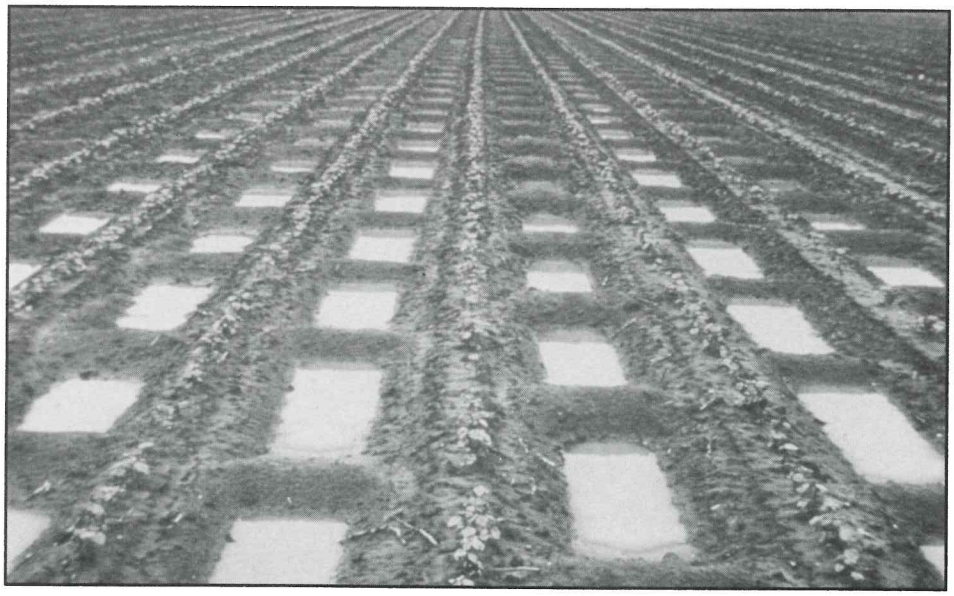
divining rod

Vol. XV No. 2 New Mexico Water Resources Research Institute Summer 1992



Low Energy Precision Application systems and furrow-diking are conservation techniques which could help save water in New Mexico's agricultural areas. UNM economists Stuart Burness and Tom Brill have been studying impediments to adopting these technologies.

Researchers study socially optimal patterns of groundwater use

What will happen when certain New Mexico agricultural areas deplete the groundwater supplies upon which they are so dependent or when pumping costs for the underground resource become prohibitive for agricultural use? In areas such as the eastern part of the state overlying the Ogallala aquifer or the Estancia Basin in central New Mexico, groundwater depletion has led to the return of dryland farming to some extent, and could lead to the deterioration of existing social structures, and create additional unemployment.

In an effort to help the state's water planners address such issues, University of New Mexico Economics Professor Stuart Burness and doctoral candidate Tom Brill have developed models which look at alternative groundwater-use patterns, incorporating into their design:

- social factors, such as municipal infrastructure
- hydrological factors, such as declining aquifer yields and
- technological considerations, such as increased application efficiency through water-saving technologies.

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Seven projects to be funded through WRRI allotment program

Out of 21 proposals received, the Water Resources Research Institute will fund four continuing projects and three new projects. These seven projects, which will provide training for 13 students, are summarized below.

An Expanded Suite of Tracers for Hydrological Investigations - *Robert Bowman, Geoscience Department, New Mexico Institute of Mining and Technology (NMIMT)*

In its second year of funding, Dr. Bowman's project will focus on the following objectives:

- Test a new series of fluorobenzoic acid derivatives for suitability as soil and groundwater tracers
- Develop analytical methodologies to measure new and existing fluorobenzoate tracers simultaneously in natural water samples
- Develop methods to lower fluorobenzoate tracer detection limits in natural water samples

During the project's first year the research team determined the basic chemical characteristics of seven of the nine fluorobenzoates and have determined the negative log acid dissociation constants (pK_as) for the subject fluorobenzoates as well as for all the fluorobenzoates which have been used previously as soil and groundwater tracers. The pK_a is important in predicting the environmental fate of weak acids as well as in optimizing analytical methods for them.

Sewage Sludge Application in Semiarid Grasslands: Effects on Soils, Vegetation, and Water Quality - *James Gosz, Biology Department, University of New Mexico (UNM) and Richard Aguilar, Adjunct Assistant Professor, Biology Department, UNM, and Soil Scientist USDA Forest Service Rocky Mountain Forest and Range Experiment Station*

This will be the second year of a two-year project being conducted at the Sevilleta National Wildlife Refuge, studying the effects of sewage sludge application to degraded rangeland. Project objectives are:

- To determine the effects of sewage sludge application on soils and vegetation in a semiarid grassland enviornment
- To determine how subsequent changes in vegetation following sludge application influence runoff and surface water quality
- To assess the fate of potential sludge-borne contaminants in the soils, vegetation, and runoff water

During the first year of study, the researchers found the sludge application led to significant runoff reduction from treated plots without introducing unacceptable levels of potentially harmful contaminants. However, they will continue intensive research and data collection at the field site to insure that previous measurements did not result from anomalous events.

This is a collaborative project involving UNM, New Mexico State University (NMSU), and NMIMT as well the Rocky Mountain Forest and Range Experiment Station and the City of Albuquerque.

Three-Dimensional Aquifer Parameter Estimation with Laplace-Domain Solution - *Chia-Shyun Chen, Geoscience Department, NMIMT*

During the past two years of this project, Dr. Chen and his research team have developed a well field at the Sevilleta National Wildlife Refuge which involves five multi-level samplers/piezometers, ten fully screened piezometers and two pumping wells. Numerous three-

University of New Mexico technician Mike Kennedy and plant biologist Sam Loftin prepare a plot for the study of sludge application for rangeland restoration.

dimensional pumping tests have been conducted, three-dimensional drawdown data collected, and a new well hydraulics solution capable of dealing with well hydraulics under confined, unconfined, leaky and factured aquifers has been developed.

During the third year of the project, Dr. Chen proposes to develop a methodology for three-dimensional estimation of unconfined aquifer parameters and apply this methodology to the field data collected in this multi-year project, then compare results from this new method with those previously acquired.

This project has provided an excellent opportunity for students to gain field experience and deal with field data analysis. Using the Sevilleta site, two graduate courses have been offered, providing hands-on experience for 30 students.

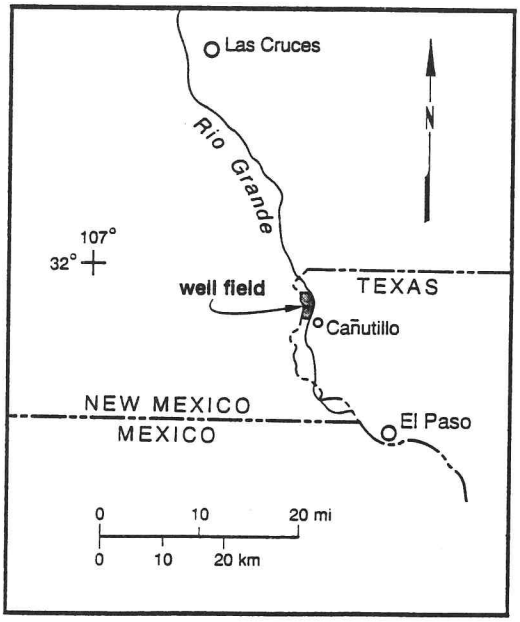
Quantitative Analysis of the Influence of Carbon Amendment on Bioremediation of Cyanide Groundwater and Soil - *Clifford Dahm, Biology Department, UNM*

Dr. Dahm's study will provide quantitative data concerning critical aspects of contaminant biodegradation necessary for the site specific implementation of *in situ* bioremediation. Also it will provide information regarding three aspects of microbial cyanide degradation in regional groundwater ecosystems:

- At what rate does microbial degradation of cyanide occur under natural conditions?
- How does the addition of a carbon amendment as an energy source for microorganisms affect the kinetics of cyanide degradation?
- What is the influence of a carbon amendment on the possible generation of toxic byproducts from cyanide degradation?

A Hydrothermal Study of Vertical Groundwater Flow Along a Profile Crossing the Rio Grande at the Canutillo Well Field - *Marshall Reiter, New Mexico Bureau of Mines and Mineral Resources, NMIMT*

Dr. Reiter proposes to determine the vertical groundwater flow at four sites along a profile at the Canutillo well field in order to further the understanding of the hydrological dynamics between the Rio Grande and the groundwater system. These data will be used in future groundwater models of the Mesilla Valley and elsewhere.



The technique to be used in the project involves making plots of heat flow vs. temperature for a number of depth intervals down each well. To obtain the required heat flow information, considerable thermal conductivity experimentation on fragment drilling samples from the sites must be done.

Biodegradation of Trihalomethanes (THMs) and Halogenated Aliphatic Compounds by Groundwater Bacteria - *Geoffrey Smith, Biology Department, NMSU*

Dr. Smith will investigate the potential for prosthecate bacteria to degrade and reduce the toxicity of halogenated aliphatic compounds commonly found in groundwater or in chlorinated drinking water supplies.

The research team will begin the process of screening known laboratory strains, groundwater isolates and mixed groundwater communities for their potential to degrade representative THMs, freons and trichloroethylene (TCE). Once biodegrading organisms are identified, the physiological role which the degradation plays will be investigated. Dr. Smith also plans to gain some understanding of the genes that code for the enzymes which mediate biodegradation.

Wetting Front Instability in the Vadose Zone of New Mexico's Soils - *Jan M. H. Hendrickx, Department of Geoscience, NMIMT*

The results of Dr. Hendrickx's study will indicate how wetting front theories can be applied to predict fingering in New Mexico's dry homogeneous and layered soils. Such an understanding is needed to assess the vulnerability for groundwater contamination by herbicide and pesticide use, for design and operation of landfills, and for planning for radioactive waste storage facilities. The results will also contribute to knowledge of groundwater recharge in arid regions.

During the project's first year, Dr. Hendrickx sought to verify the occurrence of wetting front instabilities under New Mexico conditions through field studies at the Sevilleta National Wildlife Refuge and on irrigated fields near Socorro. The

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Casa del Agua: Tucson's conservation showcase

By Nancy Gover, National Small Flows Clearinghouse

In Tucson, AZ, a city of about 500,000, population growth is stretching the limits of already scarce water resources. To help meet the challenge of providing for its future needs and to educate the public about the immediate and long-term benefits of water conservation, Tucson has come up with a unique residential water conservation and reuse demonstration project.

Dubbed "Casa del Agua," the three-bedroom, two-bath conventional single family home serves as both an educational showcase of water conservation ideas and techniques and an experimentation/ research facility where new devices and methods are evaluated by University of Arizona researchers.

The City of Tucson is facing reduction of per capita water use from 160 gallons per day to 140 gallons per day by 2025.

Occupied by a "typical" family of three who guide public tours, monitor water use, and lend real-world applicability to its research, Casa del Agua (CDA) is equipped with low water-use plumbing fixtures adapted to measure water savings. Its supply of city water is supplemented with harvested rainwater and graywater from bathtubs, showers, sinks and washers which is used primarily for landscape irrigation. CDA landscaping also incorporates drought-tolerant plants to minimize irrigation.

According to Martin Karpiscak, project manager and research scientist with the University of Arizona's Office of Arid Lands Studies, CDA's combination of water conservation and reuse has resulted in more than a 50 percent reduction in municipal water consumption than from that used by a comparable Tucson residence. "And when total water use from all three sources of water (municipal, rain, and graywater) is taken into consideration," says Karpiscak. "CDA consumes approximately 30 percent less than the average residence." In addition, CDA has also reduced the peak water demand occurring during the summer when landscape irrigation and evaporative cooling needs are at their highest.

"What's significant about this," says Karpiscak, "is that it demonstrates how much water can be conserved without significantly altering lifestyles."

Karpiscak says the development of CDA was an indirect result of Tucson's search for additional water to supplement its dwindling supply. Adding urgency to the city's mission was the state's adoption of the 1980 Groundwater Act, which deals with statewide groundwater depletion. Among other things, the law provides for the creation of water conservation plans in parts of the state where demand for water exceeds the existing supply.

The act utilizes a phased management plan calling for progressively more stringent water conservation requirements, including mandatory per capita use. In Tucson's case, per capita use must be reduced from about 160 gallons per day to 140 gallons per day by the year 2025.

It is estimated Tucson could save more than 25,000 acre-feet of water per year simply by installing one-gallon low-flush toilets.

With a water crunch looming in the not-too-distant future, Tucson decided to pursue various approaches to close the gap between supply and demand. One of these was to retrofit an existing city-owned building that would house Casa del Agua. Tucson also contracted to receive water from the Central Arizona Project, which began pumping a supplemental supply into the city in 1991, and actively promoted the reuse of treated effluent for irrigation and use of arid-adapted landscaping.

Water-efficient plumbing

Working with local businesses and community groups, the University of Arizona helped out with CDA's renovations, including repairing existing plumbing and installing water-efficient fixtures. Completed in 1985, CDA's plumbing retrofit included the addition of water-efficient fixtures such as low-flow shower heads, low-flush toilets, and faucets equipped with new washers, aerators, and flow restructures.

According to Karpiscak, aerators installed on CDA's faucets reduce flows by almost half—from a conventional faucet's 5 gallons per minute (gpm) to 2.5 gpm. Low-flow shower heads cut water consumption to about 3 gpm, he says.

"All of the modifications at

Casa are intended to reduce water flow while providing an adequate stream of water," says Karpiscak. "They have the added advantage of providing energy savings by using less energy to heat water. Many of the plumbing fixtures we've installed pay for themselves in just a few years."

Karpiscak says that a variety of low-flush toilets (1 and 1.6 gallons per flush) have been tested at CDA over the years, and it is currently testing retrofitted and standard toilets. The low-flush toilets use less than 10 gallons of water per person per day, versus the standard toilets' 31 gallons. In one year, Karpiscak estimates that Tucson could save more than 25,000 acre-feet of water per year simply by installing one-gallon low-flush toilets.

Water recycling/reuse

Rainwater used for running CDA's evaporative cooling system, for irrigating the vegetable garden, and occasionally for flushing toilets, is captured via a 2,500 square-foot roof catchment system and delivered to an 8,000-gallon cistern for storage. Rainwater is further conserved by contouring the site's walkways, patios, and driveways to direct rainfall toward plants. According to Karpiscak, recycled graywater from bathtub, sink, and shower drains is the largest source of water savings at Casa del Agua accounting for about 32 percent of the total water used. The graywater is collected and partially treated before being used primarily for landscape irrigation.

The design of CDA's graywater system required modification of its existing drain, waste, and vent systems, including routing the toilet waste and garbage liens to the municipal sewer. In the system, wastewater from CDA's water-using household appliances first flows to a sump, where a nylon stocking placed over the drain line filters out lint and hair before the graywater is pumped into two settling tanks. From there, it flows into a slow sand filter (planted with tomatoes and peppers) into an 800-gallon buried storage tank. The treated graywater is then delivered to the subsurface drip irrigation system by means of a small pump and pressure tank. CDA has the capacity to store up to 7,000 gallons of graywater for later use.

The graywater is monitored for the presence of chemical and bacterial contaminants. Researchers also examine its turbidity, suspended solids, and biological oxygen demand. Over the years CDA has tested many graywater treatment methods, including a water hyacinth system, a cartridge filter system, and a mixed media filter system. Of the systems they have collected data on, Karpiscak says that the water hyacinths proved to be one of the most effective at removing bacteria. He admits there were some problems associated with it, including a mosquito infestation, but surmises this was due to the system's small size, which didn't allow for enough water to prevent the mosquitos from laying eggs.

Because information about graywater quality is scarce, says Karpiscak, it is difficult to assess public health risks associated with reuse. Although treated municipal effluent is commonly used in Tucson to irrigate golf courses and other landscapes, he observes graywater reuse gets little attention at the residential level except in areas experiencing severe drought. Karpiscak hopes CDA's findings on

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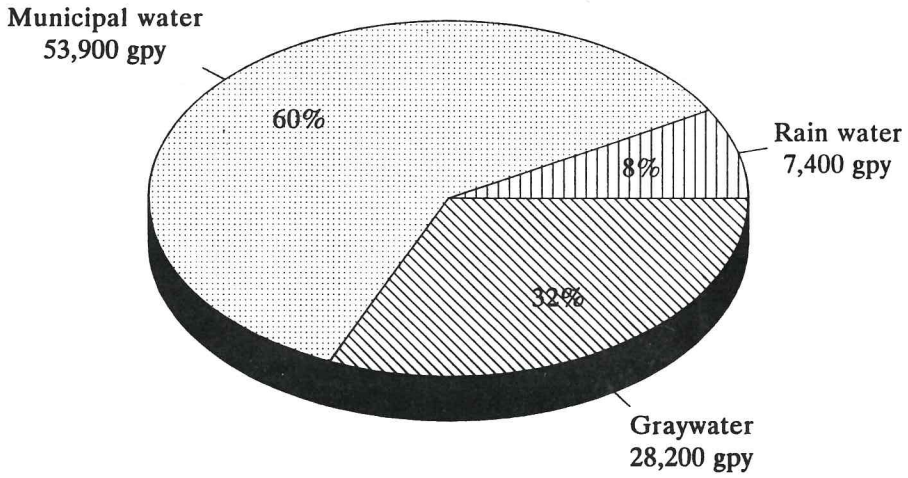
Annual Water Use by Casa del Agua Residents



Casa del Agua's residents use 53,900 gallons of municipal water during a year—less than half the 123,400 gallons used by the average single-family Tucson household during a year.

Casa del Agua, continued

graywater quality will help state and county health and wastewater management departments desiring to establish guidelines for designing graywater systems.

Although graywater quality and other research plays an important role at CDA, Karpiscak explains that education and outreach also are an integral part of its conservation program. CDA researchers host public tours and deliver lectures, for example, and they are currently working on the final design of another demonstration home—Desert House—which will be located at the Desert Botanical Gardens in Phoenix.

Other than the obvious advantages of reducing demand for diminishing resources, Karpiscak says that using the techniques demonstrated in Casa del Agua will also reduce energy and water bills. "Once people become aware that they can heat and cool their homes more efficiently," he says, "it really makes no sense to do otherwise. And because many of the systems we demonstrate are already commercially available, it takes only a little extra thought to incorporate them into new and existing housing, helping ensure that there is enough water and energy to meet future demands."

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New WRRI Publications

The following publications may be ordered from Water Resources Research Institute, Box 30001 - Dept. 3167, Las Cruces, NM 88003; 505-646-1813. Publications are free unless otherwise indicated.

Report No. 264 - Effects of Aquifer Environmental Factors on Biodegradation of Organic Contaminants - *Mary E. Watwood and Clifford N. Dahm*

These researchers examined important environmental effects on the biodegradation of benzene and 1,1,1-trichloroethane (TCA) in laboratory batch incubations of regional aquifer material. Redox status, changes in redox conditions, and long and short pre-exposure periods were investigated for their effects on complete biodegradation as indicated by $^{14}CO_2$ generation over time. Additional variables quantified included residual organics in aquifer material, residual volatile organics, and $^{14}CO_2$ incorporated into microbial biomass.

Results showed that significant biodegradation of each contaminant occurred within 40 and 120 days for benzene and TCA, respectively. Starting levels of benzene present in batch aquifer material were reduced by approximately 90% during the incubation period, and TCA levels decreased approximately 80%. Disappearance of both contaminants occurred under aerobic and anaerobic conditions, but the specific biochemical fate of each compound was influenced by the prevailing redox conditions and the length of contaminant pre-exposure.

Report No. 265 - Proceedings of the 36th Annual New Mexico Water Conference: Science and Agencies Working for the Future - *Edited by Catherine T. Ortega Klett* - Cost $5.25

Conference sessions included "Forested Watersheds," "Current Issues and University Research," "Sediment and Water Quality," and "Wildlife and Riparian Habitat." The proceedings includes 16 papers. Some of these are: "Global Impacts on Local Management," by Gerald Thomas; "Hydrologic Processes in the Pinyon-Juniper Vegetation Zone of Arizona and New Mexico," by Susan M. Bolton; "Water Quality in the Rio Costilla Watershed: Multiple Agencies, Multiplying Problems" by David Coss; and "Gila Trout Recovery and Fire in Wilderness Watersheds" by Bruce L. Anderson.

Report No. 266 - Aquatic Ecology/Toxicology and Lab Course Development - *Carleton S. White*

This is a brief summary of a University of New Mexico course developed for current practitioners in water-related fields.

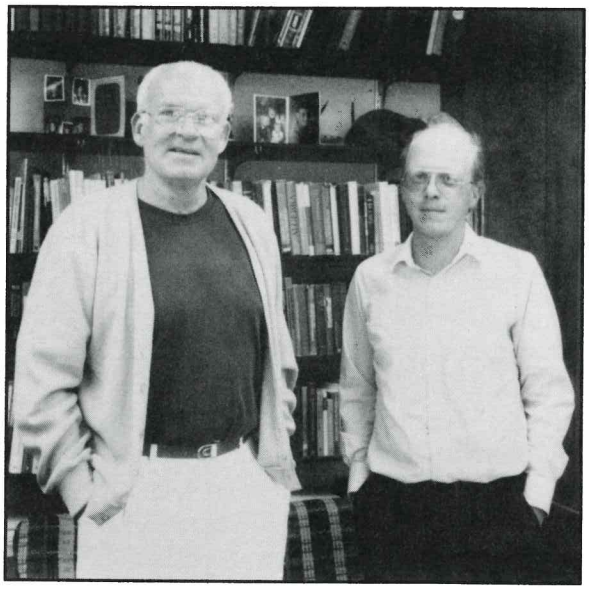
Economists look at groundwater use, continued

Using the models, Burness and Brill are able to compare the socially optimal patterns of groundwater use to those water-use patterns occurring in a competitive market. These models simulate future groundwater pumping, irrigation application efficiency, and water table levels under different economic and hydrological assumptions.

"From a practical point of view, you probably only want to look five, ten, or twenty years into the future," says Burness, "and while it is possible to estimate water-use patterns for much longer time spans, such as 100 years or more, these projections become increasingly tenuous. Nevertheless, even these long-run projections yield valuable information concerning the potential lifetime of the resource from an economic point of view."

Although there has been quite a bit of previous work in irrigation efficiencies, these studies have concentrated on short-run or static considerations, and have not investigated long-run dynamic trade-offs in terms of the economic issues involved.

Burness' and Brill's project is now in its second year with funding provided by WRRI. Phase two of the project includes incorporating the possibility of saving water using more efficient irrigation technologies, determining impediments to adopting these technologies, and identifying the role of potential policies that might be instituted to implement these changes. These technologies include water-conserving farming practices like the Low Energy Precision Application systems which apply water at low pressure 8-15 inches above the soil surface, decreasing evaporation; center pivot irrigation systems; and furrow diking as a way to gather rainfall for crop use.



Economists Stuart Burness and Tom Brill

Although these technologies have not become common practice in New Mexico, the High Plains Underground Conservation District in the Texas panhandle has been agressively promoting them for a number of years. Using information from the district, which serves 15 counties overlying the Ogallala aquifer, Brill and Burness have been able to study the impediments and policies which might affect the use of new technologies. They have found that a major problem associated with adopting these technologies is overcoming inertia of changin from the traditional practices. According to Burness, taxes and subsidies are not necessary to encourage agricultural producers to use the technologies. Often the difficulty is just convincing producers that a new technology is economical.

The models developed at UNM are much more powerful than the economists suspected they would be in the beginning and represent a major effort to incorporate hydrological factors into a long-run dynamic model. Although Burness says they have expanded the horizons for economic modeling, he adds that this is not "earthshaking." "What's useful," he says, "is that we have a relatively straightforward model, using existing software, that enables the economist to find solutions without being a mathematician." The models used SIMGAUSS, a computer program to solve simultaneous nonlinear differential equations.

Burness and Brill also are compiling a case study of the area of New Mexico overlying the Ogallala—Roosevelt, Quay, Union, Curry and Lea counties—focusing on the implications of the adoption of water-conserving technologies for patterns of groundwater use, groundwater depletions, and associated policy implications.

Meeting to focus on Clean Water Policy

The Universities Council on Water Resources' annual meeting theme is "New Directions in Clean Water Policy," to be held July 28-31, 1992 at the Boar's Head Inn, Charlottesville, VA. It will focus on renewal of the Clean Water Act, with its implications for wetlands, agricultural issues, economic policy, international water quality management, wastewater treatment, and research and water resources education. ***Divining Rod*** readers may get a copy of the program by calling 505-646-5367.

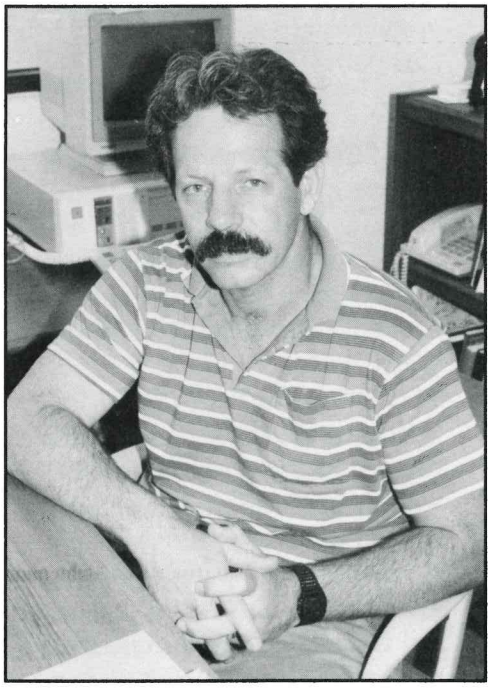
Tech hydrologist examines groundwater contamination in Mexico

By George Zamora, New Mexico Tech Public Information Office

A New Mexico Tech hydrologist has joined scientists from the University of Texas at El Paso and the Autonomous University of Chihuahua in a study to find out how raw sewage used for crop irrigation in Mexico filters through the soil and contaminates domestic supplies of groundwater.

Dr. Jan M. H. Hendrickx, assistant professor of hydrology at Tech, soon will team up with two other researchers to examine Chihuahua's agricultural Tabalaopa Valley soil for moisture content and harmful biological and chemical pollutants that might make their way into residential tap water.

Irrigating crops with untreated wastewater has been a common practice among Mexican farmers for more than century, but up until now, the raw sewage's effects on nearby water supplies has not been a subject of scientific study in Mexico. As a result of recent efforts to reduce the spread of diseases like cholera, the Mexican federal government banned the use of raw sewage to irrigate crops intended for human consumption. However, this sewage—or *aguas negras*—which is dumped by most Mexican cities into open ditches and rivers, can still be used to irrigate crops such as cotton and alfalfa.



Jan M. H. Hendrickx

As such *aguas negras* still pose environmental hazards to farm workers who come in contact with it and also to nearby residents who drink groundwater which has been contaminated with pollutants from the sewage that has filtered down from the irrigated fields.

"The main focus of our study in Mexico will be to examine the flow and transport of contaminants in raw sewage through the vadose zone into groundwater aquifers," Hendrickx says.

"Under many conditions water movement through the vadose zone does not occur in a homogenous fashion," Hendrickx says. "We have found that water does not wet the soil uniformly when it flows down, but instead channels off into finger-like projections. Because of this, the risk of contamination of groundwater aquifers is much greater than we previously thought."

Furthermore, a total ban on using *aguas negras* for irrigating crops of any kind would only serve to further complicate the pollution problems, Hendrickx says. "If you concentrate all the sewage in the rivers, then you get a larger concentration of contaminants percolating down into the aquifers in comparison to spreading sewage over a large area, like an irrigated field, where you actually lessen the chances of groundwater contamination."

Sewer water—or aguas negras—can still be used to irrigate crops such as cotton and alfalfa.

Just recently the Mexican government has begun to address some of the health and environmental problems associated with its burgeoning population, and part of that response is the mandate for every major city to have a sewage treatment plant in operation within the next three years. "Once these sewage plants are built, the effluent can be used very successfully for irrigation purposes without posing an environmental danger," Hendrickx asserts. "However, how to dispose of the sewage sludge, which is also a by-product of the treatment of raw sewage, remains a problem."

A total ban on using aguas negras for irrigating crops of any kind would only serve to further complicate the pollution problems.

Hendrickx believes that one of the most important aspects of the hydrologic research being conducted in the irrigated fields near Chihuahua is that the project will also help educate and train other people in Mexico and other economically developing nations to deal with these types of environmental problems. "Mexico lacks a sufficient

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Trivia

For hundreds of years, humans have been concerned with purifying water and getting rid of wastes and garbage. Murray Milne in his 1979 book ***Residential Water Re-Use*** (published by the University of California, Davis) reports the following:

In ancient times water was sometimes purified by exposing it to sun and air or by filtering it through sand. Water was also filtered through "tufa," which was porous limestone, and wool. It was also common to purify water by adding wine to it.

In the 18th and 19th centuries in England water from springs and wells became so polluted, water filters became familiar household appliances. Charcoal and silicated carbon were used in the filters which were sometimes designed to satisfy aesthetic needs. One company made a filter of cream-colored stoneware for the kitchen and another of marbled china for the dining room.

In the eighth century B.C., an irrigation system called a qanat was developed in Armenia and Iran. It is a sloping tunnel leading from an underground water source in a hill, through the hill and finally surfacing in the flat land at the bottom. The water was then dispersed through irrigation channels. Qanat tunnels were commonly several miles long and many supplied more than 1,000 gallons per minute.

Roman sewers reportedly possessed the protection of Cloacina, their own private Goddess.

The U.S. 1880 census reported that 103 of 222 cities queried used waste water or raw sewage for corp irrigation. The practice was most common in New England and Middle Atlantic states.

In 1872 a proposal was made to turn sewage into cement. It was estimated that 10,000 persons could produce a ton of cement a day.

The septic tank was developed in 1896 by a Scotsman, Donal Cameron.

Benjamin Franklin did something about garbage on a large scale. By 1792, Philadelphia had grown to 70,000 and the garbage had grown proportionately. Franklin's solution was to have garbage hauled to the Delaware River, downstream from the city. This is an idea for which Franklin is not well remembered.

New York, Baltimore, Cleveland and other cities sold their sewage to processing plants where it was made into fertilizer and marketed under the trade name "Pouderette." Ads boasting of its ability to improve such crops as corn, potatoes and tobacco appeared in farm journals as early as 1839.

In 1920 the city of Milwaukee began selling 50 lb. bags of dried sludge as a soil conditioner.

In Roman times, Vitruvious warned that using lead pipes for transporting water could be harmful to the body.

Tech hydrologist,
continued

number of people with hydrological and environmental training who can deal with problems such as water contaminants moving through the subsurface," he says. "This study will not only provide research, but it will provide education as well ... The transfer of knowledge which will occur is most important in this project."

A three-year, $150,000 grant from the Tinker Foundation is funding the hydrologic study Hendrickx and his research associates are conducting near Chihuahua. His associates in this study are Dr. Duncan Moss, a UTEP assistant professor of hydrogeology and Dr. Adolfo Chavez-Rodriguez, a groundwater hydrology professor at the Autonomous University.

Dr. Hendrickx is also principal investigator of a WRRI-sponsored project studying wetting front instability in the vadose zone of New Mexico soils.

Seven projects funded,
continued

second and third years will focus on quantifying the relations between precipitation and/or irrigation regime, physical soil characteristics, antecdent soil moisture status, and occurrence of unstable wetting fronts and on validating the approach modelling preferential flow paths developed by Dr. Hendrickx and his co-workers.

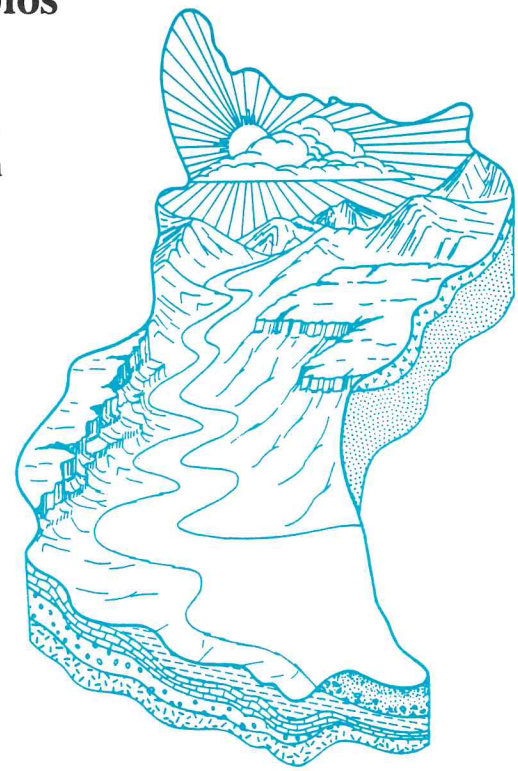
USGS reports look at groundwater flow models and water resources of three pueblos

The U.S. Geological Survey has recently published "Summary of U.S. Geological Survey groundwater flow models of basin-fill aquifers in the Southwestern Alluvial Basins Region, Colorado, New Mexico, and Texas" (Open-File Report 90-361). This report describes 14 of the groundwater flow models the agency has completed in areas from the Alamosa in Colorado to El Paso, Texas.

According to author John Michael Kernodle, "Most of the groundwater flow models have remarkable similarities in design. He took advantage of those similarities to develop guidelines for the construction of future models.

A second new USGS report is an interpretive report, "Water resources on the Pueblos of Jemez, Zia, and Santa Ana, Sandoval County, New Mexico" (Water-Resources Investigations Report 89-4091). Prepared in cooperation with the Jemez River Indian Water Authority, this report includes information about potential aquifers and hydrogeology; water quantity, movement and quality; and tables of data for wells, springs and surface water. The author is S.D. Craigg.

Both reports are available from the U.S. Geological Survey, Books and Open-File Reports, Federal Center, Bldg. 810, Box 25425, Denver, CO 80225. Cost for OFR 90-361 is $13.50 and cost for WRIR 89-4901 is $29.25. Copies are available for inspection at the USGS Albuquerque district office and at the WRRI library.



Freeze-dried wastewater could be in your future

Freeze crystallization, the same process that produces freeze-dried coffee, is being studied as a wastewater treatment method. Freeze Technologies Corporation (Raleigh, NC), in conjunction with Westinghouse Hanford Company (Richland, WA), is developing the technique for cleaning up water contaminated with organic compounds, salts, and heavy metals.

A volatile liquid refrigerant is injected into wastewater, generating crystals of relatively clean water. The ice is then removed and washed. A separate, concentrated fraction containing the waste materials is left.

—*Environmental Science Tech.* Vol. 25, No. 12 1991

California WRC searching for librarian

The California Water Resources Center (Riverside, CA) is conducting a nationwide search for a librarian to head its Water Resources Archival Library. An MLS from an ALA-accredited university is required along with a minimum of four years related experience. Salary is from $35,052 to $41,160.

Those interested should contact Margaret I. Leong, University of California, 300 Lakeside Dr., 6th Floor, Oakland, CA 94612-3560; (510) 987-0087. Refer to position number APG92-01.

Electrodes help clean groundwater

Experiments using low-voltage electrodes to clean up groundwater are being conducted by Don Runnells at the University of Colorado Geology Department.

When low voltage electrodes were placed in wells extending below a simulated water table, a variety of contaminants migrated toward them and became concentrated in the wells. The water could then be pumped out, treated using existing technology and returned to the ground. The technique is especially efficient in attracting sulfate and should be effective to a lesser degree for removing low-level uranium, copper, zinc, arsenic, chromium, selenium, and select man-made compounds.

—***Colorado Water***, April 1992

EPA report outlines border plan

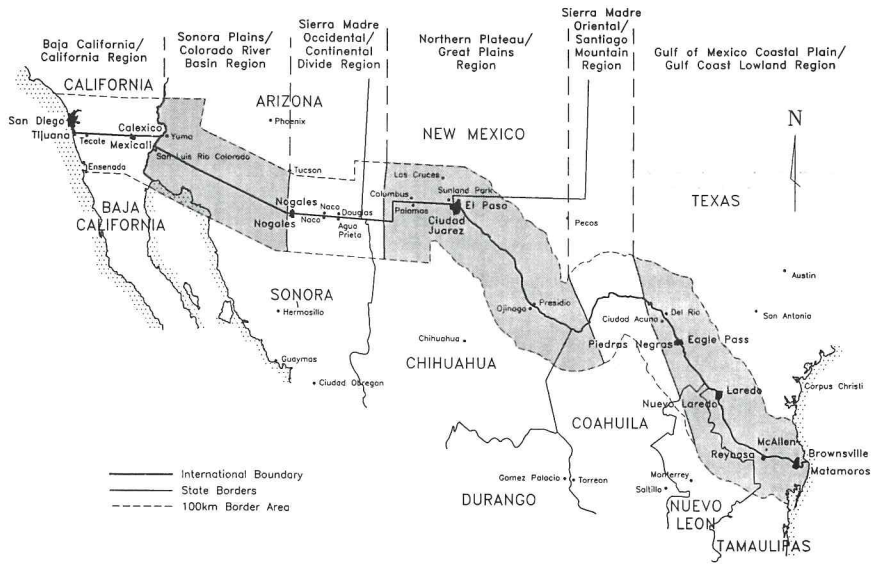
The ***Integrated Environmental Plan for the Mexican-U.S. Border Area (First Stage, 1992-1994)*** is available from the Environmental Protection Agency (EPA), International Activities Office, 401 M St., S.W., Washington, D.C. 20460 free of charge.

In November 1990, President Carlos Salinas de Gortari of the United Mexican States and President Bush agreed to direct their environmental authorities (Secretaria de Desarrollo Urbano y Ecologia or SEDUE and the EPA) to work together to develop a comprehensive plan to solve the border area's environmental problems.

This first stage of the Border Environmental Plan:

- Outlines environmental characteristics of the area and describes the present status of significant environmental issues
- Summarizes the cooperative environmental accomplishments achieved to date in the Border Area by binational, national, state and local environmental agencies;
- Sets out implementation plans to mobilize the cooperative efforts of governments at all levels, and to involve the private sector as well, in seeking solutions to the priority environmental problems.

The importance of the border environment is underscored when one considers there are 9,535,583 people living along the U.S./Mexico border, with growth of over 60% from 1980-1990. Seventy-two percent of this populations lives in 14 pairs of "sister cities" along the border. The increased population, particularly in Mexico, has fostered serious problems due to uncontrolled urban growth and unplanned land use. SEDUE estimates that services in Mexico should be increased by the following amounts: potable water - 14%; water treatment and sewage - 35%; electric power - 10%; public lighting - 30%; and roads and highways - 53%.



*Map from the **Integrated Environmental Plan** shows the six distinct regions for climate, topography, hydrology and geology along the 2,000-mile U.S./Mexico border plus the sister cities supporting the majority of the population.*

Law, hydrology and policy conference slated for Boulder

Lawyers and engineers frequently work together in the context of groundwater management or litigation, but each often has difficulty understanding the other's field. In an effort to bridge this gap, the Natural Resources Law Center at the University of Colorado School of Law will hold its annual water conference in conjunction with the Rocky Mountain Groundwater Conference, organized by the Colorado Groundwater Association.

"Uncovering the Hidden Resource: Groundwater Law, Hydrology and Policy in the 1990s" is scheduled for June 15-17, 1992 in Boulder, CO. Joint sessions will address groundwater hydrology and related legal principles, groundwater quality protection and cleanup, and international groundwater management issues. In a session on legal and engineering practice issues, a water attorney and groundwater expert will demonstrate an expert witness examination, followed by personal observations from a Colorado water judge. Other topics addressed will include groundwater development in Nevada and in the San Luis Valley; groundwater management in Arizona; groundwater contamination and clean-up in the San Gabriel Valley and at the Rocky Mountain Arsenal.

For registration materials or further information, contact Kathy Taylor, Natural Resources Law Center, (303) 492-1288.

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Make plans for the 37th Annual New Mexico Water Conference

The 37th Annual Water Conference will focus on water planning and conservation. To be held November 6-7 at the Taos Civic Plaza, the conference will look at how effective planning is accomplished and examples of good plans. It will also feature an entire session on Friday, November 7 devoted to conservation, answering some of the burning conservation questions: What can be done in New Mexico? What are some good conservation plans? What are some of the pitfalls of conservation planning?

The Holiday Inn de Don Fernando de Taos is giving us an excellent rate of $49 per night for conference participants.

Registration and detailed program information will follow this summer. If you would be interested in having a display related to conservation or planning at the conference, please call Leslie Blair at 505-646-5367.

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