tx H_2O

A Publication of the Texas Water Resources Institute

Fall 2006

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CHAMPIONS OF TEXAS WATER

GLOBAL PREDICTIONS

AND MUCH MORE...

Texas Water Resources Institute | Texas Agricultural Experiment Station | Texas Cooperative Extension

Working Together for Texas Water

The Trinity River, which stretches 512 river miles from north of the Dallas–Fort Worth Metroplex to Galveston Bay, is the principal water supply for the Metroplex and the City of Houston. Many Texans, urban and rural, depend on the river and its natural resources for maintaining quality of life and economic prosperity. Increased development and changes in land use, however, threaten the water quality, wildlife habitats, recreational opportunities and flood control of the basin.

To help improve the river, its ecosystem and its water quality, Governor Rick Perry recently announced the Trinity River Basin Environmental Restoration Project. With this announcement, Gov. Perry asked The Texas A&M University System to serve as the lead for the initiative. The Institute for Renewable Natural Resources (IRNR) will facilitate environmental restoration projects in rural areas, with emphasis on improving wildlife habitats, fisheries and recreational opportunities. The Texas Water Resources Institute (TWRI) will serve as catalyst for projects in urban areas, with emphasis on water conservation, water quality and stormwater management.

Many local, state and federal organizations are already involved in restoring the Trinity River. This initiative will bring together the talents and knowledge of these organizations and others to improve rural and urban streams, reservoirs and watersheds; to enhance wildlife habitat; and to expand ecotourism opportunities in the Trinity basin.

We have to remember that a river and its watershed include three important components: land, water and people. This initiative will help us better manage both our land and water resources for the benefit of people living in and around the basin.

TWRI is looking forward to working with IRNR and federal, state and local organizations to restore the Trinity River.

C. Allan Jones

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On the cover:
Arroyo Colorado in south Texas.
Photo by Brad Cowan, County Extension Agent, Hidalgo County

Texas Agricultural Experiment Station
THE TEXAS A&M UNIVERSITY SYSTEM

Texas Cooperative EXTENSION
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Texas Water Resources Institute
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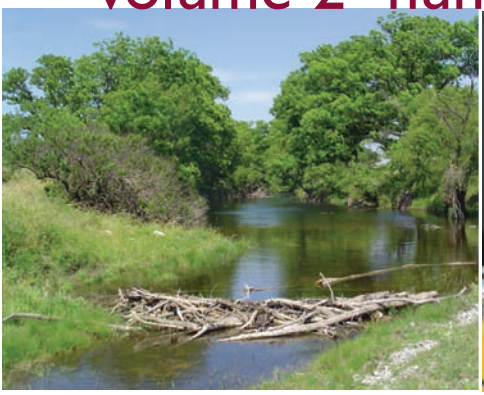
volume 2 number 3, fall 2006



tx H_2O is published three times a year by the Texas Water Resources Institute, which is a unit of the Texas Agricultural Experiment Station and Texas Cooperative Extension. TWRI is funded in part by the U.S. Geological Survey and authorized by the Water Resources Research Act.

Story by Courtney Swyden

THE WAVE OF THE FUTURE

Plans use local involvement to enhance water quality

Comprehensive watershed protection plans, outlining ways to preserve or restore watersheds, are becoming a popular approach for protecting Texas surface waters.

The Texas Water Resources Institute (TWRI), Texas Agricultural Experiment Station and Texas Cooperative Extension are taking an active role in providing assessment, educational outreach, management and training to assist in the development of watershed protection plans across the state.

A watershed is a particular land area from which water drains into a common body of water. A watershed protection plan outlines ways to preserve a watershed or restore an impaired one. These plans are becoming more prevalent as populations grow and water quality concerns from point and nonpoint pollution sources increase.

According to the U.S. Environmental Protection Agency (EPA), using a watershed approach to restore impaired water bodies is beneficial because it addresses the problems in a holistic manner and stakeholders in the watershed are actively involved in selecting the management strategies implemented to solve the problems.

The EPA has established nine key elements that must be addressed in order to have a successful plan (see page 5).

"A successful watershed protection plan will use scientifically-based methods to identify sources of water quality impairments and develop estimates of the load reductions required to meet water quality standards," said TWRI Project Manager Clint Wolfe. A good plan should evaluate the costs and benefits of addressing these sources, develop effective management measures, identify potential funding sources to correct problems, and outline ways to track progress and water quality improvements once the plan is implemented, he said.

Linda Brookins of the Texas Commission on Environmental Quality (TCEQ) said watershed protection plans embody the "watershed approach" to restoring and protecting water quality. "They assess all the factors affecting a body of water, which are bounded by its watershed and develop a strategy for reducing the loading of pollutants to the degree required to meet water quality goals, including state water quality standards," she said.

The Texas State Soil and Water Conservation Board (TSSWCB) and TCEQ are heavily involved in watershed protection plans in Texas. TSSWCB focuses on agricultural and silvicultural sources of nonpoint source pollution, and TCEQ focuses on all other sources, but both agencies are involved in the plans.

"Our two agencies work closely with local stakeholders to develop watershed protection plans and later assist in implementation of these plans," Brookins, special assistant in the Office of Compliance and Enforcement, said.

Aaron Wendt, the TSSWCB's state watershed coordinator, said, "Watershed protection plans are really an avenue for local stakeholders to get involved and to get together to make decisions about their watershed."

With its capabilities of water quality modeling, economic analysis, education and outreach, monitoring and data collection, and plan development and training, Texas A&M Agriculture—through TWRI, the Experiment Station and Extension—is providing leadership in watershed management and developing protection plans, Wolfe said. These capabilities allow the groups to assist in all aspects of watershed protection planning from individual elements to total plan development.

TWRI is currently involved in watershed management projects in the Arroyo Colorado, five reservoirs in North Central Texas, Lake Granbury, Buck Creek and the Pecos River. It is working with agencies and local stakeholders to assess current issues in these watersheds and implement watershed protection plans. Most of these projects are in collaborative efforts with the Experiment Station, Extension,

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Lake Granbury, a critical water supply in North Central Texas, has recently experienced golden algae blooms and bacterial contamination. The Brazos River Authority is working with the Texas Commission on Environmental Quality, local entities and federal and state agencies to implement an integrated watershed protection plan.

TSSWCB, TCEQ, soil and water conservation districts, and local river authorities.

Wolfe, TWRI manager for the North Central Texas Water Quality Project, said, "A successful watershed protection plan for the project will be one that works to reduce sediment and nutrient loadings in the five water supply reservoirs managed by the Tarrant Regional Water District while accommodating a growing population and maintaining water quality."

TWRI, working with Texas A&M University Spatial Sciences Laboratory and engineering consulting firms, is using EPA-supported water quality models to estimate sediment and nutrient loading in the five reservoirs. The water quality models also predict the impacts of agricultural management and land uses on water quality. With federal funds from the USDA–Natural Resources Conservation Service (USDA–NRCS), TWRI and Extension are developing a water quality education program to help landowners, homeowners, businesses and municipalities reduce nonpoint source pollution.

After the Brazos River Authority detected high levels of bacteria in some areas of Lake Granbury, a critical water supply for 250,000 North Central Texas residents, the river authority solicited funds from TCEQ and EPA to work with local groups to develop a watershed protection plan for the lake. To assist in the effort, TWRI and Extension are developing a water quality education program to help local stakeholders and businesses reduce bacterial contamination from nonpoint sources of pollution. This effort is supported by federal funds from USDA-NRCS.

Water samples from Buck Creek in the Texas Panhandle, collected and analyzed by the Experiment Station through the Bacterial Monitoring for the Buck Creek Watershed Project, have confirmed elevated *Escherichia coli* bacteria levels. The next step is a watershed protection plan in cooperation with the TSSWCB, local soil and water conservation districts and other stakeholders, according to Kevin Wagner, TWRI manager for the project.

TWRI, the Experiment Station and Extension have also teamed with the TSSWCB and local conservation districts to assess the Pecos River Basin. The Pecos River, a tributary of the Rio Grande, and Lake Amistad have experienced increased salinity and dwindled flows because of irrigation demands, droughts, dams, invasive species and oil and gas production. The team is researching and monitoring water quality and quantity, educating rural and urban stakeholders and developing a watershed protection plan describing current and future management measures to protect the river's water quality.

Five of the major reservoirs in the Trinity River Basin managed by Tarrant Regional Water District (TRWD) have problems of sediment and nutrient loading. TWRI and Texas A&M Agriculture are collaborating with TRWD to study water quality protection and improvement.

What is a Watershed Protection Plan?

A watershed protection plan is a voluntary effort developed by local stakeholders that is formed from science-based information to protect unimpaired surface waters and to restore impaired surface waters. The following elements, established by the U.S. Environmental Protection Agency, are included in a Watershed Protection Plan:

- Identification of causes that need to be controlled to achieve load reductions
- Estimate of load reductions expected for management measures
- Description of management measures needed to achieve load reductions
- Estimate of technical and financial assistance needed to implement the plan
- Information/education component to enhance public understanding
- Implementation schedule for management measures
- Description of measurable milestones to determine implementation of management measures
- Set of criteria to determine whether load reductions are being achieved
- Water quality monitoring component to evaluate the plan effectiveness

Using funds from a TCEQ grant, TWRI is developing a course to train watershed coordinators and others interested in developing watershed protection plans. The Texas Watershed Planning Short Course is a collaborative effort between the EPA, TCEQ, TSSWCB, Extension and Texas River Systems Institute at Texas State University. The course will support the development of watershed protection plans and promote sustainable, proactive approaches to managing water quality throughout Texas.

"A well-coordinated watershed training approach is needed to provide the framework for focusing public- and private-sector efforts to address the highest-priority water quality impairments," Wolfe said.

The watershed planning course, a week-long event, will provide information on stakeholder coordination and in-depth analysis of EPA's nine plan elements and guidelines. The course will also include information about data collection and analysis; the tools available for plan development, education and outreach related to water quality; and the use of case study examples.

"Case studies will allow the participants to see how others are developing their plans as well as provide ongoing watershed planning efforts with valuable input from participants and national experts on the methods being used," Wagner said.

Other efforts in watershed protection planning within The Texas A&M University System include:

- Little Wichita River—Texas Institute for Applied Environmental Research
- Plum Creek—Texas Cooperative Extension
- Arroyo Colorado—Texas Sea Grant
- Dickinson Bayou—Texas Sea Grant
- Armand Bayou—Texas Sea Grant and Trust for Public Land

Collaborative partnerships, agency cooperation and technical support are all important in assessing water quality conditions to develop a successful watershed protection plan, Wolfe said. Stakeholder participation is key, so that in the end, they have a plan that can be implemented and has local support.

For more information on current projects, visit the Texas Water Resources Institute Web site at http://twri.tamu.edu.

Story by Kathy Wythe

Recovering from the Past

Group committed to restoring the Arroyo Colorado

Paul Bergh's love of the Arroyo Colorado in the Lower Rio Grande Valley goes back more than 40 years. His first experience with the Arroyo was in 1961 when the then 15-year-old was a guest of his girlfriend whose family had a place on the channel.

"Drinking water was hauled in by truck and stored in a cistern and the toilet flushed with water scooped out of the Arroyo," Bergh said. "It was pretty rustic to say the least, but the fishing was fantastic."

That same trip Bergh remembers the water being "much cleaner and clearer, still green but a very pretty and clear green."

Time went on. Bergh married his girlfriend. They inherited the family place and spent much of their free time with their kids, fishing and swimming the Arroyo Colorado.

As more time passed, shrimp farms moved to the area, additional municipal water plants were built to serve the growing population, and dredging for barges and flood control continued. The Arroyo Colorado, which begins in Mission and empties into the Lower Laguna Madre, became less clean and less clear.

"Fishing went to hell in a handbag and the water stunk," Bergh said.

Today, Bergh and a diverse group of individuals from agriculture, wastewater management, urban planning, environmental protection, economic development, academia and other disciplines are united in a common purpose—to restore this ancient channel of the Rio Grande. The Arroyo Colorado Watershed Partnership is developing a voluntary watershed protection plan that outlines ways to clean up the 90-mile polluted stream.

The Arroyo Colorado is the primary source of fresh water to the Lower Laguna Madre, a lagoon off the Gulf of Mexico and home to many fish and shrimp species. Commercial barges travel up and down the stream from the Port of Harlingen to the Laguna Madre and the Gulf Intracoastal Waterway. The stream, which receives natural flow beginning about halfway down the channel, collects treated wastewater from 18 municipal water plants along with excess floodwaters and stormwater runoff from urban and agricultural areas, and excess irrigation water from approximately 300,000 acres of cotton, citrus, vegetables, grain sorghum, corn and sugarcane. With its abundance of birds, plants and fish, the area attracts tourists and naturalists to its birding centers and Laguna Atascosa National Wildlife Refuge along with sports enthusiasts to fish the waters.

Unfortunately, because of the dredging and runoff, the Arroyo Colorado has one of the highest levels of nutrients, such as phosphorus and nitrogen, of all streams in Texas, according to the Texas Commission on Environmental Quality (TCEQ).

Since 1998, Texas has included the lower tidal part of the Arroyo Colorado on the Clean Water Act list of impaired water bodies for low levels of dissolved oxygen. From 1999 to 2004, the stream had 19 documented fish kills, claiming 26 million fish, according to the Texas Parks and Wildlife Department. The upper part of the stream is on the impaired list for bacteria.

In 2002, TCEQ completed the first phase of a total maximum daily load (TMDL) study that showed that extensive physical modifications of the Arroyo Colorado along with excessive nutrients from urban, agricultural and wastewater sources caused the low levels of dissolved oxygen. The TMDL results indicated that achieving healthy dissolved oxygen levels would require a 90 percent reduction of nutrients and biochemical oxygen demand. Faced with this large and virtually unachievable load reduction, TCEQ turned to local stakeholders to develop a watershed protection plan to reduce pollutants, said Roger Miranda, TCEQ strategic assessment division coordinator.

The partnership, originally organized by TCEQ and the Texas State Soil and Water Conservation Board (TSSWCB), is led by a 25-member steering committee. The committee oversees the efforts of seven work groups: wastewater infrastructure, agriculture, habitat restoration, land use and development, education and outreach, TMDL and monitoring. The Arroyo Colorado Watershed Protection Plan should be published by the end of 2006 and will be one of the first completed watershed protection plans for Texas.

(clockwise from top left)

Paul Bergh, a member of the Arroyo Colorado Watershed Partnership steering committee, grew up fishing and swimming in the Arroyo Colorado. He became involved in protecting and cleaning up the Arroyo in the early 1990s. Photo by Rod Santa Ana.

Because the Arroyo Colorado is dredged, commercial barges can travel up and down the Arroyo Colorado from the Port of Harlingen to the Laguna Madre and the Gulf Intracoastal Waterway. Photo by Brad Cowan.

The Arroyo Colorado collects irrigation water from 300,000 acres of cotton, citrus, vegetables, gain sorghum, corn and sugarcane as well as floodwaters and storm water runoff from urban and agricultural areas. Photo by Laura De La Garza.

The Arroyo Colorado Watershed Partnership's mission is to reduce the addition of pollutants to the Arroyo Colorado to meet state water quality standards and to improve natural terrestrial, riparian and aquatic habitats associated with the watershed. Photo by Brad Cowan.

Dr. Jude Benavides, steering committee chairman, said this is one of the first times the state has tried to use a voluntary effort to restore a watershed that failed to meet TMDL requirements.

"We need to succeed," said Benavides, assistant professor of hydrology and water resources at the University of Texas at Brownsville.

"I think it is most important that each member can acknowledge the importance of succeeding so we can serve as a template for other watersheds and other local stakeholders," Benavides said

Laura De La Garza, the partnership's watershed coordinator, said the plan's goal "is to reduce the nutrient levels to the maximum extent feasible and, for this first phase of the planning process, we are aiming for a 20 percent reduction after the plan's recommendations are implemented."

One of the plan's top recommendations, De La Garza said, is to construct wetlands for treatment of point source and nonpoint source pollution. Wetlands can serve as a habitat for fish and other aquatic animals, stabilize streambeds and banks, and filter and process wastewater contaminants in the water, she said.

Bergh agreed that wetlands are a priority. "They will not only provide for cleaning of the water but will create habitat for wildlife that local municipal and special interest groups can take charge of, creating awareness and education and a sense of pride for the populace," he said.

Thirteen cities and public utilities have agreed to undertake projects or change their permits to reduce wastewater runoff into the stream, De La Garza said. The plan supports upgrades for a few cities, additional reuse and construction of treatment ponds and wetlands.

Miranda said the wastewater infrastructure work group has recommended voluntary permit reductions and enhanced wastewater treatment to further reduce nutrients and suspended solids in the effluent.

"Most of our municipalities have improved or plan to improve their wastewater collection and treatment systems in some way," De La Garza said. "Our cities should be commended for the numerous colonia hook-ups and for the partial reuse of their wastewater effluent."

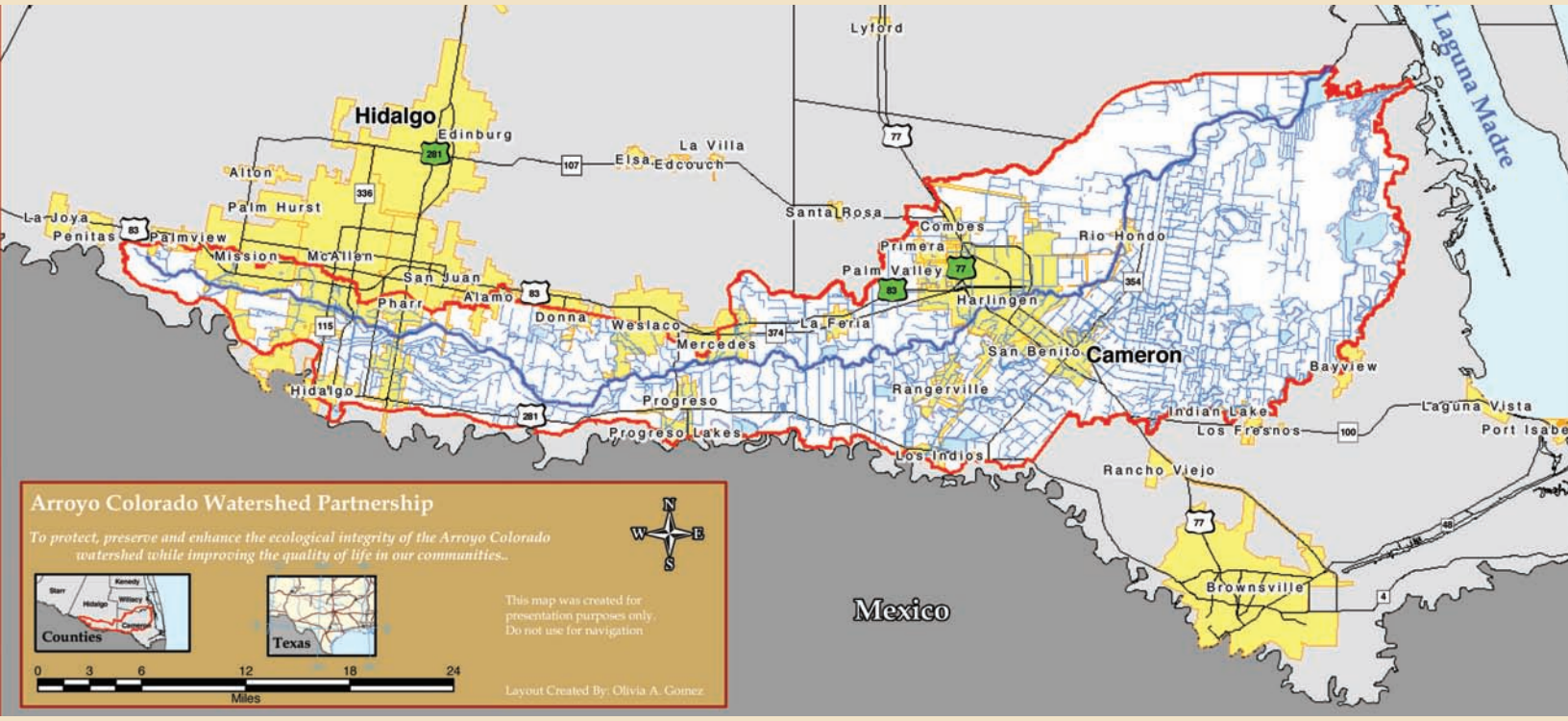
Because most of the land surrounding the Arroyo Colorado is farmland, management of nonpoint pollution from agricultural runoff that includes fertilizer and pesticides is included in the plan.

Kevin Wagner of the Texas Water Resources Institute (TWRI) said the plan's agricultural section recommends education on proper nutrient and irrigation management practices and how to implement best management practices that work on irrigated cropland. Then, monitoring actual impacts will be crucial to gauge the effectiveness of educational programs and the use of best management practices, he said.

TWRI and Texas Cooperative Extension staff, through a Clean Water Act 319(h) project funded by TSSWCB, are already addressing some of the agricultural issues addressed in the watershed protection plan. Extension agents in Cameron, Willacy and Hidalgo counties are educating farmers on managing their land to reduce the potential for nonpoint source pollution.

Wagner, TWRI's manager of the project, said Extension has sponsored free soil-testing campaigns to encourage soil testing and to endorse proper fertilizer use. Other programs provide training on crop production, integrated pest management and irrigation management. To help the producers implement these best management practices, the project promotes cost-share programs such as the USDA–Natural Resources Conservation Service's EQIP program, which provides farmers funds to apply specific conservation practices on their land, Wagner said.

"Our goal is for 50 percent or more of the farmers to implement best management practices by 2015 as a result of the educational efforts and cost-share programs," he said.



Wagner said the institute is seeking additional 319(h) funding to do the monitoring and assessment of the education and best management practices as recommended in the watershed protection plan.

The habitat restoration group puts a priority on conserving and restoring existing riparian and wetlands habitats, constructing additional wetlands, and reducing channel and stream bank erosion to reduce nonpoint source pollution.

De La Garza said the plan also calls for increasing awareness of water quality issues and their impacts through public education, school-based curriculum and outreach projects.

Benavides believes the education and outreach component, particularly in the Rio Grande Valley, is an important part of this protection plan, because as more people learn about the Arroyo Colorado and its importance, they will learn to take care of it.

When the plan is finished, the group will sponsor a "pachanga," or party, to present the plan and raise awareness of the Arroyo Colorado water quality issues within the valley.

As the watershed protection plan is implemented, TCEQ is working on Phase II of the TMDL study to determine more specifically how much of the low dissolved oxygen is caused from excessive nutrients and how much is from the stream's physical condition, Miranda said. He said the TMDL study will not be completed for a few more years pending evaluation of the implementation of the protection plan.

Once the plan is published, the partnership will continue. A watershed protection plan is an "evolving plan," De La Garza said. "We know we will need to adjust it as plan elements are implemented with a formal revision every five years."

Benavides expects the steering committee to continue to monitor activities in the watershed to ensure the partnership is reaching its objectives.

"I hope that we can come up with a good enough plan that is not only strong enough to get into compliance, but also flexible enough in the future to keep everyone behind it," Benavides said. "I hope the arroyo can serve as a model to other watersheds that fail to meet compliance in whatever regulation."

For Bergh, the success of the protection plan is more personal.

"My involvement is about protecting land and water that belongs to us all," Bergh said. "My benefit will come from enjoying the fish and wildlife and knowing that others behind me might get an even greater enjoyment of it if they take care of it."

Story by Kathy Wythe

CHAMPIONS OF TEXAS WATER

At quick glance, the two Texas women might seem opposite. One is tall, brown-haired and East-coast educated; the other petite, blonde and educated on the West coast. A closer look reveals two women who are both ranchers and state officials with a similar passion for Texas and preserving its waters.

Kathleen Hartnett White is chair of the Texas Commission on Environmental Quality (TCEQ), and Susan Combs is Texas Department of Agriculture Commissioner. In private business and in public service, both have made an impact in the arena of Texas water.

Combs oversees an agency dedicated to the state's second-largest industry—agriculture, which generates $73 billion a year and provides a job for one out of every seven working Texans. As agriculture commissioner, Combs has championed Texas groundwater rights issues and battled Mexican officials over water that country owed the United States.

White, as TCEQ's chairwoman, is involved in maintaining and improving the quality of Texas water as well as regulating surface water rights.

Both women come from a long line of West Texas ranchers from whom they developed their love of the land and respect for water. White and her husband own a 115-year-old ranch that spans Jeff Davis and Presidio counties. Ninety miles down the road, in Brewster County, Combs and her family have a working ranch established by her great-grandfather more than 120 years ago.

When asked what personal characteristics make the women effective in their positions, people who work with them say they are "highly intelligent," "articulate," "personable" and "understanding of issues."

Glenn Jarvis, a South Texas lawyer for 40 years, has worked with Combs and White on several water issues. "They both have real high quality of moral courage; they stand for and support what they believe in as opposed to what people might want them to stand for," he said. "We've been fortunate to have each of them in their respective positions."

Jarvis has worked with White through his involvement in converting water rights from irrigation to municipal purposes. "She has a good grasp of water rights and water resources. She has the ability to analyze and get to the real issues," he said, adding that she applies "legal principles in a very logical, straightforward way."

Representing the Rio Grande Valley's water users, Jarvis teamed with Combs and White, among others, in the recent fight to get Mexico to repay its water debt from the Rio Grande. Under a 1944 treaty, Mexico agreed to release water into the Rio Grande from six Mexican tributaries. In return, the United States releases water to Mexico from the Colorado River. Mexico fell behind on its obligations in the 1990s and the Mexican deficit, which peaked at more than 1.5 million acre-feet from 1992 to 2002, was repaid September 2005, but not until after a political struggle.

Combs was "very aggressive in protecting agriculture's interests" during the struggle, Jarvis said.

Ray Prewett, president of Texas Citrus Mutual and executive vice president of Texas Vegetable Association, two trade associations, also worked on the water debt issue with Combs and White. "Both were strong advocates for Texas," he said.

He described Combs as "unrelenting" in getting the debt repaid. "She was very outspoken and persistent to take on that issue and work with key officials in Washington and Austin," he said. "She has a bully pulpit and status as agricultural commissioner to become involved in water issues. Had it not been for her strong, persistent voice, I am not sure the water debt would have ever been paid back."

Susan Combs,
Commissioner,
Texas Department
of Agriculture

- Born in San Antonio
- Graduated from Vassar College, New York
- Received a law degree from The University of Texas Law School
- Served as Texas state representative from 1993-1996
- Elected as Texas Agriculture Commissioner in 1998
- Married with three sons
- Operates Combs Cattle Co., a family ranching business in Brewster County

Kathleen Hartnett White,
Chair,
Texas Commission
on Environmental
Quality

- Born in Salina, Kansas
- Graduated from Stanford University, California
- Studied law at Texas Tech University, Lubbock
- Appointed to the Texas Water Development Board in 1999
- Appointed to Texas Commission on Environmental Quality in 2001
- Named chair of the commission by Gov. Rick Perry in 2003
- Co-owner of White Herefords and a 115-year-old ranch in Jeff Davis and Presidio counties

Having ranching in their backgrounds has helped both women understand the issues facing agriculture, said Ned Meister, the Texas Farm Bureau's director of commodity and regulatory activities.

Of Combs, he said: "Owning a ranch in West Texas, having had management responsibilities on that ranch, gives her a fundamental understanding of agriculture. She is a very quick study on issues she may not be familiar with. She has good political connections, which is important in a political job like hers. That gives her the ability to help move her agenda forward."

White's ranching background, Meister said, has also given her an understanding of the challenges people in agriculture face. "When she has to make a decision that affects agriculture, she makes it with the knowledge of the impact on agriculture," he said. "She can put herself in the place of someone who is going to be regulated and she understands that."

Meister said being chair of the Commission is not an easy position because of all the environmental requirements and regulations. "It takes somebody with a lot of stamina, willpower and dedication to do that."

Meister has also worked with White on identifying the sources of bacterial pollution in Central Texas lakes and rivers. Until recently, many people felt dairies were the major source of bacterial pollution. Through bacterial source tracking, Meister said, wildlife is also recognized as a major source.

"She's very supportive in finding a way to account for the sources equitably. She's very understanding that the process needs some tweaking so it does take into account what we call background sources, which would include wildlife," Meister said.

Combs and White agreed the most pressing Texas water needs are all tied to the growing demand on the state's water supply, whether it is surface or groundwater.

In the draft *Water for Texas–2007*, the state's water plan, the Texas Water Development Board predicted that by 2060, Texas' population would double to 46 million, with a 27 percent increase in water demand. At the same time, total water supplies are projected to decrease by about 18 percent.

"Water is hugely important." Combs said. "It determines all economic activity. You can't put a dollar value on how important it is. It is critical to the state that we have adequate water."

White said, "The state's ability to meet future water demand is the overarching problem because from that steadily, rapidly increasing demand on our groundwater and surface water comes a host of other issues. Water quality, environmental flows and water rights all rear their heads as very important issues as the state tries to meet the increasing demand on our water supply."

For Combs, the increased demand plays out in one area she calls "the urban-rural interface conflict."

"There is a tension between the growing urban need for water and rural landowner rights," Combs said. An example, she said, is in East Texas where cities such as Dallas are trying to build reservoirs to meet their increased water needs, but are meeting opposition from the local residents. "This tension is going to get worse until a rational market system is found, a rational system that does not leave the rural guy without water," Combs said.

She said there also needs to be an equitable way to manage the state's groundwater rights, which unlike surface water rights, have only recently been regulated. For years, Texas landowners followed the 1904 rule-of-capture law that says landowners can pump as much water as they can use as long as it is not wasteful or malicious. In 2001, groundwater districts were given some authority to regulate groundwater use.

Today, approximately 85 percent of Texas land is in groundwater districts that manage and protect groundwater, but, Combs said, the districts vary in their ability to gather and analyze data and make decisions about competing interests for the groundwater.

Some groundwater owners, such as cities, pump large amounts of water while ranchers, farmers or small towns may pump a smaller amount. Combs compared it to straws, with some sipping from big straws; others from small straws.

"I do think that the legislature needs to come up with a way to look at balancing competing interests for groundwater," Combs said. "We should maintain and enhance the ability of these local districts to do their job and to ensure local landowners are protected and fairly treated," she said.

Advocates of preserving property rights, Combs and White said the legislature should move in the direction of a system similar to the correlative rights of the oil and gas industry, which allows landowners the opportunity to produce their fair share of the recoverable oil and gas beneath their land as long as it does not adversely impact their neighbors.

Another issue that needs legislative clarification, both said, is the reuse of water by cities after they have used it for drinking water. Until recently, cities would use the water, clean it up and then discharge it back into the river for downstream users. Some cities want to reuse the water to irrigate golf courses or for industrial use, leaving the rivers and water users downstream without that water.

"It is unclear under the Texas Water Code the manner in which the state can or can not authorize that so the issue of reuse needs clarification in law," White said.

"You start seeing interesting policy questions about purchase of water by cities and what it means downstream," Combs said. "It has far-reaching policy implications."

Because the need for water is growing, White said a concerted statewide effort on water conservation is needed. "It is very important that this state realizes the current and ever-increasing scarcity and, therefore, the greater value of our water supply and develops ways to use water more efficiently, to use less water for the same thing."

"Proper land-stewardship management techniques, including brush management and responsible grazing, increase surface and groundwater supplies," Combs said. "They are keys to meeting the state's future needs and are extremely cost-effective strategies."

Although White said she believes the legislature needs to clarify the law about groundwater rights, environmental flows and water reuse, she is a firm believer in the market system. "I think the market is the solution. I think the state forcing rural people to give underpriced water to urban areas is not right."

Solving these water issues needs to be sooner rather than later, they agreed.

"I think the quality of life, the Texas economy and the Texas environment depend on how we handle this water problem in the next few years, the next 20-30 years," White said. "There won't be any time after that.

"I think it's possible for Texas to meet that double population and be able to meet the water supply of the still-growing economy as well as protect the aquatic systems and the flows in our surface water because I think there is a growing awareness that water efficiency and water conservation is paramount to the future of this state."

Combs agreed the future of Texas depends on how the state approaches water policies today.

"Thoughtful water policy is a Texas issue that is going to take the dedication and commitment of all Texans to develop fair and equitable solutions to our future water needs."

Story by Kathy Wythe

Freeing up Water

Brush control efforts yield water

For 10 years during the 1990s drought, H. R. Wardlaw, a West Texas rancher, watched and waited.

He watched as the Middle Concho River and Rocky Creek running through his ranch near San Angelo became dry. He watched as the Florida bass from East Texas he stocked in the river and 75- to 100-year-old pecan trees lining the banks of the river died. And, he waited for the water to return.

In 2003, he stopped waiting and began participating in the North Concho River Pilot Brush Control Project and the Twin Buttes Brush Control Project. The projects are part of the Texas Brush Control Program, administered by the Texas State Soil and Water Conservation Board and designed to increase water yield by removing or controlling water-consuming plants such as mesquite, cedar and saltcedar.

In 2004, just as he finished excavating cedar, aerially spraying mesquite and hand spraying the remaining mesquite and cedar on his land on the Twin Buttes watershed, it started raining.

"The Middle Concho River and Rocky Creek started flowing again," Wardlaw recalled. "It was almost instantaneous recharge. It overcame 10 years of extreme drought in just that one year, which amazed everybody."

Wardlaw said even though the last year has been short on rainfall, the Middle Concho and Rocky Creek are still running.

"Even without the normal rain in the fall and winter, the Middle Concho River continued to flow great, and Rocky Creek continued to flow straight through the winter with no rain whatsoever," he said. "It absolutely wouldn't have continued over a dry winter and dry spring without brush control work, I am absolutely convinced."

Top photo: The Upper Colorado River Authority observed the return of perennial flow to 40 miles of Sterling Creek (top), the East Fork of Grape Creek and the North Concho River in 2005, flows that did not exist in 2000 before brush control.

Left bottom: H. R. Wardlaw, a rancher near San Angelo, has seen the streams on his land restored after he participated in the Texas Brush Control Program.

Right bottom: Chuck Brown, staff hydrologist for the Upper Colorado River Authority, measures flow in Sterling Creek after brush control.

Historically, the North Concho River and many of its tributaries flowed year round. But, since the early 1960s, the North Concho had been virtually dry and water flow into O. C. Fisher Reservoir was reduced to less than 20 percent of its normal amount, according to a study conducted by the Upper Colorado River Authority (UCRA).

The Texas Legislature authorized the State Board's brush control program in 1985, and funded the first project, North Concho River Pilot Brush Control Project, in 1999.

The State Board chose the North Concho River as the first watershed for the program because a feasibility study published by the UCRA showed that brush control could increase water flows from the river to O. C. Fisher Reservoir, a water supply source for San Angelo.

The voluntary program includes cost-share assistance for the "selective control, removal or reduction of noxious brush such as mesquite, saltcedar or other brush species that consume water to a degree that is detrimental to water conservation," according to the State Board's Web site. The program currently has three completed and 10 ongoing projects.

Working with the local soil and water conservation district's staff, landowners develop individual resource management plans that address brush control and other natural resources issues such as soil erosion, water quality and wildlife habitat. They then receive financial assistance (up to 70 percent of the costs) to clear their land of the water-consuming brush by physically removing it with bulldozers or excavators, by aerially spraying the land with herbicides or, in some cases, controlled burning. To date, landowners have treated 554,000 acres mechanically and 65,000 acres by aerial spray through the Texas Brush Control Program.

The principle is that by removing the brush, more water is left to seep into the groundwater or flow into the streams, rivers and lakes. The land also reverts to grassland.

Jimmy Powell, a West Texas rancher for 60 years, has photos of his land in the early 1900s. "There was no brush except live oak," said Powell, who began participating in the State Board's brush control program in 2002. Through the years, mesquite and cedar took over the land.

Powell, who owns land in Tom Green, Sutton, Schleicher and Menard counties, has treated 22,000 acres of his land in the Pecan Creek and South Concho River watersheds, by mechanically removing the cedar and aerially spraying the mesquite.

"I had not seen Pecan Creek run in 25 to 30 years," he said. "After removing the brush, the springs almost immediately began flowing. Pecan Creek is still flowing."

The North Concho pilot project finished with more than 300,000 acres treated and 314 landowners participating, according to Johnny Oswald, manager of the brush control program.

"We believe brush control works," Oswald said.

He cited a 2006 report by UCRA that said approximately 40 miles of the North Concho River and two tributaries, Sterling Creek and the East Fork of Grape Creek, that had brush removed had perennial flow in 2005. The report also indicated that treatment of 18,270 acres on the East Fork of Grape Creek yielded almost 1,900 acre-feet of water while the adjacent, similar-sized West Fork of the creek with no brush control remained dry.

Regional groundwater levels have risen by 3 feet, on average, since the State Board and landowners initiated brush control in the North Concho watershed, the report said.

Oswald said since the North Concho River project was a pilot project, the State Board made adaptations to the program as it went along.

One of the biggest changes, Oswald said, is targeting smaller sub-basins based on feasibility studies showing a strong potential for high water yield, cost effectiveness and landowner participation.

"Not every watershed and, within the watershed, not every area will be a good candidate for brush control," Oswald said. "Since landowners pay for their own economic benefit, we have to implement it (the program) in a way that landowners will participate. If we don't have landowner participation, we don't have a program."

Brush control for water savings is being implemented in other areas of Texas.

As part of the Pecos River Ecosystem Project, herbicide spraying to control saltcedar, an invasive water-thirsty plant, along the Pecos River began in 1999. For the project's first seven years, total water salvage estimates are between 17.7 to 26.5 billion gallons, according to Dr. Charles Hart, Extension range specialist.

Researchers have identified brush control, primarily Ashe juniper removal, as a method to increase Edwards Aquifer recharge. In January 2006, the Edwards Aquifer Authority and USDA-Natural Resources Conservation Service signed an agreement to offer cost-share to landowners in the Edwards Aquifer region to do brush control.

Johnny Oswald, the Texas State Soil and Water Conservation Board's Brush Control Program coordinator, and Tuffy Wood, program specialist, have worked with West Texas rancher James Powell (center) in clearing brush from his land as part of the Texas Brush Control Program.

While ranchers Wardlaw and Powell provide personal evidence of water savings gained by using brush control, Texas A&M University researchers have studied what watershed elements are necessary to get water savings through brush control for several years.

Dr. Richard Conner, an Agricultural Economics Department professor, has studied brush control from an economics and landowner participation standpoint. From his research, he said that usually 60 to 80 percent of landowners with 50 or more acres are willing to participate in the cost-share program. Using research conducted by NRCS for the feasibility studies of the Hondo, Medina, Sabinal and Perdernales Rivers and Seco Creek watersheds, which concluded additional water could be produced with brush control, Connor also analyzed the cost of the brush control to determine the costs to the state of $16.41 to $42 per acre-foot of additional water.

Connor said brush control can be an economical way to yield water. "If the brush control will yield additional water, and if the brush control is not too costly, and the additional water can be captured and held for use, then $16.41 to $42 is a competitive cost for additional water compared to other alternatives such as new lakes or de-salting of sea water," he said.

According to a 2005 Texas Agricultural Experiment Station research report, the relationship between brush removal and increased water yields becomes stronger as annual rainfall increases and when brush is removed from land adjacent to streams rather than in areas away from the streams.

The report's authors said the linkage between brush removal and increased water yield in upland areas (land away from the surface water) is stronger in areas where water can move rapidly through the soil or in areas where springs currently exist or historically have existed. They also concluded that the highest probabilities of water yield increases are likely for riparian areas where herbaceous plants would replace woody plants such as saltcedar and in areas where groundwater recharge is naturally rapid and high.

In areas with little subsurface water movement and where shrubs are not accessing groundwater, brush control is less likely to increase recharge or stream flow, except where direct runoff is increased.

The authors said that well-designed monitoring studies are needed in conjunction with the brush control program, and that brush control should be broadened to include "best management practices for watershed health and sustainability" rather than a simple focus on water yield.

Texas Agricultural Experiment Station researchers Brad Wilcox, William Dugas, Keith Owens, Darrell Ueckert, and Extension specialist Charles Hart were authors of this report.

The 2005 Experiment report may be read at: http://twri.tamu.edu/reports/2005/TAESResearchReport_Shrub.pdf.

A summary of the report is available at: http://twri.tamu.edu/reports/2005/TAESResearchReport_ShrubWater.pdf.

For a report on past brush control projects, read the "Texas Water Resources" article, December 2001, at: http://twri.tamu.edu/newsletters/TexasWaterResources/twr-v26n3.pdf.

The Texas State Soil and Water Conservation Board incorporated lessons learned from a pilot brush control project in the North Concho River Basin into subsequent projects.

Story by Danielle Supercinski

A DASH OF SALT

Researcher assesses salinity impacts on grasses, trees and shrubs

A Texas A&M researcher is assessing the impact of using moderately saline water for irrigating urban landscapes in West Texas and southern New Mexico.

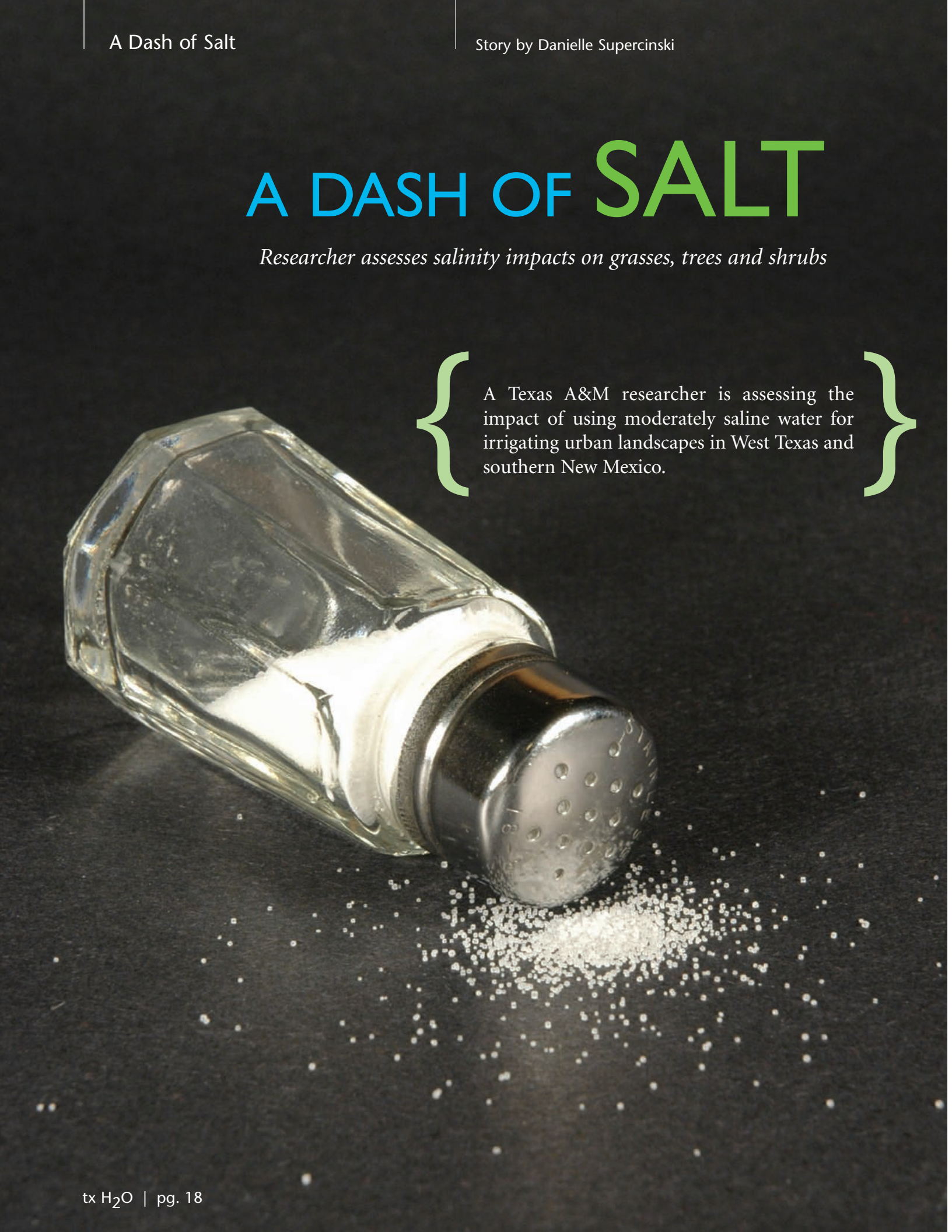


Fig. 1 – Foliar damage in Mulberry (*Morus alba*), pictured at left, and Arizona Cypress (*Cupressus arizonica*).

"The primary purpose of using moderately saline water for irrigation, including reclaimed water, is to conserve potable [drinkable] water," said Dr. Seiichi Miyamoto, a professor and researcher with the Texas Agricultural Experiment Station at The Texas A&M University System Agricultural Research and Extension Center at El Paso. Miyamoto said he is evaluating salinity in water used for landscapes because he is seeing more landscapes damaged from too much salt in the water (containing dissolved salts near or in excess of 1,000 parts per million) used for irrigation. "We just do not have good guidelines to assess potential salinity hazards to landscape plants and soils," he said.

Most reclaimed water in California, Arizona and New Mexico has salinity well below 1,000 ppm, but salinities of reclaimed waters in West Texas and some areas of southern New Mexico and central Arizona usually exceed 1,000 ppm, sometimes reaching 1,500 ppm or higher, Miyamoto said. Other areas, such as Midland-Odessa, may have even higher salinity levels.

The most common salt-induced problem appears as foliar damage when broadleaf trees or shrubs are sprinkler-irrigated, he said. Plant damage caused by sprinkler application of reclaimed water has been extensive and acute (fig. 1).

"We did not know plants are so sensitive to this form of salt damage," Miyamoto said. "Many plants grow fine along the coast where seawater spray containing 35,000 ppm of salt hits foliage during high winds.

"We conducted an experiment where different types of landscape plants were sprinkled for 30 minutes every other day, a practice common at golf courses and city parks. We found that broadleaf deciduous trees are sensitive to this form of salt damage, while pines and junipers, which grow near the coast, are tolerant."

Miyamoto said he believes that high-frequency irrigation used for maintaining landscapes is compounding this problem. Researchers also found salt crusts on leaf surfaces.

"It was a bit of a surprise when we saw salt crusts directly on the leaves, but it is not really surprising if you consider how the windshield of your car would look if it were sprinkled every other day for 180 days a year, with little or no rain," he said. "You would not be able to see through it. We now have a guideline for assessing this type of salt damage for different species of plants."

With this type of problem, Miyamoto said, "the key thing to remember is not to hit the plant leaves with sprinkler streams."

In mature trees, this can be accomplished by converting sprinklers to low-trajectory or under-canopy types of sprinklers (fig. 2); however, this option may not work for shrubs and ground covers. The use of non-sprinkling irrigation systems, such as bubblers and drips may be needed. Infrequent deep irrigation does help, but not enough to correct the problem, he said.

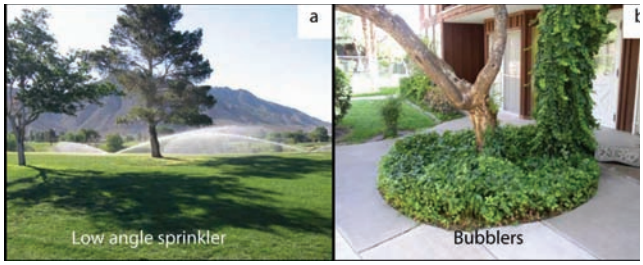


Fig. 2 – Conversion to low trajectory sprinkler (a) and to bubblers (b) for reducing foliar damage.

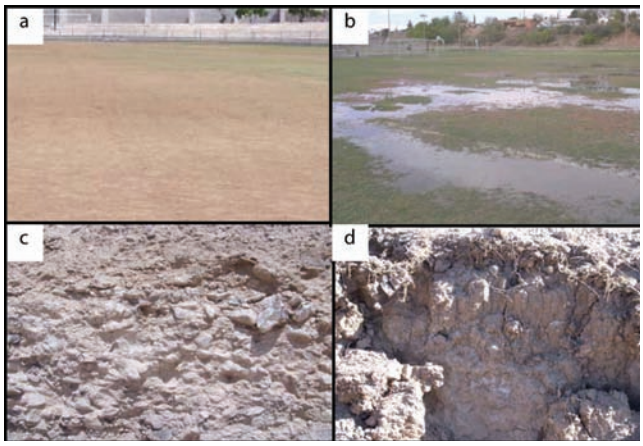


Fig. 3 – Examples of athletic fields affected by poor soils and salt accumulation. Clockwise: (a) upland soil, caliche, (b) bottomland soil, (d) a closeup of (b), and (c) a closeup of (a).

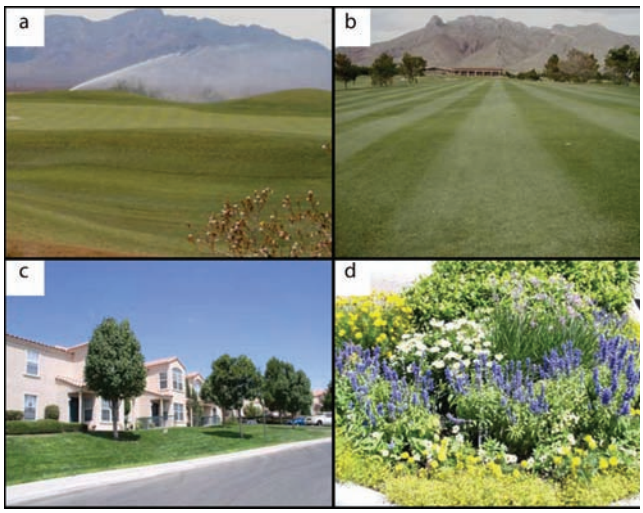


Fig. 4 – Successful use of reclaimed water for landscape irrigation: (a) golf course without trees, (b) upland soils with slope, (c) upscale apartments, and (d) flower beds with drip.

The second most frequent problem is soil salinization, or too much salt accumulation in the soil. This usually occurs in clayey (silty clay loam, clay loam and clay) bottomland and some upland soils that are poorly drained. Poor soil and irrigation management can also lead to soil salinization, even when inherent soil properties are suitable, he said.

Miyamoto said there is a definite need to develop guidelines for assessing soil suitability for irrigation with moderately saline water. To develop these guidelines, scientists are using athletic fields for their research. Poor turf growth caused by insufficient top soil, poor drainage and salt accumulation are just a few of the soil problems found in old and new athletic fields (fig.3).

Miyamoto's research group at El Paso has developed a simple method of assessing soil salinization potential for recently formed, relatively uniform alluvial soils in the valley, referred to as Entisols. The research results show that soil salinity under the prevailing irrigation practices is influenced greatly by soil permeability. In Entisols, soil permeability is controlled to a large extent by soil texture and soil compaction. Therefore, soil salinization potential can be estimated from soil textural classes, field-use categories, and, of course, irrigation water salinity, Miyamoto said. According to these guidelines developed by Miyamoto and Chacon, soil salinization is likely in athletic fields (with extensive foot traffic) when the field consists of clayey soils and is irrigated with moderately saline water.

Miyamoto and his associates also developed publications in cooperation with El Paso Water Utilities on plant response to soil salinity. *Landscape plant lists for salt tolerance assessment* and *Photo Guide: Landscape plant response to salinity* covers more than 100 species of plants used for landscapes in the Southwest. Copies of these publications are available by contacting the Research and Extension Center at El Paso at (915) 859-9111.

Research is still not completed for upland areas where soils rich in calcium carbonate prevail. There are several cases where drainage problems appeared in stony sediments that make up foothills. These areas

are prime locations for urban growth, and athletic fields are constructed by placing topsoil over the stony sediment. According to Miyamoto, these stony sediments tend to seal and impair drainage. The cause is currently being investigated.

"These findings are somewhat of a concern to us," Miyamoto said. "For one thing, public parks and school sports fields are built with engineering specifications covering soil stability and strength, but not for suitability for maintaining turf with water of moderate to elevated salinity.

"Knowing salt accumulation in certain types of soils, it seems that we may have to modify existing soil preparation guidelines in one of these clays," he said.

At the same time, we should keep things in perspective, he said. When soil conditions are suitable and leaf damage is controlled, moderately saline water is excellent for turf irrigation, he said. There are many examples of successful uses on urban landscapes and golf courses (fig. 4). When the soil condition is not good, researchers said they need to find ways to amend it. This is also part of their ongoing research.

Miyamoto said the Rio Grande Basin Initiative, along with a matching fund from municipalities, have been instrumental for funding this type of applied research program. Without them, he said, "we would not have come this far."

For additional information and a list of resources, please visit http://twri.tamu.edu/news/2006-09-25-01/ or contact the Research and Extension Center at El Paso at (915) 859-9111.

TWRI awards Mills Scholarships to graduate students

The Texas Water Resources Institute recently awarded Mills Scholarships to 13 Texas A&M University graduate students to pursue water-related research for the 2006-07 academic year.

TWRI's Mills Scholars Program, an endowed fund that supports research in water conservation and management, provided the $1,500 scholarships to the students to use for education-related expenses. The scholarship program supports graduate students in diverse water research programs at Texas A&M University.

Students receiving the scholarships and their departments include: Kendra Johnson, Department of Biological and Agricultural Engineering; Vanessa Kelly, Jeremy Rice, Nick Russo III and Kati Stoddard, Water Management and Hydrologic Sciences; Trevor Knight, Department of Wildlife and Fisheries Sciences; Meredith Langille, Oke Nwaneshiudu and Sucheta Parkhi, Department of Civil Engineering; Anna Marie Nordfelt, Department of Geography; Lisa Prcin, Department of Rangeland Ecology and Management; Ronnie Schnell, Department of Soil and Crop Sciences; and Zach Vernon, Department of Forest Science.

Mills Cox, a former chairman of the Texas Water Development Board, endowed this scholarship program.

For more information on the Mill's Scholarship program or to learn more about the projects, contact the Texas Water Resources Institute at (979) 845-1851 or twri@tamu.edu.

Story by Courtney Swyden

Global Predictions

Lab uses advanced technologies to forecast change

Every morning forest rangers and specialists from the Texas Forest Service meet to make decisions about protecting the state's natural resources from fire. Essential to making these decisions are Keetch–Byram Drought Index (KBDI) maps produced daily by the Spatial Sciences Laboratory in College Station.

Spatial Sciences Laboratory Director Dr. Raghavan Srinivasan said county commissioners across the state also use the KBDI maps to determine whether to issue countywide outdoor burn bans in their county.

"The drought index is based on a daily water balance, where a drought factor is calculated with precipitation and soil moisture," Srinivasan said.

KBDI represents dryness and wetness in Texas counties on a scale of 0 (no moisture depletion) to 800 (absolutely dry conditions) and are used to estimate forest fire potential. A county with an index above 500 will institute a burn ban.

The index uses weather station estimates of temperature and Doppler radar-based precipitation estimates to produce geographic information systems (GIS) maps.

The KBDI maps are one of more than 15 map products created every day by the lab and used by the forest service, county commissioners and others.

Using computer technology and satellites, the lab currently focuses on three core spatial technologies—GIS, global positioning systems (GPS) and remote sensing technology. The lab uses these technologies to create interactive, multi-layered maps to help environmental and natural resources managers in environmental decision making, planning and problem solving as well as providing information about demographics, socioeconomic factors and public health information.

GIS technology is a computerized system that can capture, store, process and analyze spatial data. The lab uses GIS to produce the Texas Spatial Information System Web site. The Web site provides an interactive map of the state and gives information about transportation, water resources, boundaries, land and biological resources, agricultural data, demography, environmental quality and more.

The lab is currently working with the U.S. Army Corps of Engineers in developing GIS maps for its reservoirs so the Corps can better manage and conserve natural resources while providing quality outdoor recreation.

For example, GIS technology can determine boundaries of a reservoir as well as all of the features within those boundaries such as general land leasing or facilities as well as hunting and park boundaries.

Kim Hart, research assistant, and Greg Michalak, graduate student, evaluate Keetch-Byram Drought Index maps to determine drought conditions across the state.

"Boundaries need to be established so hunters, campers or park visitors can know their limits and prevent hazards," said Srinivasan.

The lab also uses GPS, a satellite navigation system useful for surveying property boundaries and fields. GPS uses satellites to locate and track any feature on Earth at any given time.

The lab is using GPS in identifying the Corps reservoirs' physical features, such as boating dock locations and park and recreation locations. The Corps puts that information on its Web site so the public has
easier access to parks or recreational areas.

Remote sensing technology uses satellites to collect data about the earth's surface to analyze changes and variations in land use and crop patterns and vegetation variations over time or as damage assessment after a natural disaster.

"Remote sensing is used to measure urban growth and what it affects," Srinivasan said. "We look at growth in terms of how it affects water quality, its impact on natural resources and how many wetlands are lost."

The lab recently worked with the Houston-Galveston Area Council to determine how many wetlands have been lost to urbanization or other land uses. Changes are easily detected using satellite images as well as high-resolution aerial photographs.

The lab has also used water quality models to study water quality protection and improvement. Water quality models are computer programs used to mimic the biological, physical, chemical and economic aspects of current land management and estimate the water quality impacts of implementing best management practices. This information helps assess water quality problems in a watershed.

Water quality models like SWAT (Soil and Water Assessment Tool), a landscaped-based (watershed) model, can predict impacts of agriculture management practices on landscapes.

The river-based water quality model, QUAL-2E, can illustrate how a river will react to certain chemicals and its processes.

WASP (Water Quality Analysis Simulation Program) is a lake-based water quality model that divides a lake into a 3-dimensional system to simulate the various chemical and biological exchanges both horizontally and vertically.

Because water quality models are vital to the Environmental Protection Agency (EPA), it provided USDA–Agricultural Research Service (USDA–ARS) with $1 million to develop the HAWQS Project (Hydrological Water Quality Modeling System). The lab is working closely with EPA and USDA–ARS to implement the project.

"The overall objective of this project is to provide a water quality modeling system that is capable of supporting a wide variety of national-scale economic benefit assessments in the EPA's Office of Water due to water quality impairments," Srinivasan said.

The modeling system will be a software product that can be installed, modified and run on EPA servers and can be made publicly available for downloading to other computers, he said.

Research is not the only aspect of the lab; education is also available for undergraduate students who want advanced knowledge of spatial analysis. A bachelor's of science degree in spatial sciences is offered under Texas A&M University's College of Agriculture and Life Sciences and College of Geosciences. Course work allows the students to use the potential of spatial sciences in problem solving.

Texas A&M also offers a graduate certificate program for GIS and remote sensing technologies. The program gives students in-depth, practical knowledge and opens the door for better job opportunities.

"The certificate program has been really successful," Srinivasan said. "We've had about 15 to 20 students every year since we started this in 2004."

LEFT: Graduate students in the Department of Forest Science use GPS technology in their studies.

RIGHT: Jennifer Jacobs, senior research associate, Kim Hart, research assistant, and Zach Vernon, graduate student, observe a GIS map generated by the lab for information on agricultural data in a certain area.

The lab collaborates with many state and federal agencies, including:

- Texas Forest Service
- Texas Water Development Board
- Texas Commission on Environmental Quality
- Texas State Soil and Water Conservation Board
- USDA–Agricultural Research Service
- USDA–Natural Resources Conservation Service
- U.S. Army Corp of Engineers
- National Weather Service

For more information about the lab, visit their Web site at http://css.tamu.edu.

Graduate students awarded water research grants

Texas Water Resources Institute (TWRI) recently funded 10 water-related research projects for graduate students from Texas A&M University, Texas Tech University, the University of Texas at Austin and West Texas A&M University.

The students were awarded up to $5,000 to begin, expand or extend water-related research projects. TWRI received more than 30 applications in response to the request for proposals for the 2006–2007 grants.

The institute funds the graduate student projects through money provided by the U.S. Geological Survey as part of the National Institutes for Water Research annual research program. TWRI will publish articles and reports about the progress of each project.

Graduate students, their projects and their advisors are:

David Barre, Texas A&M, Georgianne Moore, advisor. "Determining effects of brush clearing on deep drainage using soil chloride; a feasibility study for South Texas rangelands"

Yongxia Cai, Texas A&M, Bruce McCarl, advisor. "Impacts of Texas inter-basin water transfers on the water dependent economy and the environment"

Bassil El-Masri, Texas Tech, Faiz Rahman, advisor. "Estimation of water quality parameters for Lake Kemp Texas, derived from remotely sensed data"

Dongsuk Han, Texas A&M, Bill Batchelor, advisor. "Arsenic removal by novel nanoporous adsorbents"

Mohammad Islam, Texas A&M, James Bonner, advisor. "Development of a coastal margin observation and assessment system to monitor the water quality in the Corpus Christi Bay"

Andrew Karonen, UT at Austin, Steven Moore, advisor. "A socio-technical case study of sustainable stormwater management in Austin, Texas"

Megan Meier, Texas A&M, Anne Chin, advisor. "Post-restoration evaluation of urban streams in Central Texas"

Arwa Rabie, Texas A&M, Mahmoud El-Halwagi, advisor. "Property-based management and optimization of water usage and discharge in industrial facilities"

Debabrata Sahoo, Texas A&M, Patricia Haan, advisor. "Modeling the effect of urbanization and optimizing land use for estuarine environmental flows"

Robert Taylor, West Texas A&M, Lal Almas, advisor. "A pricing model to assess the effects of groundwater availability on land valuation"

For more information and updates about each project, visit http://twri.tamu.edu/usgs.php.

Story by Kathy Wythe

Ripple Effects

Water conservation policies, practices impact Ogallala region's economy

With water levels in the southern part of the Ogallala Aquifer—the major source of groundwater for the Southern Great Plains—declining, researchers across the Texas High Plains and Kansas are developing agricultural practices and technologies that use water more efficiently.

At the same time, a group of agricultural economists is determining the impacts water conservation policies and practices might have on producers' incomes and water savings, as well as the ripple effects on the regional economy.

Drs. Steve Amosson of Texas Cooperative Extension in Amarillo, Lal K. Almas of West Texas A&M University, Jeff Peterson of Kansas State University, and Jeff Johnson of Texas Tech University are principal investigators of the project. Part of the Ogallala Aquifer Initiative, a federally funded project through the USDA–Agricultural Research Service, the economics project began in 2003 and is scheduled to continue at least until 2008.

The economists have divided the southern Ogallala Aquifer region into three smaller regions based on similarities in cropping patterns and water availability. Texas Tech researchers are developing economic models in the southern part; West Texas A&M, the central part; and Kansas State, the northern part. These researchers have developed economic optimization models that project for a 60-year period water use, farm net income and aquifer-saturated thickness for each county in the study.

Almas, assistant professor of agricultural business and economics, said the optimization model determines the number of irrigated acres for each crop that maximizes the value of irrigation for each county, subject to water availability. The model also keeps track of changes in inputs, such as fertilizers and natural gas used to produce crops.

The economists are then able to project the use of water for a 60-year horizon based on the current irrigation technologies and water conservation management strategies, the current mix of crops for each county and the current amount of water pumped, Almas said.

"We have estimated in our region of 23 counties in the northern Texas Panhandle that, on average, 60 percent of the crop acres are under irrigation and 40 percent is dryland," he said. Projections from the optimization model indicate that after 60 years, only 12 percent of the crop acres will be irrigated because of lack of water.

In another portion of the economics project, Amosson and Extension Associate Bridget Guerrero take the results a step further. Using a socio-economic planning model, they first incorporate economic data for the counties in each sub-region and in particular crop production costs. Finally, they input the initial effects on farmers' incomes gained from the optimization models into the socio-economic modeling program. The results give an idea of what specific policies or technological advances will do to the

Photos Courtesy of Shelby Axtell, Texas Tech University

overall economy and society in the region, including household incomes and employment levels.

The socio-economic planning model, called IMPLAN (Impact analysis for PLANning), is one of the most widely used socio-economic planning models in the country. To measure impacts, the model produces multipliers that estimate the total economic impact of a "shock" to an economy. These impacts are referred to as direct, indirect and induced effects. The model contains comprehensive and detailed data coverage of the entire United States by county.

What the economists have found is that certain strategies that save the most water may have negative impacts on producers' income.

Now, Amosson said, they are taking it a step further to see how what is happening with producers will affect the entire economy.

They are using the economic models to determine the effect of water conservation policies, such as USDA–Natural Resources Conservation Service's Conservation Reserve Program, which compensates farmers for converting farmlands to grasslands, may have on long-term water availability from the Ogallala Aquifer and the cost of water saved.

Amosson said policies or program changes, such as reducing irrigated acreage, can reverberate through the rural community. An example is "if you reduce the amount of irrigated acreage, you may not need to buy as much fertilizer," Amosson said. "If you don't buy as much fertilizer, you may not need as many fertilizer dealers. And, if you don't need fertilizer dealers, they move away, and if their kids are not going to school, you may lose a schoolteacher.

"Certain policies will have positive effects; some will have negative effects within the regional economy. Some will not have an effect at all."

Guerrero said they are currently surveying decision makers to determine the most important water conservation policies to analyze. From the survey, they will pick the top policies to run optimization and socio-economic modeling scenarios.

Amosson said the information gathered will provide scientific facts to decision makers and farmers so they understand the consequences of implementing policies or practices, and they can make informed decisions.

He said the modeling research will be able to tell them "if you implement this at this level, here are the impacts on the producer's income; here are what we are projecting are the impacts on the regional economy; here are the estimated water savings; here are the implementation costs. Then it is up to them."

Another objective of the economic research project is establishing a benchmark of currently used water-use practices and technologies, Guerrero said. This benchmark will enable the group to estimate more accurately current producer practices and irrigation technologies and get a more accurate picture of how changes in water management practices and technologies will affect the economy.

The ultimate goal of the economic project is "to minimize the drawing down of the aquifer and minimize the negative effects on the economy," Amosson said.

"We are trying to extend the useful life of the Ogallala Aquifer and make sure that water is available for future generations without compromising sustainability of rural communities," Almas said.

Charting the Course

"Charting the Course," a Texas water planning and policy development conference, is set for Nov. 15–17 at the State Capitol Extension in Austin.

Sponsored by the River Systems Institute, the conference will feature symposia by the state's leading scientists and representatives from water-resource management agencies focusing on how far the state has come in terms of water-resource management and planning. The conference will also highlight the development of the 2007 Texas Water Plan, the implications and obstacles to its implementation and how policy activities of the next legislative session can provide a framework for overcoming these obstacles. Other issues, including water conservation, reuse, environmental flows and groundwater management, will be discussed.

More information is available at www.rivers.txstate.edu or contact Annette Paulin at (512) 558-4523 or chart.the.course@grandecom.net.

New Faculty

Biological and Agricultural Engineering

Dr. Vijay P. Singh was selected in July 2006 as the inaugural holder of the Caroline and William N. Lehrer Distinguished Chair in Water Engineering in the Department of Biological and Agricultural Engineering.

Singh was a professor in civil and environmental engineering at Louisiana State University and held the Arthur K. Barton Endowed Professorship.

He received his doctorate in civil engineering with an emphasis on hydrology and water resources from Colorado State University and a doctorate of science in engineering with an emphasis on environmental and water resources from the University of the Witwatersrand, Johannesburg, South Africa.

Singh will provide continuing research, teaching and Extension programs in water engineering covering topics such as urban water resource management, water quality remediation, reuse of municipal wastewater and more.

Soil and Crop Sciences

Dr. Terry Gentry, assistant professor of soil and microbiology, joined the Department of Soil and Crop Sciences in January 2006.

Gentry received his doctorate in microbiology and immunology from the University of Arizona in 2003.

His expertise is in the area of the development and use of molecular technologies to enhance the detection and remediation of environmental contamination. This includes the detection and identification of microbial pathogens from animal, human and natural sources, and the characterization of microbial populations and communities contributing to applied remediation processes such as the bioremediation of organic and metal contaminants.

Soil and Crop Sciences

Dr. Kurt Steinke, assistant professor of turfgrass ecology, joined the Department of Soil and Crop Sciences in April 2006.

He received his doctorate from the University of Wisconsin–Madison in 2006.

Steinke's research will focus on the biology, management and ecology of plant communities within the urban/suburban environment, and what effects these systems have on the soil and surrounding areas within the shifting urban landscape. This includes urban water and nutrient management, sustainability, cultural management, soil amendments and best management practices promoting the judicious use of water and nutrients within turfgrass, native and agricultural ecosystems in order to sustain and improve soil quality.

TWRI Welcomes New Faces

Lucas Gregory joined Texas Water Resources Institute in June 2006. As a project manager, he provides leadership for several projects and is a team member for directing 319(h) projects funded by the Environmental Protection Agency through the Texas State Soil and Water Conservation Board and Texas Commission on Environmental Quality.

He earned his bachelor of science degree in agricultural systems management and a masters of science degree in water management and hydrologic sciences, both from Texas A&M University.

Cecilia Wagner joined Texas Water Resources Institute in June 2006. As a project manager, Wagner is responsible for programs pertaining to agricultural water conservation. She coordinates a collaborative Irrigation Training Program funded by the Texas Water Development Board. In addition, Wagner provides administrative guidance for the Precision Irrigation Network, a task of the Rio Grande Basin Initiative.

She earned her bachelor of science degree in plant and environmental soil science and her masters of science degree in agronomy, both from Texas A&M University.

Kathy Woodard joined Texas Water Resources Institute as office associate in August 2006. She performs general office procedures, advanced clerical assignments and special projects for the institute.

Woodard recently relocated to this area from Lubbock where she worked as a computer support specialist at Texas Tech University.

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Governor announces initiative for Trinity River Basin

Gov. Rick Perry announced the Trinity River Basin Environmental Restoration project Sept. 5 in news conferences in Houston and Arlington. Rod Pittman, Texas Water Development Board chairman as well as other local, state and federal officials were on hand for the announcement. The initiative will focus on projects to improve water quality, hydrology, wetland restoration, hardwood reforestation, wildlife habitat and voluntary landowner stewardship.