New Waves
The Research Newsletter of the Texas Water Resources Institute
Volume 8, Number 2, July 1995

New TWRI Service Lets People Search for Information on Texas Water Experts on the Internet

A new service from the Texas Water Resources Institute (TWRI) is providing searchable on-line information about water researchers at Texas universities. The database is titled " Researchers with Water-Related Expertise at Texas Universities." It is now available through Texas WaterNet -- the TWRI world wide web (WWW) site.

The researchers database was developed by TWRI Information Specialist Ric Jensen and students Steve Fuller and Jonathan Jones. Jensen says that publishing it on the WWW will benefit people who want to know about water research in Texas. "We often receive inquiries from people throughout Texas and elsewhere who want to know about the latest developments in water research," Jensen says. "This database will identify individuals who are actively researching specific topics and will provide a way for people to contact them."

The database can be searched in many ways. Users can search by the researcher's name, by university, by a pre-defined list of keywords, or by a specific term users choose themselves. After executing a search, users are shown a full description of the expertise of individual researchers. If the researchers use electronic mail, a link to a computer generated form is provided so that e-mail can be sent to them automatically.

Jensen said there will soon be links to the full text of many articles that describe research these scientists have conducted. These articles were previously published in TWRI's four quarterly newsletters [*Texas Water Resources, New Waves, Texas Water Savers,* and *Texas On-Site Insights*]. Links will also be established to TWRI technical reports that scientists have written. "This will be especially useful," Jensen said. "If you want to get more details about a scientist's research, this service will put the information at your fingertips."

Computer users with internet service can access Texas WaterNet at <URL=http://twri.tamu.edu/twri>. You choose the database by clicking a button labeled "TWRI People/ Water Experts." A paper copy of the Directory is now being compiled that will be available later this year. For details, contact Jensen at (409) 845-1851 or rjensen@tamu.edu.

TWRI Works with State Agencies to Promote Water Research

If you talk with many university scientists and administrators about funding prospects for research, the mood is generally glum. That's because it's been proposed that many federal many state research efforts programs be cut or eliminated. With that in mind, TWRI is happy to say there is some good news. Two requests for proposals (RFPs) were recently issued that deal with water research.

The Texas Water Development Board (TWDB) issued a $500,000 RFP for research in nine specific subject areas. These topics include the social and economic impact of water transfers, model agreements for water sales, computer modeling of surface and groundwater interactions, evaluation of brine management methods, and the impact of brush management on rangeland water yields. Other topics include updating estimates of free water evaporation and consumptive water use by crops, innovative methods for rainwater harvesting, evaluation of dry year water transfers from agricultural to urban users, and the role of short-term drought responses in long-range planning.

Although research ideas were solicited separately last fall, many of these research topics were identified as high priorities were similar to those put forth in a goal-setting workshop TWRI jointly conducted with TWDB in 1991. Earlier this year, TWRI and TWDB co-sponsored a conference that featured results of current research projects.

"We have been able to work with TWDB to make them more aware of university research and to get them to involve university scientists in their research program," TWRI Director Wayne Jordan said. "It is exciting when universities and state agencies can work together to expand opportunities for scientists. In many cases, increasing prospects for research will contribute to developing solutions for Texas water problems."

The Texas Higher Education Coordinating Board recently issued an $60 million RFP. For the first time, the Board's Advanced Technology Program includes a category dealing with water resources and recycling.

"In the past, we've been aggressive about informing people of opportunities to get involved with the Board's research program," Jordan says. "We do this with our newsletters and direct mailings to individual scientists. After the awards are granted, we provide information on water research projects through our technology transfer efforts. We hope that our work reinforced the notion that water research should be an important part of the Board's program."

Although TWRI's efforts to let scientists know about research have usually relied on printed materials, there are now efforts to make the information available electronically. For example, information about both these RFPs is now featured on TWRI's WWW site and is being made available to scientists through electronic list servers.

For more information about TWRI call (409) 845-1851 or e-mail us at twri@tamu.edu.

Rain Water Infiltration Through Clay Soils in Galveston County

Researchers: Steven Mills and Regina Capuano, University of Houston (UH), Houston, TX.

Problem: Clay rich sediments are typically considered confining layers, because they often have low permeability and restrict water movement. When these sediments occur at the surface, they are subject to shrinking and swelling and other processes that affect soil moisture content and infiltration. Studying hydraulic heads and changes in water chemistry associated with rainfall can improve our understanding of water flows through these systems.

Objective: To assess the infiltration and movement of rainfall and other potential contaminants through a shallow aquifer consisting of clay soils.

Site Characterization: Studies were conducted at the UH Coastal Center, which is 35 miles south of Houston in Galveston County. Surface sediments belong to the Beaumont formation. Well cuttings show that clays, silty clays, silts and shell fragments are present. A 2-foot thick clayey silt lens is widespread in the area and occurs at depths between 15 and 21 feet. Soils are clays and belong to the Lake Charles series. The soils have a high shrink-swell potential and cracks up to 0.5 inches wide can form on the surface and extend at least 5 feet deep in summer months.

Methods: Water movement was studied by collecting data using suction lysimeters, tensiometers, piezometers, and monitor wells. Water samples were collected from two nests of lysimeters and a piezometer nest. Individual lysimeters were placed at depths ranging from 2.5 to 13.5 feet deep. A tensiometer nest was located next to each lysimeter nest to gather data on hydraulic heads. Water level data was also collected through the use of a piezometer nest and a monitor well. Research was conducted throughout 1994. Data on water quality variations was gathered for such parameters as electrical conductance (EC), ion concentrations, and dissolved solids to differentiate infiltrating rain water and native groundwater.

Results: Conditions at the site were characterized into a wet season (December to May) and a dry season (June through November). During the wet season, water often puddles on

the ground for several days after a rainfall event, water tables are within 4 feet of the surface (average of 2 feet deep), and on occasion the water table rises to the soil surface. During the dry season, cracks are visible in the soil surface and the depth of the water table can drop to more than 9 feet. The dry season was also characterized by more variable and occasionally extreme rainfall events that brought about large changes in water movement in the vadose zone. The largest changes in hydraulic head and water chemistry occur at shallow depths after rainfall events in the dry season. Rapid infiltration of rain water produced the lowest EC levels. Possible pathways are soil disturbances such as cracks, ant mounds, and crawfish burrows that may allow rainfall to rapidly infiltrate groundwater supplies.

Reference: Mills, S., and R. Capuano, "Infiltration of Rain Water through Clay-Rich Soil of the Beaumont Formation in Galveston County, TX," Presented at 1995 Water for Texas Conference, TWRI, Texas A&M University, College Station, TX.

Impact of Soil Amendments on Infiltration of Wastewater

Researchers: Duane Gardiner and B. Eduardo Mendez, Agronomy and Resource Sciences Department, Texas A&M University-Kingsville, Kingsville, TX.

Problem: Industrial and municipal wastewaters may be suitable for irrigation in many arid and semi-arid areas, but often cause soil crusting problems that reduce infiltration rates. This is because these wastewaters often contain high levels of sodium and salinity. Soil conditioners including polyacrylamides (PAM) have the potential to prevent these problems.

Objective: To evaluate the performance of PAM soil conditioners to reduce soil crusting associated with wastewater irrigation, and to assess the economics and environmental impact of using these products.

Methods: Field research was conducted at the City of Kingsville wastewater treatment plant. Some of the average municipal wastewater concentrations were: sodium (410 parts per million or ppm); calcium (79 ppm); carbonates (220 ppm); chloride (480 ppm), and sulfates (350 ppm), and total dissolved solids (1,420 ppm). Treatments included applying gypsum, injecting high and low levels of PAM into wastewater, irrigation without the use of a soil amendment, and a control that included neither irrigation or the use of a soil amendment. Sprigs of Common Bermuda grass were planted in August 1993. The grass was irrigated once a week until November 1993. In February 1994, field-saturated hydraulic conductivity was measured using a constant head pressure, single-ring, infiltrometer. Conductivity was measured at the top and bottom of furrows. Soil samples were collected to determine mass soil moisture. Grass yields were not measured.

Results: Effects of PAM were immediately visually apparent in the field. Less erosion and greater structural stability were obvious. Use of PAM significantly improved infiltration and in some cases increased soil wetness. The persistence of PAM after irrigation had ceased shows that lower doses may also be effective. This research

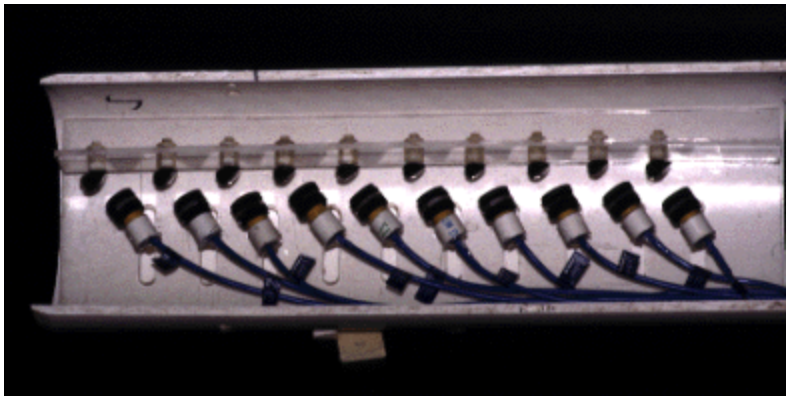
suggests that the use of PAM may allow for the more widespread irrigation of wastewaters without causing soil crusting or erosion.

Reference: Gardiner, D., and B. Mendez, "Effects of Polyacrylamide on Infiltration of Wastewater," Presented at 1995 Water for Texas Conference, TWRI, Texas A&M U., College Station, TX.

NOTE: This research project was funded by TWRI.

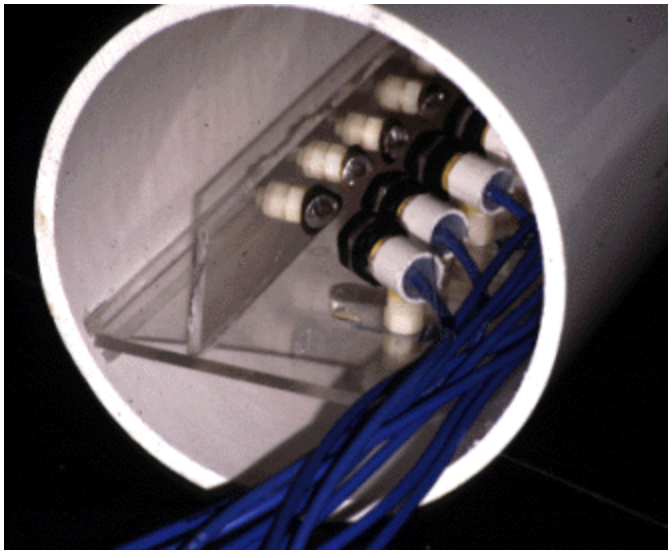
Developing a Biological System that Uses Clams to Detect Water Quality Changes

Researchers: William T. Waller, Miguel Acevedo, H. Joel Allen, Fritz Schwalm, James Kennedy, and Ken Dickson, Institute of Applied Sciences, University of North Texas, Denton, TX; Larry Ammann, Mathematics Department, University of Texas at Dallas, TX, and Eric Morgan, Tennessee Tech University, Cookeville, TN.



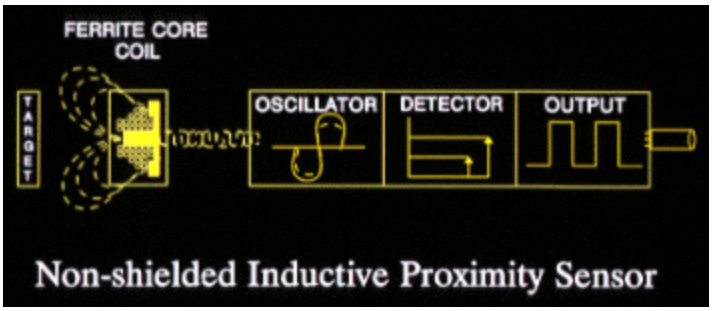
Problem: Many biologists believe that it is difficult to measure amount of toxicity in a stream or river without taking into account how pollutants affect organisms that live there. A biological-based toxicity monitoring system would have the advantage of accounting for the effects of the interaction of many pollutants on living aquatic organisms. This type of system could also help distinguish between toxic and non-toxic events, thus lessening pollutant monitoring costs associated with polluted runoff.

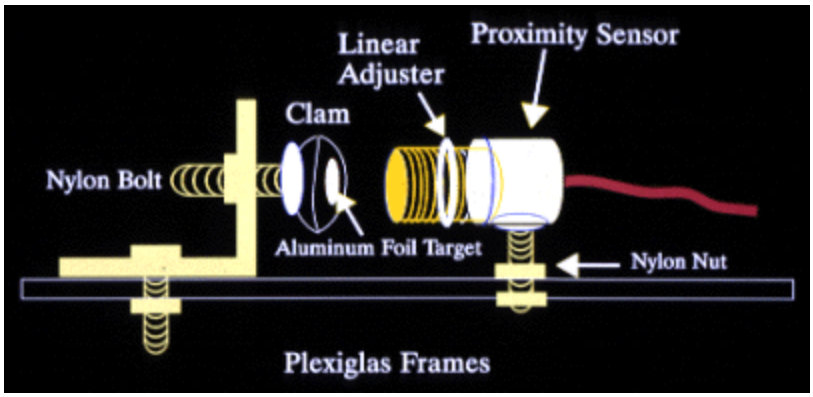
Objectives: To develop and test a method that uses a living organism (the Asiatic clam or *Corbicula fluminea*) to rapidly monitor the effects of pollutants in streams and rivers.



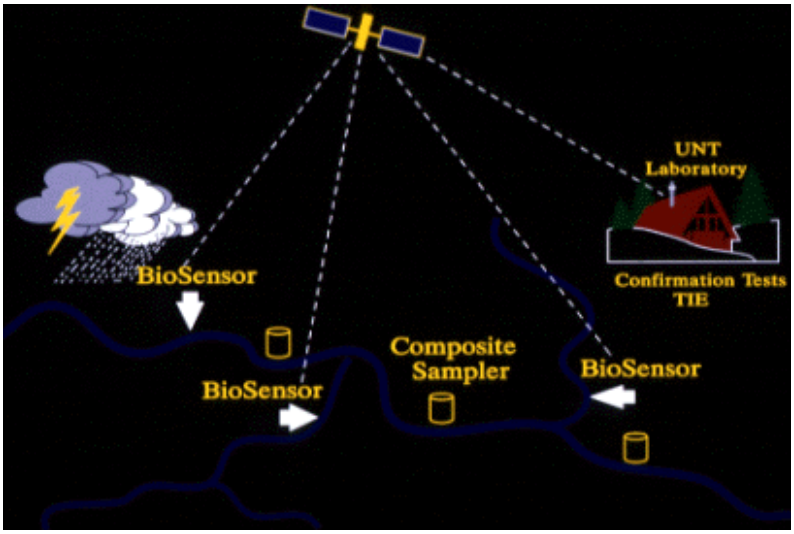
Background Information: Researchers have created a working prototype. The biomonitoring system that has been developed and is being tested measures the amount of clam shell gape -- the extent that a shell is open or closed -- to determine in real time if clams are stressed in natural

environments. The method to test clam gape is a modified industrial inductive proximity sensor. The sensor consists of a coil and iron core, an oscillator, a detector circuit, and a solid state output. Clams are glued into an upright position onto a nylon bolt that fits through a plastic frame. The frame fits through a plexiglas base that can be adjusted so that the distance between the sensor and the clams can be controlled. The sensor is aimed at an aluminum foil target that is glued to the clam. As the clam opens or closes its shell, the sensor detects a change in voltage. Data are used to estimate changes in gape. Analog signals are sent by computer to a central computer receiving system. An alarm system is activated when clam gapes fall outside a normal range of values (typically, when too many clams close their shells). When an event has occurred, the clams (which will also serve as switches) will initiate automatic samplers to collect the contaminated water. When water managers receive these alarms, they will know an event has occurred and they can retrieve the samples and perform further tests to characterize the likely toxic pollutants.





Results: A prototype system has been designed, constructed and is being tested in laboratory studies. Research is being conducted to monitor clam gape under both stressed and non-stressed conditions. Results from other studies by these researchers suggest that Asiatic clam growth is a good indicator of stress in aquatic environments. *In situ* tests in the Trinity River have shown that diazinon may be reducing growth of Asiatic clams in some parts of the River and lowering the biological productivity of water fleas (*Ceriodaphnia*



dubia). This summer the system will be deployed in Bayou Chico, Florida. This work will use a different clam (*Mulinia lateralis*). It will focus on testing the system in actual field conditions and transmitting data from the clams to a central computer.

Reference: Waller, W., M. Acevedo, H. Allen, J. Kennedy, K. Dickson, L. Ammann, and E. Morgan, "Use of Remotely Sensed Bioelectric Action Potentials to Evaluate Episodic Toxicity Events and Ambient Toxicity," in *Proceedings of the 1995 Water for Texas Conference*, TWRI, Texas A&M University, College Station, TX.

NOTE: This project was funded by TWRI.

Controlling Natural Salt Pollution in the Brazos River with Shallow Well Pumping and Injection Wells

Researchers: Martin Spongberg and Wesley James, Civil Engineering Dept., Texas A&M University, College Station, TX.

Problem: Salt springs and seeps discharge an average of 1,000 tons of chloride into the Upper Brazos River. As a result, much of the water is too salty for municipal, industrial or irrigation use without expensive treatment. Many potential solutions have been proposed to deal with this problem including brine diversion dams, pumping of shallow brines and disposing of them in injection wells. Many of these projects are too expensive or technically unfeasible. Concentrated efforts to control salt loadings at specific problem areas need to be investigated.

Objectives: To use computer simulation models and field data to determine if shallow well brine recovery and deep well disposal could be used to reduce salt loads to the Upper Brazos River basin.

Methods: Roughly 50% of the salt in the Upper Brazos River comes from the Dove Creek area in Stonewall and King counties. Four deep formations near Dove Creek (Permian Wolfcamp, Pennsylvanian Canyon, Pennsylvanian Strawn, and Ordovician Ellenberger) are saline aquifers that are thick and continuous. Porosity and permeability data were obtained from core analysis. Permeable thickness of these formations was interpreted using 41 well logs from the U.S. Army Corps of Engineers (USACE) that covered a 23 x 14 square mile area near Dove Creek. Each aquifer was modeled as a single continuous system with constant hydraulic conductivity and porosity and varying thickness. A three-dimensional, finite element model to simulate groundwater flow in anisotropic and heterogeneous media was developed to assist with the design and evaluation of a brine recovery system in the Dove Creek area. A 100-year simulation was performed in which 2 cubic feet per second (cfs) of brine was continuously injected. The impact of injection on groundwater pressure was assessed using the (Sandia Waste Isolation Flow and Transport (SWIFT) computer model.

Results: Modeling simulations indicate that a shallow-well brine recovery system pumping about 2 cfs of brine will eliminate roughly 45% of the chloride discharges into the Upper Brazos River Basin. Modeling results suggest that continuously injecting 2 cfs

of brine into the Strawn or Ellenberger formations is feasible over a long period. The Wolfcamp formation can probably be used for only a 10-year period. The critical parameter that needs to be considered is hydraulic conductivity. The Ellenberger formation can be suitable for deep well injection if it can be confirmed that it is tectonically fractured. Most importantly, these results suggest that shallow well brine recovery systems and deep well brine injection systems are a feasible strategy that can potentially lower salinity levels in the Brazos River. It needs to be noted that these results are preliminary and more research and analyses are needed before definite conclusions can be reached.

Reference: Spongberg, M., and W. James, "Partial Control of Natural Salt Pollution in the Upper Brazos River Basin by Shallow Well Pumping and Deep Well Injection," in *Proceedings of the 1995 Water for Texas Conference*, TWRI, Texas A&M University, College Station, TX.

Nitrogen Build-Up and Denitrification Processes Beneath Playa Lakes in the Texas High Plains

Researchers: Alan Fryar and William Mullican, Bureau of Economic Geology (BEG), and Katherine Romanak and Phillip Bennett, Geological Sciences Department, University of Texas, Austin, TX, and Stephen Macko, Environmental Sciences Department, University of Virginia, Charlottesville, VA.

UT Research Assistant Steve Allen monitors this well near the Pantex Plant for salinity and pH levels.

Problem: The Texas High Plains contain more than 20,000 playa lakes. Water losses from playas have typically been attributed to evaporation, not infiltration. Because it was assumed that little infiltration occurred and that pollution risks were low, many playas have been converted for man-made uses. For example, at least 11 Texas cities, 65 confined dairies and feedlots, and at least two companies that process agricultural products use playas for wastewater discharge. Recent studies by BEG and others suggest that significant recharge occurs beneath some playas and may provide a pathway for contaminants in wastewater, such as

nitrate, to reach the Ogallala aquifer. More information is needed on nitrate loading to groundwater in this area.

Objective: To assess nitrate levels from groundwater wells that may be influenced by wastewater discharge to playas, and to determine if nitrate is being converted to harmless by-products by natural denitrification.

Methods: Water samples were taken from 30 wells. Sediment or soil gas samples were collected beneath 4 playa basins in a 100 square-mile area in Carson, Potter, and Armstrong Counties. Wells were pumped to purge stagnant water from boreholes prior to sampling. Dissolved oxygen (DO) was measured by titration in the field. Nitrate and chloride were analyzed by ion chromatography. Ammonium was measured by distillation at the UT BEG laboratory. Dissolved organic carbon (DOC) was analyzed by persulfate oxidation, and the stable isotope nitrogen-15 was tested using mass spectrometry. Sediment core samples were collected at depths from 0 to 11 feet at a playa at the Pantex Plant, from 0 to 78 feet at a playa approximately 4 miles north of the Pantex Plant, and from 0 to 47 feet at a playa near Claude. Soil gas was collected using peristaltic pumping at the first two playas and one other.

Results: Nitrate levels in perched aquifers and the Ogallala Aquifer ranged from 3 to 56 parts per million (ppm), with a median concentration of 6 ppm. Chloride levels ranged from 3 to 320 ppm, with a median value of 12 ppm. DO levels ranged from 3 to 13 ppm. Ammonium concentrations were less than 0.2 ppm. Nitrate concentrations in sediment cores were typically highest within 1.5 feet of land surface and decreased with depth. Relatively enriched values of nitrogen-15 in groundwater and relatively depleted values of nitrogen-15 in soil gas suggest that denitrification limits nitrate concentrations. Because DOC concentrations were less than 2 ppm and DO concentrations ranged from 3 to 13 ppm in groundwater, denitrification probably occurs in the unsaturated zone beneath playas. Anaerobic conditions necessary for denitrification are likely to occur within poorly aerated soils and sediments and may be promoted by infiltration of wastewater along preferential pathways. Generally, enough denitrification is occurring to keep nitrate levels lower than Environmental Protection Agency drinking water standards (44 ppm as nitrate, or 10 ppm nitrate-nitrogen) in most of the region. Groundwater at one site that had received raw and treated wastewater since the 1970s experienced nitrate levels of 57 ppm and chloride levels of 320 mg/L.

Reference: Fryar, A., S. Macko, K. Romanak, P. Bennett, and W. Mullican, "Evidence of Limited Denitrification Beneath Playas Recharging the Ogallala Aquifer," Presented at 1995 Water for Texas Conference, TWRI, Texas A&M University, College Station, TX.

UT, TWDB Assess Sources of Salinity in Rio Grande Alluvial Aquifer

Determining the source of salinity in the Rio Grande alluvial aquifer in Hudspeth County was the goal of a recent study by the Texas Water Development Board (TWDB) and the University of Texas Bureau of Economic Geology (UT BEG). The investigation was conducted as part of a transboundary aquifer inventory study sponsored by the U.S. Environmental Protection Agency (EPA).

TWDB staff member Barry Hibbs collects this water quality sample on the Rio Grande. The goal of the project was to identify sources of total idssolved solids and salinity that flow into the Rio Grande alluvial aquifer.

Barry Hibbs of TWDB and Bruce Darling of Law Environmental led the investigations. Other data were taken from studies conducted by UT BEG scientists Steve Fischer and Bill Mullican. The studies were conducted because the Rio Grande alluvial aquifer, which runs along the river, suffers from moderate to high levels of total dissolved solids (1,500 to 10,000 parts per million) and salinity.

Samples were taken at two sites: a heavily irrigated and developed region near Fort Hancock and a much-less irrigated and developed part of the aquifer at Red Light Draw near Sierra Blanca. The samples were analyzed for stable and radioactive isotopes, chloride-bromide ratios and cation and anion chemistry. Gaining and losing stream conditions were assessed at sites by measuring stream discharges along segments of the river.

Results of the studies show that the geochemical signature of groundwaters in both areas is similar, despite the differences in land and water use. This suggests that many different sources may be increasing salinity in the region including irrigation return flows, intrusion of water from the Rio Grande, the presence of salt cedars that grow on the banks of the river and concentrate salts, and upward movement of groundwater from deeper, more saline aquifers.

The paper was presented at the TWRI Water for Texas Conference. For details, call Hibbs at (512) 936-0875.

Rio Grande Irrigation District to Use Remotely Sensed Data, Computer Model, to Manage Water Quality

An irrigation district in the Rio Grande Valley is implementing a high tech system that uses remotely sensed information to manage water quality.

The Hudspeth County Conservation and Reclamation District Number 1 (HCCRD) provides irrigation for agricultural producers in an 18,300-acre area along the Rio Grande that stretches from El Paso to Fort Quitman. Managing poor quality waters is a major task for the district because a large part of their water supplies consist of irrigation return flows, effluents from wastewater treatment plants, and stormwater runoff. As a result, salinity levels in HCCRD water are often higher than normal and may pose a threat to crops being irrigated with them.

The water quality monitoring and management system was designed by Allie Blair and Mike Mayhew of the Gebhard-Sarma Group, Inc. It consists of using a supervisor control and data acquisition (SCADA) system to monitor flows, salinity, and reservoir levels at sites that flow into HCCRD canals. Measured data and water demand information is used to make system management recommendations to minimize salinity and sediment loads delivered to HCCRD canals, and to optimize the amount and quality of water stored in District reservoirs. Water demand information is transmitted via radio telemetry from HCCRD headquarters to a series of remotely controlled sluice gates. The gates release water and flush sediments automatically, based on computer data they receive from the District.

The system is now being installed and is expected to be operational this year. District officials believe that it may maximize the use of tailwater flows and low salinity waters, maximize reservoir storage so that it will be available to meet peak demands, and minimize sediment flows into the canal system.

For more information, contact Blair at (512) 476-6595.

Tarrant County Water District Evaluates If Constructed Wetlands Can Remove Pollutants from Trinity River

The Tarrant County Water Control and Improvement District (WCID) is evaluating if wetlands can improve water quality in a water supply system on the upper Trinity River. The study is being performed by Woody Frossard and Darrel Andrews of the District, and consultant Alan Plummer.

The goal of the study is to determine if constructed wetlands can treat and remove many non-point source pollutants including nutrients, toxic chemicals, and heavy metals from Trinity

Workers with the Tarrant County WCID plant this wetland, which is designed to improve water quality.

River water. This supply could then be used to supplement the flows into several of the District's reservoirs which are not located directly on the Trinity River. The study also examines the use of constructed wetlands as best management practices (BMPs) upstream of reservoirs to reduce contaminant loadings.

The project began when the District constructed the 4-acre wetland in the Summer of 1992. Water is pumped from the river to two settling basins and then flows to three wetland trains with three cells each. The wetlands were stocked with native plants such as soft-stem bulrush, cattail, arrowhead, smartweed, soft rush, primrose and pondweed. Three of the wetlands cells were left unplanted to see if wetlands plants would colonize the cell from the native topsoil. Water quality in the wetlands is monitored for dissolved oxygen, salinity, pH, biochemical oxygen demand, total suspended solids (TSS), nitrogen and phosphorus.

Since construction, the wetlands have been flooded on many occasions. Despite the flooding, District officials say the wetlands have been a success. On average the facility has removed an average of 90% of nitrogen loads, 88% of phosphorus, and 99% of TSS. Plants that were harvested and replanted soon afterwards still performed well. Areas that were left unplanted were rapidly colonized by wetlands plants from native seeds in the soil. If this small system continues to perform well, the District may consider constructing a full-sized (2,000 acres) wetland at two of its reservoirs to supplement water supplies. It is also considering building smaller wetlands as BMPs upstream of other lakes.

This paper was presented at the TWRI Water for Texas Conference. For more information, call Andrews at (903) 389-3928.

Texas A&M Engineers Use New Method to Estimate Rural Flood Volumes

Researchers at Texas A&M University are now testing and evaluating new methods that may make it easier to more accurately predict flood volumes in rural areas where little hydrologic data exists.

The research was conducted by Juan Valdes of the Civil Engineering Department and graduate student Ravi Devulapalli, who is now an engineer with Carter and Burgess in Fort Worth.

This study was needed because extreme volumes for different duration floods must be accurately estimated so that engineers and planners can safely design and maintain structures like bridges, dams, and culverts. The problem is especially severe in rural areas where streamflow gauges are not present.

In the study, the researchers worked with Raymond Slade of the U.S. Geological Survey (USGS) Austin office. They used USGS daily mean flow data to estimate the annual maximum flood volumes for many gauged sites in Texas. Then, extreme flood flows were estimated for ungauged sites using such information as the drainage area, channel lengths, slope, and annual and short-term rainfall data.

Results of the research show that this method could be successfully used to accurately model flood risks in eight of the 12 regions of Texas. The model improves on previous methods because it eliminates the need to perform rainfall-runoff modeling and it uses actual historic flood volumes. It also includes data from gauged watersheds since the last major studies were performed in 1977 and has more information on sites in the Panhandle and in West Texas. Finally, it uses more compact regions, and these basins were more rigorously developed. Most importantly, this study developed the first regional flood predictions of Texas flood volumes, instead of looking only at flood peaks.

The study was funded by the USGS regional office in Austin. For more information, contact Valdes at (409) 845-1340 or jvaldes@tamu.edu or Devulapalli at (817) 735-6168. Slade's phone number is (512) 873-3060.

USGS WWW Site Lets Users Search Data On-Line

The U.S. Geological Survey (USGS) has established a site on the World Wide Web (WWW) that contains a wealth of useful on-line information about water resources.

The site is especially useful because it contains searchable on-line USGS data for surface and groundwater supplies, water quality, hydrographs, water use, and sediments. It also lets users search the USGS district library, access fact sheets, and learn more about special USGS projects in Texas including national water quality assessment studies (NAWQA), and flood investigations.

The WWW site can be accessed through the internet. The URL is http://servdtxast.cr.usgs.gov/. For details, contact Marshall Jennings at (512) 873-3068 or "MEJennin@dtxast.cr.usgs.gov"

TWRI Publishes Water for Texas Proceedings, New Technical Reports

As you read this issue of *New Waves*, you'll note that almost all the articles in this issue originated from papers presented at the 1995 Water for Texas Conference. The 735-page proceedings, *Water for Texas: Research Leads the Way*, contains more than 80 papers that describe recent water and environmental research at Texas universities as well as work by other groups. It was edited by TWRI information specialist Ric Jensen. These proceedings are for sale for $30 each.

Recent TWRI technical reports include *A Farm-Level Evaluation of Agricultural Profit and Ground Water Quality: Texas Seymour Aquifer* (TR-168) by Manzoor Chowdhurry, Ron Lacewell, Bruce McCarl, and Teofilo Ozuna of the Texas A&M University Agricultural Economics Department, Billy L. Harris of the Texas A&M University Soil and Crop Sciences Department, Paul Dyke of the Texas Agricultural Experiment Station at Temple, and, Verel Benson of the USDA/ Agricultural Research Service at Temple; *Legal and Institutional Barriers to Water Marketing in Texas* (TR 167) by Ron Kaiser, *Environmental Issues of the U.S.-Mexico Border Region: A Workshop Summary* (TR 166) by Howard Malstrom and Wayne Jordan, and *Reservoir and River System Reliability Considering Water Rights and Water Quality* by Ralph Wurbs, Gerardo Sanchez Torres, and David Dunn.

For ordering information contact TWRI at (409) 845-1851 or twri@tamu.edu.

New Book Describes History of LCRA, Colorado River Issues

The history of the Lower Colorado River Authority (LCRA) and issues relating to the Colorado River are described through words and photographs in a new book.

The 104-page book, *Born of the River: The Colorado River and the LCRA*, was written by Turk Pipkin, who also wrote *Barton Springs Eternal* and five other books and who is a regular contributor to *Texas Monthly*. The book contains chapters dealing with how people have interacted with the river, dam construction, development of electricity and power, water quality concerns, and environmental challenges. The book is easy to read and enjoyable, in large part because it contains many historical photographs.

The book is published by Softshoe Press and is being sold by the Friends of the Colorado River Foundation. To order a copy, contact the Foundation at (800) 776-5272, extension 3282.

TWDB, TPWD Report Updates Freshwater Inflow Needs

A new study by the Texas Water Development Board and the Texas Parks and Wildlife Department provides new information on the amount of freshwater that may be needed to maintain Texas coastal bays and estuaries.

The study, *Freshwater Inflows to Texas Bays and Estuaries: Ecological Relationships and Methods for Determination of Needs*, was edited by Bill Longley of TWDB, with assistance from project directors Gary Powell of TWDB and Albert Green of TPWD.

The report provides a historical perspective and outlines the analytical methods that were used. It contains detailed information on such topics as coastal hydrology, and the effect of inflows on plankton, fish and shellfish productivity. The report also describes how a new methodology was used to model freshwater inflow needs for the Guadalupe Estuary.

To obtain the report, contact TWDB at (512) 463-7847. The report was also summarized in the Fall 1994 issue of TWRI's *Texas Water Resources* newsletter.

TAEX Publishes Handbook on Water Gardening

The Texas Agricultural Extension Service (TAEX) has just published a handbook titled *Water Gardening in Texas* (B-6001).

The handbook describes how to choose a proper site to design, construct, and maintain a water garden. It includes information on appropriate plants to place in the garden and tips for managing fish, frogs, and snails that will visit these gardens.

The handbook was written by Texas A&M University Horticulture Department student Larry Shoemake, Michael Arnold of the Texas A&M University Horticulture Department, and TAEX Horticulturist William Welch.

To obtain a copy, contact your local county Extension office or call the TAEX publications office at (409) 845-6573.

Texas Tech Professors Publish Book on Environmental Law

A comprehensive book describing environmental law has been published by researchers at Texas Tech University (TTU).

The 984-page book, *The Environmental Protection Deskbook*, was written by Frank Skillern, Daniel Benson, and Charles Bubany of the TTU Law School, and James Mertes of the TTU Landscape Architecture Department.

Sections of the book deal with such issues as the history of environmental law, the National Environmental Policy Act of 1969, the evolution of programs to regulate water and air quality, wetlands protection, criminal enforcement of environmental laws, and constitutional issues in environmental law.

The book was published by Shepard's McGraw Hill and can be ordered by calling (800) 525-2474. Skillern can be reached at (806) 742-3787.

EUWD Publishes UT Study on Edwards Aquifer Permeability

A University of Texas study that examines permeability in the Edwards Aquifer has been published by the Edwards Underground Water District (EUWD).

The report, *Regional Distribution of Permeability in the Edwards Aquifer (Report 95-02)*, was written by Alan Dutton, Susan Hovorka, Robert Mace, and Edward Collins of the UT Bureau of Economic Geology.

EUWD funded the project and developed a scope of work for the research. The report describes how researchers used three integrated data sets -- structural and thickness maps of the Edwards Aquifer, permeability data determined from well tests, and analyses of the rock matrix -- to gain more insights into the distribution of permeability in the aquifer.

Other new EUWD reports include *Review and Update of the Position of the Edwards Aquifer Freshwater/ Saline Water Interface from Uvalde to Kyle* (94-05), *Edwards Aquifer Ground-Water Divides Assessment* (95-01), and *Edwards/ Glen Rose Hydrologic Communication, San Antonio Region* (95-03).

For more information on any of these reports, contact EUWD at (210) 222-2204. For more details on the UT study, contact Dutton at (512) 471-1534 or duttona@begv.beg.utexas.Edu

Information about Water Bank Available from TWDB

The Texas Water Development Board has published a report that focuses on policy issues that need to be addressed to implement the Texas Water Bank.

The report, *Texas Water Bank*, was prepared by TWDB staff in cooperation with personnel from the Texas Parks and Wildlife Department and the Texas Natural Resource Conservation Commission. The report deals with such topics as implementation of the bank; policies that are necessary if water marketing is to be successful; needed changes in Texas legislation, and ways to provide flows to meet needs for instream uses, water quality, and fish habitat. The report was submitted to the Governor's Office and to the Texas Legislature before the 1995 legislative session.

Information about the Water Bank is also now available over the internet at http://www.twdb.state.tx.us/www/twdb/wbank/wbank.html. This WWW site lists those who want to buy and sell water rights as well as deposits to the bank.

For details, call Dan Beckett of TWDB at (512) 936-0857.

EPA Report Describes Toxic Pollution Along Rio Grande

A report documenting the presence of toxic substances along the Rio Grande has recently been published.

The report, *Binational Study Regarding the Presence of Toxic Substances in the Rio Grande/ Rio Bravo and its Tributaries Along the Border Portion Between the U.S. and Mexico*, was published in September 1994. Agencies that participated in the report include the International Water and Boundary Commission, the U.S. Environmental Protection Agency, the Texas Natural Resources Conservation Commission, the Texas Parks and Wildlife Department, the Texas Department of Health, and the Mexico National Water Commission.

The report includes sections describing the study area, testing methods, and results of analyses concerning such topics as the presence of toxic chemicals in water, sediment, and fish tissue samples; assessments of macrobenthic and fish communities, and sites and toxic chemicals of potential concern.

More information about this report is available by contacting Carl Young at EPA at (214) 665-6645.

New TNRCC Reports Focus on Water Quality in Nueces, Rio Grande, Watersheds

New reports published by the Texas Natural Resource Conservation Commission (TNRCC) include the following: *1994 Regional Water Quality Assessment of Water Quality in the Nueces Coastal Basins* (AS 35), *Regional Water Quality Assessment of Water Quality in the Rio Grande Basin* (AS 34), and *Volunteer Environmental Monitoring in Texas: The 1994 Texas Watch Report; A Comparison of Methods for Following the Effects of Two Major Oil Spills on First-Order Streams in East Texas* (AS 36/ SR). Other recent TNRCC reports include *Water Quality in Cypress Creek: An Effluent Dominated Stream Segment* (AS 55/ SR), and *Proceedings of the 3rd Annual Conference on Environmental Monitoring in Southeast Texas* (AS-54/ SR).

To order any of these publications, call the TNRCC at (512) 239-0028.

Southwest Texas Researcher Uses Tree Ring Records, Drought Indices to Assess Springflow Risks

For most water managers and users along the Edwards Aquifer, it's critical to keep up with short-term or daily variations in groundwater levels. After all, a sharp drop in the Aquifer could spell immediate trouble for endangered species in Comal and San Marcos Springs.

A researcher at Southwest Texas State University (SWTSU) believes that stepping back and taking a look at long-term records of rainfall, groundwater levels, droughts and springflows may have important implications for how the Edwards ought to be managed.

Glenn Longley is the Director of the SWTSU Edwards Aquifer Research and Data Center. He has been evaluating historical climate data from tree rings of post oaks that grew in Texas from 1698 to 1980. He developed side-by-side analysis of four drought indices: the Palmer Drought Severity Index (PDSI), which is a meteorological-based method to indicate the severity of a wet or dry spell; the Palmer Hydrological Drought Index (PHDI), which assesses long-term moisture supplies; the Palmer Z Index, which gauges how monthly rainfall and moisture data vary from historic averages, and the modified Palmer Drought Severity Index, which uses a weighted average to calculate the chance of future rainy or dry periods.

Longley says that examining and comparing these databases yields some interesting results. For example, the tree ring data show that extreme droughts occurred from 1855-64 and from 1772-81. Tree ring analyses also suggest that most droughts are preceded or followed by unusually wet periods, and that strong warm El Niño events cause more rainfall than normal in winter and spring months. The Palmer drought indices show that 15 severe droughts have hit Texas since 1900.

Longley says that the analyses provide critical insights for policy makers. First, because man's water use is increasing, it takes only a moderate drought to severely reduce water levels and endanger the springs. Secondly, although annual and seasonal aquifer levels often fall within normal ranges, there are many occasions when daily aquifer levels and springflows have dropped so far that springflows are threatened.

For details, call Longley at (512) 245-2329. His e-mail address is Gl01@swt.edu.

TAES, Texas A&M, Tarleton State Researchers Study How Water Quality Influences Dragonfly Populations

A study by a research team from the http://www.tamu.edu.">Texas A&M University System is identifying the population of young dragonflies called "naiads" in ponds near Stephenville to assess what lessons the insects can tell us about pollution.

The project is being conducted by Forrest Mitchell, James Lasswell, and Kenya Kresta of the Texas Agricultural Experiment Station at Stephenville, Ann Kenimer of the

Agricultural Engineering Department of Texas A&M University, and Larry Hauck of the Texas Institute for Applied Environmental Research at Tarleton State University.

James Lasswell takes this sample to obtain dragonfly larvae from a wetland cell near Stephenville. Their studies suggest that specific dragonfly species may be a useful indicator of good or poor quality water.

The study is needed to develop baseline information about which dragonfly species are commonly found in good and poor quality water. The researchers hope to use the presence of individual dragonfly species as a measure of clean or polluted water. That information will be valuable when constructed wetlands being built at the site are operated to treat nonpoint source pollutants from agriculture. Previous studies have largely focused on species that are present in lakes and rivers from colder climates.

In this study, the researchers sampled six ponds near the Texas A&M Research and Extension Center at Stephenville in October and November, 1994. Three of the ponds had relatively good quality water, while three others had recently been afflicted by fish kills and other obvious signs of pollution. Dragonfly naiads were preserved and their species was identified. Water quality samples were also analyzed.

The results show that some dragonfly species prefer relatively clean water, while others are more often found when water quality is poor. For example, large populations of one group of dragonflies comprised of *Celithemis* (small pennants), *Dythemis* (setwings), and *Tramea* (dancing gliders) were present in good quality water, but were largely absent from the poorer quality ponds. *Plathemis lydia* (common whitetail) did not appear in any of the "clean" ponds. *Perithemis Tenera* (European amber wing) were found in all ponds, but only small numbers were found in the clean ponds. The results also show that dragonfly diversity was higher in cleaner ponds.

The next step, the researchers say, will be to conduct further studies to determine if factors other than water quality (pond vegetation, bottom sediments, predation by fish) may also be influencing naiad levels.

For details, contact Mitchell or Lasswell at (817)968-4144 or j-lasswell@tamu.edu, or f-mitchell@tamu.edu. Hauck can be reached at (817) 968-9567 or hauck@tiaer.tarleton.edu, and Kenimer can be contacted at (409) 845-3677 or alk5280@zeus.tamu.edu.

This Eastern Pondhawk dragonfly eats insects and mosquitos.

A Common Whitetail dragonfly at the TAES Stephenville research site.

A newly dug wetlands cell at TAES Stephenville. This cell will be planted with wetlands species to treat agricultural wastes.

Forrest Mitchell of TAES Stephenville collects water sample upstream of Smith Srpings Creek. This is slightly upstream from the constructed wetlands site.

James Lasswell collects dragonfly larvae from the wetlands cells. This sampling was done 3 weeks after the wetlands cells were constructed. Large dragonfly nymphs were seen and cllected including the wandering glider.

TCU Researchers Assess if Landfill Affects Water Quality in Rivers, Groundwater Supplies

Is a landfill in Tarrant County contaminating nearby aquifers, streams and rivers? That's the question researchers in the Texas Christian University (TCU) Environmental Sciences Program recently tried to answer.

The research was conducted by graduate student Michael Lees, who worked with researchers Leo Newland and Neven Kresic. The studies focused on a 180-acre landfill in western Tarrant County that receives petroleum products, asbestos, construction wastes, treated medical wastes, and brush.

The first step was to characterize the hydrology, geology, and management techniques at the site. For example, the landfill borders Mary's Creek and many intermittent streams are nearby. Soils in the are classified as belonging to the Goodland Limestone and Walnut Clay formations, which overly the Paluxy Sand. Although vegetative filter strips are used to filter runoff pollutants, only part of the landfill is lined to prevent leaching of contaminants into nearby groundwaters. Finally, explosives are used to blast the site and create new disposal areas.

In the project, the researchers collected groundwater quality samples during August and September 1994 from wells near the landfill and nearby creeks. Samples were analyzed for pH, total dissolved solids, and conductance in the field. More detailed laboratory analyses were later performed for sodium, calcium, copper and zinc.

Results suggest that the landfill may be contaminating Mary's Creek and causing lower than normal pH levels. However, the low permeability and thickness of the Walnut Clay formation appears to have protected groundwater supplies from contamination. There is also evidence that blasting at the site is creating pathways that may make the area more vulnerable to groundwater pollution.

Information on this project was presented at the 1995 Water for Texas Conference. For details, contact Newland at (817) 921-7271 or newland@gamma.is.tcu.edu, or Kresic at (817) 921-7506 or kresic@gamma.is.tcu.edu.

WTAMU Researchers Test Water Saving System that Combines Dryland Wheat Production, Cattle Grazing

Researchers at the Dryland Agricultural Institute at West Texas A&M University (WTAMU) are developing and field testing dryland farming strategies that optimize the use of rainfall in the region.

Bobby Stewart has spent much of his career evaluating water use in sorghum fields (above). He is now working on dryland wheat systems.

Throughout the Texas High Plains, many farmers are switching from irrigated to dryland farming because of depleting groundwater supplies and the high cost of irrigation. From 1974 to 1989, for example, the irrigated area in the region dropped from 6 to 4 million acres and the amount of groundwater used declined from 8 million acre-feet (MAF) to 5.6 MAF. Many of the current dryland wheat cropping systems don't take full advantage of the rainfall. As much as 60% of rains that fall on croplands are lost to evaporation when long fallow periods are part of the crop rotation.

Institute Director Bobby Stewart and student Buddy Curry are conducting the studies. The goal is to determine if more water-efficient cropping and grazing systems can be created. They are testing a system at the WTAMU Nance Ranch near Canyon that grows wheat for cattle grazing. The system is being compared to growing wheat that can be harvested for grain. Typically, wheat is planted in September. In the grazing system, cattle are placed on the wheat fields in early winter and allowed to graze until May. Then, the cattle are removed and the land is chisel-plowed to prepare it to receive May rains, that are the most dependable precipitation period in the region. That allows enough water to be stored in the soil so that wheat can be seeded each year and long fallow periods can be eliminated.

Stewart believes this system uses rainfall more efficiently than traditional methods because more water is directed to growing crops and evaporation is lessened. Erosion risks are lessened because more organic matter is held in the soil and the length of the fallow period is shortened.

For details, call Stewart at (806) 656-2299.

TAES-Lubbock Researchers Develop Real Time Estimates of Crop Water Use, Evapotranspiration Losses

It's well-known that agriculture accounts for 67% of Texas' water use. It's a much more difficult task to determine how much water a crop is using at any given time. A team of researchers at the Texas Agricultural Experiment Station (TAES) in Lubbock including Robert Lascano, Louis Baumhardt, and Stan Hicks of TAES-Lubbock, and James Heilman of the Soil and Crop Sciences Department at Texas A&M University are now using high tech methods to develop a comprehensive view of plant water use.

The researchers are working to develop accurate measurements of evapotranspiration (ET) --the amount of water lost through evaporation and transpiration. Previously, time-consuming and labor-intensive methods such as soil water depletion and lysimeters were used to measure ET. This new approach involves using a suite of tools to rapidly estimate water use in the field.

The concept involves measuring water levels in the soil, the amount of water transpired from plants, evaporation losses, soil temperatures, and climate conditions. Time-domain reflectometry, which utilizes electrical signals sent through antennas placed in the soil, is used to measure soil water. Plant water use is monitored by electronic flow gauges placed around plant stems. Thermocouples are used to measure soil temperature and soil heat flux is measured with heat plates. A weather station records data on air temperature, humidity, winds, and rainfall.

Data are automatically collected, sent to a computer, and fed into a computer model called "ENWATBAL" that calculates evaporation, crop transpiration, soil water, and soil temperatures. Output includes an energy and water balance of the soil surface and plant cover. Estimates of plant water use can be developed in a few hours.

Last summer, the researchers field tested the concept on cotton crops grown on a 690' x 250' plot on the TAES farm at Lubbock. Lascano says that research results show that this new technology provided a more thorough picture of plant water use. Data from the studies will be valuable for researchers, and may be used to compare the water efficiency of different crops and to design efficient irrigation systems. This summer, the researchers will install a drip irrigation system that will water a cotton crop, based on field data and recommendations from the computer model.

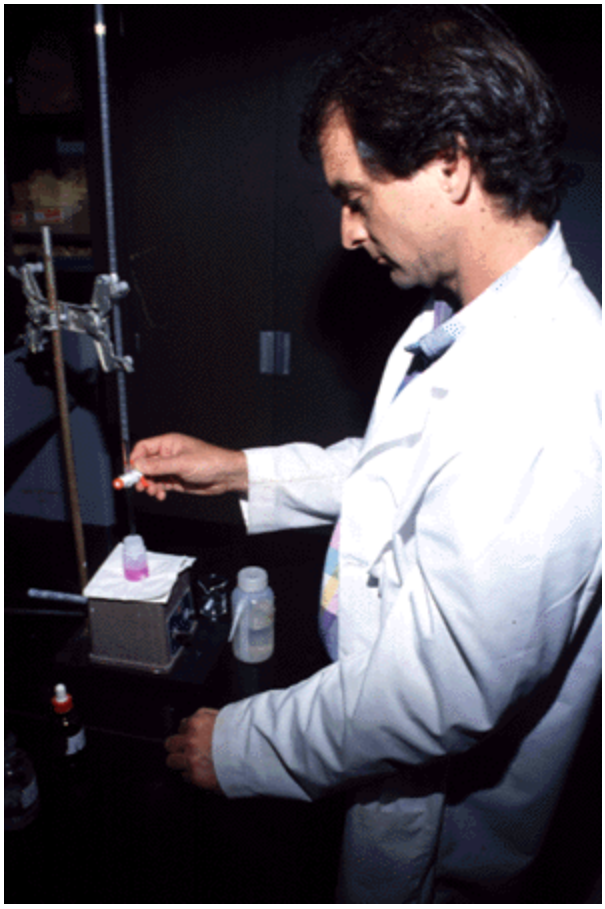
This project is funded by the Texas Higher Education Coordinating Board and the National Science Foundation. For details, call Lascano at (806) 746-6101 or Heilman at (409) 845-7169. Their e-mail addresses are rlascano@tamu.edu and j-heilman@tamu.edu.

TWRI Funds Texas A&M Study to Improve Predictions of Nitrogen Mineralization in Soils

Nitrogen is one of the tools farmers use most often to improve crop yields, but it can also pose threats to groundwater quality. Therefore, it's important to be able to specify how much nitrogen needs to be applied in forms growing crops really need, so that excess applications can be avoided and environmental threats can be minimized.

With that in mind, TWRI funded a multi-location study by Texas Agricultural Experiment Station (TAES) scientists. Lead researchers include Frank Hons of the Texas A&M University Soil and Crop Sciences Department, Gerald Evers of TAES-Overton, Matt Sanderson of TAES-Stephenville, and John Matocha of TAES-Corpus Christi. TAMU graduate students Richard Haney, Alan Franzluebbers, Cheryl

Little, and Jaime Salinas-Garcia participated in the project.



The main thrust of the project was to evaluate different methods and to develop new and improved techniques to measure nitrogen mineralization. First, the researchers gathered surface and subsurface soil samples from many parts of Texas that were used for different agricultural purposes. These included a Weswood silty clay loam from College Station used to grow grain sorghum, wheat, and soybeans; an Orelia sandy clay loam from Corpus Christi used to grow corn; two Bowie fine sandy loams from Overton that were covered with poultry litter; two Windthorst fine sandy loams from Stephenville that received dairy manure; and a Pullman clay loam from Bushland that was used to grow wheat and grain sorghum. They then used a variety of techniques to measure nitrogen mineralization, including short- and long-term aerobic laboratory incubations (ranging from 1 day to 12 weeks), arginine ammoniafication (a technique that involves placing amino acids in soils), and carbon mineralization.

Hons says that measuring carbon dioxide emissions from soils that have been air-dried and later rewetted is a rapid, reliable way to measure potential nitrogen mineralization. Measurement of carbon dioxide evolution was correlated to mineralization and was directly related to microbial activity in soils. Widespread use of this method could provide better estimates of nitrogen mineralization in different soils, and could lead to more accurate nitrogen fertilizer recommendations that could maximize yields while decreasing groundwater pollution risks.

For details, contact Hons at (409) 845-4620.

Baylor Geologists Take Chemical "Fingerprints" to Track Groundwater Flow Patterns

In many criminal cases, a fingerprint is all it takes to positively identify a guilty suspect. Researchers at Baylor University are now using a similar strategy. They are investigating if distinct chemical signatures can be used to determine flow patterns in the Hickory Aquifer system.

The research was conducted by Geology Department graduate student Troy Meinen, who worked with scientists Steve Dworkin and Joe Yelderman.

The research consisted of analyzing the geochemistry of 20 water samples from the Hickory Aquifer, taken near the town of Mason. Samples were collected in the field and were treated with hydrochloric acid to prevent precipitation of cations. Samples were titrated immediately to measure alkalinity. Parameters including pH, conductivity, and temperature were measured in the field. The samples were then taken to a laboratory and analyzed for cation and anion levels using capillary electrophoresis technology. This technique uses ultraviolet light to fluoresce water samples, and relates the amount of fluorescence in water to concentrations of chemical elements. Saturation states of gypsum, anhydrite, calcite and dolomite were calculated using PHREEQE (a computer model that relates pH, reduction/oxidation, and chemical equilibrium).

According to the researchers, the water chemistry results provide significant insights into groundwater flow patterns. Generally speaking, groundwaters from the Hickory formation were shown to have a greater variability of dissolved elements than most Central Texas aquifers, and have low electrical conductances and neutral pH levels. The research also shows that waters with high levels of alkalinity, calcium, and magnesium probably flowed through carbonate rocks. Granite formations influence water chemistry by contributing feldspar, potassium, magnesium, aluminum, and silicon to waters that flow through them.

By using trilinear plots to graphically display the data, the researchers were able to separate groundwater samples into groups with distinct geographic origins and chemical characteristics. The research suggests that groundwater chemistry is more strongly influenced by site-specific geologic variations than it is by variations in rainfall quality.

For details, contact Yelderman at (817) 755-2361 or joe_yelderman@baylor.edu or Dworkin at (817) 755-2361 or steve_dworkin@baylor.edu.