New Waves
The Research Newsletter of the Texas Water Resources Institute
Volume 5, Number 1, March 1992

TWDB's Request for Proposals Generates 49 Proposals Totaling $3.5 Million

If anyone needs convincing of the eagerness of Texas university scientists to conduct water research projects, just ask the Texas Water Development Board (TWDB).

Last winter, the TWDB issued a $500,000 request for proposals (RFP), one of their biggest awards ever. TWDB staff used the results of a research goal-setting Workshop hosted jointly by the Board and TWRI in November to identify the areas that would be most important to study. Those Proceedings are now being published by TWRI and will be available to the public shortly.

The result? Forty-nine researchers, 33 of them with universities, responded to the RFP. Their funding requests total more than $3.5 million. When matching funds are included in the analyses, the requests total $8.5 million.

The projects are expected to be awarded when the TWDB holds its April meeting. Although not all the proposals that were submitted are going to receive funding, the RFP was successful, according to TWDB staff.

"This was the first time we gave researchers a firm idea of what we considered the top priorities to be and this was one of our largest funding amounts to be awarded," said Carolyn Brittin of TWDB's!esearch planning unit. "Both of these factors made the response to this RFP more significant than those we have had previously."

Not surprisingly, the highest-ranked research priority at the Workshop, "develop and perform procedures to evaluate the actual effectiveness of best management practices for non-point pollution, including structural and nonstructural controls," received the greatest number of proposals (11) and the second most amount of funding (nearly $1.7 million). The second highest ranking research recommendation, remote sensing of water quality and associated GIS mapping including locations of contamination sources, was targeted by five projects totaling more than $1.9 million. More funds were requested for this priority than any other.

Universities from throughout Texas responded to the RFP. Most of these requests came from Texas A&M University with 15, followed by Corpus Christi State University (5), the Universky of Texas at Austin (4), and Southwest Texas State University and Tarleton

State University (2 each). Proposals were also submitted by Southern Methodist University, Huston-Tillotson College and Texas A&I University. The Lower Colorado River Authority submitted 7 proposals, the most turned in by an organization other than a university.

Details on these projects will be featured in future issues of New Waves.

ATP/ARP Studies Look at Pollution, Ecosystems

In the last issue, we reported the names and titles of new projects awarded by the Texas Higher Education Coordinating Board's advanced technology and advanced research programs.

In this issue, we'll feature some of those projects. The projects range from using living organisms like sea squirts track pollution to aquaculture, to ecological investigations. We hope you find our summaries interesting.

3-Dimensional Modeling of Flood Flows in Houston Bayous

Researchers: Keh-Han Wang and Ted Cleveland, Civil Engineering Department, University of Houston, TX, and Steve Fitzgerald, Harris County Flood Control District, Houston, TX.

Problem: The Harris County Flood Control District is improving the stream channel at the confluence of Buffalo and White Oak Bayous in Houston. The improvements will create a park that can be used during normal, non-flood flows, but will still efficiently and safely convey water during floods. Sophisticated modeling techniques are needed to assess whether the modifications will function properly in real world situations.

Objectives: To determine the velocity of water flowing at sensitive cross-sections of the two bayous and to evaluate the efficiency of the proposed changes in channel geometry.

Methodology: A 3-dimensional hydrodynamic model was used that utilized inflow hydrographs, bayou geometry, and bottom stresses as inputs. The model computed a 3-dimensional velocity field that predicted how velocities and surface water levels vary over time. The 3-dimensional model was coupled to a digital terrain model that can be modified to reflect the impact of different channel designs. A coastal hydrodynamic model was modified to simulate flows of interconnected river systems. A moving boundary algorithm was developed to simulate and graph the movement of the floodwaters. A multi-component mass transport model was developed to create dye plumes to help visualize flow patterns. 100-year flood hydrographs were used as inputs to the model and different inflows and velocities were generated for comparison purposes.

Results: Modeling results suggest that bottom stresses greatly influence flood flows. The 3-dimensional hydrodynamic model performed well under steady (base)flow and 10-year peak conditions. Simulations indicate that the proposed changes will convey White Oak floodwaters more efficiently than existing structures. Modeling of stormflows from both bayous indicated that the proposed modifications will distribute flood flows more evenly.

Stormwater velocities are reduced in some areas that are especially sensitive to flood damage.

Reference: Wang, K.H., T. Cleveland, J.R. Rogers, and X. Ren, *A Three Dimensional Hydrodynamic Flow and Transport Model of the Confluence of Bvffalo and White Oak Bayous* (UH-CEE. Report 91-5), Civil Engineering Dept., University of Houston (TX), 1991.

Radon Levels and Origins in High Plains Aquifers

Researcher: James Bartolino, Geosciences Department, Texas Tech University, Lubbock, TX.

Problem: Playa lakes on the southern High Plains recharge the Ogallala Aquifer and other groundwater systems. However, n is unclear whether naturally occurring uranium series elements contained in the Anton Lake Basin in Hockley County are percolating downward in recharging groundwater and contaminating the Aquifer. If sufficient levels of these uranium-series elements reach the Aquifer, it could constitute a public health risk.

Objectives: To assess and map the presence of elevated levels of uranium daughter products in High Plains groundwater supplies in Hockley County, and to Wennifythe source and movement of those elements.

Methodology: The decay of uranium-238 to stable lead-206 proceeds through 14 steps, with the decay of radium-226 to radon-222 roughly midway through the process. Radon-222 has a half-life of 3.8 days and was chosen to trace uranium distribution in the Aquifer. Liquid scintillation was the method chosen to analyze radon-222 in water because it is accurate, inexpensive, and quick.

Results: Water samples from 50 wells in the study area contained radon-222 levels ranging from 100 to 2,500 picocuries per liter (pCi/L). Average radon activity in the samples was 760 pCi/L. The median activity was 450 pCi/L. Using the 600 pCi/L line of equal activity, a plume-shaped belt of elevated radon activity was defined down-gradient from the Anton Lake Basin. Groundwater analyses failed to determine a clear relationship between total uranium, radium-226, and radon-222 in solution. This suggests that pH conditions in the groundwater have caused these radon parent elements to precipitate onto the groundwater matrix. The apparent source of the uranium series elements is uranium mineralization within lake sediments of the Anton Lake Basin and other playas, carried into the Aquifer by recharging groundwater. This mineralization is thought to be from the weathering of volcanic ash deposited in the playas. Another possible source of radon in the groundwater is upward migration of radon gas or radon-rich water from underlying strata.

Reference: Bartolino, James, *Radon-222 in the Groundwatsr Surrounding the Anton Lake Basin in Hockley County, Texas,* Ph.D. Dissertation, Texas Tech University, Lubbock, TX, 1991.

Use of Man-Made and Natural Marshes by Aquatic Organisms

Researchers: Barbara Ruth and Wes Tunnell, Center for Coastal Studies, Corpus Christi State University, Corpus Christi, TX.

Problem: Offsening the destruction of natural wetlands by mitigating or creating new wetland areas is required by State and Federal regulatory agencies. In Corpus Christi, some natural wetlands were destroyed when the Ship Channel was deepened. To compensate for those losses, a 200-acre marsh comprised of deep, shallow, and emergent habitat similar to that of a natural estuary was developed in western Nueces Bay. Although man-made wetlands may look like natural marshes, there are questions about whether these created wetlands provide the same functions as natural wetlands, if similar vegetation can be established in them, and whether aquatic species similar to those in natural marshes will utilize them. ,

Objectives: To compare a man-made marsh to a nearby coastal marsh in terms of water quality, vegetation, and the area's use by aquatic organisms, and to determine how well the man-made site is performing as a replacement for natural wetlands that were lost.

Methodology: Three sites within the man-made wetland and one site in the nearby natural marsh were sampled monthly from June 1989 to July 1990. Permanent transects were established to sample salt marsh vegetation at mean sea level elevations (MSL), the nearby edge of the channel, and the tidal pond. Levels of Gulf Coast cordgrass were measured in areas that were emergent and slightly, moderately, mostly, and totally submerged. Water quality samples were taken for salinity, temperature, pH and dissolved oxygen. Samples of benthic infauna, epifauna and nekton were collected and identified. Infauna include organisms that live in the mud such as marine earthworms and sea hoppers. Epifauna include animals that live on the surface of the mud including brown, white and grass shrimp and blue crabs. Nekton include such swimmers as small fish like anchovies, menhaden, sheepshead minnows, Benny, and juvenile red drum and spotted seatrout. Visual counts of birds were taken at both sites .

Results: Although aquatic species were present in the manmade wetland, species composition, abundance arid diversity differed from the nearby natural marsh. This indicates the manmade marsh is not duplicating the functions of the natural marsh. A number of factors may account for these differences. The man-made marsh features deep steep slopes, elevations at mean sea level are frequently flooded, attempts to establish vegetation have failed, and the wetland is still "young." The manmade marsh was slightly less saline than the natural marsh, because it was located nearer the Nusces Bay. Efforts to establish cordgrass at the site failed because the grass was flooded too often. The man-made site had higher densities and populations of benthic infauna than the natural site, but lower species diversity. Other species, especially less common ones, were found in the created area. Epifauna were more abundant in the natural marsh than in the man-made wetland, while nekton levels varied by species. Shrimp and other species that require vegetative habitat were found less often at the man-made site because it has no vegetation. Few of the birds observed at the man-made wetland are permanent residents of the marsh, but used the area for resting, feeding and refuge. This study is continuing.

Reference: Ruth, Barbara, and Wes Tunnell, *Establishment of Estuarine Faunal Use in a Salt Marsh Creation Project* (CCSU-9001 CCS), Nueces River Delta, TX, Center for Coastal Studies, Corpus Christi State University,1990.

Impact of High Capacity Wells on Flows of the Lower Colorado River

Researchers: Barry Hibbs and John Sharp, Geology Department, University of Texas at Austin.

Problem: The interconnection between aquifer flows and rivers and streams is poorly defined. Underflows are groundwater flows that move parallel to, under, and near streams but at very slow rates. Baseflows are aquifer flows that move perpendicular to streams and eventually flow into stream and river systems. Identifying underflows and baseflows is important for legal and policy making reasons. Texas water law prohibits the use of large wells to deplete underflows without a permit. Overpumping from underflows may lessen river flows and may lessen the ability of downstream surface water rights holders to get the waterthey are entitled to.

Objectives: To identify underflows and baseflows in key regions of the Colorado River using established methods; and to develop new methods that could be more easily implemented to estimate the impact of high capacity alluvial wells on streamflows.

Methodology: Baseflows and underflows in key regions of the Lower Colorado River were identified by using Traditional" methods. For example, monitoring wells were installed during winter and spring periods from 1989 to 1991. Potentiometric maps were generated. Three sites in Travis, Bastrop, and Cobrado Counties were selected for detailed site-specific studies. An Ualternative" method of determining the impact of alluvial pumping on stream flows called the Critical Stream Depletion Zone was developed. This method identifies areas where pumping is mostly likely to deplete streamflows. High capacity wells within the Zone were identified along the River. The new method was used in a case study to predict the impact of the City of Bastrop's alluvial wells and the hypothetical impact of increased numbers of wells on the flow of the Colorado River.

Results: The Colorado Riveralluvium is generally dominated by baseflows, but site-specific studies show that underflow zones often exist near the River. Even beyond the underflow zones, the interconnected nature of aquifers and river flows may extend thousands of feet into the floodplain. This means that the potential of high capacity wells to deplete the river's flows is great. Complete potentiometric maps of the Cobrado River floodplain were generated. Case studies show that pumpage from Bastrop's alluvial wells will deplete the River by 0.11% during an average winter and by 0.04% during a typical summer. If 600 hypothetical wells were developed, streamflows will be lessened by 35% during average winters and by 7% during typical summers.

Reference:Hibbs, Barry, and John Sharp, *Evaluation of Underflow and the Potential for lnstream Flow Depletion of the Lower Colorado River by High Capacity Wells in Adjoining Alluvial Systems*, Lower Cobrado River Authority, Austin, TX, 1991.

Recreation and Aesthetic Values of Highland Lakes

Researcher: Notie Lansford, Agricultural Economics Department, Oklahoma State University, Stillwater, OK.

Problem: Water allocation in Texas has historically focused on consumptive uses by cities, agriculture and industries. As demands for water increase, it will also become critical to consider the value of non-consumptive uses such as recreation.

Objectives: To estimate implicit price equations for Lake Travis and Lake Austin; to identify housing attributes which contribute to recreational and aesthetic value; to identify differences in recreational and aesthetic values between Lakes with constant and variable levels; and to estimate the recreational aesthetic price indicated by housing near the Lakes.

Methodology: Data sources included the Texas Central Appraisal District, the Travis County Clerk's Office, the Lower Colorado River Authority, and maps. Sales of property near both lakes from 1988 to 1990 were analyzed. Hedonic or implicit price functions were estimated using the Box-Cox functional form and marginal prices for key characteristics. Demands and supplies were estimated for those characteristics. Factors included in the analysis included recreational and aesthetic data (distance to the Lake, view of the Lake, and variation in Lake levels when the lots were sold), data on homes (size of the home and the lot), and neighborhood information (schools, distance from major urban areas).

Results: Proximity to the Lakes is the most important component of recreational and aesthetic value. Water-front locations typically command premiums of $80,000 to $100,000. Water-front homes on bluffs with limited water access experience a 10% loss in waterfront premiums. As the distance to either lake increases, marginal recreational and aesthetic values decline rapidly but at a decreasing rate. At 2,000 feet from a lake, the marginal value disappears. Lake views also influence recreational and aesthetic values. Variations in lake levels were found to significantly impact housing prices and recreational and aesthetic values near Lake Travis. Lake-front homes sell for $3,000 to $8,000 less when the water level is six feet below long-term average levels. The capitalized marginal value of water for recreation and aesthetics as reflected by housing prices is $110 to $136 per acre foot.

Reference: Lansford, Notie, *Recreational and Aesthetic Value of Lakes Reflected by Housing Prices: A Hedonic Approach*, Ph.D. Dissertation, Agricultural Economics Department, Texas A&M University, 1991.

Marine Science Institute to Examine Causes, Impacts of Brown Tide

Assessing the damages caused by last year's "brown tide" that disrupted sportfishing in South Texas' Laguna Madre and learning more about why it occurred and how to prevent it is the aim of a comprehensive study by scientists at the University of Texas Marine Science Institute (UT-MSI) at Port Aransas.

The brown tide, which is an unusual plankton variety, spread throughout the Laouna Madre and other South Texas bays and estuaries last year. Although it didn't produce toxic substances that killed other marine organisms, it destroyed a large area of seagrasses by reducing the sunlight they need for photosynthesis. Recreational fishing was eliminated during the outbreak because the waters became extremely turbid.

The research will focus on how the brown tide influenced seagrass and phytoplankton production, reduced standing stocks and grazing efficiencies of higher trophic levels, and altered nutrient cycles. Specific objectives include examining changes in food webs and nutrient cycles brought on the by the tide and to find if the organism has any competitive advantages that allow it to flourish.

The advanced technology project will be led by Ken Dutton and Ed Buskey and will involve a number of UT MSI researchers. It was funded by the Texas Higher Education Coordinating Board. For details, call the Marine Science Institute at 512-749-6711.

Helping Redfish Grow Bigger is Focus of Study by Texas A&M, Corpus Christi State

What does it take to make redfish grow as big and as rapidly as possible?

Delbert Gatlin and Wiiiiam Neill of the Texas A&M University Widlife and Fisheries Science Department and Steve Barnes of the National Spill Control School at Corpus Christi State University hope to answer that question.

Their joint project involves using controlled laboratory experiments to identify the optimum levels of nutrients and other environmental factors that redfish need. For example, diet composition and such water quality characteristics as dissolved oxygen, dissolved solids and salinity can have profound impacts on redfish growth. There could also be a cost savings as feed and oxygen expenses make up 67% of the operating costs at major aquaculture firms. Another part of the project will be to determine if diluted seawater can be manipulated to better support red drum. Results from the laboratory studies will be used in field tests with a commercial aquaculture operation, Prime Reds.

For details, contact Gatlin at 409-847-9333.

North Texas Scientists to Use Marine Worms to Measure Impact of Petrochemical Pollution

For years, Art Goven and Lbyd Fitzpatrick of the Biology Department at the University of North Texas have been using earthworms to gauge the health impacts of pollutants in the environment. For example, because earthworms are exposed to toxic chemicals near landfills 24-hours a day, they can serve as an early warning signal to chemicals that may be toxic at key levels.

Now, the scientists are taking their technique to shallow waters off Texas' coastal waters to study if sandworms and tubeworms can provide similar information about the impact of bay waters and sediments polluted by the petrochemical industry.

The project involves studying afamily of marinewormscalled polychaetes that include filter feeders, predators, and worms that live in sediments. Laboratory work is now being done to evaluate the life history functions of healthy worms grown in clean waters. Later, worms, waters and sediments will be taken from areas with pollution problems for analysis. The worms will provide information on both lethal levels of pollutants as well as levels that injure, but don't kill, the organisms.

For details, contact Fitzpatrick at 817-565-3636.

SW Texas Study Hopes Sea Squirts May Provide Clues on Trace Metals in Marine Waters

Learning more about how marine organisms like the sea squirt store trace metals and other chemicals may provide early warning signals that bays and estuaries are contaminated as well as other important information.

With this in mind, Carl Carrano of the Chemistry Department at Southwest Texas State University is beginning a study to look at how the chemical vanadium is bioaccumuiated in tunicates‹sea organisms that have a cylinder or globuiar-shaped body enclosed in a tough outer covering with concentric layers like the bulb of an onion.

Sea squirts are an ideal organism to investigate for a number of reasons. They have been shown to store vanadium levels ranging from as little as 1 nanogram to as much as 1 part per thousand (that's a million-fold difference). They may be able to provide clues as to how pollutants at various levels affect the normal function of other marine organisms, as well as means that other aquatic life use to accumulate trace metals. Information on chemical toxicology, and levels of vanadium and other elements found in the environment could also result from the study.

The study is being funded by the Texas Higher Education Coordinating Board as part of its advanced research program. For details, contact Carrano at 512-245-3117.

Plant Pigments May Yield Data on Food Webs, Carbon Sources

Using high tech methods to anaiyze pigments from inland and coastal plants and plankton may improve our understanding about the food web in the Sabine-Neches Estuary, according to a new study. The project is being conducted by Thomas Bianchi of the Biology Department at Lamar University and M. Baskaran of the Marine Sciences Department at Texas ARM University at Galveston.

Part of the study involves obtaining plant pigments which are major inputs of carbon intothe Sabine-Neches Estuary. The pigments will be tested to determine temporal and spatial differences in sedimentation and mixing rates. Steady and non-steady state tracers

such as naturally occurring radionuclides and rare earth elements will be used. The project will also separate how organic carbon is deposited by benthic mixing and by sedimentation. The study may provide clues on how organic matter is transformed and assimilated.

Call Bianchi at 409-880-8258 or Baskaran at 409-740-4476 for details.

UH Project to Determine if Seawater Solar Ponds Can Make Aquaculture More Feasible Year-Round

Two University of Houston researchers have recently begun a project to find out whether solar ponds can be modified for use in coastal areas to make year-round aquaculture and mariculture operations feasible.

Richard Bannerot and Stan Kleis of Houston's Mechanical Engineering Department want to determine if sea water can serve as the source of a concentrated salt solution that can be used in coastal solar ponds. Currently, saturated salt solutions are typically used. If successful, the seawater ponds would serve as a home for marine species like redfish and shrimp. Because they provide a source of heat during winter months, the possibility of killing winter freezes is greatly reduced and the fish and shrimp are expected to grow dramatically. Winter temperatures in the solar pond are expected to be 50 degrees to 60 degrees Fwarmerthan temperatures outside the ponds. Costs for salt and construction of the ponds could be cut by 80 to 90%.

The advanced technology project was funded by the Texas Higher Educatbn Coordinating Board. Field studies will be carried out at a mariculture company, Redfish Unlimited, in Palados.

For details, contact Bannerot at 713-749-4551.

Texas A&M Biologists Use Camera Software to Take Reef Census

A new technology being developed by biologists at Texas A&M University may increase the number of scientists taking their video cameras to the beach more often‹and not just for sight-seeing.

Mary Wicksten and John Whorff of the Biobgy Department are working on a new study that will link the use of videotape and Macintosh computer software in environmental studies. In the past, for example, it's been difficult and time-consuming to develop accurate estimates of the numbers of oysters, barnacles, limpets and algae in bays and estuaries. Now, the techniques used most often involve photographing or tracing organisms onto plastic sheets that are later digitized for analysis. Often, the methods used today also result in damage to the environment being studied.

The new technology involves videotaping aquatic environments that can be analyzed and enhanced with computer software programs. These images can also be easily saved so that changes in habitat over time can be observed. Sounds can also be recorded. Wicksten

and Whorff are testing the system by filming reef animals near the San Jose Jetty near Port Aransas. New software will be created that will generate a fixed number of random points to automatically obtain random estimates of percent cover and to automatically export data from the video images for analysis.

The advanced technology study was funded by the Texas Higher Education Coordinating Board. For details, contact Wicksten at 409-845-3388.

Water Commission Offers Compromise Strategy to Manage Edwards Aquifer

The on-going conflict about how best to manage the Edwards Aquifer may soon come to an end if a compromise strategy developed by the Texas Water Commission (TWC) is approved.

The management plan was outlined by the TWC in February. One appealing part of the strategy is that it emphasizes local control‹ many feared that State or Federal intervention would result if an agreement could not be reached. The plan recommends that water conservation and reuse programs be begun to reduce water use by 25%, that emergency water saving ordinances be implemented when Aquifer levels fall to low levels, that methods to augment springflows be studied, and that San Antonio should acquire alternative water supplies.

So far, the plan has not been agreed to by all parties. Some agricultural interests said they may protest a part the plan's "dry year" option. That option would let regulatory agencies buy 25% of irrigated acreage to be bought if the Aquifer level is less than 649 feet at January 1 of any given year while 75% of the irrigated acreage could be purchased if the aquifer level is less than 632 feet at that time.

Two other items are worth noting. The Edwards Underground Water District and other agencies are trying to acquire sensitive recharge areas to prevent potential pollution. Also, the San Antonio City Council at one time proposed limiting the use of St. Augustine and other turfgrasses that waste water.

Interagency Environmental SWAT Team Created

An interagency environmental SWAT team has been created by the Governor's Officethat will help prosecute those who knowingly violate environmental laws. The Texas Environmental Task Force will be comprised of representatives from the Texas Water Commission, the Texas Air Control Board, The Texas Department of Health, the Texas Parks and Wildlife Department. the General Land Office, the Railroad Commission, and the Attorney General's Office. These State agencies will work cooperatively with U.S. attorneys, the FBI, and the EPA. Cases will be emphasized that involve potential criminal violations of State and Federal environmental laws.

War Against More Hydrilla Includes More Widespread Use of Grass Carp, Copper-Based Chemicals

Two new developments may have just made the war against hydrilla and other aquatic weeds a little easier.

The Texas Parks and Wildlife Department announced that private landowners can now use sterile grass carp to control water weeds on their own property if they first obtain a permit. After a permit is granted, landowners must contact an aquaculture company which will deliver the fish. The fish eat hydrilla, duckweed, and other "nuisance" aquatic weeds. Previously, they were only OK'd for much more limited use. Information on the permitting process can be obtained by calling 512-389-4644.

The Lower Colorado River Authority has taken a different approach to reducing water weeds on Lake Travis. They will use a copper based herbicide called Komeen that they say will limit the weeds' growth but will not be toxic to aquatic organisms. The LCRA is concerned that up to 80% of Lake Austin and other smaller lakes downstream of Lake Travis could be overcome by the weeds if they are not treated.

Fines Urged, Lawsuits Filed Against Alleged Polluters

Two recent cases illustrate that not only does it not pay companies to pollute--it also may cost them a bit.

The Texas Water Commission has recommended that Elf Atochem of North America, Inc. be ordered to pay a record $10 million for arsenic pollution at its Bryan plant. In recommending the record fine, the TWC noted Atochem's failure to clean up arsenic pollution at two Bryan-area lakes. The TWC also charged that Atochem knew that arsenic contaminated groundwater was leaving its site but did not take adequate steps to prevent it.

The Texas Attorney General's Office announced that the State will sue ALCOA (Aluminum Company of America) for contaminating Lavaca Bay with high levels of mercury and will try to force the company to clean up the Bay. Officials with the Attorney General's Office say that ALCOA may have dumped as much as 67 pounds of mercury a day into the Bay during the past 25 years.

Winter Floods May Have Some Benefits

Although it's a safe bet that most Texans didn't appreciate this Winter's flooding, there may actually be some benefits that accompanied the raging waters.

Most of us are aware of the damages caused by the flooding. The floodwaters increased the runoff of fecal coliform bacteria into Galveston Bay in January. As a result, more than 80% of Texas' oyster reefs in the Bay had to be temporarily closed. Also, officials with the Lower Colorado River Authority (LCRA) reported that waterwells that were inundated by the flooding may have been contaminated by sewage runoff.

Although the floods were largely negative, the LCRA said that they may have a positive effect. They may have diluted and washed away salty water that had built up in the Highland Lakes in recent years. The River's lower salinity may also make it easier for white bass to spawn in the River. The floods may have also swept chlordane and other pesticides and other heavy metals out of the sediment of Town Lake and may have helped scour growth of aquatic plants out of the River system.

Texaco Changes Course of Pipeline to Avoid Flower Garden Reefs

Changing the course of an oil pipeline may help protect the northernmost coral reefs living in the Gulf of Mexico.

Texaco and Unocal are re-routing a 34 mile pipeline so that it goes around, not between, the Flower Garden Reefs. The pipeline carries crude oil to the High Island pipeline system that transports oil ashore near Porrt Arthur.

The reefs are located 120 miles southeast of Galveston. The goal is to lessen the risk of oil spills that could damage the delicate reefs. In addition, the operating pressure range in the pipeline is being lowered and additional monitoring will be conducted.

The Flower Garden Reefs were designated as a national marine sanctuary in January. Sanctuary status provides a 1-mile zone around the reef where pipelines, drilling and other related activities are prohibited.

Advanced Weather Radar System Now in Houston

An advanced radar system is being installed in Houston that may allow weather forecasters to better predict how hurricanes develop, issue flash flood warnings, and provide better information about other weather events.

The Next Generation Weather Radar System, also known as NEXRAD, is now being installed in Houston and should be operational later this year. In many areas, NEXRAD will be linked to on-ground rain gauges to measure rainfall in areas where flooding is likely. The radar will also provide more accurate data on the amount of rain fall that has occurred.

Because NEXRAD detects the movement of moisture in the air in the atmosphere, it could also better predict the development of thunderstorms. For details, contact the NWS at 713-337-5074.

New TWRI Publications Include Workshop Proceedings, "On-Site Insights"

New publications of the Texas Water Resources Institute (TWRI) include a Proceedings from a workshop that was used to develop a Statewide research agenda, a newsletter about indoor conservation, and a new newsletter series focusing on on-site wastewater disposal.

The Proceedings, summarizes research recommendations that were generated at a workshop titled, *Water for Texas: Setting the Research Agenda*. Background papers dealing with topics such as conservation, aquatic ecosystems, the impact of management decisions, hydrology and climatology, water quality and others are included.

TWRI has also begun producing a newsletter series, *On-Site Insights*, that focuses on issues related to on-site disposal of small flows of residential wastewater. The newsletter will examine performance and operations and maintenance issues about septic tanks, reed rock filters. and other on-site systems in Texas that tract flows of less than 5,000 gallons per day. The first issue was printed this month. Subscriptions are free by calling the Institute.

Finally, the most recent issue of TWRI's *Texas Water Resources* newsletter dealt with the impact of a new State law that require that only water-efficient toilets, shower heads, and other fixtures will be sold in Texas. The newsletter also examines other issues associated with indoor water conservation. For details on any of these publications, contact TWRI at 409-845-1851.

Galveston Bay Handbooks Describe Recreational Needs, Pollution Prevention

Two informative and non-technical handbooks have been produced by the Galveston Bay National Estuary Program. The *Recreational User's Handbook* includes maps of parks, recreation and fishing areas. The *Area Resident's Handbook* includes information on how nonpoint source pollution can be prevented with proper lawn care, maintenance of septic tanks, and disposal of hazardous household chemicals and wastes. In addition, a color poster graphically illustrates how man's activities can contaminate the bay.

A complete list of publications available from the Program can be obtained by calling 713-332-9937.

Rocky Mountain Institute Reports Stress Conservation

Several new publications about water conservation have been published by the Rocky Mountain Institute.

A booklet, *Water Effkiency for Your Home*, contains advice about which products save water and energy. A new report, *Water Efficient Technologies: A Catalog for the Residential and Light Commercial Sector*, lists water-saving toilets, plumbing fixtures, washing machines, and other residential features. *Water Efficiency: A Resource for Utilily Managers, Communiy Planners, and Other Decision Makers*, is a guide to assist local leaders in conservation efforts.

For details on any of these publications, contact the Rocky Mountain Institute at 303-927-3851.

UH Engineer Writes Drinking Water Guide

A new handbook that answers basic questions about drinking water has been written by James Symons of the Civil and Environmental Engineering Department of the University of Houston. The 104-page booklet, Plain Talk About Drinking Water, contains sections dealing with drinking water quality, what individuals can do, and useful facts about treatment, distribution, and health. The handbook is available for sale from the American Water Works Association. Their phone number is 303-794-7711.

Opportunities in the Hydrologic Sciences

Opportunities in the Hydrologic Sciences describes academic perspectives on critical and emerging areas of water resources research including the impact of hydrology on the earth's crust, climatic and weather processes, living communities, and applied mathematics. Scientific issues of data collection and analysis are discussed and educational priorities are evaluated. Scientific priorities are identified. The report is published by the National Academy Press at 800-624-6242.

Rice Studies Runoff to Galveston Bay

Whenever it rains in Houston, pollutants run off into Galveston Bay from all directions. Sorting out which areas generate different levels of different types of these non-point source pollutants was the focus of a study by researchers at Rice University.

The study was conducted by Phil Bedient and Hanadi Rifai of Rice's Environmental Science and Enaineerina Department and Charles Newell of Groundwater Services, Inc. It was funded by the Galveston Bay Program. It involved interpreting satellite images to determine land uses using a geographic information system. Estimates of the amount of non-point source pollutants (sediments, phosphorus, nitrogen, oxygen-demanding materials, fecal coliform and others) were generated. Results show that levels of agricultural non-point source pollution were less than anticipated. High density urban areas produced more non-point source pollutants than other areas. Lake Livingston generated more nonpoint source pollutants than Lake Houston for all categories but fecal coliform. For details, call Rifai at 713-285-5305.

UHCL Poll Shows Pollution Tops Galveston Bay Issues

Results of a recent poll taken by researchers at the University of Houston-Clear Lake sheds some light on the attitude of area residents on the importance of Galveston Bay.

Richard Allison of UH-CL's Environmental Management Division and Roger Durand of UH-CL's Public Affairs Division conducted the survey. It was funded by the Galveston Bay National Estuary Program.

Nearly 800 residents were surveyed in telephone interviews in the fall of 1990. "Very important" rankings were given to such issues as water pollution in the Bay (93% of respondents), seafood contamination (90%) and loss of natural environments (86%). The

most important sources of pollution into the Bay were perceived as industrial (26% of respondents), chemical plants (13%), Iittering by individuals (11 %), and oil spills and ships (each 7%). Nearly two-thirds of the respondents indicated they take walks along the shore, while more than half observe wildlife and birds. When asked how programs to protect the Bay should be funded, roughly two-thirds favored increased fees on Xems like fishing licenses and higher taxes on items used in the Bay. Roughly 60% of the respondents said they would support higher sewage fees to fund such programs.

For details, contact the Galveston Bay National Estuary Program at 713-332-9937.

Health Risks From Pesticide Use is Focus of TAEX Study

A new study by the Texas Agricultural Extension Service (TAEX) is going to assess potential risks to human health caused by agricultural chemicals use in the Trinity River watershed and other parts of Texas.

The study is being led by John Jackman, of TAEX's Entomology Department in College Station and is being funded by the EPA.

The project consists of documenting pesticide use in Texas and other Southwest states with a special emphasis on the Trinity River watershed. Existing pesticide monitoring efforts will be identified and evaluated and a pesticide database for the region will be developed. Methods that compare the potential risk of pesticides to human health and the environment will be compared. This could include, for example, methods to determine risks posed by workers' exposure to the chemicals, and from eating foods that have accumulated pesticide residues.

Preliminary studies by EPA suggest that pesticides represent some of the highest water-borne health risks in the region.

For details, contact Jackman at 409-845-7026.

Lamar Engineer Simulates Flows of Canal System

Simulating the flows of the Lower Neches Valley Authority's (LNVA) 400-mile canal system near Beaumont may help the water agency slash operating costs, according to studies at Lamar University.

Peter Mantz of Lamar's Civil Engineering Depanment has been working with LNVA on the long-term study for a number of years. His efforts involve using the computer programs developed by the U.S. Army Corps of Engineers to simulate Sows under different conditions. Results from that program are then transferred to a geographic information system that displays flow patterns. Yet another computer program developed by the U.S. Geological Survey is used to answer "what if" scenarios about water management and canal operations.

Some of the biggest problems confronting Mantz deal with accounting for all the water that flows through the system because now only industrial users are metered. Mantz also

has to determine H less river water can be pumped during rainy periods when flows would usually be high anyway. Lowering river pumpage could save money; water has to be raised 40 feet before it can be pumped into a canal a costly procedure.

One of Mantz' new efforts includes incorporating real time data on flows and water quality into the system. For example, tests are being conducted where sensors placed along the canal line instantly transmit data on water levels and salinity. If the water is too saline, temporary barriers could be rapidly established so that good quality water would still be usable.

For details, call Mantz at 409-880-8764.

N. T Studies Impact of Pesticides on Lake Ecosystems

Assessing how pesticides behave in experimental lakes before they are approved for everyday use is the focus of ongoing research of James Kennedy and his colleagues at the University of North Texas' (UNT) Water Research Field Station.

Many of the pesticides tested at the field station have already passed initial laboratory tests for effectiveness and safety. The UNT studies take that research a step farther and look at what happens when the pesticides run off or when too much is applied. Effects are measured by looking at both numerical water quality criteria (how much nitrogen is present, for example) and at the impact of the pesticides on fish and other aquatic organisms that are exposed to the chemicals.

UNT's research combines both laboratory and field studies. The field station consists of 46 large ponds that each cover one-tenth of an acre and hold 168,000 gallons. There are 50 2,000 gallon ponds and 24 smaller 500-gallon pools. All of the ponds are surrounded by berms so that runoff does not occur. Analysis of samples collected during the studies is conducted by the Station's analytical chemistry laboratory which houses gas chromatographs and other state-of theart equipment.

The research was featured in the Fall 1991 issue of UNT's Resource magazine To obtain a copy call 817-565-5446.

Southwest Texas Conducts Stream Sampling

Determining the populations of mayflies, stonefiles, dragonflies and other benthic macroinvertebrates in streams may be an economic and quick way to see H pollutants are present, according to researchers with Southwest Texas State University.

The rapid bioassessment study, is being funded by the USDA/ Soil Conservation Service. Samples are being taken along Seco Creek by Glenn Longley and Calvin Phillips of SWTSU. Macroinveterbrate samples have been taken once every two weeks since last fall. Sampling of fish populations and other water quality parameters is also being conducted. So far, widespread water quality deterioration has not been noted.

According to Longley, scientists already have a good idea of the numbers and types of species that should be present in the stream. If unusually low numbers are found, that may signal that additional testing for pesticides or other pollutants needs to be undertaken. For details, call Longley at 512-245-2329.

UT-El Paso Develops Low Cost Systems to Treat Wastes On-Site

Developing on-site wastewater treatment systems that provide effective treatment with minimal operating costs and maintenance is the goal of a study by Anthony Tarquin of the Civil Engineering Department at the University of Texas at El Paso.

Tarouin is testing a variety of technologies including anaerobic filters, intermittent sand filters, modified overland flow systems, and reed-rock filters. The projects involve modifications to existing systems, a pilot scale overland flow system at El Paso's municipal wastewater treatment plant, reed rock filters, recirculating wastewater at a cattle truck washing station, and other efforts.

The systems could be promising for areas like colonias which need reliable low-cost, on-site treatment systems. For example, the reed rock filter is removing roughly 80% of chemical oxygen demands (COD) and biochemical oxygen demands (BOD) while cutting nitrogen levels in half A system that treats septic tank effluents in sand filters consistently removed more than 90% of the BOD and COD levels and virtually all of the organic and ammonia nitrogen. The Droiects were funded by a grant from the Texas On-Site Wastewater Treatment Council.

For details, contact Tarquin at 915-747-5464.

Groundwater Policy Studied at Texas Tech

Legal and institutional issues surrounding water development by the City of Lubbock are being reviewed by Otis Templer of the Geography Depanment at Texas Tech University.

Templer has examined historical patterns and trends surrounding Lubbock's groundwater acquisitions. In the 1950s, when further development of looal groundwater resources became infeasible, Lubbock began purchasing groundwater supplies in the Sandhills region. This region was devoted mainly to ranching because the sandy soils could not easily be furrow irrigated. By the late 1950s, Lubbock had acquired the rights to more than 75,000 acres.

Advances in irrigation technology including center-pivot and sprinkler systems changed the situation drastically. Since the 1970s, there has been greatly increased competition for Sand hills groundwater from irrigators surrounding the City's wellfield. At the same time, other cities and public utilities have acquired most of the available groundwater rights in the area. Lubbock now relies mainly on surface water supplied by Lake Meredith and is now building a reservoir on the Double Mountain Fork of the Brazos River.

For details, call Templer at 806-7423838.

UT Engineers Work to Predict Sediment Transport

Sediments are an important building block for coastal ecosystems. They help build up marshes and deltas, contribute nutrients, and provide habitat for a variety of aquatic organisms. However, predicting sediment flows into bays and estuaries has always been difficult.

To help answer this problem, Ed Holley of the Civil Engineering Departmentatthe University of Texas at Austin worked to try to determine the relationships between river flows and sediment transport.

The first part of the study, which was funded by TWRI, involved analyzing existing data to determine correlations between sediment transport, river flows, and other physical parameters. The second part of the project involved collecting field data from the Guadalupe River near Victoria and from the San Antonb River near Goliad. Samples were taken at both low and high flow rates in 1990.

Results confirm that large, infrequent storms transport the largest percent of sediments. Good correlations were found between flow rates and sediment transport on the Guadalupe River, although there was a lag between flow rates and sediments on the San Antonio River. In general, the amount of lag time may depend on the distance that sediments travel between their source and destination. Another benefit of the study was the development of a new method to pump sediment samples from river bottoms for later analysis.

For details, contact Holley at 512-471 -4610.

Texas A&I Forms Water Center

Texas A&I University is establishing a Center that will deal with water-related issues in South Texas.

The South Texas Water Resources Center will be headed by Don Hegwood of Texas A&I University's College of Agriculture. Center goals include utilizing Texas A&I's expertise to solve local problems, meeting projected water shortages, balancing competing water demands, determining the impact of agriculture and industrial activities on water quality, and developing a database on regional water resources. For details, call Hegwood at 512-595-3994.

UT-San Antonio Developing Decision Support Model

A decision support system that can be used to plan and manage water resources in the San Antonio region is being developed by researchers at the University of Texas at San Antonio.

Richard Howe of the Engineering Division and Weldon Hammond and Frank Masch of the Center for Water Research are developing the system.

The researchers hope to develop a series of models that can assist water managers in evaluating policy options after considering complex technical, economic, and institutional data. At the completion of the project, participating agencies will be able to develop alternative management strategies and to identify costs, benefits, and impacts associated with each strategy.

Faculty from the University of Texas-Pan American, Trinity University, Texas A&M University, and the University of Texas at Austin will be asked to participate. In addition, an advisory board consisting elected and appointed officials, professional water managers, and research and extension experts will help guide the researchers throughout the study.

The project is being funded by the Texas Water Development Board, the Guadalup-Blanco River Authority, the San Antonio City Water Board, and the San Antonio River Authority. For details, contact Weldon Hammond at 512-691-5468.