New Waves
The Research Newsletter of the Texas Water Resources Institute
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TWRI Funds 23 Soil and Water Conservation Projects

The Texas Water Resources Institute (TWRI) recently awarded 20 research and extension projects that will address water and soil conservation efforts.

The projects are funded by the Texas Governor's Office, through its "Subchapter G" program. Roughly $300,000 of funds were awarded and, in several cases, were matched by contributions from cooperating agencies and organizations. Some of the organizations that provide matching funds include the High Plains Underground Water Conservation District Number 1 in Lubbock, and the El Paso Office of the U.S. Bureau of Reclamation.

"This program is very important since it represents a renewable source of funds to regularly fund research and extension projects that promote the conservation of soils and water resources," said TWRI Director C. Allan Jones. "We are especially pleased that several groups throughout the State partnered with TWRI, enabling us to leverage resources and provide as many grants as possible."

Each project began on October 1, 2001, and will run through August 31, 2002. The grants will be administered and publicized by TWRI.

Eleven projects totaling $208,000 were awarded to researchers with the Texas Agricultural Experiment Station through this program, including the following studies:

- "Assessing the Water Demand for Sprinkler Dust Control on High Plains Feedyards," Brent Auvermann, Amarillo.
- "Equipment for Irrigation Management with Extreme Water Deficits," James Bordovsky, Plainview.
- "Improving Water Management for Optimum Crop Productivity and Profits under Supplemental Irrigation," Thomas Gerik and Wyatte Harmon, Temple.
- "A Water Management Educational Outreach Program," Ron Kaiser, TAMU.
- "Establishment of a Statewide Texas Evapotranspiration and Meteorological Network Database Site," Carlos Fernandez, Thomas Marek, Temple, Raghavan Srinivasan and Guy Fipps, College Station, and Dana Porter, Amarillo
- "Evaluating Salt Accumulation and Release Processes in Riparian Zones of a Semi-Arid River System," Seiichi Miyamoto and Fares Howari, El Paso.

- "Development of a Rainfall Simulator for the Assessment of Basic Hydrological Processes Affected by Brush Control," Clyde Munster, Brad Wilcox, Bimayak Mohanty, all TAMU, and Keith Owens, Uvalde.
- Impact of PL-566 Small Dam Structures on Riparian Corridors," Ranjan Muttiah, Blackland Research Center, Temple; and Peter Allen, Joseph White, and John Dunbar, Baylor University, and Jeff Arnold, USDA/ ARS.
- "Potential for Water Conservation through Lining Canals in the Rio Grande Project," Zhuping Sheng, El Paso, and Phillip King, New Mexico State University.
- "A Real-Time Drought Assessment and Forecasting System for Texas Using GIS and Remote Sensing," Raghavan Srinivasan, TAMU.
- "Restoration of Hydrologically Disfunctional Rangeland Watersheds, Wildlife Habitats, and Improved Pastures in Western Texas," Darrell Ueckert Chris Sansome, Allan McGinty, Dale Rollins, all San Angelo, and Steve Whisenat, Wayne Hamilton, and Roger Gold, all TAMU.

Twelve projects totaling $92,000 were awarded to specialists and county agents with Texas Cooperative Extension through this program include the following:

- "Reducing Nonpoint Source Pollution in the Upper Trinity River and Galveston Bay," Julie Massey and William Johnson, Galveston County, Eddie Byrom, Tarrant County.
- "Irrigation and Rainfall Water Management and Conservation," Frank Dainello and Larry White, TAMU, Larry Stein and Marcel Valdez, Uvalde).
- "Rangeland Riparian Management," Lindi Clayton and Larry White, TAMU.
- "Training and Demonstration Support for Irrigated Crops and Livestock Production," Bob Robinson and John Sweeten, Amarillo.
- "Source Water Protection," Monty Dozier, TAMU.
- "Water for Texans," Larry White, Lindi Clayton, and Barron Rector, TAMU.
- "Water Conservation and Utilization Project," David Knight, and Russell Baker, Big Spring, and Juan Enciso, Fort Stockton.
- "South Texas Farm and Ranch Show Water Screening Program," Sam Womble, Victoria.
- "Sustainable Agriculture Approaches to Pasture Management," Dwight Sexton, Gonzales, Lytle Arche, Caldwell County, and Travis Franke, Guadalupe County.
- "Evaluation of Conservation Tillage Systems and Development of Best Management Practices," Charles Stichler, Uvalde, and Michael Kuck, Luling Foundation Farm.
- "Wagon Wheel Ranch Demonstration Area," Charles Hart, Fort Stockton.
- "Innovative Technology for Economic and Environmental Nitrogen Management," Mark McFarland, Robert Lemon, and Frank Hons, Texas A&M University (TAMU).

TWRI Project Studies Methods to Assess Sources of Sediment Loads to East Texas Surface Waters

In an effort to learn more about the sources and transport pathways of sediments in rivers, Texas A&M University graduate student Kevin Yeager is carrying out a study funded by the Texas Water Resources Institute and other sources.

The project, "Resolution of Fluvial Sediment Sources, Residence Times and Resuspension Using Lithogenic, Atmospheric and Cosmogenic Radionuclides," is coordinated with Texas A&M University–Galveston researcher Peter Santschi and Bruce Herbert of the Texas A&M University Geology Department.

In this study, Yeager collected samples from the lower basin of Bayou Loco, a small, managed watershed near Nacogdoches, TX. Samples include soil cores from topsoils, upland areas, and floodplains, as well as suspended or colluvial sediments.

To-date, Yeager has completed all of his fieldwork and much of the laboratory analyses. The lab work entails processing, and dividing all samples into aliquots for gamma counting, determining organic carbon levels, and plating Thorium and 210Pb isotopes. Much of the work has concentrated on "wet chemistry" analysis.

According to Yeager, preliminary results from this study are promising. Fractionation has been observed between Ra/Th isotope ratios with depth in soil profiles of the basin, thus allowing distinctions to be made between surface and subsurface sediment sources. Modeling of how surface and subsurface soils contribute to sediment loads in the stream shows that the fluvial system has stronger coupling between hill slopes and channel processes than surface geomorphology would suggest. Land use (agriculture and rangeland) in the basin has a strong influence on the relative importance of the two sources spatially with down-reach distance.

Ongoing work is focused on the tracing of suspended sediments to determine these relationships for suspended sediments in Bayou Loco. Yeager is also characterizing several of these isotope ratios with respect to variability in source sediment metal contents (iron, magnesium, and aluminum).

In several Texas regions such as Nacogdoches, local citizens and irrigators depend on surface waters, because high concentrations of iron and salinity are found in the area's groundwater resources. Insights into the relationships between land use, erosion, and sediment loading will help develop sustainable land use management practices for agriculture and other activities. Implementing the concepts of radionuclide fingerprinting is one way to address and assess the impacts of sediments on water quality in reservoirs and watersheds.

Notes: This project was funded by TWRI, the Geological Society of America, the Gulf Coast Association of Geological Sciences, and Texas A&M University. TWRI funding for this project ran from March 2001 to March 2002. For more details, contact Yeager at yeagerk@tamug.tamu.edu.

Examining How Congressional Hearings Have Influenced Water Resources Policy Issues

Researchers: Bob Perry, Kelly Tzoumis, and Yoriko Yamao, Political Science Department, University of Texas–Permian Basin, Odessa, TX.

Problem: Since 1789, the United States Congress has been a place where federal policies have been debated and created in nearly every issue, including water resources and the environment. One way to analyze how Congress deliberates and arrives at decisions about these issues is to study the composition and actions of Congressional hearings over time. Understanding the workings of these hearings can provide insights into how Federal policies are now being created, and how they will likely be crafted in the future.

Objectives: To examine Congressional hearings dealing with water policy from 1789 to 1997, with an emphasis on understanding how the tone of these hearings has changed over time.

Methodology: The database used for this study was the Congressional Information Service on CD-ROM, which covers hearings for the study period (1789 to 1997). The database was searched for the keyword "water." Results showed that 278 hearings were conducted, during which 3,765 witnesses testified. A member of the research team coded data from each of these hearings. Some of the ways in which the data were sorted include describing the tone of what was discussed and who was testifying. Other classifications delved into the nature of the hearings (whether they were part of a Congressional committee or subcommittee, and if they originated in the Senate or House). Efforts were made to determine if the structure of these hearings and their work could be empirically, or statistically, quantified through the use of predictive computer models. Attempts were made to correlate the tone of hearings and committees and the subjects testified about by witnesses, using such statistical methods as Chi Square, Cramer's V, and Goodman and Kruskal's tau.

Results: Two distinct eras were identified in which different paradigms of Congressional water policy are evident: Water development interests dominated during Era I (1789 to 1971), while environmental protection and Indian water rights emerged as major issues during Era II (since 1971). During Era I, there were no Congressional committees charged with the responsibility for environmental protection and only 5% of all hearings touched on environmental-related concerns. Irrigation, water development, and public works were the major topics discussed during Era I, with most of these efforts overseen by the Senate Irrigation and Reclamation Subcommittee. Most of the people witnessing at hearings from Era I were from the Western states. During Era II, the dominant forum for Congressional hearings on water issues switched to the Senate Energy and Natural Resources Committee and the Senate Indian Affairs Committee. Correspondingly, the tone of the committees during Era II converted from an emphasis on water development to one centering more on environmental-related and Indian water rights issues. However, some matters remain fairly constant between the two eras. For example, the percent of the hearings held in the Senate and the House did not change dramatically across eras, nor did the percentage of males and females that testified. Statistical analyses suggest that Congressional committees often use hearings to garner support for views they already hold. The research shows that people and organizations who felt their views were under-represented in hearings often shopped for a new venue or committee that would listen to their concerns. Perry suggests that a viable strategy that will likely be used in the future is that special interest groups will seek committees where their points-of-view are welcomed, even if these committees may not seem to be the most logical place to hear these arguments or if they are not the venues that have traditionally dealt with these matters in times past.

Reference: Perry, B., K. Tzoumis, and Y. Yamao., "Defining Water Policy in Congress: How Has it Changed from 1789 to 1997?," in press.

Note: For details, contact Perry at (915) 552-2343 or perry_r@utpb.edu.

Estimating Recharge to the Middle Trinity Aquifer Using Water Level Fluctuations

Researchers: Marshall Jennings, Chad Thomas, John Burch, Brian Creutzburg, and Lance Lambert, Edwards Aquifer Research and Data Center, Southwest Texas State University, San Marcos, TX.

Problem: The Trinity Aquifer of South Central Texas is an important and unique source of water in the Hill Country (which includes parts of Kendall, Kerr, Gillespie, Hays, Comal, Bexar, Travis, Medina, Blanco, and Bandera counties). The region includes about 4,500 square miles and is included in a Priority Groundwater Management Area, as defined by the Texas Natural Resource Conservation Commission (TNRCC). All of the counties (except Travis) have either formed groundwater conservation districts or are attempting to do so. Several groundwater districts have formed the Hill Country

Groundwater Districts Alliance as an efficient means of working together to conserve and preserve aquifer resources in the region.

Objectives: To explore the utility of recharge calculation to the Middle Trinity Aquifer in the region, based on water-level changes and the determination of storativity in a network of observation wells scattered throughout the region.

Methodology: A theoretical model of the amount of groundwater in the Middle Trinity Aquifer was developed that defines the volume of water as the result of three factors—aquifer storativity, the surface area overlying the aquifer, and the average increase or decrease in head. Water levels were obtained at 23 sites throughout the region. Six recording wells were operated in Gillespie, Hays, Bandera, and Kendall counties. Information from monitoring wells established by the SWT Edwards Aquifer and Data Center was transmitted via telemetry to computers at the university. Non-recording well sites established by the Texas Water Development Board (TWDB) were used to provide additional information. Data were obtained throughout 1999-2000. The purpose of this monitoring network is to learn more about water-level changes in the aquifer, in order to determine a more accurate recharge to the groundwater system.

Results and Discussion: The changes in water levels were mapped to determine if patterns or trends were occurring. Significant water level changes, associated with recharge, were noted in areas near cities where heavy pumping of groundwater is taking place. This might imply that recharge, in some parts of the study area, is related to the available storage space for water in the aquifer. Recharge estimated through this project was shown to be somewhat less than average values obtained by earlier modeling work by TWDB and other agencies. This may be a result of the fact that less rainfall than normal occurred during the study period, or because more monitor wells are needed to accurately reflect conditions in this complex groundwater system.

Reference: Jennings, M., C. Thomas, J. Burch, B. Creutzburg, and L. Lambert, Estimation of Recharge to the Middle Trinity Aquifer of Central Texas Using Water-Level Fluctuations (TR-185), TWRI, 2001.

Notes: Information about this project can be viewed on the EARDC website, http://www.eardc.swt.edu/tarp/tarp.htm. Since this project was completed, SWT gathered follow-up funding from other agencies, including the San Antonio River Authority, to expand the monitoring well network. Jennings can be contacted at (512) 245-2329 or mj09@swt.edu.

A Limnological Comparison of Two Freshwater Springs in the Chihuahuan Desert

Researchers: Donna Hamilton and Magaly Rincon, Biology Department, Midwestern State University, Wichita Falls, TX.

Problem: The Dalquest Desert Study Site (DDSS) lies within the Chihuahuan Desert of Texas, and is adjacent to the Big Bend State Park. The site is considered a pristine desert ecosystem, is private property, and has been protected from ranching and agriculture for the past 60 years. Consequently, this site and the waters found within it are considered to be a relatively pristine desert ecosystem. There are three known sources of water within the DDSS–Fern Springs, Willow Pool, and an unnamed spring. However, the origins and hydrology of these springs are not well-known. Better understanding of the hydrology of this region will aid in the management of this ecosystem.

Objective: To utilize limnological and biotic parameters to compare Fern Spring and Willow Pool.

Methods: Chemical and biotic surveys of the two water bodies were conducted. In the limnological survey, samples were collected from both pools five times. The water bodies were divided into quadrants. Random samples were taken from each quadrant and were evaluated for water pH, temperature, and depth. Sediment samples were also taken from each site for later particle size evaluation. Water samples from each pond were tested for the presence of dissolved oxygen, phosphates, total chlorine, sulfides, free chlorine, total alkalinity, hardness, nitrates, and nitrites through the use of colorimetric test kits and strips. A vegetation survey was conducted by collecting one specimen of each of the different species of plants present within a one-meter radius from the edge of the water bodies. Collected plant specimens were dried and identified to the lowest level possible using standard keys. Using nets, forceps, and other standard equipment, invertebrates were collected and later placed in a 70% ethyl alcohol solution for permanent preservation. Since the water bodies are small, a complete population count of each species was not attempted. However, each species collected was identified and compiled on a species list for each water body. Bacteria collected from both water sources were also analyzed.

Results and Discussion: A major finding of this study is that Fern Spring is a freshwater spring, while Willow Pool is a spring-fed playa lake. Hamilton found there was a strong linear relationship between the water and air temperature of both water bodies. From this project, it was concluded that the water temperature of both Fern Spring and Willow Pool was dependent on air temperature. Of the invertebrate species collected and compiled, 20 species were found in both waters. Of the 12 plant species found from Fern Spring, and the 15 found around Willow Pool, only 4 species were found at both sites. Of the bacteria samples collected, four species were shared between Fern Spring and Willow Pond making the resulting coefficient of community 33%.

Reference: Hamilton, Donna, "A Limnological Comparison of Two Freshwater Springs in the Chihuahuan Desert," Masters Thesis, Midwestern State University, 2001.

Note: For more information, contact Magaly Rincon at (940) 397-4254 or magaly.rincon@mwsu.edu.

Macrobenthic Community Structure in the Neches River Before, During, and After Implementing the Clean Water Act

Researchers: Richard C. Harrel and Shawn T. Smith, Biology Department, Lamar University, Beaumont, TX.

Problem: The Neches River is used by industries, citizens, and irrigation for rice farming and several other agricultural purposes. After World War II, more than 30 large refineries and petrochemical plants were constructed along the Neches, thus potentially adding to the pollution problems. In 1972, the United States Congress instituted the Clean Water Act (CWA), which utilized a three-phase plan to reduce pollution and, ultimately, make surface waters swimmable and fishable. After phases I and II were initiated, studies were conducted to evaluate and assess the success of the pollution abatement. However, no such qualitative study has been conducted since 1985 to assess the work of phase III.

Objective: To observe changes in the macrobenthos community structure of the Neches River since the implementation of Phase III of the Clean Water Act, and to compare these findings with results of studies to evaluate the effect of Phase I and II of the Act on water quality and the environment.

Methods: The community structure of macrobenthos in the industrialized, tidal, segment of the Neches River was studied 12 years after implementation of Phase III of the Clean Water Act. Data for the current study was gathered from 1999 to 2001. Results were compared to a 1971-72 study that was conducted before phase I of the CWA was implemented, and a 1984-85 project that was carried out after phases I and II of the Act were implemented. A total of 50 taxa were collected during the 1971-72 study, 104 in 1984-85, and 110 in the most recent investigation.

Results and Discussion: The permitted waste load, in terms of biochemical oxygen demand or BOD, decreased between the 1971-72 and 1984-85 studies, but then increased 19% from that period to the current project. The numbers of taxa that were collected at each station increased by a factor of 2 between the 1971-72 and 1984-85 studies. However, they were not statistically different between the 1984-85 project and the current study. Minimum collection densities in 1984-85 were greater than maximum values gathered in 1971-72. However, results from the 1984-85 project and the current study were not significantly different. Shannon's annual and station collection diversity values increased significantly between the 1971-72 and 1984-85 studies. From 1984-85 to the present, these values did not increase greatly. The dominance of Limnodrilus

hoffmeisteri (an aquatic worm) and depressed oxygen concentrations indicated evidence of some organic enrichment at upper ends of this river system.

This study suggests that water quality has greatly improved at several portions of the Neches River between 1972 and 1984, due in large part to Phases I and II of the Clean Water Act. However, implementation of Phase III of the Act has only resulted in modest improvements in the ecosystem.

Reference: Harrel, Richard, and Shawn Smith, "Macrobenthic Community Structure Before, During, and After Implementation of the Clean Water Act in the Neches River Estuary (Texas)," Lamar University Biology Department Report, 2000.

Note: For details, contact Harrel at Lamar University at (409) 880-8255.

Treating the Water Quality of Lake Houston through the Use of Nanofilter Membranes

Researchers: Shankar Chellam, Ramesh Sharma, and Grishma Shetty, Civil Engineering Department, University of Houston, Houston, TX; and Ying Wei, City of Houston Water Department, Houston, TX.

Problem: Currently, much of the greater Houston area still relies heavily on groundwater supplies, despite the fact that overpumping of groundwater has resulted in subsidence in the region. However, several factors limit the increased use of surface water in the Houston area, including a lack of distribution systems and related infrastructure and, in some cases, poor quality water. The waters of Lake Houston suffer from high levels of turbidity, total organic carbon, and nutrients. Still, if this water could be properly treated, Lake Houston could contribute to the water supply of the North Houston region. Currently used chemical-intensive methods to treat surface waters like Lake Houston have been shown to result in potentially harmful drinking water by-products like trihalomethanes. On the other hand, the use of pressure-driven membranes may treat surface waters and reduce the formation of disinfection byproducts.

Objectives: 1] To develop and evaluate scale-up procedures that may be used to evaluate how well nanofilter membranes treat surface waters; 2] To conduct simulations that mimic how well membranes would treat the waters of Lake Houston, and 3] To determine how levels of natural organic matter in Lake Houston waters change following membrane treatment.

Methods: A simplified integral computer simulation model was developed to assess changes in permeate water quality that are expected to result from membrane treatment of Lake Houston waters. Mass transfer coefficients were evaluated. Raw water samples were taken from Lake Houston. Experiments were carried out using both Lake Houston waters as well as synthetic nanopure or ultrapure water created in the laboratory that was

fortified with organic compounds. All the experiments were carried out using quality assurance and quality control procedures approved by the United States Environmental Protection Agency. Bench-scale experiments were carried out using nanofilters. Water quality analyses were conducted for such parameters as pH, conductivity, sodium, dissolved organic carbon, anions, hardness, alkalinity, free chlorine, ammonia, and disinfection byproducts. The formation of trihalomethanes, disinfection byproducts, and chlorination solvents was evaluated.

Results and Discussions: The computer model was able to accurately quantify and simulate rejection rates of natural organic matter and disinfection by-product precursors that result from the use of nanofilters to treat Lake Houston waters. The results suggest that the use of nanofilters are likely to limit the production of organic precursors which can, in turn, create disinfection byproducts. The research also shows that surrogates can be used to simulate or predict the likelihood that disinfection byproducts will be formed, thus creating a simple, rapid and accurate method to determine potential health risks associated with surface water treatment. From a practical perspective, this study confirms that nanofiltration offers great promise for removing a variety of dissolved chemical constituents from surface waters, including natural organic matter. At the same time, this treatment method can lessen the formation of disinfection byproduct precursors. This project also developed procedures that can be applied to better determine the effects of membrane treatment on Texas surface waters with similar water quality challenges. This study only evaluated improvements in water quality that nanofiltration membranes could provide. Membrane fouling, which sometimes limits the implementation of nanofilters, was not explicitly considered in this study.

Reference: Chellam, S., R. Sharma, G. Shetty, and Y. Wei, Quality and Membrane Treatability of the Lake Houston Water Supply, TWRI Technical Report 186, October 2001.

Texas A&M–International University Drought Center Broadens Scope, Changes Name

Texas A&M International University (A&M–International) has broadened the scope of its Drought Relief Information Center to better address environmental issues.

Kenneth J. Tobin is the Director of the A&M–International Center for Earth & Environmental Studies (CEES). He feels that the newly reorganized Center will be better able to address a wider range of water resources issues.

“The mission of CEES is to qualify water quantity and quality in the South Texas region and to address current environmental issues in the A&M–International service area,” Tobin said. “Water availability is the fundamental constraint on economic growth in this region and the Center is equipped to tackle this issue. The Center is focusing on researching reliable water resources for Laredo and the surrounding area.”

Currently, the Center is involved in two main projects: the installation of 25 environmental monitoring stations (EMS), and the development of a radar system.

Currently, there are 20 EMS units throughout Webb County and surrounding areas. An EMS is a data collection system that is mounted on a long pole. The stations measure rainfall, temperature, relative humidity, and soil moisture, acquiring data every 15 minutes. The logs are collected monthly and downloaded to the Center's website.

A radar system has also been established, using refurbished National Weather Service (NWS) equipment.

"The radar can register rain every six minutes, so if there is a storm or a hurricane, the Center might take more in-depth data than planned bi-weekly downloads. We still have a little bit more tweaking to do until I'm satisfied, but the radar station is now operational," Tobin said.

With the data collected from the EMS units and the radar, the Center will collect monthly weather data and generate bi-weekly radar precipitation estimate maps. Tobin says the Webb County maps, which will soon be on the website, will be valuable for water resources managers in the region.

The Center was established in 1998. To learn more, contact Tobin at (956) 326-2496 or ktobin@tamiu.edu, or visit the Center's website at http://www.tamiu.edu/cost/drought.

SWT Researchers Examine Effect of Freeway Runoff on Stream Water Quality, Aquatic Organisms

Researchers and graduate students with Southwest Texas State University recently completed a study to assess whether runoff from Interstate Highway 35 near San Marcos may adversely impact water quality.

The project was done under contract for the Texas Department of Transportation (TXDOT) and was managed by the SWT Edwards Aquifer Research and Data Center. Project leaders include SWT Director Glenn Longley and staff members Joe Guerrero and Victor Castillo.

The goal of the study was to establish a baseline of water quality in the river during dry and wet conditions upstream and downstream of the river, as well as to analyze contaminant properties that are present in highway runoff. The study will be used to determine the effectiveness of water quality protection measures now being constructed to filter highway runoff after widening of the Interstate 35 freeway is completed.

In this project, the research team assessed the effect of pollutants on fathead minnows (Pimpahles promelas), water fleas (Ceriodaphnia dubia), and the fountain darter (Etheostoma fonticola) during dry and wet-weather conditions. Tests were conducted throughout 2001 to determine if contaminants in these waters were toxic to the test organisms. Efforts were made to pay careful attention to the first flush of pollutant runoff, which is likely to contain the greatest level of pollutants.

For additional information, contact Longley at (512) 239-4799 or GL01@swt.edu.

TWRI Reports Address Membrane Treatment, Monitoring Groundwater Systems

The Texas Water Resources Institute recently published two new technical reports that can be obtained free as long as supplies last.

Quality and Membrane Treatability of the Lake Houston Water Supply (TR-186) was co-authored by Shankar Chellam, Ramesh Sharma, and Grishma Shetty (all with the University of Houston), and Ying Wei of the City of Houston. The report describes research to evaluate the use of membrane treatment of Lake Houston waters.

Estimation of Recharge to the Middle Trinity Aquifer of Central Texas Using Water-Level Fluctuations (TR-185) was co-authored by Marshall Jennings, Chad Thomas, John Burch, Brian Creutzburg, and Lance Lambert. The report describes efforts to better monitor the Middle Trinity Aquifer to gather information about changing trends in water levels.

In addition, TWRI is now posting brief progress reports about several Institute-funded projects on its World Wide Web site.

These new reports can be viewed on the “Research Reports” portion of the TWRI WWW site, http://twri.tamu.edu/reports/.

These reports include the following: *Rapid Risk Assessment of Watersheds and Dams using Geographic Information Systems (GIS) and Modeling* by Jacquelyn Duke, Joseph White, and Peter Allen; *Effects of Nursery Environmental Cycles on Larval Red Drum (Sciaenops ocellatus) Growth and Survival*, by Rafael Perez-Domínguez and Joan G. Holt; and *Pimephales promelas and Laboratory Bioassay Responses to Cadmium in Effluent-Dominated Systems*, by Bryan W. Brooks, Jacob K. Stanley, Jessica C. White, Philip K. Turner, Duane B. Huggett & Thomas W. LaPoint.

TWRI Monthly Seminar Broadcasts Can Now Be Viewed Live Through the Internet

People who have an interest in hearing and seeing a monthly discussing about the research program of the Texas Water Resources Institute (TWRI) can now participate by using the Internet to view these broadcasts at their desktops

For more than a year, TWRI has sponsored monthly seminars in which researchers and graduate students have presented the results of studies funded in part by the Institute. However, until recently the only way to view these broadcasts was to physically go to a site that was capable of receiving a Texas A&M University Trans-Texas Video Network (TTVN) broadcast.

However, thanks to the TTVN staff, these broadcasts are now being transmitted live over the Internet. People with computers that are equipped with a connection to the Internet and the latest version of Real Player software can now participate in the broadcasts from any remote location. The broadcasts are being archived so they can be viewed over the Internet at a later date.

In February 2002, the first broadcast that was shown using this technology was a presentation by Rafael Perez, a graduate student TWRI is funding at the University of Texas Marine Science Institute at Port Aransas.

THECB Awards 23 Water Resources Research Grants Worth $3.9 Million to University Researchers throughout Texas

In 2001, the Texas Higher Education Coordinating Board awarded 23 grants for research projects totaling roughly $3.9 million that deal with water resources and environmental issues.

15 water resources-related projects totaling more than $2.56 million were awarded through the Board's Advanced Technology Program (ATP). Seven projects worth more than $850,000 were funded through the Advanced Research Program (ARP). Three Technology Development and Transfer Program projects were funded totaling roughly

$423,000. We have assembled this list of these projects, and will present summaries of several of them in future issues of New Waves. For details about these projects, visit the Board's website at http://arpatp.com.

Advanced Research Program (ARP)

Biological Sciences

- Ultraviolet Communication in Swordtails–Michael Ryan, Biological Sciences Department, the University of Texas at Austin (UT).
- Water Quality Issues: Real-time Assessment of Nutrients in Aquatic Systems–Thomas Chrzanowski, Biology Department, the University of Texas at Arlington.

Earth Sciences

- Geochemical Fate and Bioavailability of Arsenic in Pesticide-applied Soils: Phase I: In-Vitro Study–Dibyendu Sarkar, Environmental Geochemistry Lab, the University of Texas at San Antonio.
- Estimating Activities of H2O in the Earth's Mantle: A Comparison of Three Methods, Will Lamb and Robert Popp–Geology Department, Texas A&M University (TAMU).
- Characterizing Fault Control of Groundwater Movement Using Geophysical Techniques–Diane Doser, Geological Sciences the University of Texas at El Paso (UTEP).

Engineering

- Nanofabrication and Performance Evaluation of a New Class of Membrane Filters for Water Purification–Shankar Chellam, Civil Engineering Department, and Paul Ruchhoeft, Electrical Engineering, University of Houston,
- Physical Simulation of Extreme Winds from Thunderstorms– Chris Letchford, Civil Engineering Department, and Darryl James, Mechanical Engineering Department, Texas Tech University (TTU).

Advanced Technology Program (ATP)

Agriculture/Aquaculture/Agricultural Biotechnology

- Sustainability of Systems for Manure Export and Water Quality Improvements on Impaired Watersheds—Donald Vietor, Soil and Crop Sciences Department, and Clyde Munster, Agricultural Engineering Department, TAMU, and Anne McFarland, Texas Institute for Applied Environmental Research, Tarleton State University.
- Creating Drought-, Salt-, and Chilling Temperature-Tolerant Cotton for West Texas–Hong Zhang and Scott Holaday, Biology Department, TTU.

- Development and Use of Hypervariable DNA Markers to Enhance Aquaculture of Morone Hybrids—Delbert Gatlin and John Gold, Wildlife and Fisheries Science Department, TAMU.
- Drought-Tolerant Pines for Texas Forests–Carol Loopstra, Forest Science Department, TAMU.
- Irrigation, Remote Sensing and Tillage Management for Pepper and Cotton—Daniel Leskovar and Giovanni Piccinni, Texas Agricultural Experiment Station (TAES), Uvalde, TX.

Environmental Science and Engineering

- Improved Aquifer Characterization Using Hydraulic Tomography, Brann Johnson, Center for Tectonophysics, and Mark Everett, Geophysics Department, TAMU.
- Hydrology and Salinity Monitoring and Modeling Along the Middle Rio Grande—Ranjan Muttiah, TAES Blackland Research and Extension Center, and Seiichi Miyamoo, TAES El Paso.
- Phase Transfer Catalytic Process for In-Situ Remediation of Underground Contaminants—Larry Britton, Institute for Environmental and Industrial Science, Southwest Texas State University, and Gary Pope, Department of Petroleum and Geosystems Engineering, UT Austin.
- Removal of Trihalomethanes from Drinking Water by Co-metabolism in Nitrifying Biofilters—Gerald Speitel, Civil Engineering Department, UT Austin.
- Development of a High-Performance Airborne Remote Sensing System for Water Resources Research—Stephan Maas and Thayne Montague, Plant and Soil Science Department, TTU.
- A Real-Time Drought Assessment and Forecasting System for Texas Using GIS and Remote Sensing– Raghavan Srinivasan, Spatial Sciences Laboratory, TAES.
- Real-Time Distributed Modeling of Flood Events Using NEXRAD Precipitation Data–William Dugas, Blackland Research and Extension Center, TAES.
- Application of High-Activity Modified Green Rusts for Treatment of Water and Wastewater—Bill Batchelor, Civil Engineering Department, TAMU.
- Pretreatment for Reverse Osmosis Membranes: Silica Removal to Increase Yield in a Border Region—Desmond Lawler, Civil Engineering Department, UT Austin.
- Application of cell recognition technology to environmental studies of harmful algal blooms–Edward Buskey, Marine Science Institute at Port Aransas, UT Austin.

Technology Development and Transfer

Agriculture/Aquaculture/Agricultural Biotechnology

- Development of High-Yielding Drought Tolerant Cotton– Randy Allen and David Tissue, Biological Sciences Department, TTU.

Environmental Science and Engineering

- Extension of HF Radar for Water Currents and Direct Observation of Transport Model Coefficients—James Bonner, Blucher Institute for Surveying and Science, Texas A&M University–Corpus Christi, and Rosa Fitzgerald, Physics Department, UTEP.
- Quantum Cascade Laser Based Gas Sensors for Chemical and Environmental Analysis, Frank Tittel, Bioengineering Department, and Robert Curl, Chemistry Department, Rice University.

TWRI Project Studies Constructed Wetlands to Treat Wastewater from Small Community, Systems

A Texas A&M University graduate student is evaluating factors that may lead to the success or failure of constructed wetlands, as part of her Master of Science thesis. Amanda Richmond is studying in the Soil and Crop Sciences Department, working under the supervision of researcher Richard Weaver. In part, Richmond's graduate studies are supported by the Texas Water Resources Institute, which awarded her a $1,000 Mills Scholarship.

In her graduate work, Richmond is participating in a project to assess the performance of constructed wetlands for on-site wastewater treatment throughout East and Southeast Texas. Her studies are just one part of a much larger project Weaver is carrying out with funds from the Texas Natural Resource Conservation Commission through the Section 319 Program. That project involves TAMU researchers Bruce Lesikar of the Agricultural Engineering Department and Kevin McInnes of the Soil and Crop Sciences Department. Other cooperators include the Pineywoods RC&D in Nacogdoches and the Southeast RC&D in Livingston.

Richmond is comparing the performance of six wetlands that use tire chips as a filter medium, as well as six wetlands with gravel substrates. She is also comparing the effectiveness of two disinfection methods—ultraviolet light and chlorine. Finally,

Richmond is learning how variations in seasonal temperatures influence how well these OSSF systems treat wastewater.

Richmond's graduate research began in May 2001. Preliminary results suggest that the wetlands with tire chips may remove more phosphorus, in part because of the iron in the steel belts of recycled tires. Although the effluent from sites with tire chips was distinctly orange or reddish in color at first, and perhaps high in total suspended solids, water quality is gradually returning to more normal levels. Richmond also said that the wetlands with tire chips also appear to have reduced levels of fecal coliform bacteria.

Weaver says that, on a broad level, the idea of involving graduate students in studying real world problems provides a number of benefits. "Giving graduate students a hands-on role in taking part in a large project like this provides them with valuable experiences they will take with them once they've graduated," he said.

At the same time, supporting graduate studies like this one provides TWRI with an opportunity to support graduate students, to train future scientists, and to learn more about important water resources issues.

Note: Richmond can be contacted at mrichmond00@hotmail.com.

TAMU System, TWRI, UT, Team Up to Form Texas Watershed Consortium; Work to Improve Computer Models

A coalition of university and agency professionals is now undertaking efforts to develop improved computer modeling tools to better manage Texas' water resources.

In November 2001, funding was awarded from the U.S. Army Corps of Engineers to the Texas Watershed Consortium. The Consortium includes scientists and engineers with various components of the Texas A&M University System (the Texas Water Resources Institute, the TAMU Civil Engineering Department, the Blackland Research and Extension Center at Temple, and the Spatial Sciences Laboratory). The Consortium also includes researchers with the Center for Water Research at the University of Texas at Austin (UT) and the Corps of Engineers Fort Worth District Office.

The overall goal of this project is to determine if existing computer modeling frameworks, including the Soil Water Assessment Tool and the Water Rights Analysis Package (WRAP), can be improved to provide water resources managers with improved analytical tools to better manage water resources. For example, researchers in the TAMU System will enhance SWAT so it can incorporate current or "real time" weather information into predictions of runoff and floods. At the same time, TAMU Civil Engineering Department researchers will further improve WRAP so that program can better evaluate the effects of reservoir operation rules, salinity, drought, and water rights, on the reliability of water supplies. Meanwhile, researchers at UT will create an

integrated geospatial database and modeling environment called the Texas Integrated Water Simulation System or TIWSS. TIWSS will store and geospatial and temporal water resources and environmental data from throughout Texas, so they can be used with WRAP, SWAT, and other models.

Note: TWRI will manage the project and coordinate efforts to communicate research results. To learn more about this project, contact TWRI Communications Manager Ric Jensen at (979) 845-8571 or rjensen@tamu.edu, David Maidment at UT CRWR at (512) 471-3131 or maidment@mail.utexas.edu, Raghavan Srinivasan at the Spatial Sciences Laboratory at (979) 845-5069 or srin@brc.tamus.edu, or Muttiah at the Blackland Center at (254) 774-6000 or muttiah@brcsun0.tamu.edu.

Texas A&M Graduate Student Studies In-Stream Flow Issues in Sulphur River Basin, with Assist from TWRI

Texas A&M University (TAMU) graduate student Christine Burgess is conducting research on instream flow issues associated with the Sulphur River, with the aid of funds provided by the Texas Water Resources Institute (TWRI). A graduate student in the TAMU Wildlife and Fisheries Sciences Department, Burgess is working under the direction of researcher Frances Gelwick.

The emphasis of Burgess' graduate study centers on the effects of physically-altered riverine habitats, specifically in the Sulphur River, on fish populations.

The Sulphur River system, in East Texas, consists of the North, Middle, and South Sulphur Rivers. These forks combine to form the main Sulphur River. Since the 1930s, this river has been substantially modified by such man-made actions as the channelization of the north and south forks and the main stem of the river, as well as levee construction. At one time, before the watershed was altered, the Sulphur River system was an interconnected network of streams. Now, the ecosystem is fragmented and some streams in the watershed flow only during wet weather seasons. The fragmentation has also resulted in the loss of spawning grounds and refuge areas.

Burgess graduate study is being carried out in cooperation with the Texas Water Development Board (TWDB). In this project, Burgess is documenting fish assemblages and studying how fish populations are associated with habitat traits upstream and

downstream of the proposed reservoir sites. By doing this, she will be able to assess the instream flows needed by key fish species during various times of the year.

Her experiments study comparing fish assemblages in channelized and unchannelized or undisturbed portions of the river. Fish use a range of habitats during their various life stages for refuge, foraging, and reproduction. The capacity and availability of these different river habitats will affect overall species survival and composition. Burgess will calculate an index of biotic integrity to determine the relative "health" and diversity of fish assemblages throughout the watershed, in comparison to regional reference sites. This will be done using standardized metrics recently developed by the Texas Parks and Wildlife Department.

The study is timely because TWDB has identified a site in the Sulphur River basin as the location for a new dam, the George Parkhouse Reservoir, that would supply water to Dallas. The reservoir site is between Cooper Lake and the confluence of the North and South Sulphur Rivers in Hopkins and Delta Counties.

Note: Burgess received a TWRI Mills Fellowship in 2001. To learn more about this project, contact Burgess at (979) 847-9335 or Fishaggie@aol.com.

TAMU Project Incorporates Salinity Considerations into WRAP Models

A TWRI-funded research project is helping a Texas A&M University graduate student examine how to incorporate salinity problems into water modeling efforts.

Graduate student Richard Hoffpauir of the Civil Engineering Department is one of 11 students who received TWRI research grants in 2001. His major professor is Ralph Wurbs.

In this project, Hoffpauir is working with Wurbs to incorporate issues associated with salinity in evaluating and modeling the availability of water rights. Most of the work focuses on modifying the Water Rights Analysis Package (WRAP) model Wurbs developed to better deal with issues associated with saline surface waters.

So far, work on the WRAP model has stressed modeling the extent to which waters may be available at specific points in a watershed, based on hydrologic and water use data.

Recently, Wurbs and a team of graduate students have worked to improve the model by incorporating new features, including assessing how salinity constrains usable water supplies, and, in a different project, examining conditional water availability.

In this project, Hoffpauir is developing new computer codes for WRAP, using FORTRAN, that address issues related to salinity. He is also reviewing research that

TAMU conducted throughout the 1990s that examined how salinity may affect reservoir operations.

Note: Hoffpauir was awarded a TWRI research grant through the National Institutes for Water Research program that is funded through the U.S. Geological Survey. In the future, TWRI will likely publish a technical report based on his studies. For more information on this project, contact Hoffpauir at (979) 845-9664 or richpauir@aol.com.

TAMU Graduate Student Investigates Arsenic Levels in South Texas Streams

Texas A&M University graduate student Graciela Lake is now investigating the effects of arsenic and water quality on South Texas watersheds. The project is supervised by researcher Bruce Herbert of the TAMU Geophysics Department.

During the 1960s and 1970s, open pit mining in South Texas released uranium, arsenic, and other elements into the watersheds of the Nueces and San Antonio rivers. Concerns exist about the continued contamination of surface waters and surrounding environments by these elements. Lake's studies focus on quantifying the bioavailability of arsenic in different geologic environments of watersheds in the region.

Lake is now building a unique sampling device that will aid in quantifying potentially available arsenic in natural ecosystems. The device, which contains liquid chromatography resins, will be buried at several field sites where they will be left to interact with soils and waters over various time intervals. She is using resins as chemical assays in hopes they will, in a sense, mimic microorganisms and aquatic and riparian plants in the environment that are at risk of taking in arsenic-related compounds.

So far, Lake has made several sampling trips to survey the area and collect soil and water samples. She is now conducting soil analyses and setting up soil microcosms that will later be compared to field results. The microcosms will be spiked with various concentrations of arsenate and be allowed to equilibriate. Then, Lake will introduce a small version of her sampling device to these contaminated environments. Concurrently, Lake will take away the resins and record the amount of arsenate they removed from the ecosystem.

"I will be using the resins as 'mimic organisms' to look at some of the geologic and geochemical mechanisms that control bioavailability," Lake said. "This is important for water quality. If there is arsenic available to plants, humans, and other organisms, we can potentially measure the levels of arsenic and remediate the problem."

Note: Lake received a TWRI Mills Scholarship to support her graduate research. For details, contact Lake at (979) 845-9683 or graciela@tamu.edu.

TWRI Project Investigates Policies to Preserve Habitats, Encourage Groundwater Marketing

Exploring whether landowner cooperatives could be a policy tool to protect water rights is part of the research being undertaken by Texas A&M University graduate student Matt Wagner. Wagner, a graduate student in the Urban and Regional Planning Department, is funded in part by a TWRI Mills Scholarship.

Besides attending graduate school, Wagner works for the Texas Parks and Wildlife Department (TPWD). Jon Rodiek of the Urban and Regional Planning Department and Ronald Kaiser of the Recreation, Parks, and Tourism Sciences Department serve on his graduate committee.

Wagner's graduate studies focus on whether voluntary wildlife management associations (WMAs), or cooperatives, could be a strategy to protect water rights and flows. In basic terms, the WMA program allows landowners to form cooperatives to maintain or enhance wildlife habitats, or to provide other ecological benefits. Each WMA develops a management plan that states tasks the association will undertake to improve the environment. Options WMAs can utilize include measures to increase streamflows, brush control to boost water yields, and lessening erosion.

Individual properties under a TPWD management plan may qualify for wildlife management property tax valuation, and not be classified as agricultural lands. Each county tax appraisal office may allow or deny the approval of wildlife use for properties within its boundaries. So far, more than 4,000 landowners have enrolled roughly 1.5 million acres in some form of WMA.

Wagner is working with the Harvey and Mid Trinity Basin WMAs and other East Texas cooperatives. He is investigating if the sales of water rights, based on sustained aquifer

yields, may help reduce land fragmentation by financing habitat restoration activities. Wagner wants to determine if WMAs may benefit from voluntarily restricting groundwater pumping within an association's boundary. He then wants to examine the economic benefits that may result if limited groundwater withdrawals could be transferred to higher valued uses.

"The problem is that rural lands are becoming increasingly fragmented, but the solution may be the use of WMAs to keep these habitats intact," Wagner says. "If we can develop policy tools to lend needed financing to these cooperatives, we could create strategies to preserve open space and wildlife habitat, while providing needed water through a free market system."

Note: For details, contact Wagner at mwagner@tamu.edu.

New TWRI Staff Member to Assess TAMU Water Resources Academic Programs in Develop Educational Materials

A new project of the Texas Water Resources Institute aims to assess the feasibility of graduate academic programs in water resources at Texas A&M University.

Valeen Silvy, who recently earned her Ph.D. in the Planning Department at the University of Texas at Austin, joined TWRI in January 2002. Much of her work focuses on developing a proposal and recommendations about how TAMU could develop interdisciplinary Master's and Doctoral programs with a water resources emphasis that could lead to majors, minors, and certificates in water resources fields. The TAMU Office of Graduate Studies funds this component of her work.

Efforts in this project include assessing the research and teaching interests and capabilities of efforts of various academic departments at TAMU that touch on water resources issues, and identifying how other universities have developed similar intercollegiate programs. If all goes well, Silvy hopes to create a proposal that could be presented to TAMU leadership by early 2003.

Another area that Silvy is engaged in focuses on water resources education. She is working with Bruce Lesikar of Texas Cooperative Extension (TCE) to develop a comprehensive resource to discuss a range of issues associated with the formation of groundwater districts. Publications will incorporate such issues as the powers and duties of these districts, the basics of hydrology and aquifers, and an overview of Texas water law. The materials will also present information on frequently asked questions often posed when groundwater districts are being considered. This part of Silvy's work is funded by TCE.

TWRI Offers Training for Small Water Systems

The Texas Water Resources Institute (TWRI) recently began what is hoped to be a series of activities to provide training and education to personnel who work with small water systems.

In October and November 2001, TWRI cooperated with the Texas Rural Water Association (TRWA) to offer one-day training workshops in Austin and Overton. The workshops provided hands-on training how to help professionals with small water systems cope with issues associated with cross-connection, backflow prevention, and how to conduct a customer service inspection.

Speakers at these workshops included staff members from TRWA and regulatory personnel from the Texas Natural Resource Conservation Commission. In addition, TRWA distributed printed materials at the workshops, including a handbook titled "Customer Service Inspection and Cross Connection Control."

Funding for this program is provided through the Technical Assistance Center (TAC), which is headquartered at the Mississippi State University Water Resources Research Center. In the near future, TWRI intends to offer similar workshops, this time focusing on issues associated with the control of pathogens and fecal coliform bacteria in small water systems.

Notes: To learn more about this small grants program, visit the TAC website at Mississippi State at http://www.tac.msstate.edu. To learn more about the excellent work of TRWA in providing training for small water systems, visit their WWW site at http://www.trwa.org.