Texas Water Resources Institute

Texas Water Resources

Spring 1998 Volume 23 No. 4

What is a TMDL? How Will It Affect You?

TNRCC Embarks on New Strategy to Improve Water Quality

by Ric Jensen, TWRI

Photo Courtesy of Marty Matlock/ TAMU

Marty Matlock of the Texas Agricultural Experiment Station (left) and Frank Aker of the Academy of Natural Sciences gather periphyton samples from the Guadalupe River near Victoria to support a TMDL.

In Texas and elsewhere, a new strategy is being implemented that is dramatically changing how water quality is evaluated and how waters are protected.

The concept is called total maximum daily loads (TMDLs) and is the keystone of recent efforts by the Texas Natural Resource Conservation Commission (TNRCC) and the Texas State Soil and Water Conservation Board (TSSWCB) to assess which watersheds are suffering from water quality problems and how to best correct pollution and restore water quality. The Environmental Protection Agency (EPA) describes the new emphasis on TMDLs as a "defining moment," because it signals a transition from a clean water program based on technological controls to water quality efforts which are implemented on a watershed basis.

This issue of *Texas Water Resources* will provide an overview of the TDML process and how it is being implemented in Texas as well as a discussion of how effluent trading and other "market driven" approaches can be used to improve the environment. The last issue of *Texas Water Resources* (March 1998) discussed market strategies that have been successfully applied to combat air pollution in Texas.

Background Information

The importance of TMDLs can be traced to the Clean Water Act (CWA), which requires that loading estimates be developed for watersheds where water quality is not high enough to meet designated uses. For example, a TDML may have to be developed for a stream segment designated for contact recreation, but exhibits large numbers of fecal coliform bacteria.

Why have TMDLs recently become such an important issue? One reason is that EPA is emphasizing this process as a way to improve water quality on a watershed basis. Another factor is that environmental groups, as well as others who want to improve water quality, have filed lawsuits against the EPA in 25 states where the TMDL process has not been implemented. They charged that EPA has neglected its duty to comply with the CWA in these states.

Just what is a TMDL? In simple terms, a TMDL is an estimate of the maximum amount of a specific pollutant a body of water can receive and still meet water quality standards for a designated use. Typically, TMDLs are established for individual pollutants within specific watersheds. Following preliminary assessments and data analyses, one or more specific pollutants are identified. For example, a goal of a TMDL could be to assess how much phosphorus is flowing into and through a watershed, identifying and quantifying the various point and non-point sources that are contributing to the problem, and developing management practices that will reduce the level of that pollutant. Even though a TMDL has been developed for one contaminant, it does not necessarily mean that all the water quality problems in that watershed have been corrected or that the TMDL process has been completed. It may well be that TMDLs have to be created and implemented for different water quality problems in the watershed. As a result of the TMDL process, a wide variety of programs can be utilized to achieve goals to reduce non-point source pollutants. Point sources will be required to achieve pollution reduction targets through the National Pollutant Discharge Elimination System process.

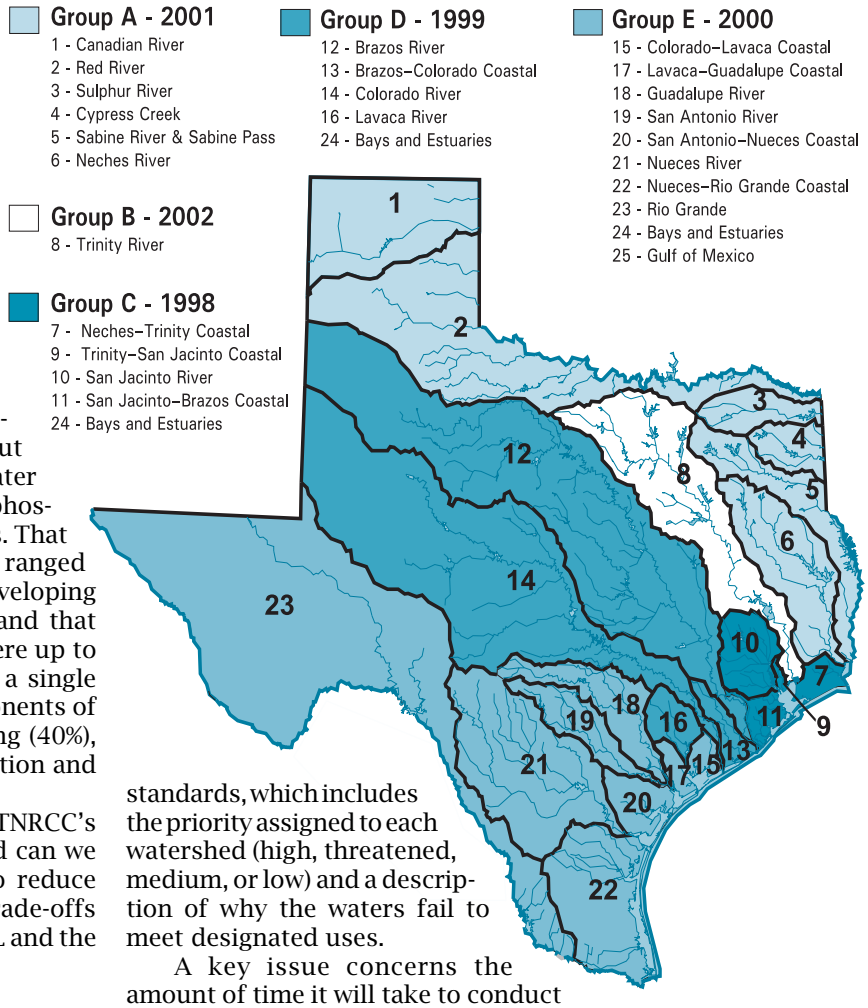
The complexity and cost of developing TMDLs will vary within each watershed, but will be influenced by such factors as the geographic area being studied, the number and complexity of pollutants, the distribution of pollution sources, and the extent to which the public becomes involved in and supports the process.

Historically, the TMDL process has utilized water quality models to develop the maximum amount of a pollutant that can be discharged to a stream over a given time period until the use of those water supplies for specific purposes is impaired. Now, the concept of TMDLs is broadening to suggest that the process should include a comprehensive assessment of water quality problems, resulting in the creation of a plan that can be implemented to reduce pollution and restore and protect

water quality. The TNRCC and the TSSWCB hope that TMDLs will become a tool the agencies can use to make key decisions about how water quality can be improved in waters that do not meet their designated uses – known as the CWA Section 303(d) list.

How much does it cost to develop a TMDL? Because few TMDLs have been completed in Texas, historical comparisons are difficult. A TMDL analysis conducted for the Houston Ship Channel cost roughly $240,000 and took four years to complete. Recently, many federal, state, and regional agencies combined their resources and assembled roughly $500,000 to conduct a TMDL study and develop a watershed action plan for the Arroyo Colorado watershed in South Texas. A recent EPA study (1996) evaluated the cost of 14 TMDL determinations throughout the United States (none in Texas) to examine water quality problems associated with nitrogen, ammonia, phosphorus, oxygen demands, and total suspended solids. That study reports that the cost of determining TMDLs ranged from $4,000 to $1.02 million, that the expense of developing a TMDL increases with the size of the watershed, and that TMDLs which addressed more than one pollutant were up to 10 times as costly as those which focused only on a single contaminant. On average, the most expensive components of the TMDL process are data collection and monitoring (40%), modeling (32%), data analyses (16%), and administration and public participation (both 6%).

"We have to address," says Mel Vargas of the TNRCC's TMDL team, "what level of certainty do we need and can we afford to conduct the in-depth studies we need to reduce uncertainty. Ultimately, we may have to make trade-offs between how much we can afford to spend on a TMDL and the complexity of studies that need to be conducted."



Texas' TMDL Program

How many watersheds in Texas need TMDL assessments? A 1997 TNRCC report suggests that 142 of Texas' 368 classified stream segments have water quality problems that may need to be addressed through the TMDL process. In comparison, Montana recently learned it may have to conduct TMDLs for more than 800 watersheds, while Michigan needs to carry out only 34 TMDL assessments.

In Texas, some of the major water quality problems that result in streams not being able to meet designated uses include fecal coliform (an issue in 41% of impaired watersheds), low dissolved oxygen levels (24%), metals (25%), organic chemicals (21%), and dissolved solids (12%). In most cases, contaminants limited the ability of these waters to meet aquatic life criteria, but the fecal coliform problems also affected such designated uses as recreation and shellfish harvesting. TNRCC has suggested that much of the fecal coliform problem may be resulting from errors in either the sampling method being used or the regulatory standard. Of the Texas watersheds with water quality problems, 44% were affected only by non-point pollutants, 30% were impaired from a mix of point and non-point concerns, and 26% were influenced only by point sources. TNRCC has published a listing of waters that do not meet Texas surface water quality standards, which includes the priority assigned to each watershed (high, threatened, medium, or low) and a description of why the waters fail to meet designated uses.

A key issue concerns the amount of time it will take to conduct TMDL studies throughout Texas. In 1997, TNRCC Chairman Barry McBee announced the initiation of a "TMDLs in 10" program. The goal is to conduct TMDL assessments in all 142 watersheds where water quality problems are present by 2007.

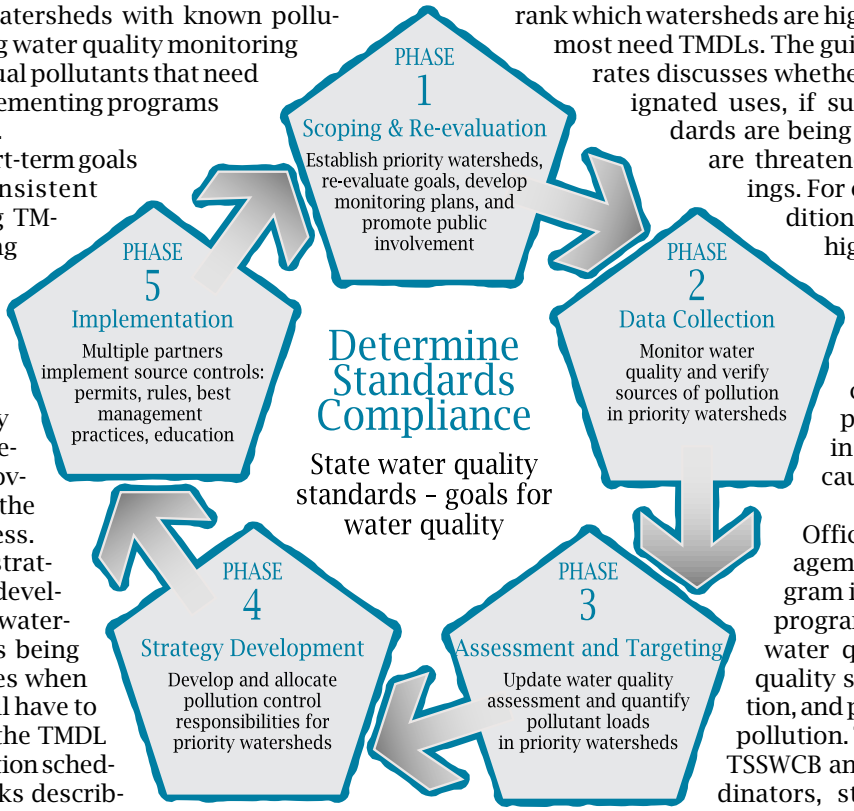
So far, the TNRCC has taken steps to begin the TMDL process in a few watersheds, including the Houston Ship Channel, the Bosque River, the Arroyo Colorado in South Texas, the Cypress Creek region of Northeast Texas, Spence Reservoir in West Texas, and Salado Creek near San Antonio. Efforts to develop a TMDL for nickel levels in the Houston Ship Channel were begun in 1991. The process included extensive sampling and the use of computer simulation models to identify sources of nickel loads and to determine how nickel was partitioned throughout the watershed. The work was a joint effort between TNRCC, the City of Houston, local industries, and the Geochemical and Environmental Research Laboratory at Texas A&M University (TAMU), which performed much of the lab work. A draft TMDL has been developed which will be used to set limits on the amount of nickel that can be discharged in the region. Soon, similar initiatives can be expected in many other watersheds.

The TNRCC is planning to coordinate a number of its internal programs and increase cooperation with TSSWCB and other partners to support the TMDL process. Activities include

selecting high priority watersheds with known pollution problems, developing water quality monitoring plans, identifying individual pollutants that need to be controlled, and implementing programs to improve water quality.

Some of TNRCC's short-term goals include developing consistent methods for establishing TMDLs, better accommodating local and regional geographic differences, identifying cost-effective solutions to water quality problems, increasing the scientific validity of water resources management decisions, and improving public participation in the water management process.

Part of the TNRCC strategy is that TMDLs will be developed on a river basin and watershed basis. A schedule is being developed that establishes when individual river basins will have to perform components of the TMDL process. This implementation schedule sets yearly benchmarks describing when river basins should be conducting scoping activities, data collection, baseline monitoring, assessment and targeting, strategy development and implementation.



How will TNRCC suggest that TMDLs be developed? Basically, there are five steps. First, priority issues are identified and plans for data collection are developed. Then, baseline data are collected and studies that focus on specific problem areas are conducted or reviewed. An EPA manual (1997) describes many of the scientific methods and principles that have been successfully used to develop TMDLs. Third, based on the data that has been collected and the use of computer models and geographic information systems, individual watersheds are assessed to quantify the impacts and sources of pollution and to compare the need for TMDLs in specific areas. Fourth, management strategies that may reduce pollutants are evaluated and watershed action plans are developed. A watershed action plan assesses water quality problems and pollutant sources and includes a strategy to implement efforts to restore and protect water bodies. TNRCC and TSSWCB plan to use "targeting" activities to determine which management efforts should be included in TMDLs. Targeting consists of determining the scale of the problem, quantifying the severity of the contamination and the risk it poses, evaluating actions that could be taken to improve water quality, identifying key stakeholders, inventorying resources to attack the problem, and determining how feasible it may be to implement specific strategies. The action plans are submitted to EPA for federal approval and, if approved, are implemented. Once a TMDL is approved, stream segments can be removed from the CWA 303(d) list.

TNRCC (1998) established guidelines that can be used to rank which watersheds are high priority candidates that most need TMDLs. The guidance document incorporates discusses whether waters are meeting designated uses, if surface water quality standards are being met, and whether waters are threatened, to generate the rankings. For example, some of the conditions which could result in a high priority ranking include threats to drinking water sources, the presence of pathogens in waters which are heavily used for contact recreation, and the presence of contaminants in fish tissue which would cause human health risks.

Many TNRCC units in the Office of Water Resources Management will support this program including the Clean Rivers program and teams in surface water quality monitoring, water quality standards, toxicity evaluation, and point and non-point source pollution. The TNRCC will work with TSSWCB and utilize river basin coordinators, steering committees, and personnel from river authorities to do much of the work involved in the TMDL process.

The Role of Effluent Trading

In regions of the United States, the TDML process is facilitating the use of effluent trading to improve water quality. For example, the use of TMDLs helps identify watersheds and stream segments where improving water quality is a high priority. TMDLs quantify the amount of priority pollutants that enter a watershed and set goals for the improvements in pollution control that are needed. In watersheds where TMDLs have been set, caps can be set on the amount of pollution which can be allowed.

What is effluent trading and how does it work? Many of the principles were outlined in a 1996 draft EPA report and a 1998 EPA policy statement. "EPA strongly promotes the use of effluent trading to achieve water quality objectives and standards. EPA will actively support and promote effluent trading within watersheds to achieve water quality objectives." According to the policy statement, EPA believes that effluent trading is an innovative way for community stakeholders to develop "common sense" solutions to water quality problems.

Effluent trading arrangements can take many different forms. A basic guiding principle is that the total amount that pollutants are reduced through trades must be the same or greater than what would be achieved if no trade had occurred. Transactions typically involve a "buyer" and a "seller." Buyers purchase pollution reductions at a lower cost than the amount they would have to spend to achieve improved water quality themselves. Sellers undertake actions to reduce pollution and improve water quality and are often compensated or finan-

cially rewarded for their efforts.

In areas where effluent trading has been implemented, buyers and sellers can negotiate trades individually or within the context of an organized framework. Third parties can be used to broker such transactions. It should be noted that effluent trades which involve point sources and/or indirect dischargers have to be approved by EPA.

Effluent trading can be an efficient, market-driven approach to meet the goals of the CWA. Typically, effluent trading aims at reducing the amount of pollutants generated in upstream, agricultural, and undeveloped watersheds. One of the appeals of effluent trading is that it provides watershed managers with flexible, innovative, management strategies they can use to improve water quality and the environment. Effluent trades can involve transactions between a point source of pollution (an industry, a wastewater treatment plant or a stormwater outfall) and a non-point source (typically urban areas or agricultural watersheds) or between two non-point sources. Indirect dischargers, those facilities which pretreat the wastewater before sending it to a public wastewater plant, are prime candidates to participate in pollution trading. Other effluent trading scenarios outlined in the EPA report involve transactions between two point sources and intra-plant trading.

In many instances, communities have turned to effluent trading to clean waters that have been identified through the TMDL process as not meeting designated uses. In North Carolina, wastewater plants pay into a state fund that helps farmers implement best management practices (BMPs). By taking part in this program, these facilities achieve water quality goals less expensively than if each plant were upgraded independently. In Florida, cities are considering collecting fees from developers and building a facility that would cost-effectively treat large amounts of stormwater. In Colorado, wastewater treatment plants help fund a project to enhance a riparian zone along a major creek by augmenting streamflows and reducing ammonia loadings. In Maryland, individuals and companies that disturb wetlands pay a fee for mitigation, if it is not feasible to create or restore wetlands. Another situation in which effluent trading may make sense involves creating "water quality improvement shares" which can be distributed to environmental organizations. Those groups can then, in turn, sell the shares to industries which need to acquire pollution credits. The proceeds can then be used to finance stream and habitat restoration projects and improve water quality.

Advocates of effluent trading believe it makes economic sense. Water pollution control measures that can be implemented as a result of trades are often less expensive than "command and control" techniques specified by regulations. As a result, the use of effluent trading may minimize anticipated increases in wastewater and stormwater treatment costs. Making pollution control more affordable may also speed the process by which water quality is improved and make it possible to clean up a greater volume of water.

As a result of effluent trading, developers may be able to add pollutant-generating activities to a watershed (a new factory, for example) without lessening water quality.

TNRCC documents that describe the TMDL process note that effluent trading is being considered as an option to improve water quality, but no policies or guidelines on the matter have yet been developed. Agency staff are concerned about the effectiveness of effluent trading to improve water quality. Some policy questions that TNRCC staff would like to see addressed before effluent trading can be implemented include how permits could be modified as a result of effluent trades, who makes sure that these transactions are implemented, what happens if BMPs that are a component of an effluent trade are ineffective, and who monitors changes in water quality to determine if the effluent trade is working. TNRCC staff note that the experiences of effluent trading to improve water quality are been mixed and problems have arisen in some cases where effluent trades have been implemented.

University Involvement

For many years, scientists at universities throughout Texas have conducted many of the water quality assessments that are needed in the TMDL process. However, because TMDLs were only recently emphasized by the TNRCC and the TSSWCB and since little funding for research has been made available, few studies that specifically address TMDL concerns have begun.

To help university scientists participate in the TMDL effort, TWRI created and is coordinating an effort called "the Watershed Working Group." The working group is led by Marty Matlock of the TAMU Agricultural Engineering Department and brings together participants from many different disciplines including economists, engineers, political scientists, ecologists and agricultural professionals. The working group provides opportunities for scientists to discuss key issues and work with regulatory agencies in developing TMDLs. So far, many research proposals have been developed as a result of the activities of the working group.

In one study, Matlock, Bill Neill of the TAMU Wildlife and Fisheries Sciences Department, John Ellis of the TAMU Agricultural Economics Department, and Keith Keplinger of the Texas Institute for Applied Environmental Research (TIAER) at Tarleton State University are working to develop a "risk-based" approach that could facilitate nutrient trading of non-point pollutants. In this project, the research team hopes to identify, characterize, and quantify the sources of uncertainty which are typically associated with effluent trading. Specific types of uncertainty that will be explored in the project deal with fluctuations in the price and cost of controlling non-point pollution, variations in water quality, effectiveness of best management practices, and enforcement issues. The goal is to develop a framework that can be used to facilitate nutrient trading in "real world" settings.

Matlock and graduate student Larry Demich are also conducting research to assist the TNRCC in the development of TMDLs for the Arroyo Colorado watershed. Matlock and Demich are investigating how point and non-point nutrient loads are influencing oxygen demands in water-

Photo Courtesy of Marty Matlock/ TAMU

TAMU students Kevin Kasprzak, Elizabeth Bryan, and Heather Harris (left to right) gather periphyton samples from the North Bosque River.

sheds in the region. One area of emphasis is to characterize the capabilities of individual watersheds to absorb varying levels of nutrients. Matlock and Demich carried out in-depth studies of a part of the Arroyo Colorado called the Llano Grande near Mercedes, TX. The researchers collected many samples over a short time period, with a goal of better understanding which natural processes are enhancing the environment.

TIAER has also teamed up with Matlock, Larry Hauck of TIAER, the Texas Agricultural Experiment Station (TAES) Blackland Research Center (BRC) in Temple, Baylor University, the Brazos River Authority (BRA), the City of Waco, and the U.S. Department of Agriculture/ Natural Resource Conservation Service to assist in the development of TMDLs for the North Bosque River watershed.

Hauck and other scientists are investigating how present nutrient loadings to rivers and streams impact the aquatic ecosystems in the Bosque River watershed and Lake Waco. The goal is to identify the levels of nutrients that can be generated within key areas of the watershed before ecosystems are adversely affected. As part of these studies, Owen Lind of the Baylor University Biology Department is conducting algal bioassays to define limiting nutrients in Lake Waco.

Ranjan Muttiah of TAES/ BRC is researching issues associated with the amount of data that may be required to study watersheds at different scales. The goal of these projects is to more accurately reflect the geographic features of watersheds by developing digital elevation models and to create modeling frameworks that can more accurately mimic the real world in small scales. Muttiah is also working to link watershed models to different sites along a network of streams using dynamic programming. The goal is to determine the "optimum" rate of pollution for individual stream segments as well as the relative cost of pollution for many stakeholders.

BRA, TIAER, and Camp, Dresser and McKee are also working to help develop measures that may lessen pollutant loadings through broader use of manure composting. These groups recently participated in a meeting of dairy producers, government personnel, and elected officials to discuss the possibility of composting animal wastes in the region. This is part of an overall project involving nutrient assessments and the demonstration of voluntary, incentive-based approaches to better manage nutrients. TIAER serves as the project manager for the nutrient assessments, while Matlock is studying periphyton levels in streams throughout the watershed. Composting operations may have the potential to lessen nutrient loadings in the watershed.

Summary

Certainly, the attention focused on the TMDL process signals a significant change in how the TNRCC manages water quality. It should not be forgotten that the TMDL process will be time-consuming, expensive, and controversial. In the end, however, TMDLs will result in the creation of locally determined watershed-based strategies that may improve water quality and help stream segments meet their designated uses. Finally, many experts suggest that the use of market-based strategies, especially effluent trading, may represent a cost-effective strategy to achieve water quality goals.

For More Information

Arrandale, Tom, "Dirty Water in Paradise," *Governing*, April 1998.

Clean Water for Texas — Solving Water Quality Problems (GI-229A), TNRCC, August 1997. WWW address — http://www.tnrcc.state.tx.us/admin/topdoc/gi/229

Compendium of Tools for Watershed Assessment and TMDL Development (EPA 841-B-97-006), EPA Office of Water, Washington, DC 1997.

Framework for Watershed-Based Trading (*Draft*), EPA 800-R-96-001), EPA Office of Water, Washington, DC, 1996a.

Effluent Trading in Watersheds (Policy Statement), EPA Office of Water, Washington, DC, 1998. WWW address — http://www.epa.gov/OWOW/watershed/tradetbl.html

Guidance for Assigning Priorities for TMDL Development, TNRCC, Austin, TX 1998.

Guideline for Screening and Assessing Texas Surface Water Quality Data, TNRCC, Austin, TX, 1998. WWW address — http://www.tnrcc.state.tx.us/waterquality/data/tmdl.html

New Policies for Establishing and Implementing Total Maximum Daily Loads, EPA Office of Water, Washington, DC, 1997. WWW address — http://www.epa.gov/OWOW/tmdl/ratepace.html

Stephenson, Kurt, and Leonard Shabman, "Effluent Allowance Trading: A New Approach to Watershed Management," *Water Science Reporter*, Virginia Water Resources Research Center, Blacksburg, VA, 1997.

TMDL Development Cost Estimates: Case Studies of 14 TMDLs (EPA-R-96-001), EPA Office of Water, May 1996b.

Texas Surface Water Quality — What Is It, and How Is It Measured?, TNRCC, Austin, TX 1998.

The Statewide Watershed Management Approach for Texas: The TNRCC's Framework for Implementing Water Quality Management (GI-229), TNRCC, Austin, TX, 1997. WWW address — http://www.tnrcc.state.tx.us/admin/topdoc/gi/229

News from TWRI

TWRI helped develop a research project between Guy Fipps of the TAMU Agricultural Engineering Department and the U.S. Bureau of Reclamation Austin, TX office. In this project, Fipps and many graduate students will gather data on the amount of evaporation and water losses that occur in open, unlined irrigation channels in South Texas irrigation districts. The information will be used as part of a larger effort to develop comprehensive water budgets in the region. TWRI will administer the grant. For details, contact Fipps at (409) 845-7454 or g-fipps@tamu.edu.

TWRI recently developed a new World Wide Web site and an Internet list server which describe issues related to water conservation, reuse, and recycling. These resources were developed by TWRI science writer Jan Gerston and webmaster Jason Middleton. The WWW site, http://tx-water-ed.tamu.edu, contains a list of meetings and links to many organizations that are involved in these issues. The list server distributes electronic mail messages focusing on these topics. For details, contact TWRI at (409) 845-1851 or twri@tamu.edu.

The WWW site of the TAMU Environmental and Natural Resources Program has been enhanced to make it more user friendly. This site provides information on environmental efforts and programs within the TAMU Agricultural Program. The site includes "Hot Topics," which discuss private property rights, drinking water, wetlands preservation, and water supply issues in a user friendly question and answer format. The Hot Topics were developed by TWRI student worker Lisa Kelley. The WWW address is http://enrp.tamu.edu.

TWRI recently published a technical report that describes efforts to implement a dry-year option program in the Edwards Aquifer region. The report, *The 1997 Irrigation Suspension Program for the Edwards Aquifer: Evaluation and Alternatives* (TR 178), was written by Keith Keplinger, Bruce McCarl, Chi Chen, and Ruby Ward of the TAMU Agricultural Economics Department. It describes the irrigation suspension system, and who participated in it, and estimates the effects of this program on cropping mixes, irrigation use, springflows, aquifer levels, recharge to other aquifers, and the regional economy. The report is on the TWRI WWW site at http://twri.tamu.edu/reports/1998/178sum.html and can be obtained by contacting TWRI at (409) 845-1851 or twri@tamu.edu.

TWRI has also begun planning for its 1998 "Water for Texas" conference, which is being co-sponsored by the Texas Agricultural Extension Service and the Texas Water Conservation Association. The conference, which is set for December 1-2 in Austin, is titled "Water Planning Strategies for Senate Bill 1." Sessions of the conference will discuss many water supply and demand management strategies. For more information, contact TWRI at (409) 845-1851 or twri@tamu.edu.

Texas Water Resources
is published quarterly by
the Texas Water Resources Institute.
Wayne R. Jordan, Director
Ric Jensen, Editor and Graphic Design

TWRI is supported by funds provided in part by the U.S. Geological Survey, U.S. Department of the Interior, as authorized by the Water Resources Research Act of 1984. Subscriptions are available free upon request. For details, call TWRI at 409-845-8571. The fax number is 409-845-8554; e-mail: twri@tamu.edu; WWW URL: http://twri.tamu.edu.

Texas Water Resources Institute
301 Scoates Hall
Texas A&M University
College Station, Texas 77843-2118

ADDRESS CORRECTION REQUESTED

NON-PROFIT
ORGANIZATION.
U.S. POSTAGE PAID
COLLEGE STATION, TEXAS
PERMIT NO. 215