New Waves
The Research Newsletter of the Texas Water Resources Institute
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TWRI Awards 17 Mills Scholarships to TAMU Graduate Students for Water Resources Research

The Texas Water Resources Institute (TWRI) recently awarded 17 grants to support graduate students researching water resources-related issues at Texas A&M University (TAMU).

The students were funded through the TWRI Mills Scholars Program, which uses an endowment to support graduate student research in water resources at TAMU. Each of the 17 graduate students supported through this program will receive tuition assistance grants of $500 in the fall of 2002 and $500 in the spring of 2003. More than 45 graduate students from 11 academic departments and Texas A&M University–Galveston applied for this competitive grants program.

Photo courtesy of April Hennebeck/ TAMU

April Hennebeck (shown above) is a graduate student in the TAMU Wildlife and Fisheries Sciences Department. She was awarded a TWRI Mills Scholarship Program in 2002.

"The Mills Scholarship Program provides a way to help increase graduate student and faculty participation in water resources projects throughout Texas A&M University," said TWRI Director C. Allan Jones. "By providing funds of this sort, we can help strengthen water resources studies in such diverse areas as efficient irrigation, pollution prevention, rangeland management, aquatic ecosystems, and many other fields."

This year's program funded five graduate students in Wildlife and Fisheries Sciences, four students in Soil and Crop Sciences, three students in Biological and Agricultural Engineering, and two students in Rangeland Ecology and Management. One graduate student was funded in each the following departments: Civil Engineering, Entomology, Horticulture, and Forestry.

Students awarded TWRI Mills Scholarships for 2002-03 include the following:

- Biological and Agricultural Engineering Department—Jason Afinowicz (graduate student) and Clyde Munster (researcher); Joshua Peschel (graduate student) and Ronald Lacey (researcher); and Chad Richards (graduate student) and Clyde Munster (researcher);
- Civil Engineering Department—Michael Sterling (graduate student), and James Bonner (researcher);
- Entomology Department—Jeremiah Dye (graduate student) and Kevin Heinz (researcher);
- Horticulture Department—Libbie Johnson (graduate student) and Daniel Leskovar and Frank Dainello (researchers);
- Rangeland Ecology and Management Department—Randy Mayer (graduate student)

See Mills Scholarships (page 12)

TWRI Grants Lead to More Funding

Many of the grants offered by the Texas Water Resources Institute (TWRI) provide seed money that results in larger efforts. In many cases, grants awarded by TWRI leverage water resources research by faculty and graduate students to expand or extend their studies.

Recently, we learned that, in at least two cases, small grants provided by TWRI helped create significantly larger opportunities for the

UH researcher Shankar Chellam and Ying Wei of the City of Houston near Lake Houston.

See Follow-Up (page 12)

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ABSTRACTS

Analyzing Policy Issues to Manage Groundwater Supplies Between Texas and Mexico

Researchers: Daniel Stein and David Eaton, the Lyndon B. Johnson School for Public Affairs, the University of Texas at Austin (UT).

Problem: Texas and Mexico share five major aquifers. These water supplies are being mined by Mexico and the United States as each country tries to meet its water needs. As populations continue to grow in the areas surrounding these aquifers, both countries are using the aquifers without joint monitoring, management, or regulation. In the future, groundwater policies between the two countries will need to be developed to allocate and preserve these aquifers. This project does not advocate a transboundary groundwater policy for Mexico and the United States, but does suggest groundwater policy options if the decision to adopt such a set of rules were made. This project also examines the existing groundwater policies between Israel and the Palestinian Authority as potential models for the United States and Mexico.

Objective: To study groundwater management agreements between Israel and the Palestinian Authority, and use the findings to develop possible agreements for shared groundwater of Texas and Mexico.

Methods: Stein traveled to Israel last summer and observed the issues that caused a groundwater conflict, as well as the methods for sharing groundwater supplies. He used his findings to develop options to administer Texas–Mexico aquifers.

Results and Discussion: In Israel, Stein observed that the policy concerning groundwater is in the form of the Taba Agreement, or the Oslo II treaty. This treaty, signed September 28, 1995, provided for the formation of a Joint Water Committee (JWC) which contains an equal number of representatives from each country, and coordinates water management issues. However, this agreement is temporary and awaiting final status. From studying the current situation concerning Texas-Mexico aquifers, Stein found a significant problem is the incompatibility of laws between the two countries. In Texas, groundwater ownership is granted to the owner of the land without acknowledgment of the interdependence of nearby groundwater supplies. In Mexico, all groundwater supplies are controlled by the central government, as they are seen as a public good. Stein's studies suggest that a mutual agreement on the allocation of the groundwater would benefit both parties, and that without such an agreement, the situation may continue to worsen and the supply of water threatened.

Reference: Stein, Daniel, "Texas-Mexico Groundwater and Global Applications," the University of Texas at Austin, May 2002.

Note: This study was funded by TWRI through a grant funded by the U.S. Geological Survey. You can contact Eaton for more information at (512) 471-4962, or Stein at steind73@yahoo.com.

Determining the Influence of Nutrient Enhancement on the Lotic Trophy Status of Lake Waco and the Bosque River

Researchers: Angela Dean Rodriguez, HDR Engineering, Inc., Austin, TX; and Marty Matlock, Biological and Agricultural Engineering Department, University of Arkansas, Fayetteville, AR.

Problem: Water quality is a major issue for the Lake Waco and the Bosque River Watershed. A key concern is increased nutrient loading, particularly concentrations of phosphorus from drainage of dairy waste application fields. More than 34,000 dairy cows reside in the upper North Bosque River area. Elevated nitrogen levels threaten the quality of the Middle and South Bosque Rivers. Lake Waco at the outlet of the Bosque River Watershed is the primary drinking water supply for the 140,000 people of Waco, Texas.

Objectives: 1) To determine the spatial and seasonal periphytic response to nutrient enrichment in the Lake Waco and the Bosque River Watershed; 2) To determine the lotic ecosystem trophic status index (LETSI) at each site as an indicator of the system's nutrient assimilation capacity; 3) To compare periphyton photosynthesis rates to biomass growth response from nutrient enrichment; and 4) To evaluate the variability and magnitude of the periphyton response to nutrient enrichment by pre-seeding the growth medium of the Matlock periphytometer with algae from various streams.

Methods: Matlock periphytometer racks were installed at eight stream sites during the time period of April 1998 to February 1999. To indicate baseline and maximum primary productivity in relation to nutrient enrichment from nitrogen and phosphorus, periphytic chlorophyll *a* was measured. Filters were pre-seeded with algae that were collected from rock scrapings within various river sites and applied to the racks in order to determine the impact of precolonization and variability of response. Fourteen days after the set up of the racks, the fiber filters were collected and analyzed for chlorophyll *a* concentrations and comparative dissolved inorganic uptake or ^{14}C analysis.

Results and Discussion: The fact that the fiber filters were pre-seeded with algae proved to have no significant impact on variability between replicated treatments at a single site. This led Rodriguez to conclude that the variability of initial algae colonization is not an influential parameter on the variability of the ultimate periphyton response. This research supported the theory that periphyton communities in episodically-enriched environments adapt to efficiently utilize nutrients to promote growth. This adaptation allows the periphyton to take advantage of elevated nutrient loading. $^{14}CO_2$ analysis of dissolved inorganic carbon uptake indicates that the periphyton community is most efficient at photoassimilating carbon under non-limiting conditions. The furthest upstream site on the North Bosque River exhibited the highest degree of biological degradation resulting from nutrient enrichment. The next site downstream showed low maximum primary productivity, which suggested active nutrient cycling and uptake. The most nutrient-enriched sites were those furthest downstream. Seasonality plays a significant role in the magnitude of the biological response to nutrients, suggesting seasonal differences in phosphorus assimilative capacity in the system.

Reference: Rodriguez, Angela Dean, *Impact of Nutrient Loading From Point and Non-Point Sources on Water Quality and Lotic Ecosystem Health in Texas' North-Bosque Watershed Using a Bio-Indicator Response Approach*, Masters Thesis, Texas A&M University, 2001.

Note: For details, contact Rodriguez at ADRodrig@hdrinc.com.

Using Fish Parasites as Biological Indicators of Water Quality in Streams

Researchers: Mary Bhuthimethee, Norman Dronen, and William Neill, Wildlife and Fisheries Sciences Department, Texas A&M University, College Station, TX.

Problem: Today, many factors threaten water quality. Among them is nonpoint source (NPS) pollution, which results from urban, industrial, and agricultural runoff. NPS pollution has been observed and blamed for damaging aquatic ecosystems. Damages include changes in species diversity and the composition of aquatic biota, as the ecosystem attempts to adjust to the changes in water quality. Fish parasites can be used as bioindicators of watershed degradation since they are sensitive to variations in water quality.

Objective: To evaluate the changes in metazoan parasite communities of fish exposed to polluted streams as a means of indicating the adverse effects of NPS pollution from urbanization and other sources.

Methods: Research was conducted during the late summers of 1999 and 2000. Two streams (Leon and Salado Creek) were selected in the upper San Antonio River basin located in Bexar County, Texas. The waters of both these streams have been declared hazardous for human and wildlife use due to NPS. Caged bluegill (*Lepomis macrochirus*) were placed in the streams at middle and lower watershed sites, and left 20 days, in order to be exposed to the streams' conditions and allow for parasite growth and community establishment. After fish were removed from the cages, they were inspected for metazoan parasite loads. At each site, water samples were also collected to allow for the examination of water quality.

Results and Discussion: In both years, there was a greater diversity of fish parasites at upper watershed sites. Low parasite diversity was associated with high nitrate levels. This project suggests that the use of fish parasites may provide useful insights into water quality characteristics in streams, as well as how water quality parameters affect fish growth.

Reference: Bhuthimethee, Mary, N.O. Dronen, and W.H. Neill, *Metazoan Parasite Community Structure in Bluegill (Lepomis macrochirus) as an Indicator of the Impact of Urbanization on 2 Streams in San Antonio, Texas*, TWRI 2002 Special Report.

Note: Bhuthimethee's research was funded in part by a TWRI Mills Scholarship. For more information about this research, contact Bhuthimethee at bhuthime@yahoo.com.

Assessing How the Mobility of Trace Elements that May Affect Choke Canyon Lake and Lake Corpus Christi

Researchers: Jill Brandenberger and Patrick Louchouarn, Texas A&M University–Corpus Christi, and Bruce Herbert, Geology Department, Texas A&M University, College Station, TX.

Problem: The availability of freshwater resources is an important issue for the south Texas Gulf Coast Region and the Lower Nueces River. In 1958 and 1982, the City of Corpus Christi developed the Choke Canyon and Lake Corpus Christi reservoir system in the lower Nueces River basin. To best manage the water supply in these reservoirs, contaminant sources must be characterized, depositional environments need to be identified, and processes that affect the remobilization of trace metals must be understood. Uranium mining may adversely influence water quality in this area.

Objectives: To perform temporal and spatial monitoring of arsenic and trace element concentrations in Lake Corpus Christi, Choke Canyon, and points along the Nueces, Atascosa, and Frio rivers, as well as selected groundwater wells in the region.

Methods: Samples were taken during the winter, spring, and summer of 2001 from surface waters. Samples were also collected from flood events that discharged high volumes of water into the reservoir system. A customized 4" polyvinyl chloride mechanism (a Multiple Underwater Syringe Sampling Tool) was used to collect water column profiles. A wide grid which extends a large area around Lake Corpus Christi was used to collect groundwater samples. Water samples were analyzed using Inductively Coupled Plasma Mass Spectrometry to determine the measurement of total and dissolved arsenic and trace metal concentrations.

Results and Discussion: Brandenberger concluded that the strong correlation between lead and manganese cycling suggests diagenetic remobilization of lead is occurring. Molybdenum and uranium concentrations remained constant within surface waters at background levels. Dissolved arsenic values in the Lower Nueces River basin are two orders of magnitude more enriched than the levels observed in the upper basin. The behavior of the arsenic leads to seasonal cycling with dilution during higher inflow periods in spring and winter, and evapoconcentration in the summer. This process may result in seasonal arsenic concentrations that are higher than recently adopted EPA standard for arsenic in drinking water. Elevated arsenic levels were seen in ground and surface waters. Groundwater samples in this project offered the first evidence that uranium levels may be above drinking water standards. These high levels could be the result of human activities or natural geologic inputs to groundwater reservoirs.

Reference: Brandenberger, Jill, *Arsenic Concentrations in Water Resources of the Choke Canyon/Lake Corpus Christi Reservoir System: Surface and Ground Waters*, Masters Thesis, Texas A&M University Corpus Christi, 2002.

Note: This project was funded by TWRI though USGS funds. For details, contact Brandenberger at Jill.Brandenberger@pnl.gov.

New Waves

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Full text of the *New Waves* newsletter is available on the World Wide Web at http://twri.tamu.edu.

Developing an Economical Modeling Framework to Assess Interstate Water Management Compacts

Researchers: Joel Hamilton, Agricultural Economics Department, University of Idaho, Moscow, ID; Norman Whittlesey, Agricultural Economics Department, Washington State University, Pullman, WA; M. Henry Robison, Economic Specialists Inc., Moscow ID; and David Willis, Agricultural and Applied Economics Department, Texas Tech University, Lubbock, TX.

Problem: Water allocation problems are increasing in the Western United States due to urban growth, interstate disputes over common water supplies, and endangered species protection. Conducting benefit-cost analyses or cost-comparisons of alternative public projects can help policymakers identify the best management policies.

Objectives: To develop an analytic approach to estimate the costs and benefits of potential water policies designed for use interstate compacts. The approach must address the distribution of impacts between regional and state economies. It must also make a distinction between indirect impacts and indirect costs, focusing on the dynamic time path unemployed resources follow as they find alternative employment. The method must also differentiate between the microeconomic categories of fixed and variable costs as they are used to compute regional direct and indirect costs.

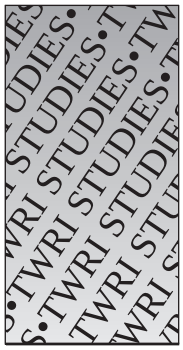
Methods: Empirical procedures were used that reconcile economic impacts gathered from input-output models. This was done by translating these measures into estimates of economic costs and benefits that are necessary to evaluate changes in economic welfare. The paper combines budgeting techniques with regional input-output modeling techniques to estimate direct regional water policy costs. The methodology is consistently applied to derive indirect and interregional spillover costs. The methodology provides economists with a flexible way to track the temporal distribution of direct water policy costs plus the temporal and spatial distribution of indirect policy costs. This modeling framework was applied to the compact that governs the management of the Pecos River between Texas and New Mexico. Three compliance policies were examined: repeated use of a short-run single year injunction policy (SY Policy), and two long-run policies. The long-run policies investigated were a land retirement policy, (P46 Policy), and a lease/purchase policy (LP Policy).

Results and Discussion: The LP Policy was the least costly policy with a net present value cost of $57 million. However, this policy shifted a larger share of total policy cost to statewide residents than in the other two policies that were considered. The LP Policy was the least disruptive to both the state and regional economies and provided a permanent solution. The P46 Policy concentrated most of its $130 million cost on the Pecos Basin. This policy also provided a permanent solution to the problem of state line delivery, without imposing chronic economic disruption on the Pecos Basin economy that may result from repeated use of the short-run SY Policy. Besides being both the most economically disruptive and most costly policy, the SY Policy failed to provide a permanent solution for avoiding water shortages between Texas and New Mexico. Based upon this analysis, the State of New Mexico has allocated funds to progress with the leasing and purchase of required lands. With the implementation of this modeling approach, future policy alternatives will be easily analyzed and weighed against each other.

Reference: Hamilton, Joel, Norman K. Whittlesey, M. Henry Robison, and David Willis, *Measuring Direct and Indirect Costs of Land Retirement in an Irrigated River Basin: A Budgeting-Regional Multiplier Approach*, December 2001. This article will be published in full in *Water Resources Research*.

Note: For more information contact Willis at david.willis@ttu.edu.

TWRI STUDIES



TAMU Graduate Student Examines Ways to Expand College Station Wastewater System

As the city of College Station continues to grow and expand, so does its need to develop and upgrade its wastewater facilities. Texas A&M University graduate student Brooke Moore is currently working on a project aimed at helping the city with this action.

Moore is one of 11 students awarded a 2001–2002 Mills Scholarship from the Texas Water Resources Institute (TWRI). She is a graduate student in the TAMU Civil Engineering Department, studying under researcher Timothy Kramer.

Through her research, Moore is aiming to alleviate College Station's capacity problem associated with the Graham Road Lift Station. This lift station has exceeded its firm pumping capacity due to continued development in the southern area of College Station, and is in need of immediate attention.

The City of College Station treats wastewater at two existing wastewater treatment plants: Carter Creek and Lick Creek. The Carter Creek Wastewater Treatment Plant handles the majority of wastewater operations for the City of College Station and currently has a capacity of 9.5 million gallons per day (mgd).

The Lick Creek Wastewater Treatment Plant is located south of the Pebble Creek Subdivision and has been recently upgraded to handle a flow of 2.0 mgd. Because the wastewater flows going to the Lick Creek plant are now very low, the facility is having difficulty breaking down the waste. One way to aid this process is to increase the flow to the plant. To do this the City of College Station would like to direct some of the flows from the Graham Road Lift Station to the Lick Creek plant.

Moore has been researching the existing and future anticipated flows to the Graham Road Lift Station, based on current flow meter data and population growth projections. In determining the most cost-effective approach to the Graham Road Lift Station problems, Moore has examined the feasibility of developing a new wet well or adding larger pumps to the existing wet well.

Moore believes a possible solution may be to use larger pumps initially, and then revert back to the current-sized pumps for the next 5 years. This may allow the City of College Station to construct a trunk line along Lick Creek and take the lift station off-line and ultimately direct its flows to the Lick Creek plant.

Note: For details, contact Moore at brooke@mitchellandmorgan.com.

TAMU Graduate Student Investigates Use of Drip Irrigation for Wastewater Disposal

Texas A&M University (TAMU) graduate student Vance Weynand is studying the subsurface drip dispersal of wastewater effluents. Weynand, a graduate student in the TAMU Biological and Agricultural Engineering Department, received a TWRI Mills Scholarship. He is studying under the direction of Bruce Lesikar of Texas Cooperative Extension.

Several studies suggest that wastewater reuse will become an important source for landscape irrigation and agricultural production in the near future in Texas. One method to functionally reuse effluent is through the use of subsurface drip irrigation. Drip irrigation is often used to dispose of effluents in areas with seasonally high water tables or with soil conditions that do not allow the use of conventional absorption fields.

Photo by Vance Weynand, TAMU

Vance Weynand installs this drip irrigation system.

In his studies, Weynand is evaluating the performance of existing subsurface drainfields. Weynand has evaluated the initial flow rates of drip emitters produced by various manufacturers that are used to land apply effluents from on-site wastewater treatment systems (OSSFs). He ran a laboratory test in which sets of emitters were buried in soil. Each emitter was set up on varying slopes and contours. The purpose was to simulate how drip systems would function in different landscapes if they were started and stopped over a year.

Following an evaluation of flow rates from these simulations, the emitters were then flushed using a scouring velocity. Flushing of drip laterals is routine maintenance for these systems. After the flushing of the drip emitters, the flow rates were then analyzed.

Data will be statistically analyzed to compare flow rates at different slopes and positions. Weynand will harvest several sets of drip emitters from systems that have had routine maintenance, as well as those that have not been well-maintained. The flow rates from field data will be compared to the laboratory experiments. Currently, Weynand is conducting the statistical analysis of the three different flows in the lab tests.

Weynand feels his project will be beneficial by showing that routine maintenance is critical to the overall performance of drip dispersal systems. The study should also provide important information about the use of drip irrigation systems to distribute treated wastewater.

For more information contact Weynand at VLWeynand@ag.tamu.edu or Lesikar at b-lesikar@tamu.edu .

Examining Potential Ecological Impact of Allens Creek Reservoir is Aim of TAMU Study

Texas A&M University graduate student Raymond Li is examining the ecological affects of the proposed development of the Allens Creek reservoir. Li, a graduate student in the Wildlife and Fisheries Sciences Department, is studying under researcher Frances Gelwick.

Li's studies are primarily funded by the Texas Water Development Board and U.S. Army Corps of Engineers. In addition, Li also received a Texas Water Resources Institute (TWRI) Mills Scholarship.

Li's project focuses on assessing how the development of the Allens Creek Reservoir, in the Brazos River basin, may affect existing natural resources and ecosystems.

To meet the water needs of the greater Houston area, water planners in Region H (working under Senate Bill 1) advocated the development of this reservoir. The reservoir site is near Wallis in northwest Austin County. The reservoir would contain impound streamflow from Allens Creek, as well as waters diverted from the Brazos River.

While working on his thesis research, Li is collecting data associated with potential influences of the new reservoir on fish species. He will evaluate the habitat use by fishes in the lower Brazos River by taking samples of aquatic organisms. This information will be analyzed using an Index of Biotic Integrity, which will assess the ecological health of these waters.

Li's research objectives are to assess the fish-assemblage structure among mid-channel and near-shore habitats, and to compare the fish communities of mid-channel and near-shore habitats at three different rates of river flows. By conducting an in-stream flow assessment, Li hopes to evaluate the relationship between the availability of river habitats and their use by fish populations at high, medium, and low flows.

While such research projects on fish assemblages and habitat associations in streams and rivers have been conducted previously, Li indicated that few studies have been carried out on large rivers with unregulated flow regimes, such as the lower Brazos.

In addition to collecting fish, Li plans to quantify the amount of woody debris (for example, logs, roots, and branches), vegetated and bare river banks, and gravel and sand bars. This will enable Li to evaluate the number of fish species and their relative abundance near each of these habitats. His work will also study how flows between nearby smaller streams and the Brazos River may change after the reservoir is developed.

The results of Li's research will be useful in determining the ecological modifications that Allens Creek Reservoir might have on the fishes of the region. Such knowledge is essential to planners and the community.

For more information about this project, contact Li at raymond_li@neo.tamu.edu or Gelwick at fgelwick@tamu.edu .

Texas Tech Study Examines Concentrations of Amoxicillin in Wastewater Plant Effluents

Texas Tech University (TTU) graduate student Audra Morse is studying the presence and effects of an antibiotic, amoxicillin, in treated wastewater. Morse, a graduate student in the Civil Engineering Department, is studying under researcher Andrew Jackson. Her study, "Fate of a Representative Pharmaceutical in the Environment," is funded in part by a grant from the Texas Water Resources Institute (TWRI) and the U.S. Geological Survey (USGS).

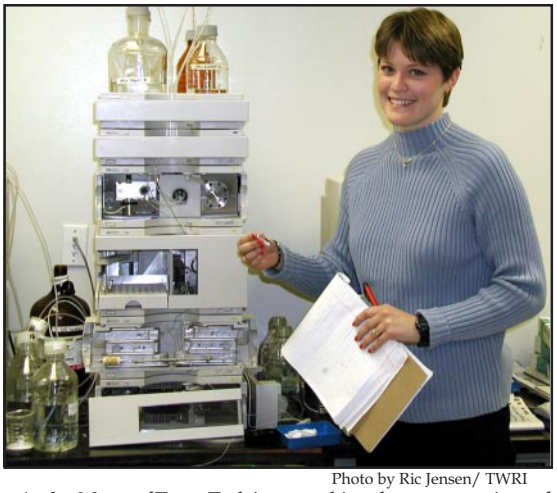


Photo by Ric Jensen/ TWRI

Audra Morse of Texas Tech is researching the concentrations of amoxicillin in wastewater plant effluents.

Previous research about this topic has identified possible sources and pathways through which amoxicillin and other pharmaceuticals enter and travel through the environment, but the concentrations are relatively unknown. Antibiotics can enter the environment from septic tank discharges, effluent from wastewater treatment plants, runoff from confined animal feeding operations, and the land application of sludge and manure.

Some experts are concerned that antibiotic-resistant bacteria may develop as a consequence of high levels of bacteria in rivers and streams. Evidence of antibiotic-resistant bacteria has been documented in several wastewater treatment plants. If antibiotic resistance is developed, then new antibiotics may have to be developed or current doses might have to be increased. By studying the concentrations of antibiotics in water supplies, insights can be obtained about the impacts of amoxicillin in the environment.

According to Morse, "One of the key problems with pharmaceuticals is that we don't know how much is entering the environment. If we can determine what actually is coming in, then we will know if there is really a problem."

So far, Morse has collected samples from the Lubbock Water Reclamation Plant, and has observed trace amounts of amoxicillin. In the future, she will continue monthly sampling of amoxicillin in the influent, effluent, activated sludge, and primary sludge from this wastewater treatment plant. The goal is to determine the concentration of amoxicillin entering the plant and the amoxicillin concentration leaving the plant and entering the environment.

According to Morse, results of this study will assist researchers in determining the impacts of pharmaceuticals in the environment. It will also provide some of the first data about levels of antibiotics in effluents in the Texas High Plains. From this work, follow-up studies could be conducted to determine the possible effects of amoxicillin and other antibiotics in aquatic environments.

Notes: Morse is also carrying out research that is funded by the National Aeronautics and Space Administration (NASA) to examine the presence of antibiotics in closed-loop water and wastewater systems used in space flights. For details on these studies, contact Morse at audra.morse@coe.ttu.edu.

TAMU Research Project Examines Whether Wetlands Can Lessen Arsenic Levels in South Texas Waters

Texas A&M University graduate student Melissa Roberts is working on a research project titled "Fluvial Geomorphic and Biochemical Controls on Arsenic Sequestration in South Texas Uranium Mining District, San Antonio and Nueces River Watersheds." Roberts, who is working with researcher Bruce Herbert, received a TWRI Mills Scholarship to support her research.

Photo by Melissa Roberts

Melissa Roberts takes this algal sample in Karnes County.

Recently, the U.S. Environmental Protection Agency (EPA) proposed reducing the maximum contaminant level of arsenic in drinking water from 50 micrograms per liter (ug/L) to 10 ug/L, due to concerns about the potential adverse consequences of arsenic in drinking water. Uranium mining in South Texas released arsenic into surface waters of the Nueces and San Antonio River until 1982

Roberts is testing the hypothesis that the mobility, bioavailability, and toxicity of arsenic is significantly influenced by organic arsenic species produced by microbes in wetlands. She is focusing on the wetlands, lakes, and stock ponds of the South Texas Uranium Mining District. Roberts is examining how microbes transform arsenic into less toxic forms and how these organisms take up arsenic. She is also examining how microbes release arsenic to bottom sediments when they die.

"If we can prove algae take up arsenic and become sedimented to remove arsenic from systems, then constructing man-made wetlands may allow us to use algae to remove arsenic from the water column," Roberts said. "As a result, the arsenic would not get transferred to other waters."

Roberts has taken samples from Karnes County near Corpus Christi. She is also growing algae in the lab to observe the effects of arsenic uptake. Roberts hopes that wetlands can be developed and maintained to minimize arsenic movement, thus lessening the chance that arsenic may reach Lake Corpus Christi and other surface waters.

For details, contact Roberts at (979) 845-9683 or mdr9612@geo.tamu.edu.

West Texas A&M Study Examines if Lessening Phosphorus Levels in Cattle Feed May Reduce Nutrient Runoff

The Texas Water Resources Institute recently awarded a grant to West Texas A&M University (WTAMU) graduate student Kevin Heflin to study if reducing phosphorus levels in cattle feed may lessen phosphorus levels in cattle manure. The studies could help lower the risks of nutrient runoff.

Heflin's study was funded by the U.S. Geological Survey. He is working with researcher Brent Auvermann of the Texas A&M University Agricultural Research and Extension Center in Amarillo.

Photo by Ric Jensen/ TWRI

WTAMU graduate student Kevin Heflin checks runoff from this cattle feedlot at Bushland, TX.

Heflin's research expands on previous a study he conducted to determine if reductions in phosphorus intake in cattle feeds may cut phosphorus levels in beef cattle manure. That unpublished study suggest that reducing phosphorus levels in cattle feed by 25% might lower phosphorus levels in cattle manure by 38%.

In this study, Heflin will measure the concentration of phosphorus in rainfall runoff from the experimental feedyard at the Texas Agricultural Experiment Station in Bushland Texas. The cattle feedlot, which is managed by researcher Wayne Green, will utilize standard rations, as well as rations with low phosphorus concentrations. This study will also estimate the environmental benefits that may result from the manure that contains lower phosphorus levels.

Field experiments began this summer. In this effort, TAES scientist Wayne Greene and WTAMU graduate student Brock Hough will feed some cattle low-phosphorus feed rations that substitute non-protein nitrogen (in the form of urea) for cottonseed meal in the diet. Cottonseed meal contains 0.9% phosphorus, but urea contains no phosphorus. This may result in significant reductions of phosphorus in the cattle manure. Manure samples will be collected and analyzed from these two groups of cattle, and runoff from 16 feed pens will be measured in modified H-flumes and collected with automated water samplers. If there is no rainfall during the study, a sprinkler system will generate runoff.

Heflin suggests that this study may show that manipulating cattle feeds could decrease the amount of phosphorus in manure. In turn, this could allow larger amounts of manure to be applied to crops without increasing the risk of nutrient runoff. Said Heflin, "Reducing the amount of phosphorus available in runoff will help to reduce the risk of pollution to lakes and streams from eutrophication."

For details, contact Heflin at k-heflin@tamu.edu.

TAMU Study Examines How Irrigation Management May Lessen Cotton Diseases, Other Stresses

Texas A&M University graduate student Nyland Falkenberg is carrying out a study at the Texas A&M University Research and Experiment Center in Uvalde to examine how optimal irrigation management might lessen the extent to which soil diseases, and other stresses, limit cotton production. He was recently awarded a Texas Water Resources Institute (TWRI) research grant through funds provided by the U.S. Geological Survey. Falkenberg is studying under Texas Agricultural Experiment Station researchers Giovanni Piccinni and Charlie Rush.

Photo by Giovanni Piccinni

Nyland Falkenberg is studying how irrigation can prevent crop stresses in field studies at Uvalde.

Falkenberg says some Texas cotton farmers may over-irrigate to maximize crop production. However, this may result in outbreaks of diseases caused by soilborne pathogens. Excess irrigations may increase many soilborne diseases. Over the past 15 years, there has been a steady decrease in the number of acres of cotton planted in soils plagued by cotton root rot (*Phymatotrichum omnivorum)* in West and South Texas.

Falkenberg's research will focus on determining the economic threshold for the irrigation of cotton grown in pathogen-infested soils. In other words, he wants to determine the amount of water needed to produce a profitable yield, while minimizing disease losses.

In this study, Falkenberg will plant cotton under a center pivot irrigation system. A lysimeter will be used to determine the optimal irrigation needs based on actual plant evapotranspiration. Three irrigation rates will be used to show daily water loss throughout the growth cycle of each crop. This data will reveal how much water a cotton plant needs to reach its maximum yield, and may answer if reducing irrigation may actually prevent root rot. Infrared thermometers and global positioning systems (GPS) will be used to detect differences throughout the field stressed by water shortages, root rot and other diseases, and insects. Falkenberg hopes to learn if limited irrigation and better crop management can improve water use efficiency, limit root rot, and cut cotton production costs. He also wants to find out if remote sensing technologies can detect stressed areas of a field, as well as how irrigation rates can be linked with GPS.

For details, contact Falkenberg at n-falkenberg@tamu.edu.

TAMU Project Seeks to Find Ways to Precipitate Phosphorus Out of Dairy Wastewater; Reduce Runoff Risks

The Texas Water Resources Institute recently funded Texas A&M University graduate student Amanda Bragg, who will investigate an innovative method to reduce phosphorus pollution from dairies. The project is supported by the U.S. Geological Survey.

Bragg is a graduate student in the TAMU Soil and Crop Sciences Department and is studying under researchers Kevin McInnes and Tony Provin. The title of her project is, "Reducing Phosphorus Pollution from Dairies by Removal of Phosphorus from Wastewater through Precipitation of Struvite."

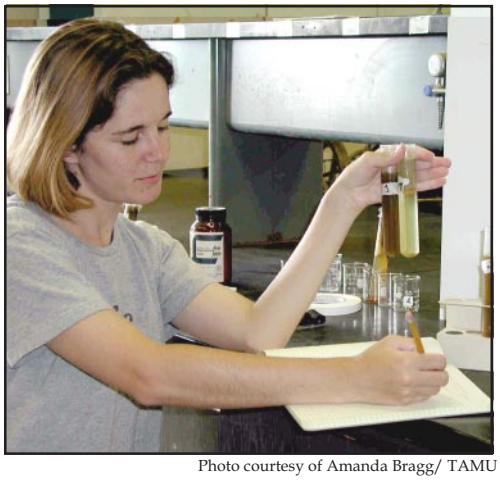


Photo courtesy of Amanda Bragg/ TAMU

Amanda Bragg carries out a laboratory test to see how to precipitate phosphorus out of dairy wastewater.

Bragg's project focuses on reducing phosphorus by the precipitation of struvite, a crystalline mineral that is a hydrous phosphate of magnesia and ammonia found in guano. Currently, struvite is used to precipitate nitrogen and phosphorus in domestic and industrial wastewater treatment plants.

In Bragg's research, the goal is somewhat different. She hopes to maintain somewhat high levels of nitrogen in the dairy wastewater, which can then be used as a fertilizer for cool- and warm-season grasses.

Bragg is removing solids from wastewaters from dairy lagoons. She will soon carry out studies about which chemicals may best precipitate phosphorus, which treatment methods will be most economical, and how long the process may take. If the solids are removed first, a smaller volume of struvite may be needed to precipitate out the phosphorus.

From this work, Bragg hopes to develop methodologies to remove phosphorus from dairy wastewater while maintaining a high nitrogen content in fertilizers that will be produced from this process. Bragg anticipates that this process may allow phosphorus to be removed from wastewater in dairy lagoons before these effluents are applied to lands and crops. This research holds the promise of lessening the risk of nutrient pollution from runoff waters while providing a high-nitrogen fertilizer source for landscapes and other uses.

For details, contact Bragg at (979) 845-4816 or abragg@ag.tamu.edu, or McInnes at k-mcinnes@tamu.edu.

Growing Turfgrass with Composted Dairy Manure and Exporting It to Urban Areas is Aim of TAMU Study

The Texas Water Resources Institute awarded Texas A& M University (TAMU) graduate student F. John Hay a Mills Scholarship to investigate best management practices associated with in exporting nutrients in manure to restore water quality in impaired watersheds.

Hay is studying under TAMU researchers Don Vietor of the TAMU Soil & Crop Sciences Department . Vietor, along with TAMU researchers Clyde Munster, Richard White, and Tony Provin are now working on a study funded by the U.S. Geological Survey titled, "Assessing Water Quality Impacts of Nutrient Imports into an Urban Gradient." Hay's work is in conjunction with this project.

Photo Courtesy of John Hay/ TAMU

TAMU graduate student John Hay works on this turfgrass test site.

This project examines whether manure nutrients can be removed from dairy wastes in this watershed by growing and harvesting of turfgrass sod, thereby improving water quality. The study involves observing leaching losses of carbon and mineral nutrients from the application of composted manure and fertilizer. To do this, Hay will quantify soluble organic and inorganic concentrations of phosphorus and nitrogen in composted manure and transplanted sod before and after they are applied to sandy soil soils used in golf course construction.

Hay and the research team have set up a runoff study in College Station, TX, to study runoff with different mixes of composted dairy manure combined with wood chips and sandy and clay soils. Sod is being harvested at College Station and Stephenville. Recently, Hay set up lysimeters to study leaching and to examine nutrient concerns. After the sod has been transplanted, it will be irrigated and water will be measured as it flows through the layers of sod and sand. This test will evaluate the extent to which nutrients flow through these soil layers. A rainfall simulator will be used to irrigate the sod and initiate the leaching processes.

The research will also utilize a 6-acre field for two runoff studies. Work on this site involves plugging Bermudagrass sod with composted dairy manure as well as organic and inorganic fertilizer. Runoff will be collected from each of the sites and the analyzed.

Hay and Vietor suggest this project may be useful in making decisions about whether turfgrass sod grown with composted dairy wastes may be environmentally beneficial for urban areas.

For details, contact Hay at fjcalypso@hotmail.com or Vietor at dvietor@tamu.edu .

Rio Grande Basin Initiative Begins Second Year; Goal is to Improve Water Conservation in the Region

ABSTRACTS

The second year of a federally funded initiative to improve irrigation efficiency and water conservation in the Rio Grande Basin is now under way.

The Rio Grande Basin is one of the most productive agricultural areas in the United States, with irrigated agriculture claiming more than 85% of its water. Yet, population in the basin is expected to increase by 70% in the next 50 years, also increasing urban water use.

"International water delivery issues and the ongoing drought make the initiative timely," said B.L. Harris, Director of the Rio Grande Basin Initiative and Executive Director of the Texas Water Resources Institute (TWRI). "But from a long-term perspective, this project is an opportunity to implement conservation planning—not only to expand efficient use of available water resources, but also to create new water supplies."

The Rio Grande Basin Initiative is a joint effort of the Texas A&M University System Agriculture Program and the New Mexico State University College of Agriculture and Home Economics. It is funded through the Cooperative State Research, Education, and Extension Service and administered by TWRI. The Bureau of Reclamation, the Texas Water Development Board, the U.S. Department of Agriculture Natural Resources Conservation Service and other agencies are collaborating on this effort.

The focus of the initiative, which was initially funded in June 2001, includes the following major thrusts:

- Irrigation district rehabilitation;
- Irrigation education and training;
- Institutional incentives for conservation;
- On-farm system management;
- Urban water conservation;
- Saline water use and wastewater reuse;
- Water quality protection, and
- Satellite imagery and hydrologic modeling.

"It is essential that regional, state and federal agencies work together with local groups to make the most efficient use of available water," Harris said. "The Rio Grande Basin Initiative provides this opportunity."

TWRI Newsletter, Website, Describe RGBI Activities

You can learn more about the Rio Grande Basin Initiative on the web and through a printed newsletter.

TWRI Extension Assistant Rachel Alexander, has begun producing a newsletter series about the project, titled *Rio Grande Basin Initiative Outcomes*.

Alexander is also leading efforts to generate content for a website about the project. The website is located at http://riogrande.tamu.edu.

In addition, TWRI has published brochures that describe various aspects of this program.

To learn more about the RGBI, contact Alexander at (979) 458-1158 or raalexander@taexgw.tamu.edu.

SAFE Program Audits Irrigation of Sports Fields, Saves Water, in El Paso

Improving the quality of athletic fields and reducing water use are two benefits of the Sports Athletic Field Education (SAFE) program organized by Texas Cooperative Extension. Now in its third year in El Paso County, the SAFE program is expanding to include football and soccer fields at 16 schools and a county park. School administrators, coaches and field maintenance crews are involved in the program, receiving site-specific irrigation recommendations from Extension specialists and agents.

Athletic fields managed through automatic irrigation systems often receive three to seven times the recommended amount of water annually. Automatic irrigation systems with design flaws, hardware problems and improper run times also result in poor field conditions and low-quality turfgrass.

"The heart of the SAFE program is water conservation," said Ray Bader, Extension agent for natural resources in El Paso, Texas. "We work with field management staff and administrators to help develop site-specific management protocols that make efficient use of resources in establishing high-quality turfgrass in athletic fields."

Though Extension, faculty with the SAFE program are concentrating on irrigation of football and soccer fields, the water-smart practices are applicable to all athletic fields. Through an irrigation audit, they work with school districts to inspect athletic fields and test irrigation systems. Then they develop recommendations for field maintenance and irrigation scheduling.

Recommendations include fertilization programs based on soil test results, turfgrass species, environmental conditions and field use, integrated pest management practices, and the best mowing height and frequency for each field based on the type of sports field, turfgrass species and mowing equipment. SAFE often recommends the best ways to aerate sports fields. Audits indicated that many fields were in need of soil aeration to create a less compact growing condition for turfgrass and a safer playing surface for athletes.

Officials said that since maintenance crews began implementing the recommendations, injuries at participating schools have decreased 40%. Bader said the change in irrigation water used at participating schools ranged from 32% to 48%. He said the average savings was 17 inches of water per season. "We've saved thousands of gallons of water through efficient irrigation while improving field quality," he said.

Note: Counties across Texas are involved in Extension's SAFE program. Funds from the Rio Grande Basin Initiative are helping to expand its reach in El Paso County. Bader can be contacted at r-bader@tamu.edu or (915) 859-7725.

TWRI Expands Efforts to Provide On-Line Technical Reports

The Texas Water Resources Institute (TWRI) has begun to post many more presentations, papers, and technical reports on its website, http://twri.tamu.edu/reports. The reports present information resulting from student and faculty research funded by the Institute.

For the most part, these materials will not be made available in print form from TWRI. Rather, we are encouraging users to print them from their own computers. In most cases, these materials are available as PDF files, PowerPoint presentations, or word processed files.

Some of the reports published by TWRI in 2002 include the following:

• "Calculating Hydrologic Parameters for Estimating Surface Water Flow with GIS," by Richard Hoffpauir. This web-based presentation summarizes some of the work of Texas A&M University (TAMU) graduate student, who was awarded a grant by TWRI funded through the United States Geological Survey (USGS).

• Examining How Agricultural Production May Affect the Water Quality of Ground and Surface Waters in Floodplains of the Brazos River Near Bryan, TX, Clyde Munster. This is a series of scientific papers resulting from a study TWRI awarded to Munster and a team of other researchers in 1993. That project was funded by the USGS.

• "Effectiveness of Buffalograss Filter Strips in Removing Dissolved Metolachlor and Metolachlor Metabolites from Surface Runoff," Jason Krutz, Scott Senseman, Monty Dozier, Dennis Hoffman, D.P. Tierney. This poster and presentation describe work done by TWRI Mills Scholar Jason Krutz.

• "Alternative Approaches to Estimate the Impact of Irrigation Water Shortages on Rio Grande Valley Agriculture," by John R. Robinson, Texas A&M University Agricultural Research and Extension Center at Weslaco.

• "Uncertainty Analysis as a First Step of Developing a Risk-Based Approach to Nonpoint Source Modeling of Fecal Coliform Pollution for Total Maximum Daily Load Estimates," by Sabu Paul, Marty Matlock, Patricia Haan, Saqib Mukhtar, and Suresh Pillai. This report describes work funded by TWRI through the U.S. Geological Survey (USGS) competitive grants program.

• "Metazoan Parasite Community Structure in Bluegill (*lepomis macrochirus*) as an Indicator of the Impact of Urbanization on Two Streams in San Antonio, Texas," by Mary Bhuthimethee, Norman Dronen, and William Neill. This abstract, slide show, and poster describe research done by TWRI Mills Scholar Mary Bhuthimethee.

• "Modeling the Effects of Low Flow Augmentation by Discharge from a Wastewater Treatment Plant on Dissolved Oxygen Concentration in Leon Creek, San Antonio, Texas," (TWRI Technical Report 190) by Tejal A. Gholkar. This report describes work Gholkar performed as part of a TWRI grant awarded to Saqib Mukhtar and Marty Matlock through the USGS competitive grants program.

• Guidelines for Developing Soil and Water Management Programs: Irrigated Pecans (TR-188), by Seiichi Miyamoto, Texas A&M University Agricultural Research and Extension Center at El Paso. This report was published as part of TWRI's Rio Grande Basin Initiative. The abstract is available on-line, and instructions on how to obtain a copy are included.

• "Rice Water Irrigation: Conservation Management at the Lower Colorado River Authority," by David Eaton, LBJ School of Public Affairs, the University of Texas at Austin. An abstract of this LBJ School-published report is presented. The project was funded, in part, by the National Institutes for Water Research and TWRI administered part of the work associated with this project.

• "Quantification of Arsenic Bioavailability in Spatially Varying Geologic Environments at the Watershed Scale using Chelating Resins," by Graciela Lake, Bruce Herbert, and Patrick Louchouarn. This poster presents studies conducted by TWRI Mill Scholar Graciela Lake.

• "Determination of Regional Scale Evapotranspiration of Texas from NOAA–AVHRR Satellite," by Balaji Narasimhan and Raghavan Srinivasan. This report presents research results of Balaji Narasimhan, who was funded by TWRI through the USGS competitive grants program.

• "*Pimephales promelas* and Laboratory Bioassay Responses to Cadmium in Effluent Dominated Systems," by Bryan Brooks, Jacob Stanley, Jessica White, Philip Turner, Duane Huggett, and Thomas Lapoint, Institute of Applied Sciences, University of North Texas, Denton TX. This report discusses work by Bryan Brooks, who was awarded a USGS competitive grant from TWRI.

• "Arsenic Concentrations in Water Resources of the Choke Canyon/Lake Corpus Christi Reservoir System: Surface and Ground Waters," by Jill Brandenberger and Patrick Louchouarn, Texas A&M University–Corpus Christi. This report discusses results of a USGS competitive grant that TWRI awarded to Jill Brandenberger.

• "A Sensitive Determination of Iodide Species in Fresh or Saline Matrixes Using High Performance Chromatography & UV/Visible Detection," by Kathleen Schwer and Peter Santschi, Texas A&M University–Galveston. This poster presents findings from a grant awarded to Peter Santschi and Kathy Schwer by TWRI through the USGS competitive grants program.

• "Rapid Risk Assessment of Watersheds and Dams using GIS and Modeling," by Jacquelyn Duke, Joseph White, and Peter Allen, Baylor University, Waco, TX. This report discusses studies funded by TWRI through the faculty incubator grants program.

• "Effects of Nursery Environmental Cycles on Larval Red Drum (*Sciaenops ocellatus*) Growth and Survival," Rafael Pérez-Domínguez and Joan Holt, University of Texas Marine Science Institute at Port Aransas. This report summarizes research funded by TWRI through the USGS competitive grants program.

Notes: TWRI will regularly continue updating this section on the website on a consistent basis. Also, please note that in the future TWRI will likely publish more reports on-line and fewer publications in a printed format. To obtain more information on any of these reports, contact TWRI Communications Manager Ric Jensen at rjensen@tamu.edu or (979) 845-8571.

TWRI, Spatial Sciences Lab, Publish 3-Volume Manual to Aid Users of SWAT Model

A three-volume series of technical manuals that provide in-depth information on how to use the Soil and Water Assessment Tool (SWAT) model has been published by co-published by the Texas Water Resources Institute, and the Texas A&M University Spatial Sciences Laboratory.

The manuals were developed by a team of researchers at the Blackland Research and Extension Center in Temple that includes Jimmy Williams and Raghavan Srinivasan of the Texas Agricultural Experiment Station, and Mauro DeLuzio, Susan Neitsch, Jeff Arnold, Jim Kiniry, and Kevin King of the U.S. Department of Agriculture Research Service (USDA/ARS).

"These manuals will provide extremely useful technical information for people developing applications of these powerful modeling tools," said Srinivasan, who originally developed the SWAT model with Arnold and now leads the Spatial Sciences Lab. "We think these manuals should be an essential component of the reference library for individuals carrying out technical projects using the SWAT model."

"Soil and Water Assessment Tool: Theoretical Documentation," is TWRI technical report (TR) 191, and includes several equations dealing with a variety of natural resources issues, including energy and temperature, hydrology, evapotranspiration, and many other topics.

"Soil and Water Assessment Tool: User Manual 2000" (TWRI TR-192) describes how to configure watersheds for the model and how to input data on basins, crops, tillage practices, and many related factors.

"Soil and Water Assessment Tool: ARCView GIS Interface Manual" (TWRI TR-193) instructs users on how to develop a geographic information system (GIS) that makes best use of SWAT data. It describes how to delineate watersheds and characterize soils and land uses, how to input and out GIS information with SWAT. It also covers databases that can be developed with SWAT.

Notes: To order the full version of these reports, contact TWRI at (979) 845-1851 or twri.tamu.edu. You can purchase the reports for $100 with a purchase order or credit card. TWRI will post the abstracts and table of contents on its website, http://twri.tamu.edu/reports. You can also learn more about the model by visiting the SWAT website, http://brc.tamus.edu/swat. Srinivasan can be contacted at the Spatial Sciences Laboratory at (979) 845-5069 or r-srinivasan@tamu.edu.

MEETINGS

The 10th annual Coastal Bend Environmental Conference "Partnership for Sustainability" is scheduled for October 30-November 1, 2002 at Texas A&M University–Kingsville. This is part of the South Texas Environmental Conference series. There is currently solicitation for posters and technical papers. For details, contact Dalia Cavazos at CBEC2002@even.tamuk.edu or (361) 593-3904.

The National Ground Water Association is offering three conferences in Dallas this summer. "Aquifer Tests: Operation and Parameter Estimation" meets August 12-13, 2002. "Disinfection, Coliforms, and Other Contaminants" in Dallas, TX, meets on August 14, 2002. "National Attenuation for Remediation of Contaminated Sites" will be offered on August 14-16, 2002. To learn more, visit their website at http://www.ngwa.org.

• **The 12th Annual Texas Water Law Conference will be held in Austin, TX on October 28-29, 2002.** Featured presentations include: "Texas Water: How We Got Here and Where we Are Going" by Texas State Senator "Buster" Brown, and "Texas Water: A Look Ahead" by Senator Kenneth Armbrister of the Texas State Senate. For details, visit http://www.cle.com or call 800-873-7130.

• **On September 9-11, 2002, the Texas Water Monitoring Council will sponsor the fourth Texas Water Monitoring Congress in Austin.** This meeting offers those interested in water monitoring an opportunity to discuss issues, network with colleagues, share successes, and gain new perspectives. Recommendations from the Congress provide guidance to policymakers about water monitoring needs. Details can be found on the web at http://www.texaswaterinfo.net/TWMC/Main.htm.

• **The 10th National Nonpoint Source Monitoring Workshop, "Monitoring and Modeling from the Peaks to the Prairies," will meet in Breckenridge, CO September 8-12, 2002.** More details are available on the WWW at http://www.ctic.purdue.edu/NPSWorkshop.html or by contacting Tammy Taylor at taylor@ctic.purdue.edu.

• **The Water Environmental Federation (WEF) 75th Annual Conference & Exposition will run September 28 - October 2, 2002 in Chicago, IL.** For details, e-mail WEF at confinfo@wef.org or visit their website, http://www.wef.org.

• **The American Water Works Association (AWWA) will sponsor a Distribution & Plant Operations Conference and Exhibition on September 7–10, 2002 in Nashville, TN.** For details, visit the AWWA website at http://www.awwa.com.

• **The American Water Resources Association will sponsor a conference, "Water Resources Policy Dialogue," on September 17-18, 2002 in Washington, DC.** Also, the 2002 AWRA conference will meet in Philadelphia on November 3-7. To learn more, visit their website at http://www.awra.org.

• **The Texas Engineering Extension Service continually offers great training classes dealing with water and wastewater related concerns.** You can learn more about all the courses they offer in these fields by contacting their website, http://teexweb.tamu.edu.

• **The American Geophysical Union will host a conference, "The Eco-hydrology of Semiarid Landscapes: Interactions and Processes," September 9-13, 2002 in Taos, NM.** You can get more details at their website, http://www.agu.org.

See Mills Scholarships (from page 1)

and Bradford Wilcox (researcher); and Amy Wentz (graduate student) and Steve Whisenant (researcher);

• Soil and Crop Sciences Department—Jason Krutz (graduate student) and Scott Senseman (researcher); Roger Havlak (graduate student) and Richard White (researcher); Nels Hansen (graduate student) and Don Vietor (researcher); and John Pitt (graduate student) and Frank Hons (researcher); and

• Wildlife and Fisheries Sciences Department—Lance Fontaine (graduate student) and William Neill (researcher); April Torres-Conkey (graduate student) and R. Doug Slack (researcher); April Hennebeck (graduate student) and Mike Masser (researcher); Brian Langerhans (graduate student) and Thomas DeWitt (researcher); and Kimberly Crumpler (graduate student) and Raghavan Srinivasan (researcher).

To learn more about these projects, contact TWRI Communications Manager Ric Jensen at rjensen@tamu.edu or (979) 845-8571.

Follow-Up (from page 1)

people we funded.

In 1999, TWRI awarded a grant to researcher Shankar Chellam of the University of Houston Civil Engineering Department to study the use of membrane filters to treat surface waters from Lake Houston. Earlier this year, Chellam obtained a large grant from the National Science Foundation to carry out a study titled, "Disinfection Using Membranes: Optimizing Virus and Disinfection By-Product Control." The goals of this study are to develop tools to predict the removal of pathogenic viruses and precursors to carcinogenic, mutagenic, and teratogenic disinfection by-products by membranes, as a step to reduce microbial and chemical risks in drinking water. Said Chellam, "The grant from TWRI helped me carry out research that laid the groundwork to obtain follow-up funding."

Texas A&M University graduate student Matt Wagner is another TWRI success story. Wagner is studying under researchers Ronald Kaiser of the Recreation, Parks, and Tourism Sciences Department, and Jon Rodiek of the Landscape Architecture Department. Wagner is studying how landowner associations may foster the conservation of land and water resources. Wagner was awarded a $1,000 TWRI Mills Scholarship in 2001 to help supplement his studies. Recently, he was awarded a National Water Research Institute (NWRI) Fellowship that provides grants of $15,000 to outstanding graduate students in water resources fields. Said Wagner, "I'm thankful that TWRI awarded me a Mills Scholarship. Any assistance that can be offered to assist graduate students with their research is very appreciated."

During the past two years, TWRI has become much more aggressive in its grants programs under the leadership of Director Allan Jones and Associate Director Bill Harris. Competitive grants programs administered by TWRI include awards for graduate students throughout Texas funded by the U.S. Geological Survey, Mills Scholarships for graduate students at Texas A&M University, and soil and water conservation grants available through the Texas Agricultural Experiment Station and Texas Cooperative Extension.

Notes: You can learn more about these grants by contacting Ric Jensen at TWRI at (979) 845-8571 or rjensen@tamu.edu.

TWRI to Develop Markets for Composted Dairy Wastes

A new project led by the Texas Water Resources Institute (TWRI) and Texas Cooperative Extension will seek to implement ways to market compost from dairy wastes in Central Texas, thus improving water quality in the region. This effort will be managed by TWRI Associate Director Bill Harris. The project is funded by the Texas Natural Resource Conservation Commission (TNRCC). Cooperating agencies include the Texas State Soil and Water Conservation Board and the Brazos River Authority.

Lead personnel involved in this study include researchers Don Vietor of the Texas A&M University (TAMU) Soil and Crop Sciences Department; Jim Muir and John Cawthon of the TAMU Agricultural Research and Extension Center in Stephenville; and Clyde Munster of the TAMU Biological and Agricultural Engineering Department. Texas Cooperative Extension professionals that will be involved in this effort include Mark McFarland, Monty Dozier, Ron Wooley, Bud Schwart, Tony Provin, Sam Feagley, Saqib Mukhtar, Twain Butler, and several county Extension agents.

The goal is to the utilize the capabilities of Extension, TAES, and a compost marketing firm to expand government and public sector markets for composted dairy manure. This project includes developing a technical assistance program to educate state agencies about the benefits of composted products, to train compost operators, and to promote the development sustainable markets for these materials.

Note: For details, contact Harris at (979) 862-3933 or blharris@tamu.edu.