



# DIVINING ROD

NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE

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Summer 1998

## WRRI publishes final technical reports *results of water quality and groundwater studies*

All research projects supported through the WRRI culminate in a final report which is published as part of the Institute's technical completion report series. The reports are disseminated to public libraries throughout the state of New Mexico and are available at no charge, while supplies last, from the WRRI.

The WRRI homepage (<http://wri.nmsu.edu>) contains a list of all published completion reports along

with each report's abstract. In the near future, the Institute hopes to provide, via its homepage, the full text of each new report.

Four completion reports were published recently. For copies of the reports, contact the WRRI at (505) 646-1813.

### **Spatial and Temporal Distribution of Mercury in Caballo and Elephant Butte Reservoirs, Sierra County, New Mexico**

by Colleen Caldwell and Christopher Canavan, New Mexico State University (Report No. 306)

This study looked at the concentrations of inorganic and organic aqueous mercury in Caballo and Elephant Butte reservoirs. The two-year study (1995-1997) was conducted to characterize the combined effect of selected physiochemical characteristics of water (pH, alkalinity, hardness, dissolved oxygen, conductivity, and temperature) and reservoir volume on the presence and availability of total mercury (THg) and monomethylmercury (MMHg).

The researchers found elevated concentrations of both organic and inorganic forms of mercury in the upstream portion of Caballo Reservoir, and this finding led to a continued investigation of Elephant Butte Reservoir and Rio Grande water coming into Caballo Reservoir. High levels of biologically available methylmercury in the upper section of Caballo Reservoir are attributed to the discharge of anoxic Elephant Butte waters to the Rio Grande.

The study determined a potential source of mercury in the Rio Grande basin to be atmospheric deposition. Further study is needed to describe Hg concentrations in runoff from the Black Range watershed entering the Rio Grande and Caballo Reservoir and to determine the influence of Elephant Butte Reservoir on the Hg cycle in Caballo Reservoir.

### **Arsenic Remediation in Drinking Waters Using Ferrate and Ferrous Ions** by Christopher Vogels and Michael Johnson, New Mexico State University (Report No. 307)

As groundwaters used for municipal water supplies become increasingly contaminated with arsenic and as the U.S. Environmental Protection Agency (EPA) acceptable threshold limits decrease (currently at 50 parts per billion but may decrease to 1 ppb), new methods for inexpensive arsenic removal are needed.



Researchers Colleen Caldwell and Christopher Canavan collect a water sample at Caballo Reservoir using the "clean hands, dirty hands" technique.

*continued on page 2*





Dr. Michael Johnson and his graduate assistants have developed new chemical procedures using ferrate [iron(VI)] to remove extremely low concentrations of arsenic and arsenic-containing compounds from water.

This report describes the method used by the researchers to determine the ability of ferrate to remediate arsenic. The method provides an inexpensive approach to meet new drinking water regulations where acceptable levels of arsenic may reach as low as 2 ppb.

**Determination of Agricultural Chemical Impacts on Shallow Groundwater Quality in the Rio Grande Valley: Las Nutrias Groundwater Project** by Robert Bowman and Jan Hendrickx, New Mexico Tech (Report No. 308)

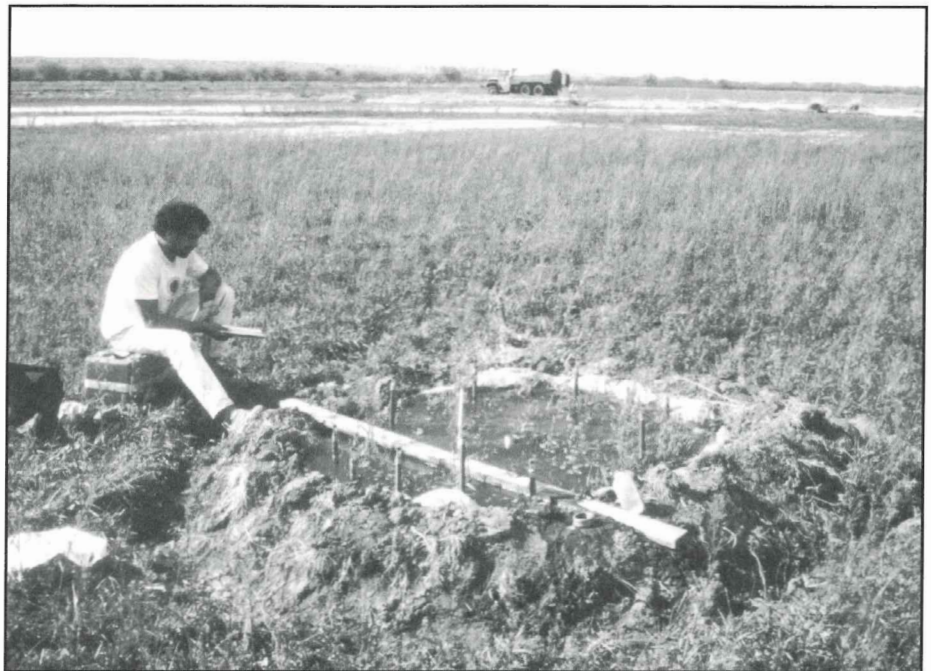
A comprehensive assessment was made of water and chemical relationships at a commercial farm in the central Rio Grande Valley during 1994-1996. The Las Nutrias Groundwater Project included a highly instrumented 15-acre tile-drained field used to collect areally averaged data on recharge rates and nitrate and pesticide leaching to shallow groundwater.

Based on the information collected during the Las Nutrias Groundwater Project, typical agricultural cropping, water, nutrient, and pesticide management practices do not appear to pose a broad threat to shallow groundwater in the Rio Grande Valley. Due to large dilution by ambient groundwater (whose source includes mountain-front recharge, infiltration losses from the Rio Grande, and recharge from other agricultural fields), temporary spikes in field drainage chemical concentrations are rapidly diluted below regulatory levels.

**Temporal Variability of Diffuse Groundwater Recharge in New Mexico** by Anne Kearns and Jan Hendrickx, New Mexico Tech (Report No. 309)

The ability to make accurate predictions of groundwater recharge from precipitation may help us make

Climate conditions supporting the initiation of recharge include both single, very large rainfall events and gradual soil moisture content increases. Recharge periods ended if two consecutive years had below average rainfall. El Niño conditions did not correlate well with the five recharge periods studied, but Eastern Pacific



*Undergraduate student Leo Porta performs an Instantaneous Profile Test for the Las Nutrias Groundwater Project.*

more responsible decisions concerning the allocation of declining groundwater resources. This project's objective was to verify the possibility of significant quantities of diffuse precipitation recharge.

One hundred years of actual precipitation data collected from Las Cruces were used as an input to a one-dimensional numerical model to explore this concept. Four soil textures were simulated in soil profiles, some barren and some vegetated.

cyclones were responsible for the two single, largest rainfall events, both of which initiated major recharge periods and may be responsible for the continuance of other periods as well.







## USGS Reports

The U.S. Geological Survey has published the following New Mexico related publications since the last issue of the *Divining Rod*. The Water Resources Research Institute library has the reports on file. They also may be ordered from the USGS, Federal Center, Box 25286, MS 517, Denver, CO 80225. You may call (303) 202-4700 for price information.

❖ **Water quality in the Rio Grande Valley, Colorado, New Mexico, and Texas, 1992-1995** by Gary W. Levings, Denis F. Healy, Steven F. Richey and Lisa F. Carter (USGS Circular 1162).

A five-year study of water quality in the Rio Grande Valley, from its headwaters in Colorado to near El Paso, Texas, has been completed by the USGS. The study focused on groundwater in the flood plain of the Rio Grande and surface water in the Rio Grande and selected tributaries.

Adverse effects on water quality were observed in shallow groundwater, which is most susceptible to contamination, by the detection of anthropogenic chemicals, such as nitrates, pesticides, and volatile organic compounds; naturally occurring trace elements, such as iron, manganese, molybdenum, and uranium; and radon.

Compared to established human health standards, nitrate concentrations in the San Luis and Rincon valleys exceeded the U.S. EPA maximum contaminant level (MCL) for drinking water in 31% and 17% of the wells, respectively. Shallow groundwater generally is not used as a drinking water source in these areas.

Pesticides were detected in shallow groundwater in both agricultural and urban land-use areas; 29% of the wells contained at least one pesticide. The detected concentrations were very small compared to established MCLs, although not all pesticides have MCLs. Multiple pesticides were detected in several wells; the effect that combinations of pesticides may have on human health is unknown. Volatile organic compounds were detected in shallow groundwater from 11% of the wells sampled. No concentrations of pesticides and volatile organic compounds exceeded EPA drinking water standards.

Only two trace elements exceed EPA MCLs or Health Advisories for drinking water. Uranium concentrations exceeded the EPA-proposed MCL in 13% of the wells and molybdenum exceeded the EPA Health Advisory in 2% of the wells.

Radon was detected in all groundwater samples. Water from shallow wells in the San Luis Valley and deeper wells in the Rio Grande flood plain contained the highest median concentrations. At present no EPA drinking water standard exists for radon.

Water quality in reaches of the Rio Grande and some of its tributaries has been impaired by pesticides, elevated concentrations of trace elements, and anthropogenic disturbance. Pesticides were detected in surface water, bed sediment, and fish samples collected at sites in the Rio Grande and its tributaries and drains. However, no pesticide concentration exceeded EPA drinking water standards or applicable federal or state ambient criteria or guidelines. One or more pesticides were detected at 94% of the sites sampled; most concentrations were at or only slightly above the laboratory level of detection.

Analysis of fish community-structure data collected at ten sites indicates that six of the sites show indications of environmental perturbation. This analysis is based on the number of introduced, omnivorous, and pollution-tolerant fish and those with external anomalies counted at the sites sampled. On the basis of habitat data collected on stream modification, bank erosion, bank vegetation stability, and riparian vegetation density, six of ten sites sampled have significant habitat degradation.

A 39-page color report summarizes the results of the study. For technical information, contact Gary Levings at (505) 262-5335 or send email to [glevings@usgs.gov](mailto:glevings@usgs.gov).

❖ **Water-quality data for the Rio Grande between Picacho Bridge near Las Cruces and Calle del Norte Bridge near Mesilla, New Mexico, 1996-97** by G.F. Huff (OFR 98-66)

❖ **Proposed expansion of the City of Albuquerque/ U.S. Geological Survey ground-water-level monitoring network for the Middle Rio Grande Basin, New Mexico** by Laura M. Bexfield (OFR 97-787)

❖ **Characterization and evaluation of channel and hillslope erosion on the Zuni Indian Reservation, New Mexico, 1992-95** by Allen C. Gellis (WRIR 97-4281)

❖ **Simulation of ground-water flow in the Albuquerque Basin, central New Mexico 1901-95, with projections to 2020** by John Michael Kernodle (OFR 96-209)



## News Briefs

### State Water Institute Program May Receive Funding Increase

In February, Robert M. Hirsch, Chief Hydrologist for the U.S. Geological Survey, announced that the President's budget for fiscal year 1999 provided a \$1 million increase for the State Water Institute Program. These additional funds would be earmarked for research on the causes, effects, and management of nonpoint-source pollution in support of the Administration's Clean Water and Watershed Restoration initiative.

The proposed increase was a significant development for the Institute Program. It was the first proposed increase in funding for the program since it was assigned to the USGS in 1984, and the first time that funding for the Institutes had been sought in direct support of a high-priority federal program.

In late June, the House Interior Appropriations Subcommittee recommended approximately \$5 million in FY99 for the WRRI program. This was \$500,000 above the FY98 level but \$500,000 below the Administration's FY99 budget request.

Significantly, the House Subcommittee recommended that grant funds be allocated to Institutes as they were pre-1996, that is, each state Institute would receive funding to support a statewide competitive program of research in collaboration with the Institute's state advisory panel. The Subcommittee further recommended that \$1 million of the appropriation be earmarked for the regional research competitive program.

The New Mexico WRRI will keep abreast of developments as the bill makes its way through the budgetary process.



### Advisory Committee Releases TMDL Recommendations

The March 1998 issue of the *Divining Rod* described that Total Maximum Daily Loads (TMDL) are watershed or basin-wide "budgets" for the amount of pollutants that can be assimilated without causing the stream to exceed the state water quality standards.

In April, the Federal Advisory Committee on TMDLs released its most recent draft report recommending that states incorporate seven elements into TMDL development. The seven recommended elements are:

- target identification—the selection of one or more quantified end points, such as a measurable environmental characteristic indicating compliance with water quality standards, that may include the water's maximum loading capacity;
- identification of the current deviation from the level of pollution reduction necessary to meet the target;
- identification of sources that contribute to the impairment;
- allocation of pollution loads or an alternative providing an equivalent showing that the standards can be attained;

- an implementation plan that should be prepared along with the TMDL that includes a plan and schedule for implementing control or restoration activities to eliminate the impairment;
- a process for monitoring and assessing the effectiveness in achieving water quality standards attainment; and
- a process for revising the TMDL, specified in the implementation plan.

A final report and recommendations are expected by mid-summer. More information is available from Hazel Groman, the Committee's Designated Federal Officer, at (202) 260-8798.



### Water Festival Set for Fall '99

The Waste-Management Education & Research Consortium has received a grant from the U.S. EPA to begin planning for a Tri-City, Tri-State, Bi-National Water Festival. The proposed festival will travel between the cities of Las Cruces, El Paso and Cd. Juarez, and will focus on providing materials and hands-on exhibits dealing with water issues in the El Paso del Norte region.

One of the objectives of the festival is to promote awareness of the relationship between groundwater and surface water and their dependence among citizens in the entire region.

For more information, contact Jim Loya at (505) 646-2038.





## Upcoming Meetings

World Water Lessons for a Changing West: Management, Conservation and Public Education  
Western State College of Colorado  
Gunnison, Colorado  
July 29-31, 1998

Cross Currents in Water Policy  
Universities Council on Water Resources  
Hood River, Oregon  
August 4-7, 1998

The Changing West: Water, Environment and the Politics of the 21st Century  
National Water Resources Association  
Big Sky Resort, Montana  
August 5-8, 1998

New Mexico Water Law Conference  
Santa Fe, New Mexico  
August 27-29, 1998

Uniting the Basin 1998  
Rio Grande/Rio Bravo Coalition Biennial Congress  
University of Texas at El Paso  
September 17-19, 1998

MODFLOW '98  
Colorado School of Mines  
Golden, Colorado  
October 4-8, 1998

Instream Flow Conference: Water for Fish vs. Water for People: A Real Conflict?  
Trout Unlimited  
Copper Mountain Resort, Colorado  
October 8-9, 1998

New Mexico Environmental Health Conference  
Albuquerque Convention Center  
October 12-15, 1998

**Water Challenges on the Lower Rio Grande  
NMWRRRI 43rd Annual Water Conference  
Las Cruces, New Mexico  
October 22-23, 1998**

### 43rd Annual New Mexico Water Conference Registration Form

To attend the 43rd Annual New Mexico Water Conference, please complete one form for each person. Mail form with check payable to NMWRRRI-Water Conference to: Water Conference, New Mexico Water Resources Research Institute, MSC 3167, New Mexico State University, P.O. Box 30001, Las Cruces, NM 88003.

Registration must be received by **October 7, 1998** to avoid a late registration fee. The registration fee will be refunded if written notice of cancellation is received by October 14, 1998. A \$25 cancellation fee will be charged.

The full registration fee includes the day-and-a-half conference, optional field trip, all breaks, a lunch on Thursday, reception on Thursday evening, and a copy of the proceedings to be published within a few months of the conference.

Please check the following:

- Registration \$125 before October 7, 1998
- Registration \$150 after October 7
- Student registration \$40 before October 7
- Student registration \$50 after October 7
- I will be attending the tour of EBID facilities on Wednesday, October 21
- Lunch/Reception ticket(s) for guest(s) \$30/guest

Total \$ \_\_\_\_\_

Name \_\_\_\_\_

Affiliation \_\_\_\_\_

Mailing Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone No. \_\_\_\_\_ Fax No. \_\_\_\_\_





## Professor patents cheap and easy toxicity test

by Jess Williams, NMSU  
University Communications

When Skip Botsford sings "Am I Blue?" it's a happy song.

Botsford, a biology professor at New Mexico State University, recently patented a chemical toxicity test that he, with the help of an army of undergraduate students, developed and perfected over the last two and a half years.

Using bacteria that grow naturally on alfalfa, Botsford created a simple, cheap and quick test that shows whether different chemical compounds are toxic. The bacteria are suspended in a solution with a special dye and the chemical compounds are added. If the solution turns blue, there is no toxicity. If it turns yellow, watch out.

His system, Botsford claims, has the potential to save millions of laboratory rats and mice that tradition-

ally have been used in toxicity testing, often with results that did not translate well to human exposure. And the process is so simple, he said, that undergraduate college students can be employed to conduct the testing.

It is, Botsford said, "by far, the cheapest, fastest and simplest" toxicity test of its kind, and the results are useful to companies introducing new products, municipalities dealing with unidentified spills, and consumers who want to know what they're using in their homes and gardens. He said he hopes the patent can be sold to a corporation that will market it heavily to Third World countries, where industrial pollution can be curbed using the data. Botsford said any proceeds from the sale of the patent would be split between him and NMSU.

Other benefactors of the process, Botsford said, are his students, who have accumulated real-time lab work on the development of the process. Botsford said that when he was in college in the 1960s, most science laboratories were the exclusive and mysterious domain of professors and selected graduate students. Undergraduates need not apply.

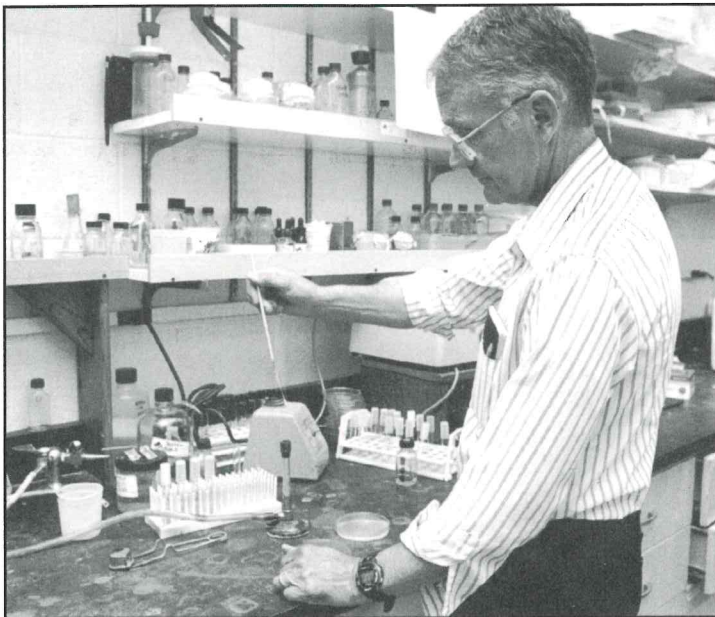
At most universities in the nation, he said, not much has changed in the intervening 30 years. But at NMSU, the labs are open to enterprising undergraduates who are willing to enhance their academic studies with hands-on scientific pursuits.

Botsford said he uses up to a dozen students each semester in his lab work. The students in the labs, he said, can test any one of the approximately 100,000 different chemicals that are put on the market each year. Each test takes less than an hour and costs about 47 cents. Traditional animal testing, he said, can take months and involve costs in the thousands of dollars for just one compound.

Advising between 140-190 undergraduates at NMSU each semester, Botsford encourages each of them to find a professor who will assign credit hours for lab work so that the students can be in on such ground-breaking innovations. Whether the nature of the work is new-fangled computer modeling or old-fashioned observation is not the issue, Botsford said.

What's important is to use university resources as early and as often as possible. From biology labs to chemistry labs, physics labs, genetics labs, engineering labs, astronomy labs, agricultural labs and entomology labs, Botsford said there is work to be done and, in most cases, opportunities for undergraduates to be involved.

*Note:* The WRRI provided Botsford with funding for his research project, *An Assay for Toxic Chemicals Using Microorganisms*, and he will speak at this year's annual water conference on the results of the project.



*NMSU biology professor Skip Botsford works in the lab on a procedure he recently patented that determines the toxicity of chemical compounds.*



## Water Challenges on the Lower Rio Grande

Holiday Inn de Las Cruces  
October 22-23, 1998

### Preliminary Program

#### Wednesday, October 21

1-5 p.m. Tour of EBID facilities

#### Thursday, October 22

7:00 am Registration - Holiday Inn de Las Cruces lobby

8:15 Welcome  
**Tom Bahr**, Director, WRRRI  
**Ruben Smith**, Las Cruces Mayor

8:30 Keynote address  
(invited) **Senator Pete Domenici**

9:00 The Rio Grande Compact: Law of the River  
**Chuck DuMars**, UNM School of Law Commissioners **Tom Turney** (NM), **Jack Hammond** (TX), **Hal D. Simpson** (CO)

10:15 Break

10:30 Regional Water Planning and Water Assessment Updates  
**Richard Cheney**, ISC Chair  
**Norm Gaume**, ISC Engineer

10:50 A Historical Look at the Evolution of the Rio Grande  
**Neal Ackerly**, Dos Rios Consultants, Inc.

11:10 New Mexico/Texas Water Commission Update on Commission Activities: **Ed Archuleta**, General Manager, El Paso Water Utilities  
Alternative Water Delivery Scenarios: **Bill Webster**, Boyle Engineering  
Environmental Studies: **Tom Haislip**, CH2M HILL

12:00 Luncheon  
**Lt. Gov. Walter Bradley**  
**Congressman Joe Skeen**

1:30 pm Basin Guidelines and Hydrographic Survey of the Lower Rio Grande  
**Calvin Chavez**, Office of the State Engineer, Las Cruces District Supervisor

2:00 Groundwater Modeling of the Lower Rio Grande  
**Peter Balleau**, Balleau Groundwater, Inc.

2:30 USGS Seepage Investigations of the Rio Grande in the Mesilla Valley  
**Ed Nickerson**, USGS

2:50 Break

3:10 Arsenic Removal from Groundwater Using Ferrate and Ferrous Ions  
**Michael Johnson**, NMSU

3:30 Environmental Factors Influencing Mercury Concentrations in Water and Sediments in Caballo Reservoir  
**Colleen Caldwell**, NMSU

3:50 Aquifer Sensitivity Assessment in the Mesilla Valley  
**John Kennedy** and **Bob Creel**, WRRRI

4:10 An Assay for Toxic Chemicals Using Microorganisms  
**James Botsford**, NMSU

4:30 Concentration of Viral Particles from Water by Ultrafiltration  
**Kevin Oshima**, NMSU

6:30 pm Reception at the New Mexico Farm and Ranch Heritage Museum  
Appetizers and Cash Bar - Dinner on your own

#### Friday, October 23

8:30 am Initiatives by the National Water Resources Assoc.  
**Wayne Cunningham**, President, NWRA

8:45 Water Quality on the Lower Rio Grande  
**Jim Davis**, New Mexico Environment Department  
**Rodger Ferreira**, USGS  
**John Baker**, Texas Natural Resource Conservation Commission

9:30 Overview of Pending Litigation on the Lower Rio Grande  
speaker to be announced

10:00 Break

10:30 Conversion of Water from Agriculture to Municipal Use: How to do it?

(invited) **Commissioner Eluid Martinez**, Bureau of Reclamation  
**Gary Arnold**, President, EBID Board of Directors  
**Len Stokes**, Consultant, City of Las Cruces  
**Johnny Stubbs**, President, El Paso County Water Improvement District #1  
**Richard Castro**, Chairman, El Paso Public Service Board

11:50 Closing Remarks  
**Tom Bahr**, WRRRI





## Students shine at science fair

The New Mexico Water Resources Research Institute presented certificates and savings bonds to several students at the 46th New Mexico Science and Engineering Fair. The award-winning students demonstrated thoughtfully developed research projects in a water-related field.

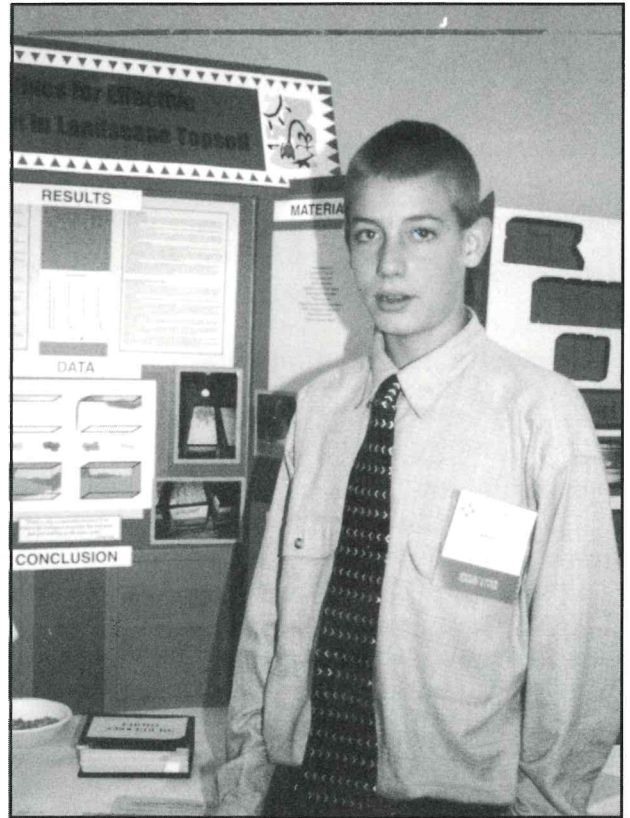
First place in the junior division was awarded to Lindsay Fagrelus from Tilletts Junior High School in Farmington. Her project was entitled, *Analysis and Interpretation of Mercury and Arsenic Compositions in Bedrock Creek*. Lindsay won a \$100 savings bond from the WRI for her effort.

Second place in the junior division and a \$50 savings bond went to Jason Zerbe for his project, *Alternatives for Effective Conservation in Landscape*

*Topsoil*. Jason attends LB Johnson Middle School in Albuquerque.

Stephanie Levine of Eldorado High School was presented with first place and a \$100 savings bond in the senior division for her project entitled, *Removal of Radioactive Uranium Wastes from Contaminated Water Environments*.

Second place in the senior division was awarded to Anna Norman of Socorro High School for her continuing project, *The Evolving Rio Grande Phase 3: Arsenic*.



Middle school student Jason Zerbe presented his science fair project at New Mexico Tech in April at the 46th New Mexico Science and Engineering Fair.



Tom Bahr, Director

New Mexico Water Resources Research Institute

Catherine Ortega Klett, Editor

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