

divining rod

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New Mexico Water Resources Research Institute

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Research focuses on contamination

It is no news ground water contamination by organic chemicals is a growing problem in New Mexico as well as nationwide. Organic contaminants are the result of wastes by industries and households alike and are found in substances such as solvents, household cleansers, pesticides, explosives, formaldehyde, and refined petroleum products.

Petroleum-based contaminants are considered troublesome because some of the hydrocarbons present are toxic at low concentrations. Since the 1950s there have been at least 151 cases of petroleum-product contamination of ground water in the state, according to Dennis McQuillan, water resource specialist for the Environmental Improvement Division.

Refined petroleum product contamination has forced the EID to shut down public water supply wells at locations including Hobbs, Angel Fire, Navajo, Taos, Tatum, Clayton, Santa Fe, Pecos, Velarde, and Alamogordo, and it is estimated between one-tenth and one-third of the state's 14,000 underground storage tanks are leaking.

Several of the research projects administered by the Water Resources Research Institute during the past two years have focused on these contaminants to our ground water resources and how to deal with them. Dr. Bobby Creel, acting director of WRRRI says, "Ground water is a vital resource in New Mexico. It supplies about 85 percent of our drinking water needs and is used extensively for irrigation. Con-

tamination of this resource is a loss for all of us. Therefore it is very appropriate for the WRRRI to focus on research that will help us in ground water cleanup as well as give us a better understanding of the complexities of this resource."

Dr. John Wilson, head of New Mexico Institute of Mining and Technology's hydrology program, and Ph.D. candidate Steve Conrad have been working on a series of laboratory experiments to help understand how organic liquids migrate through the vadose and saturated zones. "We are trying to understand some of the complex physical phenomena that occur in the field and better understand mechanisms we know little about," Wilson explains.

To date, few other experiments have been conducted regarding the migration, trapping and biodegradation of organic chemicals in aquifers, making conjectural modeling and remediation of waste sites difficult.

Understanding the behavior of the contaminants is important, according to the researchers, because ground water pollution often is not recognized until long after the contamination has occurred. Wilson reports, "The time lag between a pollutant release and its discovery is often measured in decades."

As a contaminant migrates, some of the compound is immobilized in the form of blobs, each about the size of a grain of sand, trapped underground by capillary forces. According to Wilson, the effect of the capillary forces is similar in general principle to water being absorbed by a paper towel.

Conrad and Wilson have discovered organic chemicals move

(Continued on pg. 2)



John Wilson and Robert Bowman

Research, continued

differently through the vadose zone than they do through the saturated zone. In the vadose zone, organic residual saturation is usually less than 10 percent, while in the saturated zone it can be as high as 30 percent. Although the liquid is trapped, the passing ground water can dissolve some of this residual, spreading the pollutant. The residual in the vadose zone also volatilizes, furthering pollution in a gaseous form.

In gasoline spills, the presence of additives such as detergents and ethers may alter the natural wetting soil conditions, changing the contaminant's flow and the soil's water absorption. Because these changes influence a hydrocarbon's migration and entrapment, Wilson and Dr. Robert Bowman, also from NMIMT's hydrology program, are looking at chemically altering the wettability of soils materials found in aquifers (gravel, for example), to determine how that affects the contaminants. This project is sponsored by the U.S. Geological Survey and NMIMT in addition to the WRRF.

Studying the blobs and capillary forces are important not only in predicting the movement of contaminants, but in cleaning them up. Bowman observes, "If we can predict these things, we can know how fast to begin a cleanup, or whether we need to begin it at all."

Bowman adds, "If we find ways to treat porous materials to retain contaminants, we can trap contaminants in a given zone. The larger the area of contamination, the harder it is to clean up even if the contaminants are present at lower concentrations."

Confining the contaminants within a relatively small zone should be particularly helpful when in situ treatments are used to destroy the contaminants. Such treatments include enhancing the biodegradation of organic chemicals by stimulating native microorganisms via the additions of nutrients and oxygen, and adding chemicals to react with the contaminant. The effectiveness of in situ remediation depends greatly upon the ability to distribute the treatment within the contaminated zone. The smaller the zone, the greater likelihood of success.

Three of the minor components

found in gasoline and diesel fuel, benzene, toluene and xylene, are considered especially dangerous because of their toxicity and carcinogenicity. Dr. Fernando Cadena of New Mexico State University's Civil, Agricultural, and Geological Engineering Department has been studying the feasibility of removing the trio from ground water by increasing the absorption capability of local soils.

In Cadena's study, soils native to New Mexico are treated with quaternary amines which increase the absorption of the pollutant. "We optimize soil to remove pollutants that are a major source of concern. By changing the molecular structure of the soil, we can remove different sized pollutants," explains Cadena. The chemicals applied to the soil are hydrophobic and prevent the water from adhering to the soil, allowing the pollutant to bind to it instead.

Cadena's experiments have taken place in NMSU's environmental engineering laboratory thus far. He hopes to proceed to field testing, but there are environmental factors which must be considered. He observes that although the pollutant may be removed from the water, it has not disappeared — it remains in the soil. In future projects he plans to study maximizing the biodegradation of the pollutant, while minimizing its volatilization.

Although similar studies have been conducted in other parts of the country using purified clay minerals, Cadena's project is the first to use natural local soils for the removal of contaminants. He is optimistic his research may have application for removing pollutants caused by other types of hazardous wastes.



Fernando Cadena

New Reports, Videos

To order the following new publications or videos, write the New Mexico Water Resources Research Institute, Box 30001, Dept. 3167, Las Cruces, NM 88003-0001. Publications are free of charge unless otherwise indicated. Videos are available free of charge for a 10-day loan.

#233 — *Variably Saturated Flow between Streams and Aquifers.* Wilson, J.

#234 — *Assessing the Sensitivity of High Altitude New Mexican Wilderness Lakes to Acidic Precipitation and Trace Metal Contamination.* Lynch, T., Popp, C., and Jacobi, G.

#235 — *Treatment of Water Supplies Contaminated with Toxic Pollutants Using Tailored Soils.* Cadena, F.

#236 — *Improving Livestock Tolerance of Toxicants in Kochia Toward Increased Use as a Water-Efficient Crop.* Smith, S., Kiesling, H.E., Hallford, D.M., Rankins, D.L., Erikson, M.K.

#237 — *A Stable-Isotope Investigation of Vapor Transport During Ground-Water Recharge in New Mexico.* Knowlton, R. G., Phillips, F., and Campbell, A.R.

#238 — *Proceedings of the 33rd Annual New Mexico Water Conference: Water Planning from the Town Up.* This publication will be sent to all participants of the 33rd annual conference. The cost for anyone else wishing to purchase the proceedings is \$5.

#239 — *A Physiological Route to Increased Water-Use Efficiency in Alfalfa.* Gutschick, V. and Cunningham, G.

#240 — *Removal and Selective Recovery of Heavy Metal Ions from Industrial Waste Waters.* Darnall, D. and Gardea-Torresdey, J.

V11 — *Water and Energy: When Conservation is the only Choice* (10 minutes).

V12 — *Working Toward Irrigation Efficiency* (10 minutes).

On-farm program promoting energy, water conservation

Beginning last summer, the New Mexico Energy, Minerals and Natural Resources Department, the Soil Conservation Service, Black Range Resource Conservation and Development, Inc., the Civil, Agricultural and Geological Engineering Department at New Mexico State University and the Water Resources Research Institute joined forces to improve the irrigation efficiency of farms all over the state. The project has several components including demonstration of energy-saving techniques to producers, training field technicians, and establishing a database. This page is devoted to the project's progress.

Project centers on southwestern NM

The on-farm program has centered on irrigation systems in southwestern New Mexico so far because of the high cost of pumping ground water for irrigation in the area. A number of energy-saving techniques have been presented to producers in Hidalgo and Luna counties during the past five months. These have included surge valve and infrared gun demonstrations.

About a dozen surge valve trials were performed during pre-watering on wheat fields in the Lordsburg area. John Meetze, conservationist with the Soil Conservation Service field office in Deming, said the trials resulted in a "50 percent savings in total water applied." The valves distribute the water evenly down the furrow, which saves on water.

The infrared gun was demonstrated last September on about a dozen cotton fields. It monitors how much stress a crop is under and gives guidance about whether to irrigate. It determines a plant's evaporation rate which indicates whether there is sufficient soil moisture for its needs.

Land-leveling is another technique being promoted. Meetze's office has selected farms in Luna and Hidalgo counties to participate in a land-leveling program which will take place in the next few weeks. The SCS has designed the needed changes in slope for the selected farms, which will improve efficiency by decreasing the amount of irrigation time and water required.

Also underway is a pump repair program. The SCS has been conducting pump tests since 1987 and has now selected three pumps in the two counties for repair to help demonstrate improvements to the efficiency of the systems.

Statewide database being established

During the past ten years Dr. George Abernathy, professor emeritus from the Civil, Agricultural and Geological Engineering Department at New Mexico State University, and Elston Grubaugh, agricultural engineer with NMSU's Cooperative Extension Service, have been collecting data regarding pumping plants at farms throughout the state. As part of the on-farm project, Dr. Al Blair, director of the agricultural engineering program at NMSU, has been compiling the information into a database.

The database contains a variety of information such as the location of the pumping plants and their rates of flow. It will make evaluating irrigation systems easier, according to Dr. Blair, and allow producers to see how their pumping plants have been operating for the last ten years.

Videos now available

Two videos have been released recently by the Water Resources Research Institute to help fulfill the educational aspect of the on-farm project. These two videos, *Water and Energy: When Conservation is the Only Choice* and *Working Toward Irrigation Efficiency*, promote conservation techniques used in the project and include interviews with irrigation specialists.

The videos are available free of charge for a ten-day loan by writing the WRRRI, Box 30001 - Dept. 3167, Las Cruces, NM 88003, or by calling (505) 646-1813.

Short course announced

The Department of Civil, Agricultural and Geological Engineering at New Mexico State University will host a short course May 22-25 for technical professionals (conservationists and extension personnel, for example) in agriculture. Topics discussed will include water conservation, water quality, and chemical applications using irrigation. The four-day course includes a computer lab and will be taught by Dr. Al Blair, director of the agricultural engineering program at NMSU and Elston Grubaugh, Cooperative Extension Service agricultural engineer.

Those interested in the course may contact Dr. Blair for more information by calling (505) 646-6103.

Software available for irrigation system analysis

Producers can get help making decisions about irrigation systems via the computer by using two software packages now available. One package is designed for pumping plant and irrigation system economics; the other for surface irrigation design and evaluation. The packages can tell producers such things as how long it takes to pay back an investment based on water savings.

Those wanting more information on the software may contact Dr. Al Blair, Department of Civil, Agricultural and Geological Engineering, New Mexico State University, Box 3CE, Las Cruces, NM 88003, (505) 646-6103.

New information coordinator named

As many of the *Divining Rod* readers know, Linda G. Harris resigned as information coordinator effective November 30, 1988. After seven years with WRRRI, Linda decided to form her own company, Arroyo Press. It is a publications firm which can handle any stage of a publication's production — including research, writing, editing, design and promotion. We wish Linda the best of luck.

Taking Linda's place is Leslie Blair, a relative newcomer to New Mexico. Leslie moved to Las Cruces a year-and-a-half ago from Austin, Texas. She holds a bachelor's degree in journalism from Southwest Texas State University and currently is working toward a master's degree in technical and professional communication at New Mexico State University.

In the past, Leslie was assistant to the director of education at the Texas State Historical Association where she edited the *Texas Historian*, a bimonthly magazine, and planned conferences, teachers'

workshops, and history fairs. She also worked as a manager in the member services division of Texas School Services Foundation and as a reporter/writer for the *Las Cruces Bulletin*.



New Mexico State University Research Technician Susan Fender works in the Plant Genetics Laboratory analyzing heat shock proteins found in cotton plants using electrophoretic gel analysis. The WRRRI-sponsored project, under the direction of Dr. Mary O'Connell, may lead to development of more heat-tolerant and water efficient plants.

Conference date set

Mark your calendars for the 34th Annual New Mexico Water Conference which is scheduled for Oct. 26-27 at the Roswell Inn in Roswell, New Mexico. The tentative theme is "The Relationship of Water Issues: Southeastern New Mexico as a Case Study."

Bob J. Creel, acting director, New Mexico Water Resources Research Institute
Leslie Blair, editor

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