



Volume 12, Number 4, November 1999

Higher Education Board Funds 25 “Water-Related” Projects

The Texas Higher Education Coordinating Board has announced that it will fund 25 “water-related” research projects worth more than \$4.275 million through its 2000-2001 programs.

The awards include eight grants through the Advanced Research Program (ARP) amounting to \$971,000, 16 awards in the Advanced Technology Program (ATP) worth \$3,057,125, and one project in the Development and Transfer Program (DTP) totaling more than \$247,600. Through the ARP program, the Board awarded two water-related projects in biological sciences, one in chemistry, one in computer sciences, two in earth sciences, and two in engineering. Water-related grants awarded through the ATP process included six in agriculture, aquaculture, and agricultural biotechnology, one in computer and information systems engineering, eight in environmental science and engineering, recycling, and water resources, and one in manufacturing technology. One grant which focuses on environmental science and engineering, was awarded through the DTP.

Water-related research projects were funded to the following universities: the University of Houston (8), Texas A&M University (7), the University of Texas at Austin (4), the Texas Agricultural Experiment Station (4), Texas Tech University (2), and Texas A&M University-Galveston (2). One water resources project was awarded to researchers at each of the following institutions: the University of Texas at Arlington, Southern Methodist University, Southwest Texas State University, the University of North Texas, Rice University, Texas A&M University-Kingsville, Texas A&M-International University, the University of Texas-Pan American, the University of Texas Medical Branch at Galveston, Lamar University, the University of Texas-Brownsville, Texas A&M University-Corpus Christi, and Sul Ross State University.

A&M-Corpus Christi Scientists Investigate How Tailwater Releases from Rice Irrigation May Affect Benthic Organisms

Freshwater used by the Texas rice industry may have an effect on benthic or bottom-dwelling organisms in Texas estuaries and marshes, according to a study recently conducted by researchers Elizabeth Smith and Suzanne Dilworth of the Center for Coastal Studies at Texas A&M University-Corpus Christi. The research is especially important because the wetlands investigated in this study support extensive food chains and, in many cases, are more productive than even some of the most fertile agricultural lands.

Results of this investigation were published a 1999 report prepared for The Nature Conservancy of Texas, *Effects of Rice Tailwater Inflows on Coastal Wetland Dynamics*. The report suggests that irrigation tail water (water drained off rice fields either during or at the end of the growing season) may be affecting the colonization of benthic organisms, which are typically an important ecological component of Texas coastal wetlands. Water drained off rice fields may alter habitat needed by benthic organisms by decreasing the salinity of marshes.



Smith and Dilworth conducted the study at the Clive Runnells Family Mad Island Marsh Preserve, which is located on West Matagorda Bay, adjacent to the Texas Parks and Wildlife Department's Mad Island Wildlife Management Area. Mad Island Marsh is part of a coastal wetlands system and is located within the Central Flyway, which is one of four principal North American bird migratory routes. Mad Island Marsh provides habitat for red drum, blue crab, brown shrimp, southern flounder, and speckled trout. Two

study sites were chosen within the preserve and another was selected on nearby property. Two of the locations receive rice tail water from adjacent fields, while the third site served as a control.

The objective of this investigation was to evaluate if seasonal releases of rice tail water into a coastal marsh change wetland community dynamics. A second objective was to develop a multi-year monitoring strategy to evaluate the biological effects of rice tail water release cycles. The researchers collected and identified specimens from the study sites on a bimonthly basis for 12 consecutive months. According to Smith, one of the particular strengths of this study was the large amount of replication used in the sampling.

Results of this study suggest that rice tail water released into the sites which were monitored may be altering benthic habitats. Still, there was not enough evidence to prove this claim. It should also be noted that no correlation could be made between quality parameters and the composition of benthic communities. According to Smith, the additional fresh water released into the wetlands could actually be beneficial to aquatic organisms if it was released during the right time of year, but could be detrimental if it is added when benthic organisms are trying to colonize an area. The researchers concluded that further investigation and analyses of water in the marshes and sediments needs to be conducted. This would allow scientists to authoritatively determine whether or not the low numbers of benthic organisms found in the marshes can be attributed to changes in marsh waters caused by rice tail water inflows.

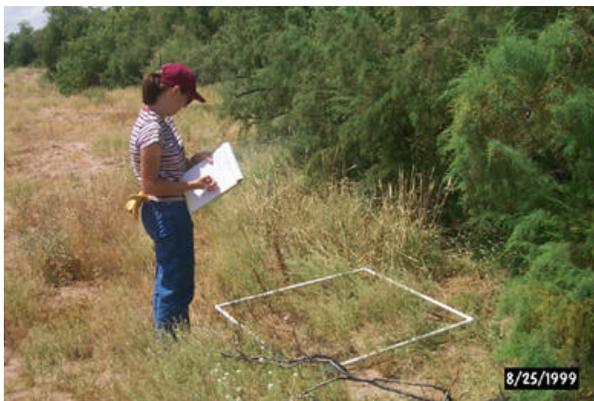
For more details, contact Smith at esmith@falcon.tamucc.edu or at (361) 361-825-6069.

Eradicating Salt Cedar Along the Pecos River Through the Use of Chemical Treatments

Researchers: Charles R. Hart, Texas Agricultural Extension Service (TAEX), Pecos, TX, and Lindi Clayton, Rangeland Ecology and Management Department, Texas A&M University, College Station, TX.

Background: The U.S. Army Corps of Engineers introduced salt cedar to the area in the 1940s for streambank erosion control. While it worked well for its intended purpose, the negative results (decreased water flows and increased salinity in the river) greatly outweigh the benefits of erosion control, according to many experts. Barney Lee of the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) and Hart are coordinating this project to eradicate salt cedar from the area.

Objectives: 1) To increase water flow in the Pecos River, and 2) To decrease the salinity of the Pecos River. This project seeks to accomplish these goals by the chemical eradication of the salt cedar population along the banks of the Pecos River.



Methods: The water quality of the river will be assessed by taking samples to measure total dissolved solids (TDS) and electroconductivity (EC). These samples are being taken along the Pecos River between Red Bluff Reservoir and the town of Girvin. Historical water quality data taken from USGS gauging stations since the 1930s is being factored into the water quality analysis. The density of the salt cedar population along the river before herbicide application was

determined in August 1999. The number of trees were counted and the average width of the river was measured along 100-foot transects. Soil and vegetation samples were taken

before and after treatment with the herbicides. The herbicides Arsenal (Imazapyr) and Rodeo (Glysofate) were applied to 12 different plots of land along the river, two of which were untreated control plots. Herbicides were applied by both fixed-wing aircraft and helicopter. Although delivery by helicopter is more expensive, it allows for a more efficient and targeted application. Aerial application of the herbicides limits off-target application since the helicopter is better able to follow the winding river. Airplane application included two plots treated with four pints of Arsenal on one pass, two plots treated with four pints of Arsenal through two passes, and two plots treated with two pints of Rodeo and two pints of Arsenal. The helicopter application included treating two plots with four pints of Arsenal through a 0.027-millimeter (mm) nozzle, and treating the rest of the river with four pints of Arsenal through a 0.047 mm-nozzle.

Results and Discussion: The herbicides have been applied to 658 riparian acres so far, but it will take approximately 2-3 years before the final impact of the herbicide can be measured. Initial evaluations will begin in the Spring of 2000 and continue annually during the Fall for four years post-treatment. Although the herbicide application is a major step in this project, it is simply the first part of a longer-term effort. The next step will be to follow up with ground-based hand treatments of surviving plants, and then removing dead salt cedar plants by fire or mechanical means. Depending upon natural reestablishment of native vegetation, the herbicide-treated areas may be seeded to native salt-tolerant vegetation.

Reference: Clayton, Lindi, "Pecos River Salt Cedar Project Summary," Rangeland Ecology and Management Department, Texas A&M University, 1999.

Note: Hart can be contacted at CR-Hart@tamu.edu.

Assessing Indoor Air Pollution Risks from the Use of Dishwashers and Washing Machines

Researcher: Richard Corsi, Environmental Engineering Department, the University of Texas at Austin.

Background: A series of experiments was conducted to determine if chemicals in tap water could be polluting indoor air after consumers utilize routine household appliances. Chemicals may potentially be released into the air after using such appliances as dishwashers or clothes washing machines, or even by taking a shower or bath. These chemicals include trace amounts of radon, gasoline, and such chlorination by-products as chloroform or trihalomethanes. Ironically, while chlorination protects the public from water-borne diseases, it may also harm residents when chemicals are transferred into indoor air.

Objectives: To determine if chemicals present in tap water could be transferred to indoor air by the use of such appliances as dishwashers and washing machines, and whether they may increase indoor air pollution and possibly pose health hazards.

Methods: The first phase of this study involved reviewing water use data for showers, wash basins, bathtubs, washing machines, dishwashers, and toilets. Existing literature was examined to determine if previous studies had focused on chemical emissions which may result from the use of these devices. In the second phase of this project, experiments were conducted to determine volatile chemical emissions from many indoor water sources. Each source was studied under a wide range of operating conditions. A "cocktail" of five chemicals was used to determine gas- and liquid-phase mass transfer coefficients for each source. Tracers such as acetone, toluene, ethylbenzene, and cyclohexane were placed into the water used by the various appliances, since these chemicals have properties similar to toxic chemicals which may be found in public water supplies. While these appliances were operating, the researchers measured the amount of chemicals released into the surrounding air.

Discussion: Important findings from these studies include new information about the dynamic behavior of emissions from different indoor water uses. Based on the results of this study, Corsi suggests that areas where bathroom- and kitchen-appliances are most often used should be well-ventilated to prevent health risks. Another strategy may be to use activated carbon canisters to remove these potential pollutants from water before it comes out of a faucet or showerhead. This study underscores the need for effective protection of the public water supply from harmful pollutants.

Reference: Howard, C., and Corsi, R., "Volatilization of Chemicals from Drinking Water to Indoor Air: Role of the Kitchen Sink," *Journal of the Air & Waste Management Assn.*, 46(9): 830-837 (1996)

Note: For details, contact Corsi at (512) 471-3611 or corsi@mail.utexas.edu.

Incorporating Greenbelts into the Design of a New Drainage Plan for the City of Lubbock

Researchers : Mark Rich and John Billing, Landscape Architecture Department, Texas Tech University

Background Information: Areas south of Lubbock which may soon be annexed present unique challenges for effective drainage because of unusual geographical considerations. This area is rich in playas (dry lakes), and has been plagued by flooding. For his Master's thesis, Rich developed a flood prevention plan for the area that uses greenbelts and open parks, not streets, for flood control.

Objectives: This project created a plan to deal with three particular problems inherent with planning and development of the south Lubbock area: how to control the quantity and quality of stormwater runoff to each playa basin, how to deal with the alleged public health effects resulting from exposure to electrical transmission lines and accompanying electromagnetic fields (EMF), and how to design areas for recreation and open spaces to meet the anticipated needs of new development. Rich's flood prevention plan proposes to use grassy and tree-lined channels, instead of streets, to slow the rate of water movement

into playa lakes, thereby reducing chances of flooding. It would use the vegetation as natural filters to trap chemical contaminants before they enter the lakes. This plan was designed to allow development that is compatible with the City of Lubbock Comprehensive Land Use Plan and manage surface runoff so that water held in playa lakes meets U.S. Environmental Protection Agency standards, under the National Pollutant Discharge Elimination System (NPDES) permitting program for urban storm drainage systems.

Methods : A hydrologic analysis of study area was conducted to calculate storm runoff volume, peak discharge rates, and storage volumes required for stormwater detention reservoirs using methods borrowed from the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Engineering Division. NRCS analyzed the soils in Lubbock County and divided them into four groups based on runoff characteristics. These data were used to determine the 100-year floodplain elevation for each playa in the study area. These flood elevations were then used to determine the relationship between each playa lake and surrounding land uses.

Results and Discussion: The thesis proposes dividing the acreage covered in the study into five land use categories: residential use (64%), and areas for open space, stormwater flows, parks, greenbelts, and an equestrian park (19%). In addition, Rich proposes setting aside 11% for existing land uses, 4% for commercial uses, and 2% for a linear park which would house the power lines. Conceptually, this study shows that small watersheds and corresponding playa lakes can be interconnected by a series of specifically planned greenbelts. The greenbelts would carry stormwater away from individual playas before waters rise to levels which can damage private property. The study shows that environmentally compatible stormwater management can be fostered, without the initial and ongoing expenses of an underground stormwater management system. This plan could improve water quality in the playa lakes. Less surface evaporation will occur, and infiltration of stormwater will increase, thus recharging groundwater levels. Aesthetically, this plan will create a citywide open space system and will link neighborhoods. This plan will also mitigate concerns about the effects of EMF from power lines by creating a 50- to 200-foot wide buffer zone on each side of the lines.

Reference: Rich, M., *Stormwater Management and Recreational Master Plan for South and Southwest Lubbock*, Master's Thesis, Texas Tech University, 1998.

Note: For details, contact Billing at (806) 742-2858.

Associating Environmental Conditions in Colonias on the Texas-Mexico Border with Public Health

Researchers: Jo Marie Rios, Political Science and Public Administration Department, Texas A&M University-Corpus Christi, and Avelardo Valdez, Sociology Department, the University of Texas at San Antonio.

Background Information: Much of the Texas-Mexico border is characterized by the widespread occurrence of colonias, which are subdivisions lacking adequate water and wastewater treatment. Generally speaking, the extent of water and air pollution stemming from colonias has not been documented. Additionally, even though there are anecdotal reports of widespread health problems among colonia residents, the environmental sources that lead to these illnesses are often not reported. It is essential that efforts be made to seek relationships between environmental pollution within colonias and the health of residents if conditions are to be improved.

Objectives: 1) To assess the extent to which different environmental sources and media contribute to human risks for residents living in the border area, and 2) To develop and test field strategies to communicate results to study participants, the public, and local environmental health professionals.

Methods: For the purposes of this study, colonias were defined as subdivisions which are sited in economically distressed areas, and which, now or when they were first sold, lack basic infrastructure (including properly treated water and wastewater). In addition, the definition of colonias incorporates the presence of substandard housing and a large Hispanic population. Activities were identified which colonia residents might typically engage in and which may cause pollution-related health problems. These include many water-related activities such as storing drinking water for many days, failing to purify drinking water, walking close to and/or washing clothes in rivers and lakes, and eating fish caught from nearby waters. Other activities the researchers wanted to learn more about include the use of clay containers (which may contain lead), and crossing the border more than once a year. Eight colonias, where it was suspected that environmental contamination was likely, were selected in Brownsville, TX, and Matamoros, Mexico. A nine-page questionnaire was developed in English and Spanish. Verbal, face-to-face, interviews were conducted among 393 households in Brownsville and 402 homes in Matamoros. Each interview took roughly a half hour to administer. Data were gathered about household characteristics, the presence or absence of utilities and infrastructure, the number and type of illnesses suffered by family members, and residents' perceptions about environmental conditions, public health, and the quality of life.

Results and Discussion: This study found no direct evidence of a relationship between contaminated water quality and disease rates. The data suggest that polluted air is more strongly associated with the incidence of disease in this area. Crossing the border was the activity most strongly related to air pollution-related health problems. Many types of pollution seem to be more prevalent in Texas than in Mexico. Finally, the main source of pollution is not within Brownsville. Instead, many contaminants originate in Matamoros

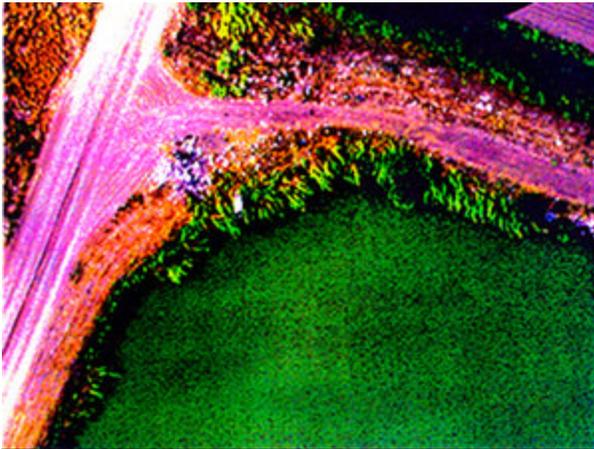
and are deposited in Cameron County through runoff into the tributaries of the Rio Grande and related watersheds, the use of open-air burning in Matamoros landfills, and lead-based fuel emissions from automobile and truck emissions at border crossings.

Reference: Rios, J., and A. Valdez, "Activities, Practices, and the Incidence of Disease Along the Texas-Mexico Border," presented to the 1999 South Texas Environmental Conference, Corpus Christi, TX.

Note: Rios can be contacted at jrrios@falcon.tamucc.edu or (361) 825-2387. Valdez is at avaldez@utsa.edu or (210) 458-2370.

Using Aerial Photography to Identify Sites Polluted by PCBs

Researchers: Charles Webster, Texas Natural Resource Conservation Commission, Weslaco, TX, and Michael Davis, David Escobar and James Everitt, U.S. Department of Agriculture Research Service (USDA/ ARS), Weslaco, TX.



Aerial digital image of southeast corner of Donna Reservoir (150m altitude), documenting unauthorized municipal solid waste disposal.

Background: In 1991, Cameron County in the Lower Rio Grande Valley experienced a high rate of infants born with neural tube defects, prompting the U.S. Environmental Protection Agency (EPA) to begin a study of contaminant exposure of families in the area. Fish caught from the Donna Reservoir, the local drinking water source, were shown to be contaminated with PCBs (polychlorinated biphenyls), which are considered to be possible human carcinogens. The manufacture and use of PCBs was banned in the United States in 1977. Common ways for PCBs to enter

the environment include unauthorized dumping of refrigerators and air conditioners as well as leaks from transformers. The Integrated Farming and Natural Resources Research Unit of USDA/ ARS in Weslaco took aerial photographs of the reservoir shoreline in order to locate sources of PCB pollution.

Objectives: 1) To assess the utility of aerial photography as a means of rapid inventory and mapping of potential point and non-point sources of PCB contamination into the Donna Reservoir, and 2) to assess the feasibility of using aerial photography to rapidly inventory unauthorized solid waste disposal sites in this area.

Methods: Several ground trips were made to visually locate all possible PCB contamination sources. Aerial photographs of the area were taken using color-infrared film at an altitude of roughly 10,000 feet. Two photographs of the reservoir were taken and then combined in a computer graphics program. An on-site investigation was

undertaken at the unauthorized dump site in the northwest end of the reservoir. A second flight used aerial color digital oblique photographs to inventory this dump site, as well as other areas surrounding the reservoir. Sediment samples were collected along a leachate line of shallow groundwaters seeping into the reservoir from beneath the landfill.



Aerial digital image of northwest corner of Donna Reservoir (150m altitude), documenting presence of solid waste landfill, where: (a) & (b) = soil leachate sample sites, (c) = Elamentous algae on standing groundwater pools, (d) = construction and municipal wastes, and (e) = fill dirt & decaying vegetation.

Results and Discussion: The aerial photography efforts revealed the site of a large unauthorized waste dump on the northwest corner of the reservoir. This dump site was later investigated by an on-site expedition. Items that would contribute to PCB pollution were not located at this site. Sediment samples taken earlier near the landfill revealed PCB contamination, but not in the levels necessary to pollute the reservoir to a large extent. PCBs were not detected in leachate samples taken from groundwater flowing beneath the landfill. Further studies revealed that PCB contamination was occurring in the Donna Main Canal, which delivers water from the Rio Grande to the reservoir, and the nearby Arroyo Colorado.



Aerial digital image of rural area west of Donna Reservoir (150m altitude), documenting typical unauthorized solid municipal waste disposal.

Reference: Webster, C., M. Davis, D. Escobar, and J. Everitt, "Utilization of Airborne Photography in the Investigation of PCB Contamination in Donna Reservoir, Lower Rio Grande Valley, Texas," *Texas Journal of Science*, August 1999.

Note: Everitt can be contacted at j-everitt@tamu.edu.

1999 Recipients of ARP and ATP Grants from the Texas Higher Education Coordinating Board

Advanced Technology Program Awards

Agriculture, Aquaculture, and Agricultural Biotechnology

"Microbial Pathogens and Multi-Drug Resistant Bacteria in Irrigation Water and on Vegetables," Suresh Pillai, Animal Sciences Dept., TAMU, Steven Ricke, Poultry Sciences Dept., TAMU, and Keith Sternes, Biology Dept., Sul Ross State University.

"Molecular Mapping and Functional Genomics of Sorghum Adaptation to Stress Environment," Henry Nguyen, Plant and Soil Science Dept., TTU.

"*Vibrio parahaemolyticus* and Texas Oysters: Biology and Public Health Significance," John Schwarz, Marine Biology Dept., Texas A&M University at Galveston (A&M-Galveston).

"Peptide Spawning Pheromone for Commercial Oyster Production in Texas," Gregg Nagle and Sherry Painter, Marine Biomedical Institute, UT Medical Branch at Galveston, and Sammy Ray, Marine Biology Dept., A&M-Galveston.

"Ocean Freight Futures for Risk Management to Enhance the Global Competitiveness of Texas Ports," Michael Haigh and Stephen Fuller, Agricultural Economics Dept., TAMU.

"Dietary Modulation of Health in *Morone* Hybrids for Increased Production Efficiency in Aquaculture," Delbert Gatlin, Wildlife and Fisheries Sciences Dept., TAMU.

Computer and Information Engineering

"Internet and Component-Based Modeling System for Lake Water Quality and Fish Habitat Projections, Xing Fang and We-Ran Zhang, Civil Engineering Dept., Lamar University, Theodore Cleveland, Civil and Environmental Engineering Dept., UH, and Alan Groeger, Aquatic Biology Dept., Southwest Texas State University.

Environmental Science and Engineering, Recycling, and Water Resources

"Multi-Purpose Water Management Technology for the Texas-Mexico Border," Hanadi Rifai, Civil and Environmental Engineering Dept., UH, Philip Bedient, Environmental Science and Engineering Dept., Rice University, Andrew Ernest, Environmental Engineering Dept., Texas A&M University-Kingsville, Sushma Krishnamurthy, Natural Sciences Dept., Texas A&M International University, and William Berg, Engineering Technology Dept., University of Texas-Brownsville.

"Surfactant Remediation of Recalcitrant Groundwater Contaminants," Gary Pope and Russell Johns, Petroleum and Geosystems Engineering Department, University of Texas at Austin (UT).

"Novel Caged Crown Ligands for Waste Remediation: Toxic Heavy Metals in the Rio Grande River," Jennifer Brodbelt, Chemistry Dept., UT, and Alan Marchand, Chemistry Dept., University of North Texas.

"Field Scale Evaluation of Phytostabilization for Closure of Waste Impoundments," Raymond Loehr, Civil Engineering Dept., UT.

"Electron-Beam Technology for Remediation of Chemical and Biological Contamination of Water," Peter McIntyre, Physics Dept., TAMU.

"Integrated Multifunctional Fluorescence Sensors for Real Time Environmental Effluents and Water Analysis," David Starikov and Nasr-Eddine Medelci, Space Vacuum Epitaxy Center, UH.

"Developing Portable Integrated Membrane Systems for Producing Drinking Water in Texas Border Areas," Dennis Clifford and Shankar Chellam, Civil and Environmental Engineering Dept., UH.

"An *in situ* Catalytic Process for the Remediation of MTBE in Groundwater," William Rixey, Civil and Environmental Engineering Dept., UH.

Manufacturing Technology

"Laser Beam Guided by Waterjet in Cutting Thin and Heat Sensitive Materials," Heather E. Beardsley, Automation and Robotics Research Institute, University of Texas at Arlington, and David Johnson, Mechanical Engineering Dept., Southern Methodist University.

Advanced Research Program Awards

Biological Sciences

"In Vivo Analysis of Dynamic Gene Expression in Zebrafish," Gregory Cahill, Biology and Biochemistry Dept., University of Houston (UH).

"Evaluation of Rio Grande Wildlife Corridor Revegetation Efforts," Frank Judd and Robert Lonard, Biology Dept., University of Texas-Pan American.

Chemistry

"The Workman-Reynolds Effect at the Ice Interface: From Thunderstorm Electricity to Cryoprotection," Anthony Haymet, Chemistry Dept., UH.

Computer Sciences

"Multiscale Techniques for Model Development for Groundwater Remediation and Their Efficient Solution," Richard Ewing and Xuejun Zhang, Mathematics Dept., Texas A&M University (TAMU).

Earth Sciences

"Contaminants from South Texas Uranium Mines: Environmental Fate from Molecular to Watershed Scales," Bruce Herbert, Geology and Geophysics Dept., TAMU, and Patrick Michaud, Computing and Mathematical Sciences Department, Texas A&M University-Corpus Christi.

"Investigation to Refine the Application of Geophysical Instruments to Ground Water Problems," Harold Gurrola and George Asquith, Geosciences Dept., Texas Tech University (TTU).

Engineering

"Phytoremediation of Soils Contaminated by Chlorinated Hydrocarbons," Yavuz Corapcioglu, Civil Engineering Dept., TAMU, and Malcolm Drew, Horticultural Sciences Dept., TAMU.

"In Situ Ion-Exchange and Biological Removal of Perchlorate from Groundwater," Deborah Roberts and Dennis Clifford, Civil Engineering Dept., UH.

Technology Development and Transfer Program

Environmental Science and Engineering

"Modeling and Computer Simulation of Environmental Remediation Using Parallel Finite Elements and Personal Computer Clusters," Mary Wheeler, and Graham Carey, Center for Subsurface Modeling, UT.

UT BEG Scientists Characterize Properties of Shallow Aquifers in South Texas

Evaluating the geophysical properties of shallow South Texas aquifers is the goal of a study underway by researchers at the University of Texas (UT) at Austin. The project is led by Jeff Paine of the UT Bureau of Economic Geology. It is funded by the Texas Water Development Board and the U.S. Bureau of Reclamation.



This twin engine plane (shown here at Harlingen) was used to gather airborne EM data

In this project, Paine and colleagues are focusing on near-surface groundwater resources (less than 600 feet deep) in Hidalgo, Willacy, and Cameron counties in the Lower Rio Grande Valley. A non-invasive geophysical method, electromagnetic induction, is being used to identify and assess potential groundwater resources in two test areas. EM data gathered in August and October

1999 are being combined with geologic and hydrologic information to develop three-dimensional models of electrical conductivity, to map significant geologic and hydrologic features, and to identify the amount and quality of water in different geologic zones.

Results will be made available as a geographic information system database, a world wide web site, and in printed maps and reports. The ultimate goal is to use these data to delineate most promising areas for groundwater exploration.

According to Paine, the importance of this study is that the region is looking to groundwater as a significant water source in the future. This is because surface waters are fully allocated and since increasing populations will likely boost water demands. For details, contact Paine at (512) 471-1260 or jeff.paine@beg.utexas.edu.

UT Civil Engineer Evaluates Performance of Ultrafiltration Membranes Used for Drinking Water Treatment

A scientist at the University of Texas at Austin (UT) is now carrying out research to better understand why membranes used as ultrafiltration devices foul and, as a result, don't perform as effectively as they should.. The goal is to identify promising options that utilize precipitative softening as a pretreatment method before ultrafiltration to produce safe drinking water.

The studies, which are sponsored by the American Water Works Research Foundation, are being carried out by Desmond Lawler of the UT Civil Engineering Department.

In many instances, Lawler explains, water treatment plants rely on precipitative softening to process drinking water. Precipitative softening, which removes calcium and magnesium from raw waters, is often used by treatment plants throughout Texas and much of the Midwestern United States. Plants which utilize softening often encounter difficulties removing natural organic matter as well as the fouling of membranes, which lessens their efficiency.

In this study, Lawler will conduct bench-scale laboratory tests using waters from Lake Austin and the Mississippi River near St. Louis, MO, as well as a synthetic water supply. The performance of four membranes, representing different pore sizes and chemical compositions, will also be investigated. The effectiveness of these membranes and different water softening methods will be assessed.

For details, contact Lawler at (512) 471-5870 or dlawler@mail.utexas.edu, or visit the Foundation's World Wide Web site at <http://www.awwarf.com>.

LCRA to Develop Guidelines for Wastewater Reuse

Helping water planners and managers decide about the relative merits of wastewater reuse projects is the goal of a project recently awarded to Jobaid Kabir, a water planner with the Lower Colorado River Authority (LCRA). The study was funded by the Texas Department of Agriculture's Texas-Israeli Exchange.

The focus of the project is to provide water managers with a way to evaluate the environmental benefits of proposed reuse projects. Another desired outcome is to develop a methodology which can be used to evaluate the economics of these ventures. For example, how do you relate increased yields and other benefits of irrigating specific crops with nutrient-rich wastewater to expenses associated with storing and conveying the wastewater?

The thrust of this project is to identify how wastewater is being used in Texas and Israel agriculture. The potential advantages and pitfalls associated with wastewater sources, as well as crop needs, will be assessed. A case study will be conducted on reuse opportunities which may be associated with the LCRA Camp Swift Regional Wastewater

Treatment Plant near Bastrop, as well as a comparable site in Israel near Tel Aviv. Data will be collected on such factors as the level to which wastewater is treated, the type of irrigation systems now used, and the water use needs of crops now being grown. Information will be compiled about the cost to treat and distribute wastewater as well as the extent to which wastewater irrigation may boost farmer profits.

According to Kabir, this type of comprehensive information is needed if thoughtful, systematic analyses of site-specific wastewater reuse scenarios are to be conducted. Understanding data needs and having a framework in place to evaluate these projects should make it easier to assess individual projects of this kind. For details, contact Kabir at (512) 473-4076 or jkabir@lcra.org.

Estimating Pollution Risks Posed by Uranium Mines is Focus of Study by TAMU, A&M-Corpus Christi

A grant from the Texas Higher Education Coordinating Board will enable researchers from Texas A&M University (TAMU) and Texas A&M University-Corpus Christi (A&M-Corpus Christi) to better assess environmental risks posed by South Texas uranium mining operations. Lead investigators in this project are Bruce Herbert of the TAMU Geology and Geosciences Department and Patrick Michaud of the A&M-Corpus Christi Computing and Mathematical Sciences Department. The study was funded through the Board's Advanced Research Program.

From the 1960s to the 1980s, extensive uranium mining was carried out throughout South Texas. During this time, mining companies provided state and federal agencies with self-reported data about the amount of uranium and related pollutants (arsenic, molybdenum, selenium, and vanadium) discharged to point sources. However, little attention was paid to the dangers posed by nonpoint pollution, or runoff, from these mining operations.

The premise of this project, Herbert says, is that understanding the geological variability found throughout the region will yield critical insights into chemical interactions which will likely occur. In turn, knowing the geochemistry will provide insights about the pollution potential when contaminants are found in specific geological settings. For example, Herbert suggests that lake sediments, stock ponds, and slack water deposits in lakes and rivers (often found behind logjams or in floodplains) may be most vulnerable to pollution, since they are often in clay soils, and exhibit high levels of organic matter and sulfides.

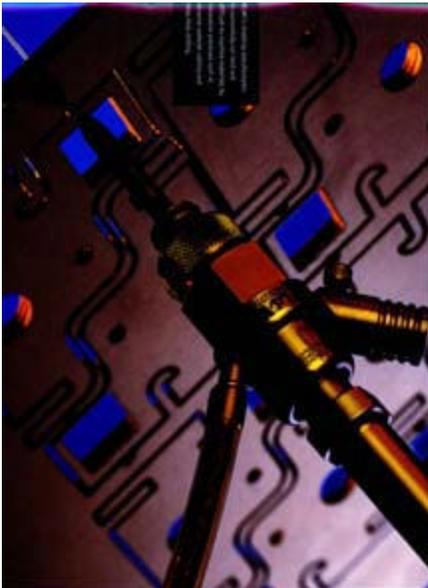
In this project, Herbert and Michaud will first conduct field sampling near Falls City, Corpus Christi, and George West. They will develop a geographic information system with information about geologic features and uranium disposal sites, and will use non-point source pollution models to project and estimate contamination risks.

For details, contact Herbert at (409) 845-2405 or herbert@geo.tamu.edu or Michaud at (361) 994-2678 or pmichaud@tamucc.edu.

UTA, SMU, Researchers Will Conduct First-Evaluation of New Laser-Waterjet Technology in the United States

A team of researchers from the University of Texas at Arlington (UTA) and Southern Methodist University (SMU) were recently awarded a grant to perform the first-ever evaluation of a new high-tech waterjet cutting device in the United States. The research is led by Heather Beardsley of the UTA Automation and Robotics Research Institute, Radovan Kovacevic of the SMU Research Center for Advanced Manufacturing, and David Johnson of the SMU Mechanical Engineering Department. It was funded by the Texas Higher Education Coordinating Board's Advanced Technology Program.

Throughout the past 30 years, laser beams and waterjets have been widely used in many mechanical cutting processes. However, these systems had many drawbacks -- lasers produced a high amount of heat, while waterjets expended significant amounts of kinetic energy.



Recently, scientists at the Swiss Federal Institute of Technology developed a novel new technique which incorporates the best aspects of water jets and laser beams into an improved system. In basic terms, a laser beam is guided through a hair-thin jet of water (only 0.002-0.004 inches thick). The laser beam is contained within and guided by the waterjet, which serves much like an optical fiber. The laser beam is focused in a nozzle by passing through a pressurized water chamber. Finally, the nozzle and the chamber couple the laser beam with the waterjet. The diameter of the laser-waterjet is typically 0.004-inches. The device can be used to cut most metals and alloys as well as many plastics, ceramics, and composites.

In this project, the UTA and SMU researchers will work with Synova, the Swiss company marketing this technology, to test this system in the United States. The objective is to produce baseline data about the governing technologies as well as potential applications for this method. Another goal of this study is to develop a research facility in Texas where the science behind this method as well as potential uses can be evaluated.

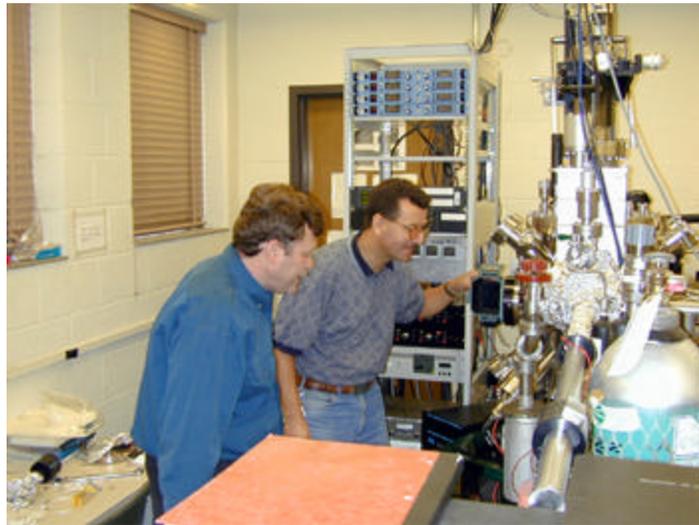
Ultimately, Beardsley says, a waterjet- and laser-based system could be very useful to precisely cut thin and heat-sensitive materials needed for a wide array of industries, including microelectronics, sensing units, medical applications, aeronautics and aerospace, and nuclear processing.

For details, contact Beardsley at (817) 272-5936 or hbeardsley@arri.uta.edu, Johnson at (214) 768-3126 or dbj@seas.smu.edu, or Kovacevic at (214) 768-4865 or kovacevi@seas.smu.edu.

UH to Develop High-Tech Computer Chip to Monitor Water Changes for Outer Space Missions

Developing a high-tech sensor which can detect changes in water quality, temperatures, and flows is the goal of a new research project by scientists at the University of Houston (UH). The hope is that results from this project may provide key water data needed for extended space flight missions and related applications. The study, funded through the Texas Higher Education Coordinating Board's Advanced Technology Program, is led by David Starikov and Nasr-Eddine Medelci of the UH Space Vacuum Epitaxy Center.

The researchers hope to develop a manufacturing process to create inexpensive, miniature, rugged devices which could provide real-time water resources data. They hope to take advantage of recent technological advances in semiconductor material growth. This makes it more feasible to utilize ultraviolet and blue light-emitting diodes and tunable photodetectors to create a monitoring system which fits on a single semiconductor chip. A prototype device will be created which will precisely measure the levels of organic chemicals and heavy metals in waters, as well as changes in water flows and temperature.



David Starikov (left) and Nasr Medelci work to develop a high-tech water monitoring device.

According to Starikov, this device could be useful for outer space explorations, as well as improved water monitoring for semiconductor processing and biomedical facilities. For details, contact Starikov at (713) 743-3621 or DStarikov@orbit.svec.uh.edu.

Proposal to Dam Neches River Provides Framework to Discuss Land Ethics, UNT Scholar Says

For many years, the merits and disadvantages of building dams have been argued by proponents and critics of these projects. Currently, there is a lot of debate about a proposal to build the 3 million acre-foot Rockland Dam on Texas' Neches River. According to a researcher at the University of North Texas Philosophy Department, Rockland Dam may provide an ideal scenario to discuss environmental ethics associated with large water development projects.

In 1998, Pete Gunter of UNT and Max Oelschlaeger (now with the University of Northern Arizona) wrote *Texas Land Ethics*, a book which discusses how Texas manages

environmental treasures. The premise of the book is that Texans need to consider more sustainable use of natural resources. Gunter suggests that many aspects of this project make it an intriguing case study about land ethics issues. For example, the dam would be built near Lufkin on the Upper Neches River, which is one of the few lengthy undammed river segments in Texas. The reservoir would cover more than 125,000 acres and would permanently flood as many as 100,000 acres of bottomland hardwood and other forest habitats. Some environmentalists have even suggested that the Neches River remain protected, and undeveloped, by designating it as a wild and scenic river. Critics contend the project may not be needed because surplus water may be available from the Sabine River basin. The project is advocated by cities and industries in the region as a much-needed water source.

"This project provides an excellent opportunity to reexamine the current state of environmental ethics in Texas," Gunter says. "It should promote discussions of how the stability, integrity, and beauty of natural areas should be balanced against human needs. It raises the issue of how a full set of environmental issues needs to be considered when weighing the merits of large developments."

Gunter is now participating in the debate surrounding this project. For details, contact him at gunter@unt.edu or (940) 565-2257.

Improvements to Nuevo Laredo Wastewater System Are Still Not Enough, A&M-International Scientist Suggests

According to recent studies by a Texas A&M-International University (TAMIU) researcher, a new wastewater treatment plant which serves the city of Nuevo Laredo, Mexico, may be improving wastewater quality downstream of Laredo, but much more needs to be done.

Since 1993, researcher Tom Vaughan of the TAMIU Natural Sciences Department has monitored water quality at four sites above and downstream of a 31 million gallon per day (mgd) capacity wastewater treatment plant in Nuevo Laredo that began operating in 1996. The problem, Vaughan says, is that even with this new facility, as much as 11 mgd of raw sewage is not being routed to the plant, but is flowing untreated into the river. The main source of these troubles is that there are still major sewage outfalls which are not connected to collector lines which were built to carry sewage to the wastewater plant.



Vaughan's studies show that, water quality upstream of the two cities is generally pretty good, averaging only about 200 colony forming units (cfu) per 100 millimeters (ml) of

water. Before the plant was built, fecal bacteria counts averaged 5,392 cfu per 100 ml immediately below the treatment plant, and 13,249 cfu per 100 ml at a site 24 miles south of Nuevo Laredo. Since the plant began operations, Rio Grande waters immediately downstream plant have averaged 1,957 cfu per 100 ml, while levels at the site 24 miles downstream have averaged 3,773 cfu per 100 ml.

If conditions are to improve, Vaughan suggests the existing infrastructure which carries sewage to the plant needs to be improved. At least four outfalls still discharge untreated sewage directly into the river and need to be tied onto the wastewater distribution system.

For details, contact Vaughan at tvaughan@tamiu.edu or (956) 326-2592.

Texas Tech Tests Applying Phosphorous Through ‘Fertigation’

A researcher at Texas Tech University is now working with the High Plains Underground Water Conservation District No. 1 to assess the feasibility of applying phosphorus through the use of center pivot irrigation systems. The research is being led by researcher Dan Krieg and graduate student Scott Reiter of the Plant and Soil Science Department.

Applying phosphorus by using irrigation equipment, a practice known as fertigation, may help save farmers money and ensure that it is applied most efficiently. At many sites in the High Plains, the chemistry of local groundwater supplies is such that it may clog center pivot nozzles when it reacts with phosphorus. Chemical reactions between calcium, magnesium, and phosphorus can cause solids to precipitate and fall out of solution, thus leading to blockage or clogging of sprinkler nozzles.

This project is in its third year. In this effort, Krieg is testing the application of a balanced nutrient solution (which includes phosphorus, sulphur, and nitrogen) to irrigation water. He is also evaluating the effectiveness of applying different ratios of nitrogen and phosphorus by fertigation, compared to conventional methods in which these nutrients are sprayed directly onto the soil. The project also involves using maps and data developed by the Texas Water Development Board to locate sites in the area which may pose challenges for the application of phosphorus through fertigation. For details, contact Krieg at (806) 742-1631 or dkrieg@ttu.edu.

University of Texas Press Publishes Books About History of the Texas Coast, Texas’ Sky

Two new books from the University of Texas Press provide new insights about the history of coastal Texas, as well as the unique imagery presented by Texas skies.

The Historic Seacoast of Texas was written by David McComb and illustrated by J. U. Salvant. This book includes essays discussing the history of the region as well as illustrations of important people, buildings, and nature. Sections in the book describe such issues as the Sabine Crossing, the Bolivar Peninsula, Galveston Island, the Brazos

Landing, “troubled waters” at Matagorda Bay, the Aransas Passage, Corpus Christi and the “Cowtowns of the Coast,” Padre Island shipwrecks, and Tourists.

The sky of Texas and its changing faces and moods have long been a source of fascination for Texans, from brilliantly blue cloudless days to the blackest of thunderstorms punctuated by blazing lightning bolts. Photographer Wyman Meinzer has produced a book titled *Texas Sky*, which displays scenic photographs of thunderstorms, cloudbursts, rainbows, and sunsets from throughout the State. Meinzer's photographs of skies and landscapes are accompanied by quotes from nature artists, poets, and writers. In addition, Meinzer and John Graves wrote essays which serve as an introduction to the book.

Texas Sky and *The Historic Seacoast of Texas* are published by the University of Texas Press. To order, call the Press at (800) 252-3206 or visit their WWW site at <http://www.utexas.edu/utpress/index.html>.

Groundwater Quality is Topic of Book by UH, Rice Scientists

A newly revised book provides a thorough discussion of the causes of groundwater contamination as well as treatment methods. The book, *Ground Water Contamination -- Transport and Remediation (Second Edition)*, was written by Philip Bedient of the Rice University Environmental Engineering Department, Hanadi Rifai of the University of Houston Civil Engineering Department, and Charles Newell of Groundwater Services, Inc.

This book addresses scientific and engineering aspects of subsurface contaminant transport and remediation in groundwater systems. Theoretical and practical information is provided. Highlights include detailed coverage of analytical and numerical methods, extensive case studies and field research from military and Superfund sites, waste site characterization, and remedial design. Emerging remediation methods, including the use of surfactants and soil flushing, are presented. Engineering methods and theory as well as mathematical and chemical modeling are discussed in detail.

To order this book, contact Prentice Hall at (800) 282-0693 or visit World Wide Web site at <http://www.phptr.com>. Bedient can be reached at (713) 527-4953 or bedient@rice.edu, while Rifai can be contacted at (713) 743-4250 or rifai@uh.edu.

Users' Manual, Software for 'WRAP' Available from TWRI

An updated users manual and computer software which can be utilized to analyze the availability of water rights is now available from the Texas Water Resources Institute (TWRI). *Reference and Users Manual for the Water Rights Analysis Package (WRAP)*, was written by researcher Ralph Wurbs of the Texas A&M University Civil Engineering Department. The report was published in September 1999 as TR-180. TWRI is selling single copies for \$35. Subjects described in detail in this report include input and output to WRAP-SIM, WRAP-HYD, and TABLES, as well as hydrology and water rights

features of the simulation model. Individuals who purchase this report will also receive a floppy disk which contains compressed files for three programs -- WRAP SIM (a simulation model), WRAP HYD (used to develop hydrologic inputs for WRAP SIM), and TABLES (which creates output tables). The program is written in FORTRAN, but can be compiled to be used with personal computers as well as mainframe computers.

TAMU Probes Link Between Dolphin Deaths, PCBs

When a group of 26 bottlenose dolphins stranded and died near Matagorda Bay in 1993, the cause was not readily apparent. A study in progress by researchers at the Texas A&M University (TAMU) College of Veterinary Medicine is investigating whether high levels of a class of chemicals called polychlorinated biphenyls (commonly known as PCBs) may have played a key role in why the dolphins died. The research is being carried out by David Busbee and Beverly Finklea of the Center for Environmental and Rural Health and the Anatomy and Public Health Department. Cooperators include the National Marine Fisheries Service, the National Oceanic and Atmospheric Administration, and the Southeast Fisheries Science Center.

Prior to 1976, PCBs were manufactured and used in many industrial processes. The use of PCBs is no longer legal, but these pollutants still occur in the environment as a result of runoff from hazardous waste sites, leakage from equipment which contains PCBs, or the dumping of stockpiles. PCBs cause a special health threat for dolphins, because cetaceans are long-lived, have a high fat content, and, therefore, bioconcentrate these pollutants.

In this effort, tissues from dead dolphins were wrapped to prevent drying and frozen. Blubber extracts were analyzed for the presence of pesticides and PCBs using gas chromatography and electron capture detection. Toxicity equivalency values were calculated for each animal. The results suggest that some of the dolphins which were stranded and died exhibited PCB values which were high enough to potentially cause developmental anomalies, diminish immune functions, and decrease reproductive efficiency. A hard freeze which occurred two weeks prior to the strandings and deaths may also have played a role. The freeze killed much of the dolphins' food source (mullet, other small estuarine fish, and crustaceans). This may have meant the dolphins would have had to use reserves of stored fat and release fat-stored pollutants, including PCBs. This may have increased the serum PCB to toxic levels. For details, contact Busbee at (409) 845-6463 or dbusbee@cvm.tamu.edu.

A&M-Kingsville Studies if PAM Makes Soils More Permeable

Results of a study by researchers at Texas A&M University-Kingsville (A&M-Kingsville) suggest that applying polyacrylamide (PAM) to irrigation water may leave soil significantly more permeable several months afterwards. The project was carried out by researcher Duane Gardiner and students Qingguo Sun, and Todd Carr of the A&M-Kingsville Agronomy and Resource Sciences Department, and Eduardo Mendez of the Texas State Soil and Water Conservation Board. The experiments suggest that soils

treated with PAM may erode less easily, be less likely to contribute to runoff, and be more permeable to irrigation and rainwater.

Applying PAM to soils which are regularly irrigated with low quality- or high sodium-water can be very helpful in agriculture. PAM improves infiltration rates and reduces the strength of the mineralized crust that forms on soil surfaces. The researchers conducted several laboratory experiments which measured hydraulic conductivity in columns of PAM-treated soil. They metered PAM into irrigation water and measured the infiltration weeks later. A non-irrigated field was treated with PAM, after the ground had been seeded with three grass species. Successful application of PAM may also indirectly help save water. Industrial and municipal wastewaters, as well as salty or brackish water, could be used for irrigation when PAM is used. Since PAM improves hydraulic conductivity in the soil, less water may be needed to efficiently irrigate crops. The quality of surface water may be improved, since PAM acts as a stabilizing agent which may lessen erosion and sediment-laden runoff.

The researchers recently found that applying PAM can inhibit seedling emergence, since it has a tendency to desiccate the top half-inch of non-irrigated soils. A study comparing the use of an extract from the prickly pear cactus to PAM was recently concluded. Results show that both substances have similar effects on water infiltration. Unlike the PAM, the cactus extract is 100% natural, poses no environmental problems, and may decompose more quickly. For details, contact Gardiner at duane.gardiner@tamuk.edu or at (361) 593-3691.

Texas Water Foundation WWW Site Provides Source for Texas Water Facts, Educational Activities

The Texas Water Foundation is a nonprofit organization which hopes to generate a heightened public awareness among Texans about the vital role that water plays in everyday life.

The Foundation's World Wide Web (WWW) site contains substantial information about water resources issues facing Texas, as well as educational materials.



Some of the information contained on the WWW site highlights the Foundation's 1999 "Clear Gold Summit," which was a conference designed to generate discussion about water marketing and related issues. In addition, the WWW site also provides basic information about such wide-ranging issues as rainfall, surface and ground water resources, water use by various sectors, water quality, and the amount of money expended on water-related activities.

The WWW site also contains information about many educational resources. For example, it describes joint efforts of the Foundation and the Texas Parks and Wildlife Department to present a workshop, "Spaceship Earth: Saving Aquatic Habitats," at the National Aeronautics and Space Administration's Johnson Space Center in 1999. In

addition, educational activities for youth on this web site include a word search, fun facts, and a science project about the hydrologic cycle.

The WWW address is <http://www.texaswater.org>. For details, contact the Foundation at info@texaswater.org.

Quarterdeck WWW Site Features News, Research from TAMU Oceanography Department

The Texas A&M University Oceanography Department has created a World Wide Web (WWW) site with information about research conducted by scientists and graduate students. The WWW site, *Quarterdeck*, is at <http://www-ocean.tamu.edu/Quarterdeck/>.



Quarterdeck regularly highlights research pertinent to the Texas coast and related environments as well as recent findings from research cruises. It profiles the research interests of new faculty members.

The current issue discusses such topics as whether there may be oceans on Mars, a photo contest for the Department's graduate

students, and research by graduate students about such topics as the use of biomarkers to indicate carbon and nitrogen sources and pathways. In addition, there is an article about collaborative work between TAMU and the National Marine Fisheries Service Southeast Fisheries Science Center to create a database of cetacean sightings.

Subscriptions to the printed version of *Quarterdeck* magazine are free of charge. For more information, contact the editors at quarterdeck@ocean.tamu.edu.

Wastewater, Water Pollution Issues Are Emphasis of Water Environment Federation WWW Site

For anyone interested in water pollution, wastewater treatment, or water quality protection, the Water Environment Federation (WEF) World Wide Web site is a gold mine of information.

WEF is an international non-profit association. It provides members with wastewater treatment and water quality protection services, as well as information about such issues of point and nonpoint source pollution, hazardous waste management, biosolids recycling, groundwater contamination, and small community wastewater systems.

WEF's World Wide Web site, located at <http://www.wef.org> has many useful features for those interested in these issues. It includes weekly updates on water and wastewater news. The WWW site includes both current issues as well as a searchable archive. Other useful sections include information on commercial water and wastewater treatment suppliers and manufacturers, legislative updates, position statements and testimony from WEF staff, and links to governmental and for-profit web sites. The WWW site also lists upcoming conferences and workshops, and houses a career opportunities section with a job bank.

For those seeking technical information, the WWW site includes a resource catalog, discussion groups about specific topics, and press releases. Titles of technical reports and manuals of practice are also posted. Free sample issues of many WEF newsletters, including bulletins which focus on biosolids, watershed and wet weather issues, industrial wastewater concerns, and many related topics are also on-line.