automobiles, fertilizers and pesticides from agricultural and residential activities, as well as other contaminants are not filtered out and can have a significant impact on surface water quality. Therefore, even if a development does not pump ground water directly from a well or withdraw surface water, its impact on local water resources as well as other users can be significant.

---

[37] *Tennessee Code Annotated,* § 6-58-109(a).
[38] *Tennessee Code Annotated,* § 6-58-102(3).
[39] Tim Adkins, "Development tax may be lowered," *The Ashland City Times*, August 9, 2000, pages 1A, 2A.
[40] This concern was raised repeatedly by TDEC officials and others in discussions of the Water Policy Panel during summer and fall of 2001.

Tennessee presently lacks elements of an effective, comprehensive, long-term water policy. Elements of such a policy include:

- Data Needs and Uses
- Regionalization of Water Policy
- Interagency Coordination
- Interstate and Interbasin Water Management
- Incentives for Efficient Use
- Public Awareness

Data Needs and Uses

Many water-use data sources necessary for formulating water policy are available; however, the data often are based on estimates or self-reporting by individual users, and Tennessee lacks tools for modeling and analyzing the data. Sound decision-making and judgment on the part of policymakers, citizens, developers, and others require complete, detailed, accurate, and comparable data. Maintaining such data and developing regional models with which to analyze the data will facilitate the smooth implementation of a long-term policy.

No policy may be effectively developed and implemented without sufficient information, and data on water demands and supplies are necessary to any water policy or planning process. Many potentially useful data sources already exist, particularly those collected by TDEC's Water Supply Division and the U.S. Geological Survey, as well as the Tennessee Valley Authority and the U.S. Environmental Protection Agency. However, much of the data are estimates, not actual measurements. For example, industrial users self-report water use through a survey conducted by the U.S. Geological Survey every five years. Some reports are based on metered usage while others are simply estimates reported by environmental engineers employed by the companies. Natural Resource Conservation Service district representatives estimate water used for irrigation in their districts based on pump capacities and days of irrigation if they are known, and based on crop type, rainfall, soil type and other factors if pump capacity is not known. The U.S. Geological Survey estimates water use by private wells by taking the average consumption per capita from small public water systems and multiplying that number by the number of people in the state not served by any public water system. Also, the U.S. Geological Survey estimated water use for livestock watering and mining for the 1995 report but will not include this information in the 2000 report (due to be released in late 2001 or early 2002), because the 1995 estimates were difficult to defend.[41]

Lack of more accurate and detailed knowledge of the magnitude of various uses impairs projection of future needs and limits policy responses to present and future situations. An evaluation of the Division of Water Resources in 1982 by the Comptroller's Division of State Audit discusses the impacts of what it considered at that time to be an unreliable survey of well drillers, writing: "Without an accurate appraisal of water resources, the division may fail to identify potential areas of water shortage." The same conclusion may be applied today to data

[41] Interview with David Draughon, Director, Water Supply Division, Tennessee Department of Environment and Conservation, May 31, 2001; telephone interview with Susan Hutson, Water Use Specialist, U.S. Geological Survey, Southeast Region, July 18, 2001.

that are incomplete or, even if relatively accurate and complete, are not adequately incorporated into the decision making process.[42]

Analysis tools that are based on existing data in digital form, as part of geographic information systems (GIS), would facilitate local planning and regional policy making. While data currently exist to describe water demands, water flows, total available supplies, and population growth, TDEC should continually analyze how these factors combine to create water stress conditions. In addition to regional representation of data through GIS databases and mapping, an integrated system for analyzing current and future water supply and demand is essential to implementing a long-term, regional planning process. Such an integrated model might include information on quantity and quality of water sources, locations of various types of developments and activities (industrial, agricultural, residential, commercial), population growth rates, and the ability to estimate impacts of any proposed withdrawals, return flows, and development on existing and future (projected) water supplies. This may require aggregating some data sources and disaggregating others so that all relevant data sources would be at comparable units of analysis.

An inter-agency water supply data clearinghouse would facilitate the gathering and compilation of reliable water supply data and would enhance TDEC's policy making capacity. It would also help determine remaining data needs and suggest the appropriate means of gathering such data, establish standards for data format and reliability, and provide customized data to agencies and researchers examining water supply issues. The clearinghouse could be established within TDEC or a state university, for example. Its activities could be governed by a board or council composed of representatives of various stakeholders, regulators, and other entities that gather and use water data.

A University of Tennessee Energy, Environment and Resources Center report to TDEC echoes this conclusion. It found that a number of tools, both existing and to be developed, "could be utilized to better protect Tennessee water resources." Expanding on this finding, the report suggested: "These tools include a clearinghouse for water supply data that would include a compendium of information on water withdrawals by major users, withdrawal capacity, and return flow. Such a clearinghouse should identify who owns the data, why it is collected, and the criteria used for its assessment."[43]

Regionalization of Water Policy

Tennessee's current approach to water use and development is fragmented. Regionally focused water- and land-use policies would be more efficient and effective. Presently, most water supply planning is done at an even smaller scale than the city or county level, with multiple utility districts and water systems planning, investing, and growing without regard for the goals and conditions of neighboring political entities or broader regional constraints. TDEC has the statutory responsibility to propose such regional planning with regard to water, but clearly a broader set of development issues must be addressed to effectively implement such a proposal.

---

[42] *Program Evaluation on the Department of Conservation*, Comptroller of the Treasury, Division of State Audit, 1982, p. 22.

[43] David Lewis Feldman and Julia O. Elmendorf, *Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for Long-Term Planning* (Knoxville, TN: Energy, Environment and Resources Center, 2000), 72.

TDEC views "regionalization" of water policy as a key step to effective planning and implementation of the state's water policy. This means viewing water supply and demand from a broader perspective. A regional policy approach would promote local policies and practices that recognize that the supply and demand for water by water districts, cities, counties, and other political entities are interconnected.

Implementing a "regionalization" policy approach might be accomplished with mandates, with incentives, or with services that facilitate water suppliers' voluntary compliance with the state's policy goals. Mandates may include requiring long-term water supply and demand impact analyses before beginning any annexation or obtaining local and state building approval. Some existing regional or state-level regulatory structure may be used to implement such a mandate.

Alternatively, new regulatory structures may be useful. For example, state law gives the director of the Water Resources Division of TDEC the power and responsibility to define and propose water control districts based on that director's findings concerning the state's current and future use.[44] Water basin boundaries are one example of a geographic division along which some state or regional authority might operate and initiate an approval process for any development that significantly impacts water supplies. The Comptroller's 1993 report, *Special Report: Utility Districts in Tennessee*, also suggested the possibility of organizing regional water authorities along the lines of development districts or the Department of Economic and Community Development's planning regions. In pursuing such an option, Tennessee may use other states' experiences as models. For example, Florida's five water management districts, over which the Department of Environmental Protection has supervisory authority, are responsible for permitting as well as other planning and regulatory activities within their boundaries.[45]

The General Assembly may have implicitly recognized the challenge that numerous and fragmented utility districts pose to regional planning when it created the Utility District Revitalization Fund.[46] The statute's stated intent is to help financially distressed utility districts consolidate, but such consolidation could also help to implement a regionalization policy. The Comptroller also addressed this issue in its 1993 report. That report pointed to the absence of funding for the Utility District Revitalization Fund and suggested that the General Assembly consider appropriating the necessary state dollars and expanding access to that fund to all utility districts wishing to consolidate.

New governance structures and regional policies for water use and development are key components of regional water planning. Recent regionalization efforts by TDEC focus primarily on utility district consolidation. The TDEC web site defines "regionalization" as "the sharing of water sources and infrastructure to address future water supply needs."[47] Although utility district consolidation is one component of a regional water policy, a comprehensive and effective regionalization policy must combine water sharing and utility district consolidation measures

---

[44] *Tennessee Code Annotated*, 69-8-103(3).
[45] Office of Program Policy Analysis and Government Accountability, *Review of the Economic Components of State Water Policy*, Report No. 96-82, April, 1997, 2.
[46] *Tennessee Code Annotated*, § 7-82-704.
[47] Tennessee Department of Environment and Conservation, http://www.state.tn.us/environment/news/release/jul98/cumbwtr.htm (accessed February 13, 2002).

with broader regional planning strategies, such as regional water authorities based on natural rather than political boundaries.

Interagency Coordination

Different gubernatorial administrations have orchestrated water-related activities among state agencies to varying degrees. For example, Governor Sundquist transferred the State Planning Office's water-related functions to a new TDEC Policy Office in March 1995.[48] However, in law or rule Tennessee has no system of institutional arrangements among its agencies or with other levels of government to help facilitate a consistent long-term water policy. A major consideration for policy makers when developing a regional approach is the ability to coordinate and link various state government functions that affect water resources. Economic development, agriculture, tourism, environmental protection, and other activities that impact land and other natural resource uses also impact water availability.

Under the reasonable use doctrine, water use and allocation conflicts are decided by the judicial system, after harm has been done and parties take legal action. The state may help avoid costly litigation by implementing more formal processes for siting new developments, permitting withdrawals, collecting and sharing data, and receiving public input. Policy makers may look at these and other mechanisms that examine the impacts of new withdrawals before water is actually removed from the natural hydrologic cycle, rather than relying on the judicial system to resolve conflicts after damage has been done.

Interstate and Interbasin Water Management

Conflicts over shared water resources appear increasingly likely unless Tennessee and its neighbors take additional steps to prevent them. Current law remains largely untested with regard to interstate conflicts. Interstate compacts or other agreements that require information sharing and monitoring, allocation of water supplies, and linkages to land use, population growth and other non-water issues constitute one method of addressing such issues before conflicts or litigation arise.

Long-term, regional water policy and planning must also recognize that water resources do not adhere to political boundaries. The Cumberland, Tennessee, and Mississippi river systems and the Memphis Sand Aquifer are the major examples of surface water and ground water resources shared by Tennessee and its neighbors. With regard to the latter, the Sundquist Administration participated in the creation of the Mississippi, Arkansas, and Tennessee Regional Aquifer Study (MATRAS) to assess tri-state water use and aquifer sustainability.[49] The Interbasin Water Transfer Act of 2000 was an important step in defining a water policy along natural boundaries (i.e., basins) and therefore beyond political boundaries. However, numerous issues in addition to water transfers have interbasin and interstate dimensions, and Tennessee's water policies should include cooperation with its neighbors and other riparian states sharing its water resources. For

[48] Public Chapter 501 of 1995; Memorandum from Governor Don Sundquist to Commissioner Don Dills, March 13, 1995. Public Chapter 501, signed into law in June 1995, abolished the State Planning Office.
[49] Tennessee Department of Environment and Conservation, "Report from Multi-State Water Supply Research Project," http://www.state.tn.us/environment/epo/hotlist.htm#WaterResearch (accessed February 13, 2002).

example, Tennessee is a signatory state to the Ohio River Valley Water Sanitation Compact (1995), which focuses on future pollution control and current pollution abatement in the Ohio River drainage basin.

Two other regional water compacts may offer some guidance as to the various issues Tennessee and its neighbors may consider in future water supply compacts. The Apalachicola-Chattahoochee-Flint River Basin Compact (1997) is an agreement among Alabama, Florida, and Georgia, and the Alabama-Coosa-Tallapoosa River Basin Compact (1997) is between Alabama and Georgia. Both of these compacts focus on water supply. Each compact includes information sharing and monitoring components; however, they do not address issues such as arrangements for dividing water supplies among the states or explicit linkages to non-water issues.[50]

Incentives for Efficient Use

Financial incentives may promote efficient water use. Rather than using direct mandates, legislative or regulatory stipulations, policy makers may influence water use through the "market" by creating or enhancing incentives for efficient use. These incentives may be created through taxes, subsidies, increasing block-rate pricing, or other mechanisms. The economic rationale for doing so is that individual users, whether firms or households, generally do not consider the impacts their private behavior has on the broader society and environment. As an example of one of these incentives, legislators might levy a tax or fee on water use based on users' impacts on others.

Block-rate pricing is used by many utilities, generally to discourage consumption at high levels or to garner additional revenue from those with high consumption levels and inelastic demand for the service. This approach simply raises the rate per unit that customers pay above a given consumption level. For example, Tennessee American Water Company charges Chattanooga residential water customers $0.149 per cubic foot for the first 400 cubic feet of consumption, then $2.436 per cubic foot for the next 6,100 cubic feet, and then the rates per cubic foot drop again for higher levels of consumption. The first two "blocks" of consumption (400 and 6,100 cubic feet, respectively) constitute increasing block rates, while subsequently higher "blocks" of consumption are a decreasing block rate pricing system. For those consumers using only a few hundred cubic feet per month, the higher rates may be a disincentive to increase consumption, and for those using 500 or 600 cubic feet, the lower rate at lower consumption levels may be an incentive to reduce consumption.

The state might require more "blocks" and/or higher rates of increase among those blocks as an incentive to conserve water. These rates might be higher or increase faster in areas or periods of greater scarcity. Such a system could be imposed through the permitting process, in which a permit for withdrawals is tied to a pricing structure, or it might be imposed through a system of water taxes that mimic block-rate pricing.

Implicitly, this type of approach also tends to favor willingness (or ability) to pay, and results in allocation of water to the highest valued (by the "market") uses first. As price rises, the market

[50] These and other interstate water compacts are available at the Transboundary Freshwater Dispute Database, housed at Oregon State University, and found at the following web site: http://terra.geo.orst.edu/users/tfdd/.

will allocate water to those uses or users for which the marginal value is highest and for which the elasticity of demand (i.e., ability to substitute or reduce consumption) is the lowest.

Public Awareness

The public often does not understand how individual actions may affect other water users. Passing laws and implementing policies that create incentives or regulate water use or related activities, particularly when quantity restrictions or cost increases are involved, require a public that understands the context in which the policies are made. In particular, citizens must be aware that their actions affect others by reducing water availability, degrading water quality, and limiting the capacity for further growth in a region. Creating public awareness is a process that requires coordinated efforts through educational institutions and media outlets. However, experience from other states suggests that chronic crisis (i.e., drought) conditions are often crucial to effectively communicate the need for individual behavior changes and potentially costly or restrictive policies.

The University of Tennessee Energy, Environment and Resources Center report to TDEC recommended a "state-sponsored water conservation program at the K-12 level, as well as one for adults."[51] TDEC has used media outlets, particularly newspapers, to build public awareness of water supply problems, both intrastate and interstate. TDEC's web site also publicizes water supply issues.[52]

[51] David Lewis Feldman and Julia O. Elmendorf, *Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for Long-Term Planning* (Knoxville, TN: Energy, Environment and Resources Center, 2000), 72.
[52] http://www.state.tn.us/environment/water.htm (accessed February 8, 2002).

Recommendations

Legislative Recommendations

The General Assembly may wish to provide a statutory framework within which the Department of Environment and Conservation may regulate the impacts of land use and development on water supplies. Such a framework may include

- a long-term water supply planning component in the comprehensive growth plan statute (TCA § 6-58-101, *et seq.*);
- broader water use registration and permitting authority;
- authority to create incentives for appropriate and responsible land use.

The General Assembly may wish to appropriate funds to the Utility District Revitalization Fund (TCA § 7-82-704) or to develop some other mechanism to promote broader regional water supply planning.

The General Assembly may wish to amend the Water Resources Act (TCA § 69-8-101, *et seq.*) to include rule-making authority for the Division of Water Resources such as registration, permitting, fees, and civil penalties sufficient to deter violations, and to provide a fiscal means for that Division to carry out its statutory responsibility for collecting and analyzing water-use data necessary to formulate water policy.

The General Assembly may wish to enact fees, taxes, subsidies, pricing structures, or other tools that provide incentives to use water efficiently. Such tools would encourage consideration of the needs of and impacts on other users, as well as the environmental impacts of private activities. Similar tools may also be applied to other related activities, such as land development. Action on the part of the General Assembly may include authorization for TDEC to implement such measures.

Administrative Recommendations

The Department of Environment and Conservation should seek the necessary funding and implement the provisions of the Water Resources Act (TCA § 69-8-101, *et seq.*). Three provisions of that act of particular value to a long-term water policy are:

- establishing, maintaining, and publishing an accurate inventory of the state's water resources;
- determining, maintaining, and establishing estimates of existing and future water use in the state; and
- defining and proposing water control districts in the state and making engineering plans and surveys for improving the quantity of the water supply in these districts.

The Department of Environment and Conservation should develop formal institutional arrangements in rule or law among state agencies to facilitate a consistent, long-term water policy. Placing such arrangements in rule or law would help ensure that they remain in effect from one administration to the next. Such arrangements may be contained in memoranda of understanding, strategic plans, contractual agreements, or other established mechanisms. These

would explicitly define each agency's role in information sharing, economic and environmental impact assessment, and planning for future growth.

The Department of Environment and Conservation should continue use of available media and use educational outlets to heighten public awareness of water supply issues. Such efforts are expected to result in greater public understanding of how individual or community water use affects the resource and other users.

The Department of Environment and Conservation should seek the necessary funding and develop a database and data analysis tools on which water and development policy decisions may be based. These may include:

- improvements in monitoring and data collection and a set of standards by which various data sources would be compatible with each other;
- analysis tools based on existing data in digital form, as part of geographic information systems (GIS);
- an interagency water supply data clearinghouse to facilitate the gathering and compilation of reliable water supply data.

The Department of Environment and Conservation should develop a regional approach to managing the state's water resources, such as creation of regional water authorities defined along natural as opposed to political boundaries. Although the Department of Environment and Conservation has encouraged utility district consolidation and local government cooperation, a regional water policy may include a broader set of planning and enforcement tools through such structures as regional water authorities or water control districts.

The Department of Environment and Conservation should investigate and propose a comprehensive approach to land and water use. Possible tools that may be used to implement such an expanded policy include:

- *Broader water use registration and more comprehensive permitting:* These may assist in assessing existing practices, and such enhancements may link water use registration and permits to such factors as geographic location, season, particular uses, and environmental conditions, depending on the particular factors contributing to water stress.
- *Expanded statutory and regulatory requirements:* These may be used to explicitly link land use planning and water use planning.
- *Financial incentives within communities or between state and local governments:* For example, development fees or shared taxes.

The Governor and the Commissioner of Environment and Conservation should continue to evaluate the need for additional interstate compacts or other agreements to protect Tennessee's shared water resources. Such arrangements may include information sharing and monitoring, allocation of water supplies, and linkages to land use, population growth, and other non-water issues.

Appendices

Appendix A: Useful References

-----. *Program Evaluation on the Department of Conservation* (Nashville, TN: Comptroller of the Treasury, Division of State Audit, 1982).

-----. *Program Evaluation on the River Basin Agencies and Authorities* (Nashville, TN: Comptroller of the Treasury, Division of State Audit, 1983).

Detch, Ethel R., and Scarlett J. Weakley. *Special Report: Planning and Service Delivery in Tennessee* (Nashville, TN: Comptroller of the Treasury, Office of Local Government, 1991).

Feldman, David Lewis, and Julia O. Elmendorf. *Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for Long-Term Planning* (Knoxville, TN: University of Tennessee, Energy, Environment and Resources Center, 2000).

Feldman, David Lewis, and Ruth Anne Hanahan. *Southeast Water Resources: Management and Supply Issues Symposium Report* (Knoxville, TN: University of Tennessee, Energy, Environment and Resources Center and Water Resources Research Center, 1999).

Feldman, David Lewis, and Ruth Anne Hanahan. *Southeast Water Supply Roundtable Report* (Knoxville, TN: Energy, Environment and Resources Center and Water Resources Research Center, 1999).

Jones, Jack D., Vincent A. Sikora, and Jane Woodward. *Study of Tennessee Water Resources Law: Legal Considerations for Effective Water Management under Conditions of Shortage*. Tennessee Water Resources Research Center, Research Report No. 97 (Knoxville, TN: University of Tennessee, Water Resources Research Center, 1983).

Kundell, James E., and Diana Tetens. *Whose Water Is It?: Major Water Allocation Issues Facing Georgia*. Carl Vinson Institute of Government, Public Policy Research Series (Athens, GA: University of Georgia, Carl Vinson Institute of Government, 1998).

Sellers, Frith Karin, and Ethel R. Detch. *Special Report: Utility Districts in Tennessee* (Nashville, TN: Comptroller of the Treasury, Office of Local Government, 1993).

Sikora, Vincent A. *Public Water Supplies: The Effect of Federal and Tennessee Water Resource Law*. Water Resources Research Center, Research Report No. 72 (Knoxville, TN: University of Tennessee, Water Resources Research Center, 1979).

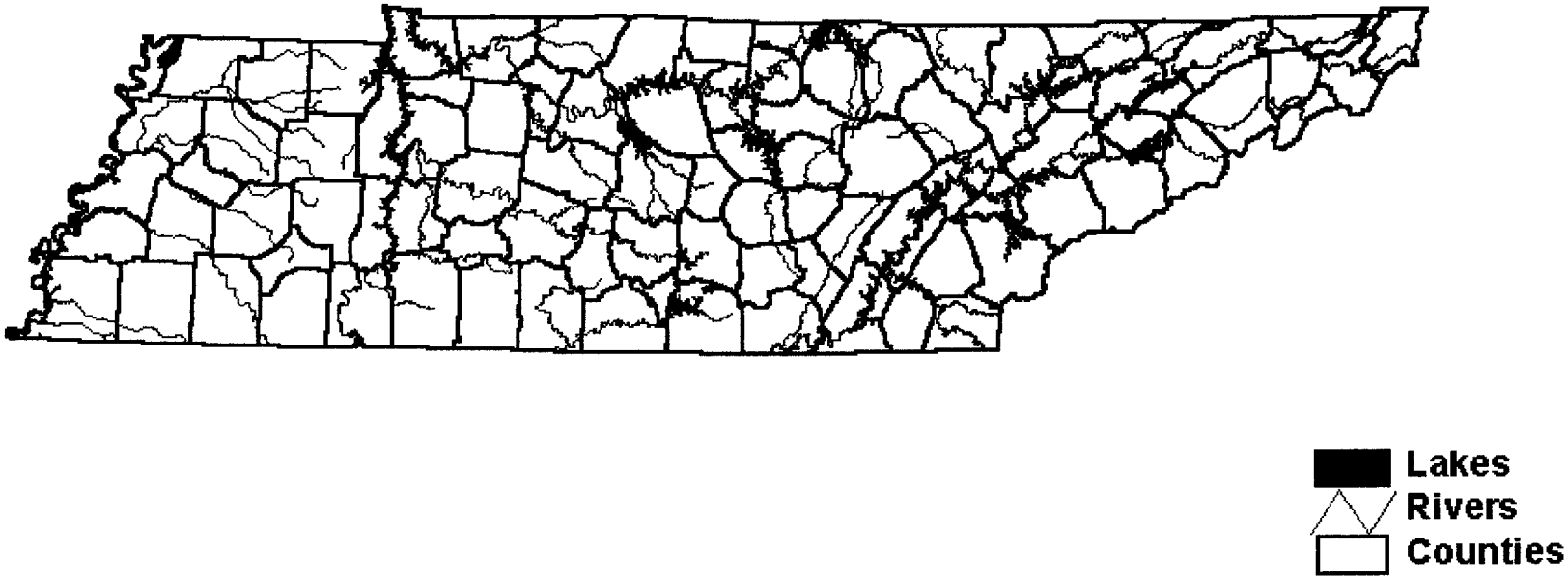
Thackston, Edward L., Frank L. Parker, Michael S. Minor, William S. Goodwin, and James D. Bowen. *Water Policy in Tennessee: Issues and Alternatives*. Water Resources Research

Center, Research Report No. 94 (Knoxville, TN: University of Tennessee, Water Resources Research Center, 1983).

Transboundary Freshwater Dispute Database. Oregon State University. http://terra.geo.orst.edu/users/tfdd/.

Appendix B: Maps

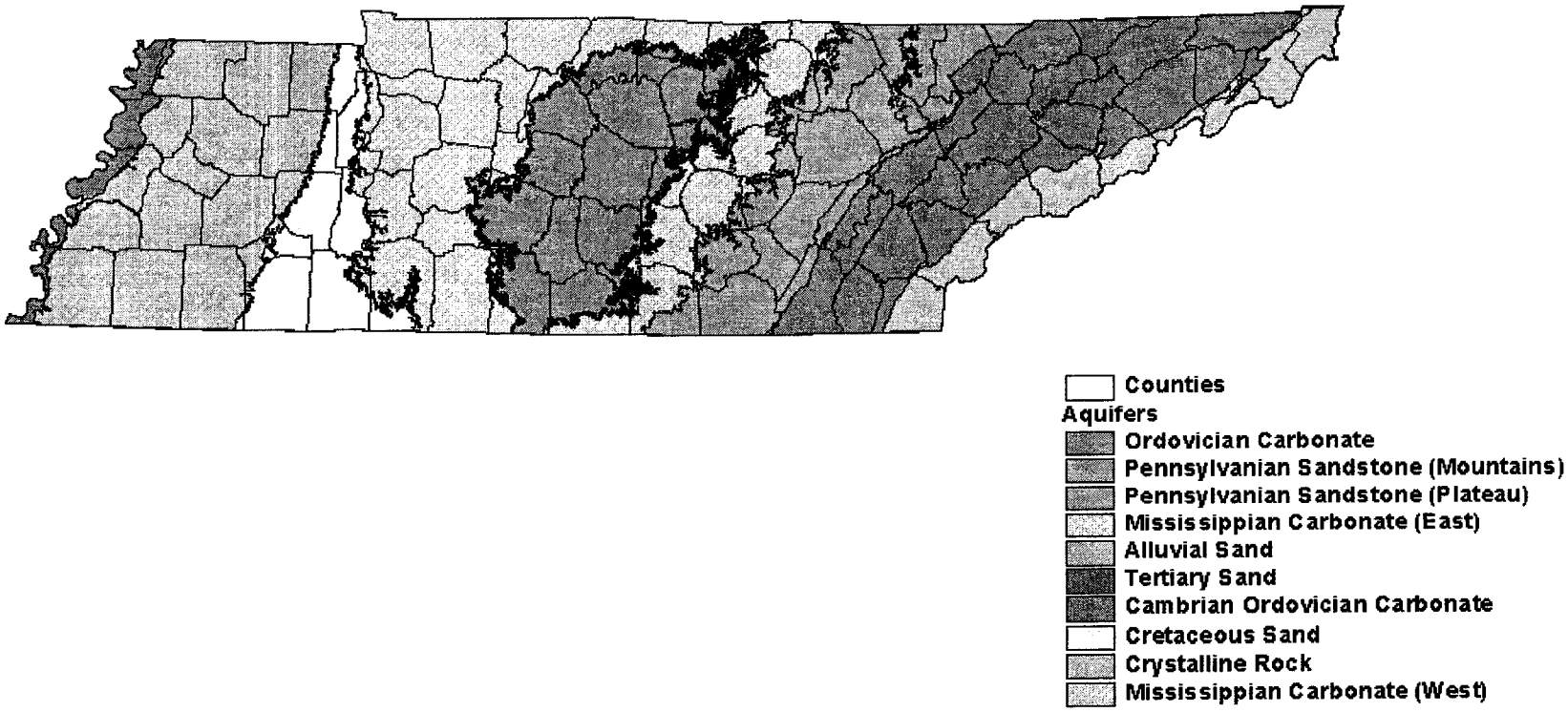
Map 1: Surface Water Resources – Lakes and Rivers



Source: Tennessee Department of Environment and Conservation, Division of Water Supply, Ground Water Management Section.

Appendix B: Maps (cont.)

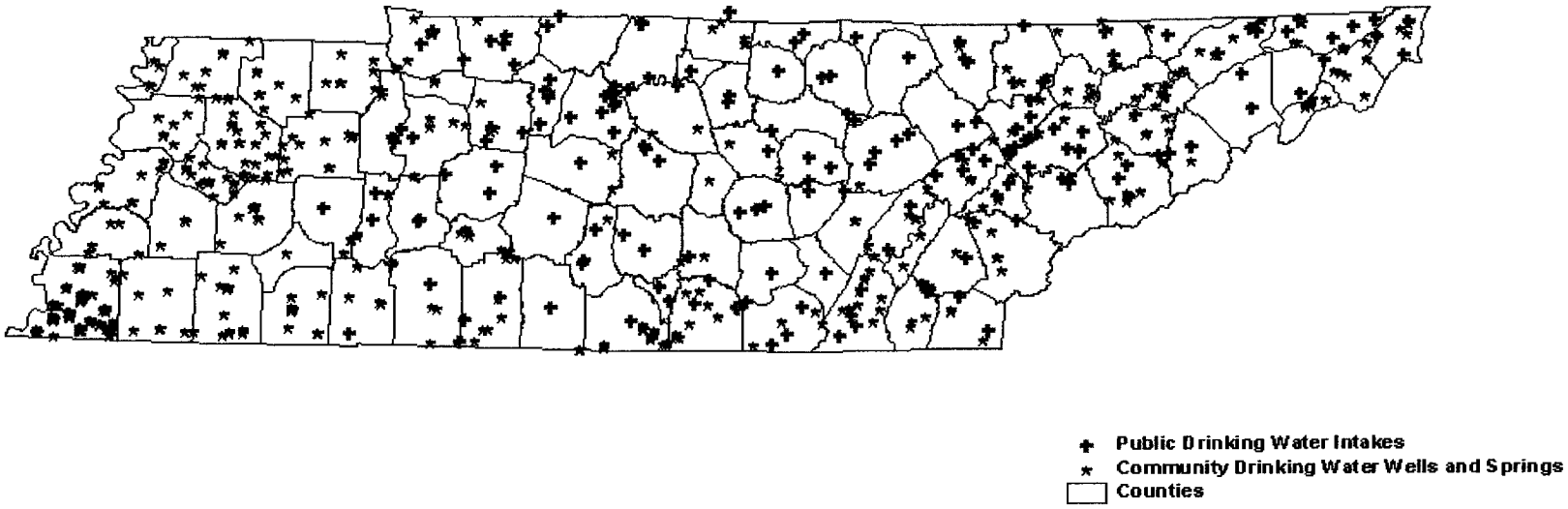
Map 2: Ground Water Resources – Aquifers



Source: Tennessee Department of Environment and Conservation, Division of Water Supply, Ground Water Management Section.

Appendix B: Maps (cont.)

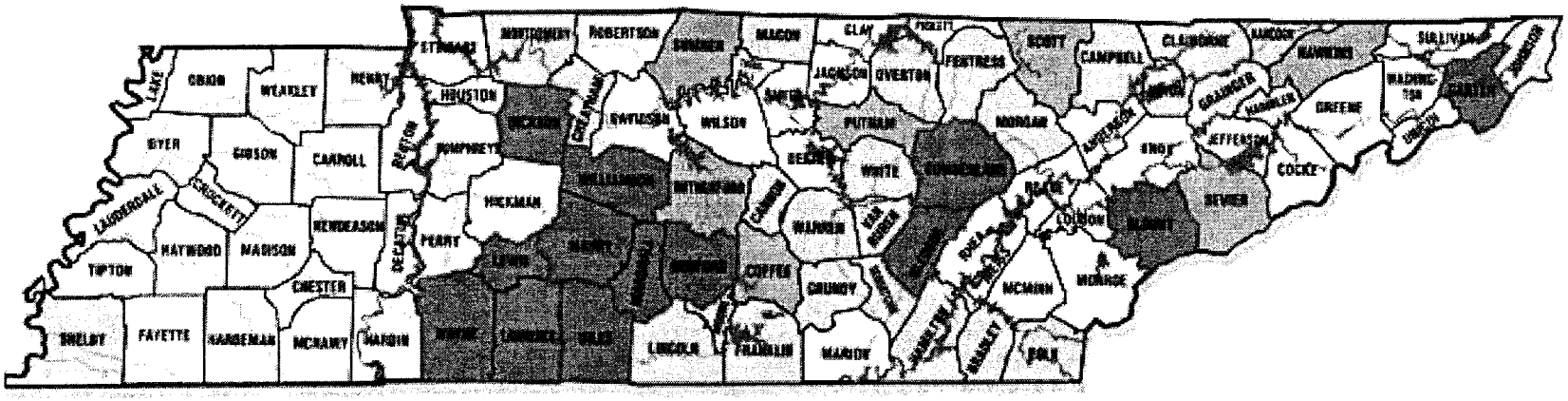
Map 3: Public Water System Wells, Springs, and Intakes



Source: Tennessee Department of Environment and Conservation, Division of Water Supply, Ground Water Management Section.

Appendix B: Maps (cont.)

Map 4: Counties with Potential Water Supply Shortages or Conflicts



Counties with emerging water conflicts and/or shortages

Counties with priority need for additional water supply

Water supply studies or regionalization already underway

Source: Tennessee Department of Environment and Conservation, Environmental Policy Office.

Appendix C: Water-Related Permit Requirements in Tennessee

WORK IN OR NEAR WATER

If you will	You may need this permit/license
Divert, obstruct or change the natural flow or bed of any waters of the state (e.g. debris removal, bank stabilization or culverting)	WPC Aquatic Resources Alteration Permit (ARAP)
Construct within navigable waters	WPC Aquatic Resources Alteration Permit (ARAP)
Dredge or place fill into waters of the state and/or wetlands	WPC Aquatic Resources Alteration Permit (ARAP)
Cultivate food fish, shellfish or other aquatic animals	WPC Aquatic Resources Alteration Permit (ARAP)
Perform a dye trace study in streams or ground water systems of the state	DWS Dye Trace Registration

WATER USE

If you will	You may need this permit/license
Transfer water out of one major river basin and into another	Interbasin Transfer Permit
Withdraw ground water in excess of 50,000 gallons per day	DWS notification WPC Aquatic Resources Alteration Permit (ARAP)
Divert surface water	WPC Aquatic Resources Alteration Permit (ARAP)
Construct a barrier across a stream, channel, or watercourse that will create a reservoir	WPC Aquatic Resources Alteration Permit (ARAP) DWS Certificate of Dam Approval and Safety
Construct, modify, or repair any dam or controlling works for storage of 30 or more acre-feet of water, waste, or mine tailings	DWS Certificate of Dam Approval and Safety
Operate a public water system or bottle and sell spring water	DWS Plans Review and Approval for Public Water Systems DCA Water/Wastewater Operator Certification DWS Wellhead Protection Program Approval WPC General NPDES Permit for Discharge of Filter Backwash and Sedimentation Basin Washwater from Water Treatment Plants
Drill a drinking water well and/or install well pumps or filtration devices.	DWS Well Driller or Installer License

DISCHARGE TO GROUND OR SURFACE WATER

If you will	You may need this permit/license
Discharge wastewater to a publicly owned treatment facility	Coordinate w/WPC Pretreatment program and municipality
Discharge wastewater to surface water	WPC NPDES Permit WPC Non-Stormwater General Permits • for discharges of Hydrostatic Test Water • for Discharges of Stormwater Runoff and Process Wastewater Associated with Reacy Mixed Concrete Facilities • for Discharge of Filter Backwash and Sedimentation Basin Washwater from Water Treatment Plants
Construct a subsurface sewage disposal system	GWP Subsurface Sewage Disposal System Installer Permit

Appendix C: Water-Related Permit Requirements (cont.)

Discharge wastewater into a subsurface system	GWP Septic System Construction Permit [Local program permits in eight counties : Blount, Davidson, Hamilton, Knox, Madison, Sevier, Shelby and Williamson]
Discharge stormwater runoff from an industrial or commercial facility	WPC NPDES General Permit for Industrial Stormwater
Discharge commercial or industrial wastewater into a subsurface system	DWS Underground Injection Control (UIC) Permit
Collect or treat wastewater that does not discharge to any surface or subsurface waters	WPC State Operating Permit
Remove and/or dispose of domestic septage from septic tanks, holding tanks, portable toilets, etc.	GWP Septic Tank Pumping Contractor GWP Domestic Septage Disposal Site Permit
Operate a Concentrated Animal Feeding Operation (CAFO)	WPC Class II CAFO General Permit WPC NPDES Discharge Permit (for Class I operations)
Discharge hydrostatic test water to the waters of Tennessee	WPC General NPDES Permit for Discharges of Hydrostatic Test Water
Operate a ready mix concrete facility with discharges of washwater, stormwater, or a no-discharge recycle system	WPC NPDES Permit for Discharges of Storm Water Runoff and Process Waste Water Associated with Ready Mix Concrete Facilities
Discharge ground water associated with remediation of contaminated ground water at an underground storage tank (UST)	WPC General NPDES Permit for Discharges of Treated Ground water Associated with Underground Storage Tank Remediation
Discharge filter backwash and sedimentation basin washwater from water treatment plants to the waters of Tennessee	General NPDES Permit for Discharges of Filter Backwash and Sedimentation Basin Washwater from Water Treatment Plants

Source: Tennessee Department of Environment and Conservation, Environmental Permits Handbook, www.state.tn.us/environment/permits/whoami.htm.

Appendix D: Relevant chapters of the Tennessee Code Annotated

Comprehensive Growth Planning
Title 6, Chapter 58

Dams
Title 69, Chapter 12

Tennessee-Tombigbee Development Compact
Title 69, Chapter 9

Utility Districts
Title 7, Chapter 82

> Utility Revitalization Fund
> Part 7

Water and Sewage
Title 68, Chapter 221

Water Management
Title 69, Chapter 8

> Water Resources Division; Registration of Withdrawals
> Part 1
>
> Interbasin Water Transfers
> Part 2

Water Pollution Control
Title 69, Chapter 3

Water Wells
Title 69, Chapter 11

Appendix E: People Contacted for This Report*

Columbia Power and Water System
James Clark, General Manager

Energy and Environmental Research Center, University of Tennessee
David Feldman, Senior Research Specialist

Tennessee Association of Utility Districts
Bill Dobbins, Executive Director

Tennessee Department of Agriculture
Mike Countess, Assistant Commissioner (Policy and Legislation)
Stanley Trout, Chief (Marketing Services)

Tennessee Department of Environment and Conservation
Paul Davis, Director (Water Pollution Control)
David Draughon, Director (Water Supply)
Dodd Galbreath, Director (Policy Office)
Robert Hunt, (retired) Director (Water Resources)
Alan Leiserson, General Counsel
Tom Moss, Manager (Ground Water Protection)
Phil Simmons, Environmental Protection Specialist (Water Pollution Control)

Tennessee Valley Authority
Larry Clark, Environmental Engineer

United States Geological Survey
Mike Bradley, Assistant District Chief, Water Resources Division
Susan Hutson, Water Use Specialist, Southeast Region

* Many of the interviews were conducted by Kimberly Douglass, a former research analyst with the Offices of Research and Education Accountability not listed as an author on this report.