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### ***Workshop to Set Texas Water Research Agenda***

For the first time, Texas is formulating a formal long- range water research plan. Policy makers, scientists, and interested citizens are invited to participate.

The Texas Water Development Board (TWDB) and the Texas Water Resources Institute (TWRI) are co- sponsoring a workshop November 18- 19 in Austin titled "Water for Texas: Setting the Research Agenda." The meeting will be at the Crest Hotel on Town Lake.

According to Wayne Jordan, TWRI Director, the process is important in many respects. "Scientists at universities and researchers with government agencies and the private sector want to know that their studies are relevant to the State's needs," he said. "To really make that happen, you need a detailed blueprint of what the State's leaders feel are the really critical issues. The human and financial resources devoted to water resources research are limited, but an agenda developed jointly between State agencies and the research community will help focus those resources so they can be used as efficiently as possible."

On the first day, participants will first listen to presentations on such issues as hydrology and climatology, aquatic ecosystems, water quality, development, infrastructure and operations; laws, institutions and policy; the impacts of management decisions, and water use efficiency. Speakers will include Tommy Knowles of the TWDB, Clyde Bohmfalk of the Texas Water Commission, TWRI Director Wayne Jordan, Glenn Longley of Southwest Texas State University, Lloyd Urban of Texas Tech University, Tom Brown of the South Texas Water Authority, John Balliew of El Paso Water Utilities, and Alan Plummer of Alan Plummer and Associates.

That afternoon, participants will form break- out groups dealing with one of the seven specific topics discussed in the morning session. Participants will be able to identify and prioritize research needs in their particular topic using a procedure called the Nominal Group Technique. The technique allows individuals to present a variety of suggestions in a non-confrontational manner.

The following morning, all the different groups will come together and all the recommendations from each of the individual groups will be discussed. Finally, a list of the highest priorities will be developed from all seven topics. It is expected that the final

list of priorities will be utilized by the TWDB and other groups when they develop water research strategies.

A registration coupon is enclosed. Registrations received by TWRI before Nov. 1 are only \$15. Those received after that date are \$25. On-site registration will also be available for the \$25 fee. The registration fee includes a copy of the proceedings and a lunch. Another benefit to registering early is that participants will get a better chance to be included in their top priority break-out group. Each group will only have about 20 members and the first 20 received will be given the highest priority to be included in the break-out group they most want to take part in.

For details about the Workshop, contact TWRI at 409-845-1851.

### ***Evaluating the Performance of Texas Rural Water Systems***

**Researcher:** R. N. Singh, Sociology Department, East Texas State University, Commerce, TX.

**Problem:** Texas has perhaps the largest number of nonprofit rural water systems in the U.S. Although problems involving poor management, inefficient economics, and others have been reported, little detailed information is available on the performance of these systems. Improved understanding of system performance and the sociodemographic nature of the customers of these systems will provide better insights into actual and perceived problems and solutions.

**Objectives:** To provide an overview of the organization and functioning of rural water systems, and to evaluate the quality and effectiveness of selected rural water systems in different geographical regions of Texas.

**Methodologies:** A literature search was conducted and interviews were carried out with representatives from the Farmers Home Administration (FmHA), the EPA, the Texas Rural Water Association, and the Texas Department of Health. District offices of FmHA were surveyed for information on demographics, finances, and operations of rural water systems. Data were collected from 108 rural water supply systems and from personal interviews with 98 customers of rural water systems (both groups were randomly selected) on the nature and scope of services

provided by rural water systems, the quality of service delivered, organizational and operational management, and overall maintenance. Groups of experts were utilized to identify and rank goals, operational procedures, needs and problems.

**Results:** Results suggest that many rural water systems are poorly planned, that the costs of water from such systems will continue to go up, that skills of systems managers need to be carefully scrutinized, and that rural water systems are cited more often than urban systems for water quality violations. A scale was developed in the project to rate system effectiveness. It shows the most effective rural water systems have not violated State health and water quality codes, have relatively fewer residential water connections, have

not denied water connections to potential customers, are relatively smaller systems in terms of miles of pipe, are single county systems, and use sources other than groundwater. Other findings suggest that systems with higher proportions of black and Hispanic residents are less effectively operated, and that large systems are less effectively operated than smaller systems.

**Reference:** Singh, R.N., *On Managing Texas Rural Water Supply Systems: A Socioeconomic Analysis and Quality Evaluation* (TR 150), TWRI, Texas A&M University, College Station, TX.

### ***Construction and Start-Up of a Pilot-Scale Water Treatment Plant***

**Researcher:** Syed R. Qasim, Civil Engineering Dept., University of Texas at Arlington, Arlington, Texas.

**Problem:** Pilot plants are valuable tools to test new chemicals, optimize doses and evaluate new processes to improve water treatment plant performance, meet future anticipated regulations, and reduce operating costs. Most state agencies may require a pilot plant study as a matter of policy before allowing innovative treatment processes to be utilized in future plant expansions.

**Objectives:** To optimize the operation of the main water treatment plant to improve performance and reduce costs, to evaluate and test new processes to be used in the future expansion of the main plant, and to use the pilot plant to train City of Fort Worth water treatment plant operators.

**Methodology:** Under a research contract with the City of Fort Worth, the Department of Civil Engineering at The University of Texas at Arlington designed and constructed a 6 gallons- per- minute (GPM) pilot plant at the Rolling Hills Water Treatment plant. The pilot plant is fully operational at this time. The pilot plant has been designed to utilize conventional as well as many innovative treatment technologies. The treatment processes provided in the pilot plant include preozonation, two- stage rapid mixing, three- stage flocculation, gravity and lamella type settlers, three filter columns, one granular activated carbon (GAC) filter and one biological active carbon (BAC) filter. The pilot plant can be operated in conventional, direct filtration, preozonation, post- GAC filtration and BAC filtration modes. Chemicals such as chlorine, ammonia, lime, coagulants, polymers and powdered activated carbon can be added at any desired location.

**Future Studies:** The pilot plant will be operated for several years. A number of water treatment studies have been planned for the future. These studies include: process simulation of Rolling Hills and Holly Water Treatment Plants, prediction and documentation

of process performance, optimization of current water treatment plant operations, preozonation as a coagulation aid, evaluation of filtration rates including direct filtration, disinfection tests including CT evaluation and reduction in THMs and VOCs, and long-term studies for taste and odor control including several oxidants and PAC, GAC and

biofiltration. Criteria for future plant modification and expansion of Rolling Hills and Holly Water Treatment Plants will be designed and developed.

**Reference:** Qasim, Syed R., Wallace A. Clines, and M. I. Hossain, *Construction and Start-up of Pilot Plant at the Polling Hills Water Treatment Plant*, Civil Engineering Department, University of Texas at Arlington, June 1991.

### ***Using Supercomputers to Simulate How Raindrops Form, Collide and Fall***

**Researcher:** Donald Greenspan, Mathematics Dept., University of Texas at Arlington, Arlington, TX.

**Problem:** Understanding how raindrops form, fall, and collide is essential to understanding larger phenomena of rainfall and climate patterns. Other instances where liquid drops mix are important in manufacturing and engineering. The mathematical simulation of liquid drop phenomena is complicated by the presence of large gradients due to surface tension and these are not represented accurately by continuous mechanics equations.

**Objectives:** To utilize a supercomputer to simulate the molecular formation and fall of liquid drops.

**Methodology:** Since surface tension is a consequence of molecular structure of liquids, a new molecular approach to liquid drop simulations has recently been developed and implemented. The fundamental ideas are that two molecules interact only when they are in close proximity to one another. This interaction is characterized by the molecules attracting when pulled apart and repelling when pushed together (repulsion is the much stronger force of the two). Experimental equations are available for many such molecular interactions including the Rowlinson formula. To

simulate interactions for a microdrop of water (consisting of 4,000 molecules), the Rowlinson formula could be used along with Newtonian dynamic equations to simulate molecular motion. However, this would require more than 12,000 second order Newtonian differential equations to represent the interactions of all the molecules with all the other molecules. Because of the large number of calculations, a super computer is required.

**Results:** Single water drops were first simulated. Later, two- and threedimensional simulations of colliding water drops were performed by duplicating the single water drops using mirror imaging. At extended times, surface tensions transformed oblate (egg shaped) spheres into relatively spherical drops. Collisions at different speeds were also simulated. To simulate large drops, aggregating the molecules into large units called quasimolecules and scaling the force formulas to conserve mass and energy is recommended. More than 2,000 seconds of processing time were required to compute 1,000 numerical time steps.

**Reference:** Greenspan, Donald, "Supercomputer Simulation of Colliding Microdrops of Water," *Computers and Mathematics with Applications*, Vol. 19 (1990). page 91.

### ***Impact of Farm Programs on Groundwater Pumping in the Texas High Plains***

**Researchers:** John Lee, Department of Agricultural Economics, Purdue University, West Lafayette, IN, and Ron Lacewell, Agricultural Economics Dept., Texas A&M University, College Station, TX.

**Problem:** Federal farm policies can affect the rate of transition from irrigated to dryland agriculture in the Texas High Plains. Producers in the region rely heavily on funds from government price support and conservation programs. There are concerns that Federal farm programs may also be limiting the adoption of water- conserving crop rotations by encouraging farmers to keep growing the same crop mixes on a perpetual basis.

**Objectives:** To identify the impact of farmer participation in Federal farm programs on cropping systems and groundwater pumping rates in the Texas High Plains.

**Methodology:** Three scenarios were considered: continuation of the current farm program, non- participation by farmers, and allowing farmers flexibility in selecting crop rotations with full government programs. Simulation models provided data on crop yield estimates by irrigation regime and crop rotations under variable climate conditions. Optimization models were used to predict crop mixes and the rates of groundwater pumping and to provide data on how groundwater levels were influenced by the crop production strategies. Optimal crop rotations were identified. Risk aversion preferences of farmers were evaluated.

**Results:** In the Southern Texas High Plains, farmers participating in programs pumped 74% more groundwater than farmers not taking part in the programs because the area had already begun the transition from irrigated to dryland production. Farm programs had a lesser impact in the Northern Texas High Plains. Net incomes for producers throughout the region are likely to decline over time because fewer acres will be irrigated due to declining groundwater supplies. If Federal farm programs were modified to promote multiple cropping systems, groundwater pumping would accelerate. This would hasten the transition from irrigated to dryland agriculture. Producers who participated in Federal farm support programs pumped more groundwater than farmers who did not take part in the programs because the programs enhanced the profitability of high waterusing crops and encouraged high irrigation use to produce high yields. Farmers avoided risks by irrigating fewer acres but more water was applied per acre.

**Reference:** Lee, John, and Ron Lacewell, "Farm Program Impacts on an Exhaustible Groundwater Supply: An Analysis of the Texas Southern High Plains," *Water Resources Research*, March 1990, pp. 361- 368.

## ***Reductions of Reservoir Storage Capacity by Subsidence and Sedimentation***

**Researchers:** Kathlie Sheu and William Bulloch, Water Production and Customer Service, City of Houston, and Jerry Rogers, Civil Engineering Dept., University of Houston, Houston, TX.

**Problem:** Sedimentation and subsidence are reducing the storage capacity of Lake Houston and other reservoirs. Upstream construction and other activities cause runoff that makes sediments accumulate in lake bottoms. Subsidence can lower the surface elevation of dams, reducing their storage capacity.

**Objectives:** To use existing data to determine the relative contributions of sedimentation and subsidence to reduce the storage capacity in Lake Houston.

**Methodology:** Previous studies were conducted on the independent roles of subsidence and sedimentation on reducing the storage capacity of the lake. These data were reanalyzed to compare the relative role of subsidence and sedimentation. Construction and other activities that result in increased sedimentation were evaluated. The impact of altering natural drainage ways on increased sediment loads was assessed and potential sediment control strategies were evaluated. Storage capacity losses due to sedimentation and subsidence were estimated.

**Results:** The study suggests that roughly 67% of the storage capacity loss (595 acre feet per year from 1966 to 1983) was due to subsidence of the dam structure. Sedimentation accounted for losses of roughly 288 acre feet (AF) per year. The overall reduction in lake storage capacity is more than 950 AF per year. Roughly 30% of the sediments were attributed to runoff from Cypress Creek. More than 24,000 AF of potential storage capacity has been lost to sedimentation and subsidence since the dam was completed in 1954.

**Reference:** Sheu, Kathlie, Jerry Rogers, and William Bulloch, "Sedimentation and Subsidence Capacity Reduction of Lake Houston," Texas Section ASCE Spring 1991 Meeting.

## ***USDA Awards Two Water Quality Projects to Texas A&M***

Two teams of Texas A&M University scientists have been awarded grants by the USDA Cooperative States Research Service Water Quality Program.

"Management of Dairy Waste to Minimize Potential Groundwater Contamination" will be studied by Mary Leigh Wolfe of the Agricultural Engineering Department, Kevin McInnes of the Soil and Crop Sciences Department and Matt Sanderson of the Texas Agricultural Experiment Station in Stephenville. The focus of the study is to determine the impact of irrigation with dairy wastewater on groundwater pollution. The researchers hope to learn how much nitrogen from dairy wastewater is lost to the atmosphere and how much is removed by forage plants. Simulation techniques will be used to integrate

the data developed in this project with other information into a model of the water-nitrogen system.

"Pesticide Degradation by a Genetically Engineered Fungus" will be studied by Charles Kennerley of the Plant Pathology and Microbiology Department and Albert Garcia of the Agricultural Engineering Department. They hope to develop a fungus that can degrade methyl parathion (the most widely used insecticide in the U.S.). Biodegradation genes will be incorporated from various microbes into the engineered fungus. The research will characterize and select optimal microbes that can degrade the pesticide and will establish parameters for soil based biodegradation.

### ***TCU Begins Operating Eagle Mountain Fish Hatchery; Should Bolster Aquatic Research***

Fisheries research capabilities at Texas Christian University were bolstered earlier this year when the University began operating the Eagle Mountain Fish Hatchery.



*Durward Smith (left) and Ray Drenner of TCU examine these water quality samples. The goal was to determine if algae-eating fish can improve water quality by consuming excess nutrients.*

The hatchery, containing 30 ponds and six small holding troughs is being leased for five years from the Tarrant County Water Control and Improvement District. TCU hopes to work with District personnel for research projects. Plans at the site include conducting simultaneous experiments with ponds at the hatchery and fiberglass tanks on the TCU campus.

Two research projects are under way at the site. Ray Drenner of TCU's Biology Department is determining the effects of gizzard shad on bluegill and largemouth bass reproduction. Drenner is also involved in a study with Mark Ernst and Dave Marshall of the Tarrant County WCID to determine whether the food chain can be manipulated to improve water quality in "balancing reservoirs" that hold water immediately prior to its being pumped into water treatment facilities. Drenner hopes that adding fish-eating bass (piscivores) can reduce fish that eat plankton. This could allow zooplankton (small crustaceans) levels to increase. The zooplankton could improve water quality in the lakes by eating suspended algae.

For details, contact: Ray Drenner, Biology Department, TCU, Fort Worth, TX 76129 or call 817- 921 - 7165.

### ***Wetlands May Lose Protection Under New Federal Rules***

New Federal rules have been proposed by the Bush administration that will change the definition of wetlands and that critics say may remove needed protection for millions of acres of marshes and swamps. Still, numerous efforts are

under way in Texas to preserve and protect wetland areas.

The changes would define whether areas were wetlands or

not through the use of a scale based on soil types, vegetation, and whether areas are flooded or inundated for 15 consecutive days a year. Those rule changes could open as many as 10 million acres national for development. The new regulations increase funding

for wetlands research by 50% and add bans against dredging,

draining and flooding protected areas. Current regulations

guard only against filling wetland areas.

Despite the rule changes, there are many cooperative

efforts to enhance Texas wetlands. The U.S. Army

Corps of Engineers is working with conservation groups to

create wetlands in Barker Reservoir near Houston. Legislation in

the U.S. House of representatives has been passed to purchase 5,000 acres of wetlands including a 600- acre lake, in Calhoun County on the Texas Gulf Coast. In the Seabrook area near Galveston Bay, a 5- acre marsh was created from clay materials that were displaced after flood control structures were improved.

### ***Lead Slag May Be Polluting Dallas Groundwater***

Lead pollution is typically associated with fixtures used in pipes and drinking water fountains, but there are concerns in Dallas that slag heaps led over from smelters may be causing groundwater pollution in many area neighborhoods.

Many of the slag heaps are thought to be concentrated in a 10 square- mile area between the Trinity River levee and 1- 30 west of downtown Dallas. Test samples revealed that lead levels of more than 21,000 parts per million (80 times greater than the amount considered hazardous by EPA) were found in some areas. Laboratory tests by the Texas



Water Commission showed that as much as 395 milligrams of lead could leach from some of the slag heaps.

Acidic rainfall and other factors could provide a way for the lead could leach into groundwater supplies.

### ***Catfish Farm, Water Transfers, Highlight Edwards Aquifer Water Woes***

A catfish farm that uses massive amounts of water, a preliminary plan to possibly obtain surface water from the lower Colorado River, and new agreements to use Medina Lake to supply water to some Bexar County residents, are among just a few of the recent twists and turns in the ongoing efforts to resolve water disputes in the San Antonio region.

First, the Living Waters Artesian Springs Catfish Farms allows more than 43 million gallons daily (almost a quarter of the water pumped by the City of San Antonio) to flow from an twri well. The catfish farm has angered a number of area leaders who argue that the pumping is significantly lowering water levels in the Edwards Aquifer. Many critics charge the farm negates the conservation efforts of many cities and water districts who are trying to stabilize water levels in the aquifer and keep nearby springs flowing. There are also concerns that the wastewater generated from the catfish farm may contain high levels of gas- producing microorganisms similar to fecal coliform bacteria. Some solutions are being investigated. A bill was passed in the Texas Legislature and signed into law that deletes a provision that previously said that using water for a fish farm is not waste. The bill would not necessarily shut down the

aquaculture operation. However, it could mean that local and State regulatory agencies could eventually force the fish farm to recycle and more efficiently use its water supplies or be shut down.

Second, a plan under discussion may allow San Antonio and Corpus Christi to obtain up to 30,000 acre feet of water from the Colorado River near the Gulf Coast. The Garwood Irrigation District has the rights to irrigation water along the Colorado River and supplies water for irrigation to rice producers during the growing season. However, during the winter months rainfall and runoff flow unused past the District to bays and estuaries at the mouth of the Colorado River. The proposed plan would transport much of that water through irrigation canals from the Garwood District to Lake Texana and then to San Antonio and Corpus Christi. It still remains to be seen if diverting the water could have a detrimental effect on bays and estuaries at the mouth of the Colorado River.

Third, the Bexar Metropolitan Water District (MWD) has agreed to buy the rights to up to half the water in Medina Lake from an irrigation district. The water would be used by the MWD for its customers or could be sold to other water districts if pumping limits are imposed on the Edwards Aquifer.

### ***Septic Tanks May Pose Pollution Problems***

Controlling septic tank pollution in lakes and rivers has recently become a major issue in at least two areas of Texas.

Along the south fork of the Guadalupe River this summer, there were concerns that a septic tank system at a resort near Hunt was causing fecal coliform contamination. However, later tests suggested that the pollution may have come from "natural sources and not from human sources. High levels of chlorides, sulfates, and dissolved solids normally associated with human waste were not found in the river. Still, area water quality officials are concerned that septic tanks may be at least part of the problem.

Meanwhile, the City of Weatherford is developing a new sewer system to replace septic tanks that were used to treat domestic wastewater at many lots near Lake Weatherford. Previous studies done by Ken Morgan of the Geology Department of Texas Christian University and others suggested that septic tanks were contributing pollutants to the lake, which is Weatherford's only source of drinking water. To pay for the new sewer system, the city is doubling the cost of leases for developed lots near the lake.

Parks and Wildlife Department Hopes

Spoonbill Catfish Can Recover, Flourish

The spoonbill catfish, also known as the paddle fish, is one of most ancient and oddest looking of Texas fish species. Now officials with the Texas Parks and Wildlife Department (TPWD) are hoping that the once- endangered species can come back and are asking that

volunteers play a part in that effort.

Paddlefish may have lived in Texas for the past 300 million years. Adult spoonbill catfish grow to more than seven feet in length and can weigh as much as 200 pounds. The fish filter zooplankton (microscopic animal life) from fresh waters and swim with their mouths open.

Spoonbill catfish were

placed on the State endangered species list in 1977 and harvesting the fish has been illegal ever since. Today, only small numbers of the once common fish now inhabit the Trinity, Neches, Angelina, Sabine, and Sulphur Rivers and Big Cypress Bayou.

To boost fish populations, the TPWD is now stocking thousands of young paddlefish in the Neches, Trinity and Sabine rivers. TPWD officials are hoping that recreational groups and other volunteers can help identify potential spawning and feeding areas.

If you want to participate, contact Ronnie Pitman of the TPWD at 512- 866- 3356.

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If you want to participate, contact Ronnie Pitman of the TPWD at 512-866-3356.

### ***Wastewater Could Benefit Corpus Christi Aquatic Life***

The Corpus Christi area is faced with the challenge of storing enough water in its reservoirs to serve its customers, while still releasing enough water down stream to keep bays and estuaries healthy and productive.

One possible solution is being explored by the South Texas Water Authority, Corpus Christi officials, and scientists at the University of Texas Marine Science Institute (MSI) in Port Aransas. It involves diverting wastewater return flows back into the inner harbor to benefit fish and wildlife.

Options being considered include targeting return flows into specific portions of the estuary to enhance productivity and provide additional treatment, developing wetland areas in existing mud flats, and creating artificial flooding events where existing rivers would not have to flow over their banks. Terry Whitley, a researcher with UT-MSI, says early results suggest that estuary productivity could increase significantly if some of the proposals can be implemented.

If successful, the project could provide the benefit of lessening the 151,000 acre feet of water that Corpus Christi now releases from Choke Canyon Reservoir, thus freeing up more water for municipal uses.

### ***Legislation Approved to Create New Environmental Agency, Increase Plumbing Efficiency***

A number of changes in the way Texas state agencies administer water and environmental laws have recently been enacted by the Texas Legislature.

The Legislature passed Senate Bill 2 to create a new agency, the Texas Natural Resources Conservation Commission, that will administer environmental regulations. The solid

waste, drinking water and radioactive waste disposal divisions of the Texas Department of Health will be combined with The Texas Water Commission (TWC) in March 1992. Later, the Texas Air Control Board, the Water Well Drillers Board and the Board of Irrigators will be merged into the agency. The TWC will not adopt the name of the new Commission until 1993.

The Legislature also passed a bill that requires river authorities to develop water quality plans, a law that authorizes the General Land Office to develop a comprehensive plan to combat coastal erosion, and a bill that sets efficiency standards for plumbing fixtures. The plumbing efficiency rules require that wall mounted flush valve toilets use only 2 gallons per flush (gpf), that other toilets require 1.6 gpf, that shower heads use only 2.75 gallons per minute (gpm), and that faucets use only 2.2 gpm. By the year 2040, the efforts may save more than 800 million gallons annually.

Another significant change is that the

TWC has adopted more stringent water quality standards for all surface waters in the State. The changes provide the highest level of protection possible for aquatic life in small streams, and provide numerical standards for 61 more toxic chemicals. Site specific standards for 63 additional water bodies in Texas were added including higher dissolved oxygen standards for the Trinity River and lower amounts of toxic chemicals in the Houston Ship Channel.

### ***Many In Bexar County Are Without Adequate Water***

An area just a few miles away from San Antonio may be in almost as bad condition as the impoverished Colonias in the Rio Grande Valley.

An estimated 20,000 to 40,000 residents in southern Bexar County do not have adequate water for drinking, bathing, and cooking. Those few residents with access to wells occasionally find their water contaminated with heavy metals, flammable liquids, and fecal coliform bacteria, and the well water is rarely chlorinated. Inadequate wastewater treatment is also a problem. Many residents are still without indoor plumbing and are utilizing outhouses.

Some efforts are underway to improve conditions. More septic tanks may soon be built by those who can afford them, because a new Bexar County regulation requires residents to have a septic system before they can receive electricity. The Bexar County Commissioners' Court has approved projects to supply water to roughly 400 households in the area last year. Critics charge those improvements are too few and have not yet occurred.

The Texas Section of the **American Water Resources Association** is sponsoring a **Seminar on Surface and Ground Water Hydrology** November 8 at the Balcones Research Center at the University of Texas at Austin. Call Eva Kuniandy at the U.S. Geological Survey in Austin for details at 512- 873- 3068.

### ***Cooper, Palo Duro Lakes Near Completion***

Two major Texas water projects are nearing completion, while two others are being actively considered.

In East Texas, the Corps of Engineers has announced it will begin to divert water from the Sulphur River into Cooper Lake in late September. With average rainfall, the 441,000 acre-foot (AF) lake should fill up in roughly 19 months. In the Texas High Plains, officials with the Palo Duro River Authority say that 60,900 AF Palo Duro Lake is nearing completion. The facility cost \$22 million. Constructing pipelines and aqueducts to transport the water to area cities to supply water could take 10 more years and will involve additional costs.

### ***New TWRI Reports Cover Non- Point Source Pollution, Trinity River Ecosystem, Impact of Particle Size on Pollutant Transport***

Proceedings from two recent conferences, a new technical report dealing with particle transport in surface waters, and a directory of university scientists working with water are some of the new publications available from the Texas Water Resources Institute (TWRI).

*Solutions to Non- Point Source Pollution* is the title of The Proceedings of the 23rd Water for Texas Conference that was held in Lubbock in December, 1990. The proceedings cost \$25 and deal with the broad topics of controlling urban and agricultural runoff. Individual papers discuss EPA's national survey of pesticides in drinking water wells and private sector studies of alachlor levels in groundwater. Other papers deal with complying with

urban non- point source regulations, using stormwater runoff to enhance fish and wildlife habitat, and other issues. Many of the papers dealt with limiting runoff of nutrients and pesticides from agricultural fields including developing and following nutrient budgets.

*How Healthy is the Upper Trinity River? Biological and Water Quality Perspectives* is the title of a proceedings from a symposium TWRI sponsored at Texas Christian University in October 1990. Sections of that proceedings deal with the biology and ecosystem quality of the river, urban and agricultural runoff, short- term and longterm water quality trends, and the impact of wastewater on water quality. Although the Proceedings is specific to the Trinity River, many of the concepts

are applicable to other urban river systems.

*Particles in Surface Waters: Coagulation and Transport (TR152)* was co- authored by Gerald Culkin and Desmond Lawler at the University of Texas at Austin. The report describes research to simulate size- dependent contaminant transport and transformation mechanisms using computer models. The information is essential to better understand the transport and fate of nonpoint source pollutants and other contaminants. The report describes how particles behave in "ideal" simulated lake systems, and shows how the model was applied to Austin's Town Lake in a case study.

*Water Related Researchers at Texas Universities* is a directory describing the expertise of more than 400 university scientists working with water-related issues. Scientists are referenced by current research areas, academic disciplines and institutions. Paper copies are available free of charge. A version that works with the FileMaker Pro software on Macintosh computers is also available on diskette for \$10.

To obtain any of these reports, contact TWRI at 409- 8451851.

### ***"Crazy Water" Tells the Story of Texas' Spas, Springs, and Mineral Waters***

In 1863 Sam Houston, physically and emotionally scarred by a lifetime of battles, tried the soothing mineral water baths at Sour Lake, Texas. Almost a century later, Dallas billionaire H. L. Hunt heard of miraculous cures at Indian Hot Springs, on the Mexican border, and bought the fading resort. His improvements--and the famed springs which could restore all kinds of powers--attracted such celebrities as boxing champ Gene Tunney and Texas Congressman Olin Teague.

The many oil booms in Texas are well documented. Not so well known is the story of another geological discovery that started a social stampede--the mineral- water boom. Boomers sought health more often than wealth, though the mineral water business became

quite profitable for some.

In Mineral Wells, Marlin, Glen Rose, Sour Lake, Indian Hot Springs, Wizard Wells and dozens of places all over the state, heavily mineralized water lay beneath the soil. In pioneer days, the news often set off a land rush, with wagons flocking to the medicinal founts of "miracle" healing. Before the discovery of antibiotics (and sometimes afterward) drinking and bathing in mineral- waters were an important part of health care for many Texans. They even used mineralized mud salves and sat in radioactive dirt. Taking the waters was as fashionable as it was restorative, and health resorts turned into vacation playlands.

In a lively look at resorts large and small, Gene Fowler takes readers from one end of the state to the other, listening to testimonials, reading amazing descriptions, marveling at the gullibility of the afflicted and the inventiveness of the healers who attracted the rich and the poor.

The book is available from the Texas Christian University Press, TCU, Box 30783, Fort Worth, TX,76219 or by calling 817- 921 - 7822.

### ***EPA Unveils U.S.- Mexico Border Environmental Strategy***

Steps to improve water quality and environment along the U.S.- Mexico border have been outlined in a new EPA study.

The report, *The Integrated Environmental Plan for the U.S.- Mexico Border Area*, describes water quality, hazardous wastes, and other environmental problems along the border. Along the Texas- Mexico border, for example, improvements in wastewater treatment are recommended for the Laredo- Nuevo Laredo area. Protection of water supply sources and improved municipal and industrial wastewater treatment are top priorities in El Paso- Ciudad Juarez and Brownsville- Matamoros.

The report stresses that throughout the border, water quality is threatened by limited sewage treatment and collection facilities, untreated and poorly treated industrial effluents, and improperly handled hazardous wastes. These conditions pose significant health risks and threaten drinking water safety.

The plan recommends that cooperative enforcement strategies be developed between Mexican and American water quality and environmental agencies, and that transboundary standards for acceptable pollutant levels be established. Additional financing for wastewater treatment, and heightened emergency planning and response capacities are also recommended.

The report is available from: EPA, International Activities Office, 401 M Street SW, Washington, DC, 20460 or by calling 202- 260- 1383.

### ***Steps Cities Can Take to Cut Flood Insurance Rates Described in FEMA Manual***

Detailed information on steps communities can take to lower the flood insurance premiums for individuals in their area are outlined in a new manual from the Federal Emergency Management Agency (FEMA).

The report, *National Flood Insurance Program: Community Rating System Coordinators Manual*, explains specific steps that can be taken including public information programs, detailed floodplain elevation mapping, preserving open spaces, controlling stormwaters, implementing flood warning programs, measures to increase dam and levee safety, more stringent regulations on floodplain development, and others to minimize flooding risks. When these steps have been completed, communities participating in the national flood insurance program can then qualify for reduced flood insurance rates. For example, residents in 21 Texas cities including Austin, El Paso, and Dallas are eligible for 5% reductions in flood insurance premiums and higher reductions in the future.

The manual and other information on flood insurance and floodplain management is available by contacting the Texas Water Commission at 512- 371- 6316.

### ***Texas Water Laws, Quality Rules, Explained in New Books***

Two new books dealing with Texas and environmental laws are now available.

Regulations concerning wastewater discharges, pollution control, injection wells and storage tanks, hazardous waste sites, ownership of river and streambeds and submerged

tidelands, recreational and access rights, and interstate water compacts are analyzed in a new book by Frank Skillern of the Texas Tech University Law School. The book, *Texas WaterLaw: Volume II*, also describes regulations governing aspects of water control and improvement districts, groundwater conservation districts, and municipal utility districts such as financing, powers of eminent domain, annexation and others. The oversight of water districts by the Texas Water Commission is also explained. The book is available from Sterling Press at 512- 492- 8873.

*Texas Environmental Law* was written by David Bridges, Michael Brown, Jacob Friedlander, and Pamela Schaaf. The book includes sections dealing with the Clean Water Act, groundwater protection, injection wells, obtaining insurance coverage for environmental claims, Texas enforcement of Superfund legislation, emergency planning and community right to know statutes, Texas regulation of storage tanks and solid and hazardous wastes, and many other issues. The report was published by Federal Publications which has also published books and cassettes on Federal environmental laws. For more information, contact them at 202- 337- 7000.

### ***On- Farm Irrigation Management Strategies Outlined***

A comprehensive guide to agricultural irrigation management with information on the water needs of plants, evapotranspiration, irrigation efficiency, irrigation scheduling, measuring the amount of water to be supplied, and other topics has recently been published by the American Society of Agricultural Engineers (ASAE).

The book, *Management of Farm Irrigation Systems*, was edited by Terry Howell of the USDA/ARS at Bushland, TX, G. Hoffman of the University of Nebraska, and K. Solomon of California State University at Fresno. Many chapters of the book were written by Texas scientists with universities and the USDA/ARS.

For ordering information, call ASAE 616- 429- 0300.

### ***Bioremediation Proceedings Available from Lamar University Center***

A new proceedings dealing with bioremediation of polluted soils and aquifers is available from the Gulf Coast Hazardous Substance Research Center.

The proceedings, *Bioremediation Fundamentals and Effective Applications*, contain papers that were presented at the Center's 3rd Annual Symposium in February, 1991. The papers discuss the fundamentals of bioremediation using microbial organisms. Reports on pilot plant, laboratory, and full scale studies are included. Topics of some of the papers include the fate of volatile materials in soils, cleanup work done following the Exxon Valdez oil spill in Alaska, removal of benzopyrenes from soils, public responses to hazardous waste management strategies, and deep well oxidation of hazardous wastes. Abstracts dealing with issues such as the demographic and social characteristics of persons active with NIMBY (Not In My Back

Yard) issues, models of contaminant responses of contaminant transport in aquifer systems, the use of microwave heating techniques to detoxify contaminated soils, and



others, are also included. Many of the papers were written by scientists from Texas universities.

The proceedings are available for purchase from the Gulf Coast Hazardous Substance Research Center at Lamar University at 409-880-8768.

### ***Texas Tech Health Center Provides Medical Services to Colonias***

Health problems in unincorporated areas near the TexasMexico border called Colonias are among some of the worst in the U.S. But thanks to the Texas Tech University Health Sciences Center in El Paso, many of the residents are getting the care they desperately need.

Many Colonias residents do not have wastewater and water services so local groundwater supplies used for drinking water are often contaminated with human wastes. As a result, many more Colonias residents are afflicted with hepatitis, dysentery, gastroenteritis and other illnesses that are rare in regions of the State with adequate water and wastewater facilities. Compounding the problem, only 4% of El Paso's private doctors serve areas where Colonias are located.

To improve conditions, Texas Tech has developed programs where 80 faculty members and 130 residents treat patients at their El Paso clinic and in the Colonias. In addition, Texas Tech physicians staff five school clinics daily in rural parts of El Paso County.

Texas Tech is the only university nationally with a health science center along the U.S.-Mexico border. Thus, while many challenges exist, there are also unique opportunities for research and training.

An article on Texas Tech's efforts was featured in the Summer 1991 issue of *Vistas*. For more information, call Texas Tech at 806- 742- 2136.

### ***University of Houston- Clear Lake Study Suggests Stress Proteins May Signal Pollution***

Grass shrimp and other invertebrates living in the mud of Galveston Bay may yield clues as to whether pollutants from oil and gas exploration and production are harming aquatic life in the region.

Many invertebrates, including the grass shrimp, are restricted to a relatively small area throughout their lives. As a result, they may be excellent sentinels of longterm exposure to pollutants such as oilfield brines.

Cynthia Howard of UH- Clear Lake's School of Natural and Applied Sciences

has been investigating the effects of the pollution. One problem was that contaminant levels in sediments are not usually strong enough to kill large numbers of aquatic life, but they may have more subtle, but still dangerous, side effects.

To solve the problem, Howard investigated whether stress proteins in the grass shrimp could serve as bioindicators of pollution. Howard gathered sediments and grass shrimp and other aquatic life from sites where oilfield brine was being discharged and measured whether stress pro

teins had accumulated in the animals. Her studies show that the shrimp nearest to two sites where brines were being discharged and sediments were being contaminated contained the most stress proteins. However, traditional bioassays indicated there was no significant toxicity. This suggests that stress proteins may reveal low levels of pollution when other methods may not.

For details, contact: Cynthia Howard, School of Natural and Applied Sciences, University of Houston at Clear Lake, Houston, TX 77058 or call 713- 283- 3745.

### ***Brown Tide Invades Gulf Coast; May Threaten Sea Grasses***

People visiting the upper Laguna Madre to fish, swim or use the waters might see something new this year when they look in the water, but it won't be the bottom. Brown tide, a chrysophyte that has defied classification and might even be a new species, has infested the upper Laguna Madre.

Robert Jones, Director of the UT Marine Science Institute in Port Aransas said that brown tide shades the water column, causing it to look murky. This shading can reduce the light penetration into the water. Since the Laguna Madre is a sea grass driven ecosystem, it could effect it drastically.

Research being conducted on brown tide's effect upon sea grass has shown that the grasses have, to this point, withstood the shading. However, sea grasses store carbohydrates they can use during hard

times, Jones said, and only further research will determine how brown tide will effect sea grass in the long run. Sea grasses provide a nursery and habitat for larval and juvenile fish and shrimp. If the brown tide persists for a long time, it could kill off the sea grasses and change the Laguna Madre from a sea grass ecosystem to a phytoplankton ecosystem. Changing ecosystems would have an extreme effect upon recreational and commercial fishing," Jones said.

Larry McEachron, Fisheries Resource Program Leader for the Coastal Fisheries Regional Office of the Texas Parks and Wildlife in Rockport, said that the fishing is at its best since the 1989 freeze, but they are concerned about brown tide's effects upon the wildlife. Although not complete, research being conducted has not shown

any effect upon juvenile or adult fishes, he said.

McEachron said brown tide was first sighted in May and June of 1990 in Baffin Bay. Since then it has spread from its point of origin and has been spotted in surrounding bays

up and down the Texas coast. Last fall, a cold front pushed the brown tide as far south as Port Mansfield, but he said it has since receded.

Jones said there are several hypotheses "floating around" dealing with the removal of brown tide from the bays. Since research has shown that the organism does not like fresh water, he said a tropical storm, hurricane, or an extreme amount of rainfall could flush it out of the Laguna Madre. Secondly, since it is such a new organism, it is possible that it could develop a viral enemy which could kill it off.

### ***Special Water Quality Needs of Texas' National Parks Studied at Texas A&M***

National parks may have special water quality needs that may not be covered by current regulations. Now researchers at Texas A&M University are evaluating water resources in Texas' national parks on a case by case basis to see if special protection measures may be necessary.

Ron Kaiser, an attorney and associate professor in the Recreation, Parks, and Tourism Sciences Department, is examining the problem. He said that problems can arise when stream standards are not strong enough to protect the designated uses of streams and lakes in parks. For example, water quality standards for park waters used for swimming and canoeing need to be strong enough to protect human health. In some cases, special protection may need to be applied to protect endangered plants and aquatic life.

In the study, Kaiser hopes to identify waters in Texas' nine national parks that may be of concern and to determine if existing state water quality standards are adequate. After consulting with park staff, specific water quality needs will be developed for many stream segments. The results could be used to provide special safeguards for waters that could be designated as "outstanding natural resource waters." In any event, the process could make sure that park waters are of the proper quality for their intended uses.

For details, contact Kaiser at (409) 845-5303.

### ***Texas A&M Study Shows Fish May be Returning to Upper, Middle Reaches of Houston Ship Channel***

As recently as the late 1970s, fish populations in the upper Houston Ship Channel were severely limited by industrial, municipal, and nonpoint source pollution. Since that time, pollution controls have been implemented and water quality standards have been bolstered by State and Federal agencies. Still, there are concerns as to whether or not fish are moving back into the upper portions of the Ship Channel.

To answer that question, Andre Landry of the Marine Biology Department at Texas A&M University at Galveston and George Guillen and Richard Seiler of the Houston regional office of the Texas Water Commission surveyed fish populations in the upper and middle reaches of the Ship Channel. Some fish and macroinvertebrates (crabs and

oysters) were collected from revolving screens of the cooling water intake structures at power plants. Other samples were collected using gill nets and seines.

Both stretches of the Ship Channel have not been designated to support aquatic life. However, results suggest portions of the Channel are being utilized by a variety of aquatic organisms. The region may be more important as habitat for young fish and macroinvertebrates such as shrimp and blue crabs than first thought.

The number of aquatic species in the upper Channel is highest during cooler months when dissolved oxygen levels are highest. When the weather warms up and dissolved oxygen levels decline, the fish populations decrease in the main part of the upper channel but many fish are still present along the shorelines. In the middle Channel, the most species were present when temperatures were high and dissolved oxygen was lowest.

For more details, contact: Andre Landry at Texas A&M University at Galveston at 409-7404448 or Richard Seiler at the Houston office of the Texas Water Commission at 713-457- 5196.

### ***Corpus Christi State Awarded New Water Research Center***

Corpus Christi State University (CCSU) will be creating a new center to collect and analyze data on water supplies and other related issues in the region.

The Corpus Christi Regional Water Supply Center will be headed by Alan Berkebile of the Division of Sciences and Jennifer Prouty of the Geology Department. Much of the Center's activities will focus on compiling and analyzing water- related regional data now being gathered by local, state, and federal agencies as part of an information clearing house. The Center will also serve as a source of information on the impact of alternative water management strategies (including reservoir operations and water and wastewater treatment) on regional rivers, bays, and estuaries.

The Center will be part of a recently formed Environmental Research Consortium at CCSU, along with the Center for Coastal Studies, the Blucher Institute for Surveying and Science, and the National Spill Control School. Berkebile can be reached at the Division of Sciences, CCSU, 6300 Ocean Drive, Corpus Christi, TX 78412 or by calling 512-9942741.

### ***Pressurized Carbon Dioxide May Clean Oilfield Brines, Limit Groundwater Pollution***

A new method of cleaning oilfield brine that uses pressurized carbon dioxide is being developed by researchers at The University of Texas at Austin.

Brines are salty and can be oil contaminated and have been linked to groundwater pollution problems in some regions of Texas. Typically, most of the oil and water extracted from petroleum exploration separates easily. However, a small amount of emulsified and dissolved oil remains that's more difficult to treat.

To test the process, James Fair, Jose Louis Bravo, Frank Seibert, Chester Little, and Diane Bauer of UT's Center for Energy Studies used carbon dioxide at pressures of 250 to 1,400 psi (pounds per square inch) to treat brines contaminated with 1,000 parts per million (ppm) of oil. The procedure reduced oil levels to less than 30 ppm. Studies now underway also suggest the process could be more economical and would take up less space than conventional systems.

For details, contact: UT Center for Energy Studies, 10100 Burnet Rd., Austin, TX, 78758 or call 512- 471 - 7792.

### ***Corps to Allow Universities to Use Lake Lewisville Site for Aquatic Research***

The U.S. Army Corps of Engineers has entered in a formal agreement with several North Texas universities that will provide opportunities for environmental studies.

- The agreement creates the Lake Lewisville Environmental Learning Center and allows scientists from the University of North Texas, Southern Methodist University, Texas Christian University, the University of Texas at Arlington, the University of Texas at Dallas, Texas Women's University, the Texas ARM University Research and Extension Center at Dallas, and other groups to use the site.
- The new agreement encourages the use of 2,000 acres of formerly agricultural lands with creeks and relatively undisturbed bottomland hardwoods. Those lands could be used for biological and environmental science education, research, and training efforts. One benefit is that long- term studies could be carried out at the site. A meeting was held in September to plan initial research activities at the site. An annual schedule is being developed by members of the consortium to plan the use of the area.
- For details, contact: Rhonda Ekblad at the Corps of Engineers at 817- 334- 3246.

### ***UNT Scientist Recommends Fish Stress Tests to Gauge Impacts of Pollution***

Pollution is often measured by the numbers. For example, how many parts per billion of a given chemical are found in a stream. But a better way to gauge the impact of waterquality degradation may be to judge the effects of pollutants on the fish and other aquatic life that live there.

Tom Beitinger of the Biology Department at the University of North Texas has been assessing stresses that pollutants can cause in fishes. Many of the tests deal with measuring the effect of variations of temperature, oxygen, and salinity on growth processes. However, more complicated assessments include continuously monitoring physiological changes as the fish swim in water wheels and tunnels. Other

tests (listening to coughs) are used while the fish are exposed to water- borne pollutants.

Results of studies by Beitinger and others suggest that many fish species avoid about a third of pollutants at harmful levels, but that roughly 67% of contaminants were not often

avoided. More than 90% of environmental conditions that cause stress make fish more vulnerable to their prey.

The research was featured in two articles in Vol. 16, No. 4 (1990), of *The Journal of Great Lakes Research*. For details, contact Beitingger at: Biology Dept., University of North Texas, Denton, TX 76203 or call 817- 565- 3598.

### ***TEEX Teaches Firefighters How to Extinguish Marine Blazes***

When supertankers and other ships exploded, burned, and spilled fuel into the Houston Ship Channel and other Texas water bodies last year, they tragically brought attention to the fact that these accidents can happen. They also pointed out the need for expertly trained firefighters and emergency response crews that can be rapidly deployed to deal with these major accidents.

To help provide such training, the Fire Protection Training Division of the Texas Engineering Extension Service offers basic and advanced marine firefighting courses. The classes are held at the Brayton Firemen's Training Field on the Texas ARM University campus. Fires are simulated in a World War II liberty ship the *SS William Allen*. that is

set ablaze. The basic course includes marine firefighting and emergency training and includes extensive hands- on training with sophisticated mockups and simulations. The advanced course emphasizes strategy and tactics needed to attack and control fires and other shipboard emergencies. It provides participants with the knowledge required to precisely assess onship fires and the hazards to human life that may result. Both courses meet all mandatory requirements of the Coast Guard for fire training of shipboard personnel.

For more information on either course, contact the TEEX Fire Protection Training Division at 409- 845- 1158.

### ***Applications for USGS Matching Grants Due Nov. 19***

The U.S. Geological Survey (USGS) is accepting proposals for its FY 1992 water resources research matching grant program. The program covers a wide range of subjects including the hydrologic cycle, water supply and demand, improvement of saline and other impaired waters, conservation, reuse, and others.

- Only \$1.8 million has been authorized for the program this year, compared to \$4.3 million previously. As a result, the USGS may not issue a request for proposals next year. They may select research grants for the next two years based on proposals received this year. Scientists are encouraged to apply for this year's program.
- Guidelines and application forms are available from the Texas Water Resources Institute by calling 409- 845- 1851. Proposals must be received by the USGS by November 19. Funding for selected projects will begin in September 1992. The program requires applicants to match each Federal dollar with a non- Federal dollar.

### ***TWRI Announces Call for Research Proposals; Deadline Oct. 28***

Preproposals for research and technology transfer projects are now being accepted for the Texas Water Resources Institute's FY 1992 Cooperative Research Program. The program is funded by the USGS. TWRI is particularly interested in projects dealing with groundwater quality and urban water management.

- Detailed instructions for submitting preproposals are available by calling TWRI at 409-845- 1851. Preproposals must be submitted no later than October 28. Preproposals will be evaluated by the Institute Director and TWRI's 14- member Advisory Committee. Later, full proposals of selected projects will be required.
- The program requires that federal funds be matched with nonfederal dollars at a ratio of 2- to- 1. Funding for selected projects will begin Sept. 1, 1992 and will run through August 31, 1993.
- TWRI hopes to fund three or four research projects with budgets of up to \$25,000.

### ***Gulf Coast Hazardous Substance Research Center Proposals Due November 1***

The Gulf Coast Hazardous Substance Research Center at Lamar University is now accepting proposals dealing with hazardous waste minimization in specific industries, pollution prevention, bioremediation, economic and marketing studies on recycling and reuse, and other issues.

Innovative proposals (for example, applications to treat presently unmanageable wastes or applications of existing technology to waste streams not currently treated by biological methods) are encouraged.

Faculty members at Texas universities including Texas A&M University, The University of Texas at Austin, Lamar University and the University of Houston are eligible.

Proposals are due Nov. 1. Award winners will be notified in March. Projects will run from May 1992 to March 1993. For application information, contact the Center at 409-8808768.