



### Crypto Creature Jolts Public Into Heeding Water Quality Threat

Does it take a Crypto Creature to catch public attention and raise concerns about critical water issues citizens should know and care about? The Water Services Department of Bryan Texas found the approach effective in educating citizens about the threat of cryptosporidium in drinking water. Whatever else might be said of the strategy of relying heavily on the skills of a cartoonist, the message came readily across that the cryptosporidium pathogen is mean, nasty and dangerous, a pest best shunned.

Another cautionary water message that recently caught public attention was that drinking water supplies throughout the country contain pharmaceuticals. The Associated Press interviewed scientists, federally funded researchers, university professors and private drinking water experts for an article that found a vast array of pharmaceuticals in the drinking water supplies of at least 41 million Americans. AP noted the problem in the water supplies of 24 major metro areas, including Tucson.

Prompt response was forthcoming. Editorials appeared in newspapers throughout the land urging communities that test for pharmaceuticals to make the information

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*A Bryan, Texas Water Services Department calendar contained the following caption for the above image: "Your H2O heroes are constantly on the lookout for the dreaded nemesis "Crypto." Cryptosporidium is a microbial contaminant that exists in all drinking water, but it sometimes infects infants, some elderly, those undergoing chemotherapy, organ transplant recipients, patients receiving steroid treatment, HIV or AIDS sufferers, and others with weakened immune systems." Image courtesy of Water Services Division, Bryan, TX.*

### Drop 2 — End-of-The-Line Reservoir Salvages Colorado River Water

by Joe Gelt

The curiously named Drop 2 reservoir, the latest major Colorado River project to be built to secure a water supply, is to be constructed at the end of the river, one of the last downriver structures in a series of dams, reservoirs and canals that control and distribute Colorado River water.

Among other Colorado River projects Drop 2 stands out as a project of its time, different than other projects built during different periods of Colorado River development. Consider, for example, Hoover Dam, a monumental, multipurpose project built by the federal government in the 1930s. Its purpose was to harness the full flow of the river, considered at the time to be an abundant source of water, in order to control flooding and provide water to arid regions of California and Arizona and hydroelectric energy to millions in adjacent regions.

Over 70 years later, the purpose of Drop 2, which is to be built along the All-American Canal, is to salvage water from a now over allocated river, a project that will be bankrolled, not by the federal government, but by the states of Nevada, Arizona and California as a cooperative venture. The planning and development of the project

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reflect current political and hydrological realities far different than those that prevailed during previous eras along the river.

**State water needs create opportunities**

During these dry, drought-stricken times, the seven Colorado River States' strategies are to protect their river interests and allocations, to be sure they get their share of river water. Arizona especially has reason to fret; in the event of shortages, the state will take the big hit, absorbing the greatest share of the shortages than other Colorado River states. This situation drives the state's position when negotiating shortage sharing strategies with the other states.

Nevada is nagged by a different Colorado River problem. With a mere 300,000 acre-feet Colorado River allocation a year, compared to Arizona's 2.8 million acre feet and California's 4.4, Nevada is decidedly at a disadvantage. The state's long-term planning goal is to temporarily increase its Colorado River share, its strategy necessarily relying less on a defensive posture than an assertive approach as the state seeks promising opportunities to increase its Colorado River supplies.

Drop 2 is one of those promising opportunities that Nevada vigorously pursued as serving its water interests. The project also serves as a case study of states working together to solve Colorado River issues.

The intent of the Drop 2 reservoir is to salvage Colorado River water supplies that hitherto had been lost. As it now works, agricultural interests downriver from Lake Mead may request a water delivery. In response, water is released from Lake Mead to downriver farmers or irrigation districts. The released water, however, may take several days to reach its destination. Meanwhile changing conditions such as rain may result in customers cancelling their orders. Unclaimed by U.S. agricultural interests, the released water would then flow to Mexico; it is not counted against Mexico's legal allocation of 1.5 million acre feet.

The 8,000 acre-foot reservoir, which would be located in California about 25 miles outside Yuma, along the All-American Canal, would provide temporary storage until the water is returned to the system for use. Initially the Southern Nevada Water Authority was to pay the full \$172 million cost of the project and correspondingly receive more water. It later became a multistate venture when Nevada approached California and Arizona to share the costs of the project, with each state to contribute about \$30 million. Both states agreed.

The reservoir will conserve water for Nevada's use over the next two decades, with the state expecting to get 400,000 acre feet. Following that period, the additional water will benefit all water users in the lower basin states. The U.S. Bureau of Reclamation figures that operation of the reservoir will

### **The Nature Conservancy Sponsors Supplement**

This edition of the AWR includes a four-page supplement from The Nature Conservancy, titled *The Ecological Implications of Verde River Flows*. TNC's sponsorship of the supplement helps pay the expenses of newsletter publication. We appreciate the opportunity to work with TNC and the organization's generous support.

readily provide the 600,000 acre feet promised to the three lower basin states by 2036.

**Arizona's Drop 2 payoff**

Arizona's payoff for its investment is 100,000 acre feet of reservoir water, with the Central Arizona Project having access to the water for 20 years, between 2016 and 2036. This would be a propitious time for the state to receive an additional allocation since some projections indicate shortages may be occurring on the Colorado River at that time. If this should occur, Arizona will have additional Drop 2 Colorado River supplies to make up for allocations cut short due to a declared shortage.

Also to Arizona's benefit is that operation of Drop 2 will slow water declines in Lake Mead. The water level in Lake Mead is the prime deciding factor determining when a Colorado River shortage is declared. If the water level in Lake Mead drops to a level between 1,075 feet to 1,050 feet above sea level, Arizona's share of water would be reduced by about 320,000 acre-feet. If the level drops between 1,050 feet and 1,025 feet Arizona would lose approximately 400,000 acre-feet, with a more severe drop to 1,025 feet or lower, the state's reduction is about 480,000 acre-feet.

Whatever maintains Lake Mead levels above the critical trigger points therefore serves Arizona's water interest.

**Nevada's water needs drives projects**

Drop 2 is part of Nevada's strategy to take fuller advantage of Colorado River water. In a Dec. 20, 2006 ENS story reporting passage of legislation directing the U.S. Bureau of Reclamation to construct the Drop 2 reservoir, Pat Mulroy, general manager of the Southern Nevada Water Authority, is quoted as saying, "Like the Arizona and California water storage banks we have created, this new reservoir allows us to optimize our use of the Colorado River."

Mulroy is referring to a water banking agreement worked out in 2001 in which the Arizona Water Banking Authority stores sufficient supplies of Colorado River water to enable Nevada to pay for and earn 1.25 million acre feet of long-term storage credits. Nevada could then recover those credits at a later date by paying full price to CAP for delivery, storage and recovery of the stored water that would then go to CAP customers.

This would entitle Nevada, by exchange, to an additional amount of water from Lake Mead. In effect, AWBA would be storing Arizona's water in Arizona at Nevada's expense. In turn, Nevada would earn the right to withdraw additional supplies from Lake Mead.

Mulroy said this water banking agreement broke down interstate barriers and promoted common solutions to water supply problems.

**Drop 2 is unique**

The Drop 2 project is a component within the *Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead*, an agreement worked out by the seven Colorado River basin states. The agreement in effect formalized a plan to follow if Colorado River supplies should be reduced due to drought.

The agreement and its Drop 2 Project attracted high praise during the December signing ceremony. Interior Secretary Dirk Kempthorne said, "This is the most important agreement among the seven basin states since the original 1922 compact."

Kempthorne singled out Drop 2 for special notice. He said, "I am particularly impressed by the innovative approaches you have taken to conserve water, especially the construction project known as Drop 2. ... This is truly an innovative example of cooperation among states...that may help other states facing shortages meet their needs." 



## Water Vapors

### WRRC's Colorado River Conference Charts Currents of Law and Public Policy

What does John Wesley Powell's exploration of the Colorado River and the upcoming University of Arizona Water Resources Research Center conference have in common? Each in its way is a quest to understand the Colorado River.

Back in 1869 and 1872, John Wesley Powell's historic Colorado River expeditions braved treacherous currents and the unknown to explore, map and collect geologic data. "The Importance of the Colorado River to Arizona's Future" addresses contemporary issues relating to Arizona and the Colorado River. Instead of the heady drama of navigating the river, the conference will chart the unpredictable currents and cross-current of law and public policy.

The conference interest is historic rather than geologic time. The starting point is 80 years ago when the Boulder Canyon Project Act authorized Arizona's 2.8 million acre-foot allocation. Then, 40 years ago the Colorado River Basin Project Act authorized construction of the Central Arizona Project. The question posed by the conference is what can be expected in the next 40 years in Colorado River affairs. The conference is positioned at the crossroads between the Colorado River past and the future.

The WRRC conference, presented in collaboration with the Central Arizona Project, is scheduled for June 24 at the Arizona Biltmore Resort & Spa in Phoenix. Visit the WRRC web site, [www.cals.arizona.edu/azwater/](http://www.cals.arizona.edu/azwater/), to register or for additional conference information.

See page 12, the back page of the newsletter, for the conference agenda.

### WRRC Awards Internship; Plans Water Writing Contest

The goals of two WRRC competitions, one an internship competition, now completed with an intern selected, and the other a writing contest still in the planning stages,

is to increase water awareness on-campus and to encourage students to write about water issues in a way to interest the public. The WRRC is doing its part to help fill the need for good water and environmental science writers.

The Montgomery & Associates Summer Internship at the WRRC, inaugurated this year with the generous support of Errol L. Montgomery & Associates, Water Resource Consultants, will enable a university student to research and write an article addressing water and environmental science and policy. The intern will gain experience working one-on-one with WRRC staff members responsible for publication projects. The resulting article, intended for the general public, will be published as an *Arroyo*, the WRRC newsletter that focuses on critical Arizona water issues. Graduate and undergraduate students at Arizona state universities were eligible to apply. (See sidebar for profile of winning intern.)

Also, the WRRC is planning an annual writing contest, with students interested in water issues invited to submit papers to compete in the event. The purpose of the contest would be to encourage creative, interesting and thought-provoking articles

### Student Selected as Summer Intern

Claire Landowski has been awarded the 2008 Montgomery & Associates Summer Internship at the Water Resources Research Center. She was chosen from among a number of well qualified candidates. Ms. Landowski, an undergraduate student at the University



of Arizona, is majoring in geosciences and journalism. She has written for the *Arizona Daily Star*, served as news editor for a small monthly paper and traveled to Antarctica on a National Science Foundation grant. Her varied interests and experience eminently qualify her to take on the challenge of explaining the complexities of water science and policy to a wide audience. She says, "I hope I will be able to use the internship to pursue both geology and journalism and help narrow the gap between the science and non-science communities." The WRRC welcomes Ms. Landowski as its 2008 summer intern.

about water that demonstrate the author's analytical skills and imaginative powers. Articles would need to be suitable for use in publications of wide and general circulation, such as newspapers or magazines. The contest would be open to undergraduate students at Arizona state universities. More information will be available as plans develop.



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## News Briefs

### Prescott Valley's Auction Wins International Award

Prescott Valley's effluent water-rights auction, considered a groundbreaking, innovative strategy, achieved international recognition recently when London-based Global Water Intelligence presented Town Manager Larry Tarkowski its Water Deal with Distinction award. It is a second place honor.

Global Water Intelligence first recognized the Prescott Valley project when it published a story about the auction. In February, the publication notified Tarkowski that the town was nominated for an award and extended an invitation to him to present a paper at its April conference on Water, Finance and Sustainability 2008 at Whitehall Palace in London.

The other candidates in the running for the Water Deal of the Year award were Hyflux Water Trust IPO for its creation of a new water and wastewater investment

model in China; Jumeirah Golf Estates for incorporating treated wastewater in large-scale real estate developments in Dubai; and the Greensands consortium for purchasing Southern Water in England.

The award-winning auction was conducted Oct. 29-30, 2007 and attracted local and national interests. Water Property Investors LLC, a New York water investment firm and a wholly owned subsidiary of Water Asset Management LLC submitted the winning bid of \$24,650 per acre foot to acquire the water rights developed by the town through its wastewater treatment and recharge program. As the winning bidder, WPI purchased the 1,103 acre feet of water rights currently in the ground and available together with an option to purchase additional supplies as they become available, up to the 2,724 acre feet approved by the Arizona Department of Water Resources.

Water Property Investors LLC outbid a group of Prescott Valley developers for the water rights that must be put to beneficial use within the town.

### Coping With Drought — Motorboating on a Depleted Lake Mead



*But at best we have accommodated ourselves to nature's fickle realities. Our greatest asset is not necessarily our technology but our opportunism and endless capacity to adapt to circumstances. We must learn from the history of the great droughts and begin to think of ourselves as partners with, rather than potential masters of, the changing natural world. From a Los Angeles Times Op-Ed piece by Brian Fagan, emeritus professor of anthropology at UC Santa Barbara. Photo: U.S. Bureau of Reclamation*

### Home Cooling Systems' Water Use Figured

Once using an evaporative cooler or swamp cooler rather than an air conditioner was a point of pride, establishing that the user was environmentally conscious by committing to the more energy-efficient choice. Switching to air conditioning, an appliance that cools better but requires much more energy, would have been viewed as selling out.

That was then; now is now.

Swamp coolers have since fallen into disfavor due to their water use. An article in *Southwest Climate Outlook*, Sept. 2007 reports on the issue. The article refers to the



*For many homeowners it is not an either-or matter, either a swamp cooler or an air conditioner. They have installed both. Photo: Joe Gelt*

work of T. Lewis Thompson of the University of Arizona's Environmental Research Laboratory that found during summer conditions in Tucson (May - September) a swamp cooler working at 75 percent efficiency uses an average of 150 gallons of water per day. In comparison, air-conditioning units would appear to be models of water efficiency, not directly using any water in their cooling operations.

Their energy use, however, comes with a water cost, albeit an indirect water cost, that must figure into any comparison between swamp coolers and air conditioners. Generating energy requires water, an issue of increasing prominence. The article refers to work at the National Research Laboratory that found that hydropower, which supplies about 12 percent of Arizona's electricity, consumes about 65 gallons of water per kilowatt-hour generated; coal-fired plants consume about half a gallon of water for each kilowatt-hour of electricity produced.

The ERL analysis considered coal plant water use in figuring the monthly water consumption of an air-conditioning system cooling a 2,000 square-foot home; it came to 425 gallons. This same analysis was used to determine that a swamp cooler would use about 4,620 gallons.

Applying the same calculations but using water consumption of hydropower found that air-conditioners use 55,250 gal-

## Gila River Makes Most Endangered River List

*Arizona has role in New Mexico's claim on Gila River water*

The Gila River earned a dubious distinction recently when American Rivers included the river in this year's annual list of the most endangered rivers in the country. This is the third Arizona River in five years to achieve that distinction, although the proposed water diversion plan that is said to threaten the Gila would occur in the upper stretch of the river in New Mexico. American Rivers says the project "could deplete a desert Oasis."

Their water supply threatened, Arizona water users, located downriver from the proposed project, have an obvious interest in the issue. Environmentalists also are concerned.

From New Mexico into Arizona, the Gila River stretches 649 miles to its juncture with the Colorado River near Yuma. Along the way the Gila River undergoes great changes, its upper reaches a free-flowing river with cottonwood and sycamore and its flow in eastern Arizona sufficiently significant to be protected as the Gila Box Riparian National Conservation Area. The river then dries up as it journeys across Arizona, with little flow remaining below Coolidge Dam, southwest of Globe. The Gila has not reached the Colorado River in decades.

The American Rivers' designation is in response to conditions in the uppermost reaches of the Gila, an area where the free-flowing river is unobstructed by dams or reservoirs, at least for the present. Plans have been in the works to build a dam to divert water from the Gila and its tributary, the San Francisco River, to enable the state to claim about 14,000 acre-feet of water. Planning continued until last year when Gov. Bill Richardson announced that no dam would be built on the Gila as long as he remained in office.

The threat remains that a subsequent administration might re-

verse the decision.

Understanding New Mexico's claim to this share of the Gila River requires a look at the 1968 Colorado River Basin Project Act, the law authorizing the Central Arizona Project. Unbeknownst to many, the act also allocated 18,000 acre-feet of Colorado River water to New Mexico. Along with the allocation, a dam or suitable alternative was authorized in the upper reaches of the mainstem of the Gila.

New Mexico's CAP advantages might be viewed as compensation for previous neglect. In 1964, four years before CAP was authorized, the U.S. Supreme Court adjudicated states' use of water in the Colorado and Gila basins. The court allotted Arizona and California water based on future growth, without extending the same consideration to New Mexico, which was assigned the same amount it had been using as of 1957. The decision rankled New Mexico officials.

Payback came in 1968 when New Mexico's congressional delegation maneuvered to hold up the proposed CAP project until gaining various concessions including an allocation of Colorado River water. The allocation could then be exchanged for an equal amount of Gila River water that would otherwise flow into Arizona.

The 2004 Arizona Water Settlement Act, passed to resolve various CAP matters critical to Arizona including Indian water right issues as well as Arizona's federal CAP repayment obligation, also affirmed New Mexico's right to take Gila and San Francisco waters. Funding also was provided to pay for future water projects. These developments prompted American Rivers' concern for the health of the river.

lons of water per month and swamp coolers 20,745 gallons.

Obviously homeowners wanting to determine the comparative water use of a swamp cooler and air conditioner would need to know the source of energy in areas in which they live. For example, coal fired plants supply most of Tucson's energy needs.

### Town Seeks Legislation to Remedy Illegal Drilling

The town of Williams erred when it drilled a well to transfer water from one groundwater basin to another, a transfer that a 1993 Arizona state law does not allow. Officials say it was an honest mistake that fell through regulatory cracks when the Arizona Department of Water Resources approved the drilling.

The mistake was costly, with the town spending \$13 million or more than \$4,000

per person to drill the misplaced well. Drilling occurred between 1999 and 2003 before the town became aware of its mistake in August 2007.

Water pumped from the Williams' well does not fall into the same category as water over dam which, according to folk wisdom, has an over-and-done quality about it. Pumping the water violated the law, and the city is looking to legislation to retroactively resolve the issue. The bill, which is making its way through the Legislature, would grandfather Williams' use of water drilled from the well for an emergency. The bill's sponsor Rep. Lucy Mason, R-Prescott, says the bill is intended as a good neighbor gesture, to provide relief to a community in a difficult situation.

Others don't agree, arguing that seeking a legislative bailout after violating state water law sets a bad precedent. The issue has gained added prominence because of concern that the deep well may have penetrated

the Redwall Limestone, a water source for streams in the Verde Valley.

Arizona Department of Water Resources Director Herb Guenther testified that many well locations are not clearly defined, and there is no way to verify that a production well is located in the groundwater basin to be pumped. Department strategies to remedy the situation include requiring well drillers to use a global positioning system to locate wells and attempting to digitize basin boundaries. ADWR supports the legislation, saying it is needed to correct a department error.

Taking the opposite view, the Sierra Club opposes the legislation because of its potential impact on water supplies and water law. The Sierra Club testified that, in effect, the bill's passage would codify a mistake. It suggested a provision be included to allow the transfer only if it can be demonstrated that no harm would result to the Verde River.



## Guest View

### Citizen Scientists Serve Vital Role in Gathering Water Information

*Some water professionals, however, are wary of data collected by volunteers.*

*Gary Woodard, associate director of SAHRA (Sustainability of semi-Arid Hydrology and Riparian Areas), University of Arizona, contributed this Guest View.*

For water resource managers seeking data, these are the best of times and the worst of times. Never before has so much data been available; never before has the need for more data been as acute.

This apparent contradiction stems from two factors. First, Arizona's growing population and economic development are increasing municipal water demands. A resurgent copper industry, growing electricity demand, and a desire to preserve remaining surface water flows and their riparian ecosystems are creating new water demands as well.

These new and growing demands have triggered the need for more intensive water resources management. Researchers have responded with improved scientific understandings, better physical models that integrate relationships between atmosphere, land surface, surface water, and groundwater at the basin scale, and sophisticated decision support systems. But these new management tools are data hungry. And many key components of basin-scale water budgets remain largely unknown, such as aggregate precipitation, soil moisture, ET, and pumpage from the state's 100,000 exempt domestic wells.

Simply put, improved water management requires more water data.

Second, global change researchers have declared the end of stationarity, the fundamental assumption underlying water resource planning. Climate change, and land cover changes triggered by development and climate change, will alter patterns of precipitation, runoff, surface flows, and recharge. Calculations based on historical data about where the flood plain is, and what constitutes an assured water supply, may be seriously in error. What is certain is that in a non-stationary world, more observations and long-term, continuous observations are critical.

Simply put, our historic data are, at best, less predictive of the future; at worst, they are dangerously misleading.

Increasingly, researchers conducting field-intensive studies with limited resources are recruiting citizen scientists to gather critical data at low cost. Networks of volunteers also can make qualitative observations of changing environmental conditions that require human observers, and they often become effective advocates for research.

The number and diversity of citizen science networks has increased sharply in recent years. For example, RainLog.org was created by the University of Arizona's SAHRA Center and Cooperative Extension in 2005 to gather monsoon data in the Upper San Pedro for researchers developing a watershed model. Since then, it has expanded enormously in numbers and geographic coverage. Today,

over 1,400 active RainLoggers across Arizona report precipitation from backyard gauges.

The uses of RainLog data have multiplied as well, and now include urban runoff researchers, watershed modelers, drought monitors, weather reporters, master watershed stewards and K-12 educators. In addition, over 2,400 homeowners subscribe to RainMapper.org, a service that provides neighborhood-specific precipitation estimates.

We designed RainLog, to sit at the intersection of three trends: growing numbers of potential volunteers, inexpensive instruments capable of gathering research-quality data, and increasingly ubiquitous high-speed internet access. Citizen scientists are recruited, educated as to the scientific issues being addressed, provided with basic information on how to make observations, and shown how to report those observations.

Successfully recruiting and retaining hundreds of volunteers requires a seamless system of gauges, web apps, databases and user support that is flexible, scalable, reliable, low-cost, and easy to use. Retention also requires that volunteers receive positive feedback, including communication with researchers, seeing their data entered into research databases and graphically visualized, and receiving regular updates on the progress of the research and its implications for society.

Despite the apparent success of RainLog and other citizen science networks, there is a fly in the ointment. Some water professionals are reluctant or unwilling to use data collected by volunteers. And there is no denying that data collected citizen scientists inherently have potential problems.

In any of citizen science network, the level of training received by volunteers and the type of instruments used to collect data can vary widely. Some experienced volunteers may need very little training to correctly collect and report data, while others may need more extensive, hands-on training. Our RainLoggers range from retired Weather Service staff and irrigation district employees to middle schools students and a troop of Brownies.

Volunteers often are allowed, even encouraged to select their own instrument based on personal preference and affordability. Some 57 percent of RainLoggers have large, wedge-shaped gauges, and 16 percent have tipping buckets, but a few use tuna fish cans or jelly jars. This heterogeneity in volunteers and instruments within a network may result in significant reporting biases that decrease confidence and utilization of the data for some purposes.

RainLog.org is addressing these concerns by systematically investigating five significant QA/QC issues that apply to many other volunteer data collection networks: 1) instrument siting may be sub-optimal; 2) gauges vary in accuracy and precision; 3) experience and skill of observers varies; 4) missing data are not randomly

*Continued on page 10*



## Legislation and Law

### Bill Mandates Dishwasher, Clothes Washer Water Efficiency

The recently passed Energy Independence and Security Act, H.R. 6, breaks new ground by establishing for the first time minimum national water efficiency standards for residential clothes washers and dishwashers.



The result of negotiations between appliance manufacturers and efficiency advocates, the standards set water use for standard-sized dishwashers manufactured after Jan. 1, 2010 at 6.5 gallons per cycle and compact dishwashers at 4.5 gallons per cycle. Residential clothes washers manufactured after Jan. 1, 2011, must meet a maximum water factor of 9.5.

Further, the new law leaves the door open for even stronger efficiency standards for clothes washers and dishwashers by directing the Department of Energy to undertake new rule

making to consider such standards. If approved by the Secretary, the standards would take effect in 2015 and 2018 respectively. This is first time a law required the department to consider any new standards for clothes washers and dishwashers.

With the new standards in place, clothes washers are expected to rack up a significant proportion of the new law's water savings. Consider: Seventy percent of today's sales that are top-loaders have an average water factor of about 11.5. Beginning in 2011, the water factor will be reduced to 9.5. The resulting potential water savings is substantial. It is anticipated that each year's production of clothes washers with the mandated 9.5 water factor will save over a 40 million gallons per day. If stretched out over four years, the water savings would be about 175 mgd.

A potential exists for further savings. Water conservation advocates say it is possible that DOE rulemaking, to be completed by December 2011 and take effect in January 2015, will mandate a water factor of 8.0 or less. They consider this very good news since a 8.0 water factor would boost water savings by over 75 mgd per year to nearly 650 mgd by the end of 2020 — or about 1.5 percent of recent U.S. total annual public water supply withdrawals.

Also to the liking of water efficiency advocates is a provision in the bill that gives the Secretary of Energy the authority to adopt new or revised efficiency standards on an expedited basis if multi-stakeholder groups, including manufacturers, states, and efficiency advocates propose such standards. Some are heartened by the provision they believe will expedite DOE's rulemaking process and overcome the agency's reluctance to view water efficiency as a rulemaking priority.

The bill also includes a provision directing energy managers of

federal facilities to complete comprehensive energy -and-water-use evaluations of all federal facilities every four years. Within two years of the evaluations, all energy-and-water-saving measures found to be life-cycle cost-effective are to be implemented. Further, permanent authority is granted to federal agencies to enter into new energy-and-water-saving performance contracts for federal facilities. Up to now sunset provisions had required congressional action to periodically extend such authority. Federal agencies now have greater freedom to improve energy and water efficiency.

### Chandler's \$100 Rebate Promotes Water-Efficient Washers

Chandler residents now have an added incentive to purchase a high-efficiency washing machine. Not only will they experience a do-good glow of satisfaction from adopting new water-saving ways, but they also will be eligible for a \$100 rebate.

The City Council approved the rebate plan to begin April 1. The water-saving payoff was considered substantial enough to justify the rebate, with estimates that a high-efficiency washer will save about 7,000 gallons of water a year. The water-saving front-loading washers use as little as 12 gallons per load; conventional models typically require 39 gallons.

Another factor not to be overlooked when Chandler residents consider the rebate offer is that the City Council had recently raised water rates.

Cathy Rymer, water conservation coordinator, says, "The Council approved the program for basically two years. Next year after we have at least eight or nine months worth of data we will go back to Council and brief them on how the program is going."

She says, "It is really hard to know how popular this is going to be but in our budget we estimated that 500 rebates would be issued each year. That is our target."

Rymer says that a rebate applicant must be a Chandler water utility customer and be replacing an existing washer with a more efficient machine. Regarding the latter qualification Rymer says "We really do not have any control over that. It is one area we are on the honor system, but in any case they will be saving water using the efficient washer."

She says, "We are asking they purchase a washing machine with a water factor of 6 or less. Not all the machines on the CEE or the Energy Star lists qualify. We needed to help some of the sales people understand that."

The final step is an on-site inspection to ensure the purchased washer is in fact being installed at that location and that the model number matches the number on the receipt.

Water efficient washers range generally from \$600 all the way to \$2,000 for a more deluxe model; the models that are more lavish in their water use generally cost from \$350 to \$500.

Other features of the high efficient machine that will appeal to the savvy consumer is that they save time and electricity by extracting more moisture, thus resulting in less time in the dryer, and they have larger load capacities.

Chandler is the first Valley city to offer such rebates, although the mountain communities of Flagstaff and Payson offer them.



## Publications & On-Line Resources

### River Restoration is Topic of Two Recent Publications

*Two recent publications discuss river restoration projects, one focusing at the state level and the other taking a regional perspective.*



#### Arizona Perspective

Like rivers in the state, which vary in length, flow and quality, river restoration projects in Arizona vary greatly in size, scope and complexity. A recent Water Resources Research Center publication, *River Restoration: Arizona's Oft Neglected Waterways Get Overdue Attention*, provides an overview of river restoration activities in the state. Projects included for discussion represent various types of efforts undertaken

in the state, ranging from the individual efforts of ranchers to the complex Lower Colorado River Multi-Species Conservation program; from urban to back country projects; and from projects sponsored by tribal, local, state, and federal entities to work by The Nature Conservancy. Acknowledging that many Arizona rivers have suffered neglect, the publication also illustrates that many rivers are now benefitting from creative efforts to restore and enhance them.

The publication is part of the *Arroyo* series and is available at the WRRRC web site <http://cals.arizona.edu/AZWATER/>. Hard copies are available by contacting WRRRC; phone, 520-792-9591; email, [wrrrc@cals.arizona.edu](mailto:wrrrc@cals.arizona.edu)

#### Regional Perspective

The focus of the report, *Restoring Rivers in the West*, is on the Rocky Mountain states. Background information, however, is relevant to the larger national picture. The report discusses recent federal developments affecting restoration planning, mentioning, for example, that in 2007, Congress allocated \$39 million for road removal projects in national forests, including land in the Rockies, specifically to restore storm-damaged watersheds and fisheries. Impediments to restoration that are identified include inconsistency of state laws and state data collection. Case studies are provided that report on various river restoration projects in the West. The report ends on an optimistic note stating, "Rivers are the life of the dry Rocky Mountain West. By refocusing the attention of resource management in the Rockies to emphasize restoration — particularly of the region's precious waterways — we may find that the legacy of mining, damming, and road-building can translate into the economic boom of the future. Only this time, the boom could benefit the environment rather than leave it in need of repair."

The report is a chapter within Colorado College's 2008 Colorado College State of the Rockies Report Card and is available online at <http://www.coloradocollege.edu/StateoftheRockies/reportcard.html>

#### *Crypto Creature...continued from page 1*

public and those that don't test to start soon. Some called for a more active federal role in testing and upgrading water treatment plants. Illinois announced the start of a water testing program, and the New York City Council held an emergency hearing. Pharmaceutical industry officials announced an initiative focused on informing Americans how to safely dispose of unused medicines. Senate hearings were scheduled to assess risk and consider national remedies.

In Arizona, the cities of Phoenix and Scottsdale heeded the call and announced they would begin testing drinking water supplies for pharmaceuticals. Phoenix Mayor Phil Gordon said, "We read the AP story and made a determination that we should test our water and be transparent, just let the people know what we find."

AP's director of media relations said many government and academic researchers "are thanking AP for sounding an alarm and bringing the situation to the attention of millions of Americans."

The odd, and to some the discouraging fact is that the presence of pharmaceuticals in water supplies is not unknown to water researchers and many public officials; the issue has attracted much concern, study and research. Whatever awareness the public has of the issue, if any, did not raise undue concern, however, until AP published its articles. Through newspaper exposure the concern achieved

celebrity status and became the talk of the town, a cause célèbre. The public then took note, and red flags were raised throughout the land.

Apart from the fact that pharmaceuticals are present in water supplies — a serious and urgent concern — another issue is at stake here, one that researchers and public officials have long pondered: What must be done to attract public attention to an important water issue? The public response to the AP article is no doubt the envy of many university researchers working diligently in labs with the hope that their work will get some public attention and make a difference in the world.

When it comes to water issues — and many other kinds of issues as well — a gap often exists between the people in the know and the people needing to know. Bridging that gap is a serious challenge. Relying on newspapers comes with some risks — inaccuracy, distortions and sensationalism among them — although no gainsaying that newspapers can play a powerful role in helping to get word out about important issues, such as pharmaceuticals in drinking water.

It would undoubtedly be to the advantage of water professionals if, in some way, they could take a more active role informing the public about important issues, a prescription that is admittedly easier said than done. ■



## Special Projects

### WRRC 104(b)-Funded Research Projects Report Results



The University of Arizona Water Resources Research Center administers Section 104(b) of the Water Resources Research Act, funded by the U.S. Geological Survey. Funds support small research projects that focus on state and regional water issues, reflecting the WRRC mission of promoting understanding of critical state and regional water management and policy issues. Only faculty at Arizona state

universities are eligible for 104(b) funding. Following are brief descriptions of recently completed 104(b) projects funded in 2007.

*Riparian Vegetation Response to Cessation of Groundwater Pumping, Lower San Pedro River, Arizona, Principal Investigators: Gabrielle Katz, Juliet C. Stromberg, Arizona State University*

This research examines the results of a river and riparian restoration project implemented by The Nature Conservancy of Arizona on the lower San Pedro River. The Conservancy removed ecosystem stressors (groundwater pumping, livestock grazing) but did not conduct any direct riparian manipulations (e.g., planting or channel modification).



*A non-perennial reach of the Lower San Pedro River, vegetated by Tamarix and other drought-tolerant riparian shrubs. Photograph by Gabrielle Katz.*

The restoration project was conducted at two farms on the lower San Pedro River, where irrigation pumping was stopped to allow groundwater levels to recover, and riparian zones were fenced to exclude livestock. Our goals were to describe target conditions for restoration (defined as conditions typical of perennial-flow sites), and to assess changes at the restoration sites in comparison to these targets. To this end, we tracked groundwater levels, occurrence of surface flow, and characteristics of the streamside herbaceous vegetation (plants growing alongside the low-flow stream channel) for five years. We have six study sites at the restoration farms, and six comparative reference sites located elsewhere along the river.

*Modification of Conventional Wastewater Treatment Processes for Estrogen Removal, Principal Investigators: David M. Quanrud, Robert G. Arnold, Martin Karpisak, University of Arizona*

This project compared the efficiency of two full-scale municipal

wastewater treatment plants, a membrane bioreactor and an activated sludge plant, to remove estrogenic activity from wastewater. Removal of estrogenic activity was more efficient in the membrane bioreactor than at the activated sludge plant. Estrogenic activity remaining in plant effluent from the membrane bioreactor and activated sludge plants represented 2 percent and 30 percent of the influent levels, respectively. Removal efficiency of total estrogenic activity paralleled expectations based on general plant performance indices. That is, plants that best removed biochemical oxygen demand and suspended solids also removed more estrogenic activity. At both plants, concentrations of estrogenic activity in sludge were less important than in effluent, although estrogenic activity in sludge did increase after anaerobic digestion.

*Compound Specific Isotope Analysis of Natural Attenuation Activity in Chlorinated-Solvent Contaminated Aquifers, Principal Investigator: Mark Brusseau*

In Arizona, chlorinated solvents, including tetrachloroethene, trichloroethene, dichloroethene, and vinyl chloride, are the primary contaminant at 43 of 48 state and federal Superfund sites. Recently, monitored natural attenuation, a process that uses intrinsic transformation and retention processes while carefully monitoring contaminant conditions to control and shrink groundwater plumes has come into favor as a low-cost approach for site remediation. One key step in the implementation of this promising technology is the demonstration that natural attenuation processes are occurring at a hazardous waste site. This project used compound specific isotope analysis, a relatively low-cost and rapid analytical method, to demonstrate that biodegradation of chlorinated solvents is occurring at the Park-Euclid State Superfund site.

*Sources of Nitrate in Groundwaters of the Tucson Basin, Principal Investigator: Thomas Meixner*

Since understanding the mechanism of contamination is the first step to understanding how to solve any contamination problem, significant efforts have been expended in the past to understand the sources and mechanisms of nitrate contamination in groundwater. This project will utilize two differing flow path transects within the Tucson basin to investigate the sources of nitrate to groundwater in the Tucson basin. The research has three objectives 1) Use geochemical and isotopic techniques to quantify groundwater sources; 2) Quantify nitrate isotopes to connect groundwater nitrate to various nitrate sources and sinks; and 3) Develop conceptual model of nitrate sources and processes along the two flowpaths using results of first two objectives and existing nitrate and groundwater geochemical data. To achieve these objectives we will collect water along two flowpaths using Tucson Water wells. Samples from each transect will be analyzed for major geochemical composition and sulfur, water and nitrate isotopes. These suites of geochemical and isotopic analyses should allow us to partition the reasons for nitrate variability in Tucson groundwater between water sources, biogeochemical sinks and mixing. ■



## Announcements

### NM Water Institute Hosts Technical Seminar

The New Mexico Water Resources Research Institute will be sponsoring a one-day technical symposium on August 12 at Macey Center, New Mexico Tech, Socorro. Its annual symposium attracts water experts including researchers from academic institutions, national laboratories, state and federal agencies, private firms and students from throughout the Southwest. Brief presentations will be made and posters displayed. For questions regarding the symposium call Cathy Ortega Klett at 575-646-1195 or check the WRRRI web site: <http://wrrri.nmsu.edu>

### Call for Abstracts: Water Efficiency Conference

Forester Media, Inc. is accepting abstracts for its first International Water Efficiency Conference scheduled for Mar. 30 to April 3, 2009 at Newport Beach, California. The conference is to reflect Water Efficiency magazine's commitment to providing a venue where water efficiency and conservation professionals can convene to get

advice, share success stories, and ultimately work for fair, equitable, and cost-effective water distribution. Anyone fitting under the twin umbrellas of water conservation and water efficiency is invited to share information, trade ideas, and examine and compare water-related products. Deadline to submit abstracts is Aug. 4. For additional information check: [http://waterec.net/wec\\_call\\_papers.html](http://waterec.net/wec_call_papers.html)

### Conference: Watersmart Innovations

A WaterSmart Innovations Conference and Exposition will be held in Las Vegas, Oct. 8-10. Presented by the Southern Nevada Water Authority in conjunction with the U.S. Environmental Protection Agency's WaterSense Program, the conference's goal is to broaden the knowledge of innovations in urban water efficiency and water conservation including products, programs and outreach. Education and training tracks at WaterSmart Innovations include alternate sources; drought management; plumbing, appliances and fixtures; code, policy and rates; conservation and incentive programs; construction and development; education; landscapes; utility and infrastructure; innovation marketplace; marketing and outreach; and special topics. To register and for additional information check: [www.WaterSmartInnovations.com](http://www.WaterSmartInnovations.com)

#### *Guest View...continued from page 6*

distributed; and 5) volunteer networks may exhibit clustering

While the research is ongoing, we have reached some preliminary conclusions. First, gathering metadata on volunteers and their instruments can help spot problems and allow for adjustments and corrections. For example, a tipping bucket gauge that tips every 1 mm (0.04") will under-record rain by an average of 0.02" per event. Central Tucson averages 75 events per year, meaning that uncorrected data will under-report annual precipitation by about 1.5", or 12 percent.

Second, if the network is dense and the time series is long enough, interpolating rainfall amounts for points within a volunteer network can be a highly useful way to identify suspect data. Large, persistent deviations between reported rainfall amounts and interpolated values using nearby gauges can be evidence of suboptimal instrument siting, inaccurate instruments, or data reporting errors. Often, patterns in the deviations will suggest the likely source of error.

Recent research by Garcia, Peters-Lidard & Goodrich (Spatial interpolation of precipitation in a dense gauge network for monsoon storm events in the southwestern U.S., 2008, Water Resources Research special issue, "50 Years of Walnut Gulch") has shown that the standard one-over-distance-squared ( $1/d^2$ ) interpolation approach is inappropriate for convective storms such as monsoon events. Weighing by one-over-distance-cubed ( $1/d^3$ ) produces a better fit, but both approaches fail when the instrument network has clusters of gauges. Volunteer networks

often exhibit such clustering due to volunteers recruiting their neighbors.

A multiquadric biharmonic (MQB) interpolation approach fits well and is impervious to clustering. Unfortunately, MQB imposes major computational requirements for large networks that vary over time. Volunteer networks vary constantly, and the Tucson basin alone has over 500 active volunteers. Thus, we are working to develop a modified MQB approach that uses only the nearest few dozen gauges to interpolate each point.

A final conclusion is that even official networks of expensive gauges are not immune to QA/QC issues. Some networks of rain gauges are largely co-located with stream gauges, putting them in topographical low spots. Others are located near trails in mountainous areas, resulting in most of them being on or near ridgelines. Gauges for flood warning purposes selected to work reliably in heavy downpours and strong wind gusts may under-report precipitation in moderate events. And while clusters of gauges are rarely seen in official networks, strings or filaments are, and these raise interpolation issues as well.

The bottom line is, we need all the data we can get, from official gauges, remote sensing, and networks of volunteer citizen scientists. The challenge is to identify potential sources of bias and error in each type of data, employ automated methods for data screening, and develop better approaches for incorporating different types of data into our models and forecasts. QA/QC methodologies are fairly well developed for data from official gauges and remote sensing instruments. Developing similar approaches for data from citizen scientists is doable and should be a priority. ■



## Public Policy Review

by Sharon Megdal

### Study Raises Issues to Consider in Fourth Management Plan

*Fourth Management Plan is next GMA milestone.*



We are at a critical juncture in water management in Arizona. We are increasingly relying on known renewable water supplies, particularly Central Arizona Project water. Meanwhile drought continues, and the effects of climate change on our water supplies is unknown. Also uncertain is the amount of water to be reused and for what purposes. The 1980 Groundwater Management Act provides

a framework for groundwater regulation, but, interestingly, regional planning within the Active Management Areas is not mandated. Nor does the GMA address surface water management or regulation of effluent utilization. Further, the GMA offers no assistance to non-AMA areas of the state in any efforts they may undertake to address water management challenges.

In its focus on groundwater management and regulation, the GMA scored some notable results. The act included a management goal for each AMA; mandated an assured water supply program; limited the expansion of agriculture; and required a series of management plans. Amendments later added the very important storage and recovery program. The major requirement for the management plans is conservation programs for each of the major water using sectors — municipal, industrial and agricultural. Conservation programs are considered an important water management tool.

The Arizona Department of Water Resources, the agency responsible for implementing and enforcing the groundwater code, is gearing up for the stakeholder process involved in developing the Fourth Management Plans for each of the five AMAs. What should the Management Plans include? The GMA offered specific direction for the first three Management Plans, particularly relating to their increasing stringency. The law, however, provides far less guidance regarding strategies the fourth and fifth plans would apply to advance the management goal of each AMA. Is that because the framers of the GMA thought we'd be close to achieving the goals by then? Or did they not want to presume what tools would be needed almost 30 years after passage of the GMA? A recent study by Northern Arizona University Professor Zachary Smith, University of Arizona Research Assistant Aaron Lien and me sheds some light on these questions.

The Arizona Department of Water Resources joined with the Arizona Water Institute to fund the study, *Evolution and Evaluation of the Active Management Area Management Plans*. Our research examines the management plans to date for all of the AMAs and includes numerous stakeholder interviews. Framers of the GMA indicated they viewed the management plans as a vehicle for achieving some degree of centralized control to ensure groundwater conservation. They acknowledged the need to provide time for groundwater users to adjust to the new paradigm of water regulation in the AMAs. Management periods were developed allowing for progress toward

management goals over time through conservation, augmentation, reduction in the amount of groundwater used for irrigation, and use of the best available conservation practices. They also indicated that the requirements for the Fourth and Fifth Management Periods were purposely left vague to allow maximum flexibility.

Also interviewed were many water stakeholders, including current and former ADWR staff. An initial study objective was to determine if the effectiveness of the management plans to date could be assessed using data from the management plans themselves. Unfortunately, we were unable to achieve this objective because the information in the management plans is insufficient to gauge effectiveness.

We did find stakeholders holding strong opinions about the conservation programs and the process used to develop them. Overall, the general opinion is that the time has come to shift the management plan focus from regulation toward collaborative, long-term water planning. Many preferred the management plans to be actual planning documents to be implemented, rather than just a set of conservation regulations. If ADWR were to facilitate long-range planning for the AMAs, some shared governance or oversight of the process of plan development would likely have to be agreed upon.

Our study concluded with the following recommendations: ADWR should provide water use data for all sectors on at least an annual basis, with the data reported in a consistent format over time and across AMAs; State of the AMA reports should be produced on a yearly or biennial basis; ADWR should shift its focus to long-term water planning, but still maintain the current conservation programs; and Augmentation and Recharge Program and the Central Arizona Groundwater Replenishment District rules need to be reviewed and updated to ensure fairness.

The report is available at [http://ag.arizona.edu/azwater/publications.php?rcd\\_id=54](http://ag.arizona.edu/azwater/publications.php?rcd_id=54).

I will conclude by looking beyond our study which did not consider in its scope the management goals themselves or progress toward achieving them. The safe-yield AMAs were given a 45-year time horizon to meet their goal. (The Pinal AMA is the only AMA that does not have a safe-yield goal.) The GMA actually only requires an attempt to balance groundwater withdrawals with natural and artificial recharge, with no penalties imposed for failure to achieve safe-yield. Safe-yield is calculated on an AMA-wide basis.

As the 45-year timeline draws to an end, the AMAs need to understand their position relative to their long-term water management goals. In addition, collective discussions should either reaffirm the goals or suggest modifications to them. The development of the Fourth Management Plan may provide an opportunity to consider these big picture issues. Encouraging a full and open discussion of the issues helps ensure that regional water planning will proceed on a firm and solid footing. ■

**The Importance of the Colorado River for Arizona's Future**  
 Annual Conference of the Water Resources Research Center - Tuesday, June 24, 2008  
 Arizona Biltmore Resort & Spa, 2400 East Missouri Ave., Phoenix, Arizona

**AGENDA**

- 7:30 – 8:30 Registration and light breakfast
- 8:30 – 8:40 **Welcomes:** Sharon Megdal, Director, WRRC and Sid Wilson, General Manager, CAP
- 8:40 – 9:40 **Looking at the Past; Looking Toward the Future**  
 A Report from 1968, Marvin Cohen, Attorney, Sacks Tierney P.A.  
 A Report from 2048, Tom McCann, Resource Planning & Analysis, CAP
- 9:40 – 10:45 **Where and How Will the Water Be Used in 2048? Part I**  
 Moderator: Sid Wilson, General Manager, CAP  
 Gila River Indian Community, Governor William R. Rhodes  
 Tohono O'odham Nation, Chairman Ned Norris, Jr. (Invited)  
 State Land – What State Land will be developed by 2048? Commissioner Mark Winkleman, State Land Department  
 The CAGR – What will the 2044 Plan of Operation look like? Susan Bitter Smith, Board President, CAP
- 10:45 – 11:00 Break
- 11:00 – 12:00 **Where and How Will the Water Be Used in 2048? Part II**  
 Moderator: Sid Wilson, General Manager, CAP  
 Yuma County, Wade Noble, General Counsel, Wellton-Mohawk Irrigation & Drainage District  
 Mohave County, Maureen George, General Counsel, Mohave County Water Authority  
 Pima County, Chuck Huckelberry, County Administrator, Pima County  
 Pinal County, David Snider, Supervisor, Pinal County  
 Maricopa County, Ray Jones, Chairman, WESTMARC
- 12:15 – 1:15 Lunch: Keynote Address  
**An Overview of West-Wide Water Challenges**  
 Commissioner Bob Johnson, U.S. Bureau of Reclamation
- 1:30 – 2:30 **Addressing Uncertainties Associated with Drought and Climate Change: The 40 Year Outlook**  
 Moderator: John Hoffmann, Director, USGS Arizona Water Science Center  
 Arizona Water Banking Authority and Shortage Sharing, Herb Guenther, Director, ADWR  
 Lower Colorado River Flow Modeling, Terry Fulp, Deputy Regional Director, U.S. Bureau of Reclamation  
 Water Management Adaptation Considerations, Kathy Jacobs, Executive Director, Arizona Water Institute
- 2:30 – 3:00 **Desalination and Public-Private Partnerships**  
 Michael Tramer, President, Ambient Technologies, Inc.
- 3:00 – 3:15 Break
- 3:15 – 4:15 **The Environment as a Water Using Sector: The 40 Year Outlook**  
 Moderator: Sharon Megdal, Director, WRRC  
 The Lower Colorado River Multispecies Conservation Program, Lorri Gray, Regional Director, U.S. Bureau of Reclamation  
 The Delta, Francisco Zamora, Program Director, Sonoran Institute  
 General Environment, Sandy Bahr, Director: Conservation Outreach, The Sierra Club
- 4:15 – 4:45 **Wrap Up and Audience Discussion**