

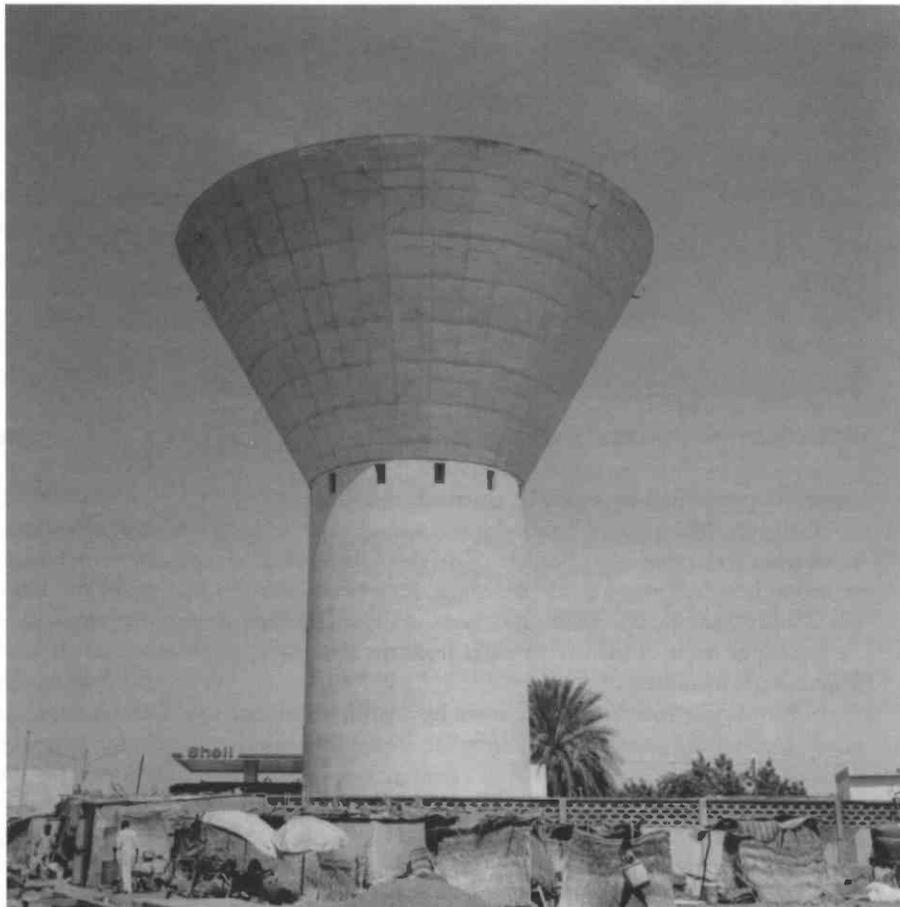
## Court Backs Indian Groundwater Claims

*Will Action Broaden ESA Enforcement?*

Officials ponder the implications of the Arizona Supreme Court's recent ruling that Indians' rights to groundwater trump the state-granted rights of cities, mines and others. Most agree that the Indian water rights cause will undoubtedly be well served, but some speculate that the decision also will provide a strategy to expand enforcement of the Endangered Species Act.

In a unanimous decision, the justices rejected the premise that state laws have precedence in determining who may pump from underground aquifers. The court noted that "some Indian reservations have been entirely dewatered by off-reservation pumping." Allowing wholesale groundwater pumping to continue — even if state law allows it — would undermine the tribes' reserved claims, the high court stated. State groundwater law therefore does not apply when it conflicts with federal reserved water rights according to the court.

*continued on page 12*



*The above photograph shows a water tower in the African nation of Mali. The photo was part of an exhibit titled, "Africa: Photographs by Lynn Davis," shown at the University of Arizona's Center for Creative Photography.*



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## Global Water Shortage Looms In New Century

When most U.S. citizens think about water shortages — if they think about them at all — they think about a local problem, possibly in their town or city, maybe their state or region. We don't usually regard such problems as particularly worrisome, sharing confidence that the situation will be readily handled by investment in infrastructure, conservation, or other management strategies. Whatever water feuds arise, e.g., between Arizona and California, we expect to be resolved through negotiations or in the courtroom.

But shift from a local to a global water perspective, and the terms dramatically change. The World Bank reports that 80 countries now have water shortages that threaten health and economies while 40 percent of the world — more than 2 billion people — have no access to clean water or sanitation. In this context, we cannot

*continued on page 2*

## Book Says Irrigation Miracle Ending

Sandra Postel's book, "Pillar of Sand: Can the Irrigation Miracle Last?", explores 8,000 years of irrigation history and discusses whether irrigation can feasibly be used to feed the world's population as it approaches seven billion. The dramatic increase in population is accompanied by depletion of groundwater supplies, inadequacy of surface water supplies, salination of land, and conversion of agricultural land to other uses. None of these developments is conducive to irrigated agriculture. Meanwhile growers maintain the status quo because it is uneconomical to invest in major new water schemes. According to the author the problem of food supply will not be solved by increasing agriculture acreage or productivity since water is the limiting factor. The book includes many charts and graphs that show increases in irrigated acreage, changes in water supplies, etc.

### Water Shortage...continued from page 1

expect water conflicts to always be amenablely resolved.

Consider: More than a dozen nations receive most of their water from rivers that cross borders of neighboring countries viewed as hostile. These include Botswana, Bulgaria, Cambodia, the Congo, Gambia, the Sudan, and Syria, all of whom receive 75 percent or more of their fresh water from the river flow of often hostile upstream neighbors.

In the Middle East, a region marked by hostility between nations, obtaining adequate water supplies is a high political priority. For example, water has been a contentious issue in recent negotiations between Israel and Syria. In recent years, Iraq, Syria and Turkey have exchanged verbal threats over their use of shared rivers. (It should come as no surprise to learn that the words "river" and "rival" share the same Latin root; a rival is "someone who shares the same stream.")

More frequently water is being likened to another resource that quickened global tensions when its supplies were threatened. A story in *The Financial Times* of London began: "Water, like energy in the late 1970s, will probably become the most critical natural resource issue facing most parts of the world by the start of the next century." This analogy is also reflected in the oft-repeated observation that water will likely replace oil as a future cause of war between nations.

Global water problems are attracting increasing attention, not just at the international level, but also within the United States, in its popular press, in natural resource journals and as the subject of books. Former Sen. Paul Simon from Illinois recently authored *Tapped Out: The Coming World Crisis in Water and What We Can Do About it*. A book for the general, non-specialized audience, Simon's publication sounds an alarm about the approaching crisis. "Within a few years, a water crisis of catastrophic proportions will explode upon us — unless aroused citizens ... demand of their leadership actions reflecting vision, understanding and courage."

A prime cause of the global water concern is the ever-in-

creasing world population. As populations grow, industrial, agricultural and individual water demands escalate. According to the World Bank, world-wide demand for water is doubling every 21 years, more in some regions. Water supply cannot remotely keep pace with demand, as populations soar and cities explode.

Population growth alone does not account for increased water demand. Since 1900, there has been a six-fold increase in water use for only a two-fold increase in population size. This reflects greater water usage associated with rising standards of living (e.g., diets containing less grain and more meat). It also reflects potentially unsustainable levels of irrigated agriculture. (See sidebar.) World population has recently reached six billion and United Nation's projections indicate nine billion by 2050. What water supplies will be available for this expanding population?

Meanwhile many countries suffer accelerating desertification. Water quality is deteriorating in many areas of the developing world as population increases and salinity caused by industrial farming and over-extraction rises. About 95 percent of the world's cities still dump raw sewage into their waters.

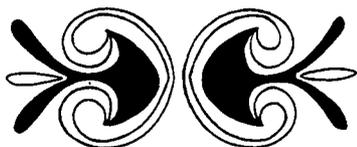
Climate change represents a wild card in this developing scenario. If, in fact, climate change is occurring — and most experts now concur that it is — what effect will it have on water resources? Some experts claim climate change has the potential to worsen an already gloomy situation. With higher temperatures and more rapid melting of winter snowpacks, less water supplies will be available to farms and cities during summer months when demand is high.

A technological solution that some believe would provide ample supplies of additional water resources is desalination. Some researchers fault the United States for not providing more support for desalination research. Once the world leader in such research, this country has abdicated its role, to Saudi Arabia, Israel and Japan. There are approximately 11,000 desalination plants in 120 nations in the world, 60 percent of them in the Middle East.

Others argue that a market approach to water management would help resolve the situation by putting matters on a businesslike footing. They say such an approach would help mitigate the political and security tensions that exacerbate international affairs. For example, the Harvard Middle East Water Project wants to assign a value to water, rather than treat rivers and streams as some kind of free natural commodity, like air.

Other strategies to confront the growing global water problem include slowing population growth, reducing pollution, better management of present supply and demand and, of course, not to be overlooked, water conservation. As Sandra Postel writes in her book, *Last Oasis*, "Doing more with less is the first and easiest step along the path toward water security."

Ultimately, however, an awareness of the global water crisis should serve to put our own water concerns in perspective. Whether our current activity is evaluating Arizona's Ground Water Management Act or, at a more personal level, deciding whether to plant water-conserving vegetation, the wiser choice would likely be made, if guided by an awareness that water is a very scarce and valuable natural resource.



## Water Vapors

About this time each year we are urged to brazenly ring out the old and bring in the new. One venerable ringing-out tradition is the publication of the "Top News Stories of the Year." In the spirit of the times, we present a few recent news stories that have to do with water. They don't qualify as top news stories of the year, but they are timely, for they provide food for thought as we reflect on the future and what may become of us.

### Mutant Cow Dung Threat

Some residents of Craig County, Virginia are worried that genetically altered cows will produce genetically altered manure that will pollute their groundwater. Pharming Healthcare Inc wants to establish a herd of 200 cows in the area capable of producing human proteins in milk. Those opposed to the farm say proteins in cows' milk could also end up in the cows' urine and manure, potentially endangering area groundwater. Pharming President Otto Postma says the cows are genetically designed to excrete the proteins only in milk.

### Spreading Desertification

Water cops face tough customers in Las Vegas, at least according to a *Washington Post* article. The *Post* carried a story of a water district investigator confronting a resident about his water-wasting sprinkler. The man angrily retorted, "Man, with all these new rules, you people are trying to turn this place into a desert!"

### Survival of the Least Fit

A single genetically modified fish could wipe out local populations of the original species if released into the wild, biologists warn in the December 4 issue of *New Scientist*. William Muir and Richard Howard of Purdue University included hGH, the human growth hormone gene that increases growth rate and final size, in embryos of Japanese medaka, a common

aquarium fish. They found that modified individuals matured faster than normal fish and produced more eggs, rapidly spreading the new gene throughout the population. But only two thirds of modified medaka survived to reproductive age, which led the population to dwindle. The researchers plugged their results into a computer model to find out what would happen if 60 transgenic individuals joined a wild population of 60,000 fish. The population became extinct within just 40 generations. Even a single transgenic animal could have the same effect, they found, although extinction would take longer. "You have the very strange situation where the least fit individual in the population is getting all the matings — this is the reverse of Darwin's model," says Muir.

### "Unspoiled" Nature Beckons

In his book *Glen Canyon Dammed* author Jared Farmer describes the time when Lake Powell was filling and boaters were sufficiently few in number to feel they had the lake to themselves. He records impressions of these early boaters as they confronted the grandeur of altered nature. "Most observers of the new reservoir mentioned both the geographic isolation and the personal solitude — days spent without seeing another soul. Here you could really escape the world. Several went so far as to describe the man-made waterway as 'unspoiled,' 'untrammled,' or 'unexploited.'" (See page 8 for review of Farmer's book.)

### Modern Engineering Does/Undoes the Job

The decommissioning of Edwards Dam in Maine has been named one of the best developments of 1999 by *Popular Science*, the world's largest science and technology magazine. The dam's removal was completed in October after the Federal Energy Regulatory Commission determined that the environmental benefits of dam removal outweighed the economic benefits of relicensing the dam. "What's new and exciting about removing Edwards Dam is the use of modern engineering tools to unleash the natural power of rivers," said Laura Rose Day of the Kennebec Coalition and the Natural Resources Council of Maine. "This award demonstrates that removing a dam at the end of the 20th Century can be as exciting and important for society as building a dam was 100 years ago."

### Air Pollution Protects the Earth

Italian researchers have found that air pollution may have one unexpected benefit — offsetting global warming. Organic compounds from some air pollutants can cause more water droplets to form in clouds. The clouds then become brighter and reflect more sunlight which in turn keeps the earth cooler. One percent more sunlight than normal would be reflected, enough to lower local and regional temperatures. The results of the study were published in the journal "Nature."



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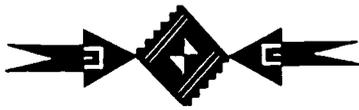
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## News Briefs

### Warm, Dry, La Niña Winter Likely

Ongoing La Niña conditions in the central tropical Pacific will bring warmer and drier conditions to the Southwest from late fall to early spring. This makes the probability of less than normal snowfall at higher elevations likely, according to scientists at the National Oceanic and Atmospheric Administration's Climate Prediction Center. La Niña conditions developed in May-June 1998 and have persisted since that time.

Speaking during the recent Climate Diagnostics Workshop in Tucson, Ants Leetmaa, director of the Climate Prediction Center, noted that La Niña conditions will likely persist into March 2000. He noted that the La Niña will be a weak-to-moderate episode, but strong enough to impact weather patterns across the Southwest later this winter.

"Although this year's La Niña is not of the same strength as last year's, we cannot rule out seeing similarly extreme conditions in the Southwest this winter," said Leetmaa. Last year was the third driest and the fifth warmest in 105 years of record keeping.

"We were very concerned about wildfires last winter because of the dryness, but fortunately the wetter than normal spring helped to mitigate some of that danger," he added. Last year's monsoon season started abnormally early and was quite active, with the Southwest region experiencing its 15<sup>th</sup> wettest July - September on record, and Arizona seeing its seventh wettest monsoon season.

La Niña refers to cooler-than-normal ocean waters across the central and eastern equatorial Pacific, whereas El Niño refers to warmer-than-normal ocean waters in these regions. Both La Niña and El Niño affect the weather patterns across the North Pacific and North America by directly changing the character of the wintertime jet stream, which ultimately controls the weather patterns.

### Scottsdale Opens Upscale Treatment Plant

Although it does in fact treat sewage, Scottsdale's new facility is called a water campus, not a sewage treatment plant. This is in keeping with its high-tech, low-impact, upscale design — not to mention the fact that alluding to a sewage treatment plant might be unseemly in polite Scottsdale society.

Considered the first of its kind in the nation, the \$116 million Water Campus is located on 143 acres in north Scottsdale. After a decade of planning and two years of construction, the facility officially opened on November 20.

Operated entirely by remote control and computers, the facility recycles wastewater for golf courses, filters canal water for drinking and recharges treated sewer water into the ground. The campus will receive about 12 million gallons of wastewater daily, via an underground network of pumping stations and 30-inch pipes running 300 feet uphill from central Scottsdale.

After the wastewater arrives at the water campus, most will be filtered and pumped to 20 golf courses in north Scottsdale. The remainder will be purified with a reverse osmosis system before being pumped more than 450 feet into the aquifer. The water campus has 11 buildings, 27 tanks and 13 miles of underground piping. It includes a renovated and expanded Central Arizona Project treatment plant for filtering 50 million gallons of canal water for drinking.

Design and aesthetics also were considerations when planning the campus. Constructed of brown bricks, the low-slung buildings are located within a basin, with mountains in the background. One reporter described the buildings and setting as resembling a Scottsdale resort. A public art display graces the main entrance, with laser detection beams triggering motion-activated fountains. Because of a complex odor control system, neighbors need not fear unpleasant wafts of air coming their way.

Nor were pumping stations overlooked by the designers. Each is designed to fit into its surrounding area. For example, the station near Scottsdale Airpark resembles a World War II airplane hangar.

### ADEQ Faulted by Auditor General

The Arizona Department of Water Quality was faulted for not adequately protecting the state's water supply. A report by state Auditor General Debra Davenport says the agency will not likely meet legal deadlines for examining and issuing aquifer protection permits. Such permits are needed by companies and facilities with the potential to contaminate the groundwater. Further, the report says ADEQ has not given priority to those facilities "with some of the most serious potential for groundwater pollution."

ADEQ Director Jacqueline Schafer took issue with Davenport's findings, especially her contention that a company lacking an aquifer protection permit poses a risk. She says other ADEQ rules adequately regulate discharge limits and require monitoring and reporting. Further, Schafer said new policies and "innovative staffing" will ensure that the agency will meet the 2004 deadline for issuing most permits.

According to federal and state law any individual or company releasing pollutants must get a permit that sets specific limits for what pollutants can be discharged and in what quantity.

To meet the deadline Davenport says the agency would need to nearly double the annual number of permits it now issues. She does not believe this is likely given the agency's perennial staffing and training problems. She especially criticized the lack of a "formal training process to help ensure that new and existing staff have the knowledge needed to make consistent and timely decisions."

### Rule OK's AZ Interstate Water Storage

Recently-issued rules enable Arizona to act as water banker to Nevada and California. These three western states are now partners in an interstate Colorado River water bank Interior Secretary Bruce Babbitt chartered. The new interstate water bank is basically Arizona's water banking program expanded to serve interstate water needs. In 1996, the Arizona Legislature created a state water banking program as a way for the state

to use more of its share of the Colorado River. Water not immediately needed was recharged into declining aquifers.

The Legislature, however, prohibited interstate water banking negotiations until the director of the Arizona Department of Water Resources was satisfied that the state's interests were safeguarded. If the new federal rules provide this reassurance, then Arizona may begin negotiations with Nevada to store its water supplies.

At present, California has little to gain from the banking plan. The state has greatly benefitted from Arizona and Nevada not fully using their Colorado River allocations. What water they did not use, Southern California did. Nevada, however, has much to gain from the bank. Las Vegas continues to rapidly grow, with water demand steadily increasing. Nevada officials strongly backed the new plan.

The bank could enable Arizona and Nevada to capture their full allocations, saving what is not immediately needed for periods of drought or increased demand. For example, if Nevada has a supply of water, whether it is part of its regular Colorado River allocation or a share of annual river surplus, the state can ask Arizona to store this surplus supply. Instead of flowing down river for California to use, the water then would be banked and available to meet Nevada's future needs.

Arizona would pump and transport water Nevada wants to bank through the CAP canal for storage in the aquifers. When Nevada then is ready to use its banked water, Nevada would pump from Lake Mead an amount of water equal to its supply in Arizona. Arizona then will refrain from pumping an equal amount from the Colorado River as part of its own allocation and instead draw water from its storage aquifers.

"Nevada could bank as much as 1.2 million acre-feet of water in Central Arizona aquifers, but the project's eventual cost is unclear," reports the Las Vegas Review Journal. Estimates range from \$120 million to \$240 million.

This represents an historic step toward water management of the Colorado River in the 21<sup>st</sup> century," said Babbitt. "It says to the states: To the extent you can find mutually beneficial ways to use the water, we are here to facilitate that."

*Arizona Water Resource* is financed in part by sponsoring agencies, including:

Arizona Department of Environmental Quality

Arizona Department of Water Resources

Arizona Hydrological Society

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Central Arizona Water Conservation District

Geraghty & Miller

Metro Water District

Salt River Project

Tucson Water

USGS Water Resources Division

Water Conservation Alliance of Southern Arizona



*The Water Conservation Alliance of Southern Arizona (Water CASA) received the Governor's Pride in Arizona Award for its innovative approaches to water conservation. This is the first time the award was given for water conservation. Pictured above from left to right are Patsy Waterfall, University of Arizona's Pima County Cooperative Extension, Low 4 Program, Val Little, Water CASA manager, Alan Forrest, Water CASA vice chair and general manager of Community Water Company of Green Valley, Betsey Bayless, Arizona Secretary of State and Warren Tenney, Water CASA chair and assistant to the general manager of Metro Water Company. Water CASA is a program of the UA Water Resources Research Center.*

## EPA Targets Gasoline Spills on Arizona Tribal Lands

The U.S. Environmental Protection Agency has approved a pilot plan to begin cleanup of the underground gasoline plume originating from the Tuba City Thriftway and SunWest (also known as Navajo Trails and Super Fuels) gas stations, in an area occupied by Navajo and Hopi Indians. The cleanup on the Thriftway leasehold is expected to start by late February. EPA has directed the owners of the SunWest and Thriftway facilities to come up with a cleanup plan for a second area near the existing evaporation ponds on the south side of Highway 160.

In 1996, EPA ordered the two gas stations to investigate underground contamination from leaking fuel tanks and pipes. Since that time, over 80 monitoring wells have been installed to identify the boundaries of an underground petroleum plume and determine if there is groundwater contamination beyond the two facilities' leaseholds. While the plume has migrated a short distance off the leaseholds, it does not pose a threat to any drinking water sources in the Tuba City/Moenkopi area. The plume is still far from the Upper and Lower Village's drinking water sources. Cleanup measures are expected to remove the contamination long before it threatens these water supplies. EPA and tribal inspectors also investigated four nearby gas stations in November and found poor leak monitoring practices, inadequate leak detection record keeping, and other violations of the federal underground tank rules.



## To Drip or Not to Drip, That Is the Question

*Drip irrigation has been generally accepted as the most effective, water-efficient method of landscape irrigation. Research by Peter Waller, University of Arizona professor of agricultural and biosystems engineering, leads him to question this assumption. He argues for the use of bubbler irrigation. Patsy Waterfall, UA extension agent, water conservation, and Vicki Richards, project coordinator, Low 4, respond to Waller, claiming that the benefits of drip irrigation outweigh those of bubbler irrigation.*

### Bubbler, Not Drip by Peter Waller

In the past, irrigation companies as well as Arizona cities, state agencies, and university personnel have recommended drip irrigation of desert landscapes as the best method to conserve water in urban landscapes. However, I recommend bubbler irrigation over drip irrigation for most desert landscapes. Why? Our evaluation of 38 landscape drip irrigation systems revealed an average uniformity of less than 20% (> 70% is acceptable). Degradation of emitters and lack of adjustment of number of emitters as plants grew resulted in low uniformity. Site efficiencies ranged from 14% to 400% and revealed a lack of ability by most irrigation managers to calculate watering schedules. Of the 38 sites, only one received regular maintenance and adjustment of emitters to match tree canopy area — the only site with acceptable uniformity. During our drip system evaluations, we found that drip irrigation maintenance is hot, dirty, and thorny, and we received many ant bites. In a controlled experiment in Phoenix, desert plants (mesquite, acacia, encelia, and cassia) in bubbler irrigation treatments generally had significantly greater canopy growth than in most drip irrigation treatments, and rodents were continually chewing up one of our drip irrigation systems.

Drip irrigation, a technology that has varied success in a different environment — agriculture — is not suitable for most urban landscapes. Most city dwellers do not have the training, motivation, or time to manage drip irrigation systems. I recommend bubbler irrigation with water harvesting. Bubblers are inexpensive, easily adjustable with a screwdriver, and reliable. See the following web site for a description of the bubbler irrigation/water harvesting system — <http://ag.arizona.edu/abe/urbbler/>. The web site includes a calculator for flow and timer adjustment for drip and bubbler systems, details on installation of bubbler irrigation systems, and a summary of our drip irrigation research project.

Let us imagine that there were no irrigation systems in Tucson, and our job was to recommend an irrigation system for xeriscapes to the citizens of Tucson and Phoenix. What should we look for?

- Adjustable, visible, and measurable flow rate.
- Calculation of flow rate per plant/emitter and time between irrigation cycles must be simple.
- System should require infrequent maintenance, and maintenance must not be unpleasant.
- System must be immune to clogging, heat degradation, insect damage, and animal teeth.
- Attractive.

Compare bubbler and drip irrigation:

*Bubbler...continued on pg. 10*

### Drip, Not Bubbler by Patsy Waterfall/ Vicki Richards

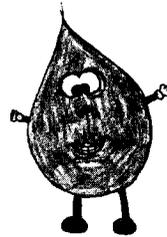
Peter Waller has concluded drip irrigation is an unsuitable strategy because the systems evaluated in his study were not working properly and/or maintained adequately. He advocates the use of bubbler irrigation systems instead. Most drip irrigation problems cited in his study, however, resulted from improper maintenance or the use of older style or low-quality components. We believe that up-to-date, properly installed, well-maintained drip systems are still the most efficient, water conserving irrigation systems for urban landscapes.

Drip irrigation has many advantages over bubblers. The most important are application of water directly in the plant's root zone and ability to water many plants on one valve. Other benefits include multi-valving for mixed plantings with varying water requirements in the same physical area; reduced weed growth and surface evaporation; slow application rate which eliminates runoff and erosion; ease in installation and repair; and lower overall installation cost. In some situations bubblers can be effective, specifically with monocultures such as hedges, orchards, lines of trees and areas of groundcover. Even in these cases, however, uniformity and suffer if the grade is not level. Drip irrigation is much more adaptable to unusual situations, such as clayey soils, slopes, hilly areas, berms, and small, low density landscapes. Bubblers installed close to buildings and walls damage footings, stucco, adobe, and mortar.

Bubbler systems (bubblers, pipes, valves, trenches, and basins), like drip systems, require routine maintenance. Bubbler systems are not immune to vandalism and wear, particularly at commercial, institutional and multifamily sites. In addition, the basins and trenches need to be kept clean to prevent overflow. Because of higher flows, bubbler systems waste more water when leaks, breaks, or over-scheduling problems occur. Low flow drip irrigation is more forgiving, wasting less water because of the low flows.

The basins and trenches for directing and containing bubbler irrigation water are problematic. They are unattractive and are impractical for intensely used landscapes. Tree roots are generally 1½ to 4 times larger than the actual tree canopy, and most of the tree's water is absorbed in the area at the drip line and beyond. The basin for a mature 25-foot tree would be enormous. When basins are enlarged, surface roots, which take in water, will be destroyed. Drip irrigation maintenance was described as hot, dirty, thorny, with imminent danger from insects and rodents. Bubbler maintenance occurs outside (hot); if repairs are need, bubbler trenches are deeper than drip trenches and require more digging (dirty);

*Drip...continued on pg. 10*



*Drip drawn by Jade Shepler, 6<sup>th</sup> grade, Apache School, Sierra Vista.*



## Legislation and Law

# Congress Acts on Water-Related Legislation

Its appropriations work done, Congress has adjourned for winter recess until January. Following is a review of various water-related legislation from the first session of the 106<sup>th</sup> Congress.

**Agriculture-Rural Development-Related Agencies Appropriations Bill:** In early October, Congress passed the FY'00 funding bill for Agriculture and Related Agencies, with President Clinton signing it into law on October 22 (PL 106-78). For discretionary spending, not including emergency spending, the bill includes \$14 billion, \$0.5 billion below the Administration's request. The Natural Resources Conservation Service received \$813 million, including \$661 for conservation operations, \$10 million for watershed planning, \$99 million for watershed and flood prevention operations, \$35 million for resource conservation and development, and \$6 million for a forestry incentives program. The measure limited the Wetlands Reserve Program to 150,000 acres and the Environmental Quality Incentives Program to \$174 million. The House and Senate bills were H.R. 1906 and S. 1233 respectively.

**VA-HUD-Independent Agencies Appropriations Bill:** President Clinton signed the VA-HUD-Independent Agencies funding bill for FY'00 on October 20 (PL 106-74). The bill includes \$7.6 billion for the Environmental Protection Agency, up from \$7.5 billion in FY'99. Of the total, \$3.5 billion is for EPA's operating budget, \$1.4 billion for superfund programs, \$5 million for the Office of Science and Technology, and \$3 million for the Office of Environmental Quality. The measure provides \$1.35 billion for the clean water state revolving loan fund and \$820 million for the safe drinking water revolving loan fund.

**Energy and Water Development Appropriations Bill:** On September 29, President Clinton signed the FY'00 appropriations bill for Energy and Water Development (PL 106-60). In conference, Congressional negotiators agreed to a total funding level of \$21.3 billion for the bill, including \$4.14 billion for civil works programs by the Army Corps of Engineers – flood control, shoreline protection and navigation. The figure, \$246.5 million more than requested by the Administration, includes \$309 million for flood control on the Mississippi River and its tributaries. The Bureau of Reclamation received \$769.4 million, \$87.3 million below the Administration's recommendation, and the Energy Department received \$16.7 billion, \$441.4 million below the Administration's request. Of the total, power-marketing administrations received \$262 million. The final version also includes \$608 million for water and related resources under the Bureau of Reclamation, \$60 million for California Bay-Delta ecosystem restoration and \$42 million for the Central Valley project restoration fund.

**Interior-Related Agencies Appropriations Bill:** Largely due to disputes over mining and oil royalty riders and low funding levels for Administration priority programs, the FY'01 funding bill did not pass as a stand-alone bill but had to be rolled into the \$390 bil-

lion consolidated funding package (H.R. 3194) signed by President Clinton on November 29. The \$14.9 billion measure added to the consolidated package included an additional \$220 million for land acquisition, grants to states for conservation and planning, urban parks, the cooperative endangered species fund, urban and community forestry, and the forest legacy program, as well as another \$30 million for energy conservation programs.

Of the \$1.24 billion for the Bureau of Land Management, \$37 million is for wildlife habitat and fisheries, \$19 million for threatened and endangered species, \$34 million for resource protection and maintenance, and \$16 million for the Land and Water Conservation Fund. Of the \$878 million for the U.S. Fish and Wildlife Service, \$190 is for fish, wildlife and ecological services. Of that \$190 million, \$109 is for endangered species, \$72 million is for habitat conservation, and \$86 is for fisheries. The National Park Service received \$1.81 billion, including \$54 million for national recreation and preservation and \$121 million for the Land and Water Conservation Fund. Conservation grants for planning assistance and the Urban Park and Recreation Fund did not receive any funding for FY'00. The Office of Surface Mining Reclamation and Enforcement received \$196 million for the Abandoned Mine Reclamation Fund. The US Forest Service received \$2.83 billion, including \$109 million for wildlife and fisheries habitat management, \$40 million for land management planning, and \$80 million for the Land and Water Conservation Fund.

**Water Resources Development Act:** On August 17, President Clinton signed the Water Resources Development Act of 1999, which authorizes new projects and sets policy for the U.S. Army Corps of Engineers. WRDA, traditionally a biennial package, had been held up since 1998 largely due to conflicts over flood protection measures for Sacramento and a water supply project for Representative John Doolittle's (R-CA) nearby district. WRDA 1999, which will provide \$4.3 billion in federal funds for \$6.3 billion worth of projects, includes a new flood program and 45 other projects. Under Challenge 21, the new flood control program, the Corps will receive \$200 million over five years for a watershed-based flood protection program focused on nonstructural and riverine ecosystem projects.

Specifically, WRDA 1999 authorizes 30 new projects, 15 projects pending favorable reports by the Corps by the end of the year, and more than 200 project modifications and other provisions.





## Publications

# University of Arizona Press Publishes Books on Water in the West, With More Forthcoming

*The following two books, Hoover Dam and Glen Canyon Dammed, were recently published by the University of Arizona Press. These publications are just the beginning of an expanding list of books on water scheduled for publication by UA Press. In the next few seasons, the Press will publish a guide to the San Pedro River by Roseann Hanson; a collection of essays edited by Char Miller on the history of water in the West, currently called Fluid Arguments; and an environmental history of the Santa Cruz River by Michael Logan, currently entitled Ever a Dwindling Stream. The Press is looking for more books on water in the Southwest and West, specifically one-author river histories, environmental histories, and histories of water issues in the Borderlands.*

**Glen Canyon Dammed: Inventing Lake Powell & the Canyon Country** by Jarred Farmer, 288pp/20 photos, 3 maps/\$26.95 cloth  
Were Lake Powell and the Canyon Country invented? Invented implies the intervention of the human hand, and, in that sense, Lake Powell at least might have been invented. Inventing, however, also can mean creating with the imagination, and in that sense, lake and canyons were indeed invented, both figuring predominantly in human affairs. As this book emphasizes, human and natural history are intertwined.

The human history of canyon country begins with settlers gaining greater access to the area. Later came another breed, the tourist. Both groups — and others who arrived in between — were seekers. Those newly arrived wrought changes to the land, from roads and tourist facilities to the Glen Canyon Dam. Like it or not, these changes are part of canyon country, part of the human invention of the area.

The author laments many of the changes to the area, the effects of millions of visitors. At the same time, however, he believes that the aesthetic thrill and spiritual solace that canyon country, and especially Lake Powell, provide to many of today's visitors are not to be underestimated. To them, the land still holds the sense of adventure and discovery that it did to early settlers of the area.

This book might be described as providing a balanced account, with both critics and supporters of Lake Powell able to find ideas and sentiments to their liking.

**Hoover Dam, the Photographs of Ben Glaha** by Barbara Vilander, 69 duotones/4 half-tones/\$39.95 paper/\$55 cloth

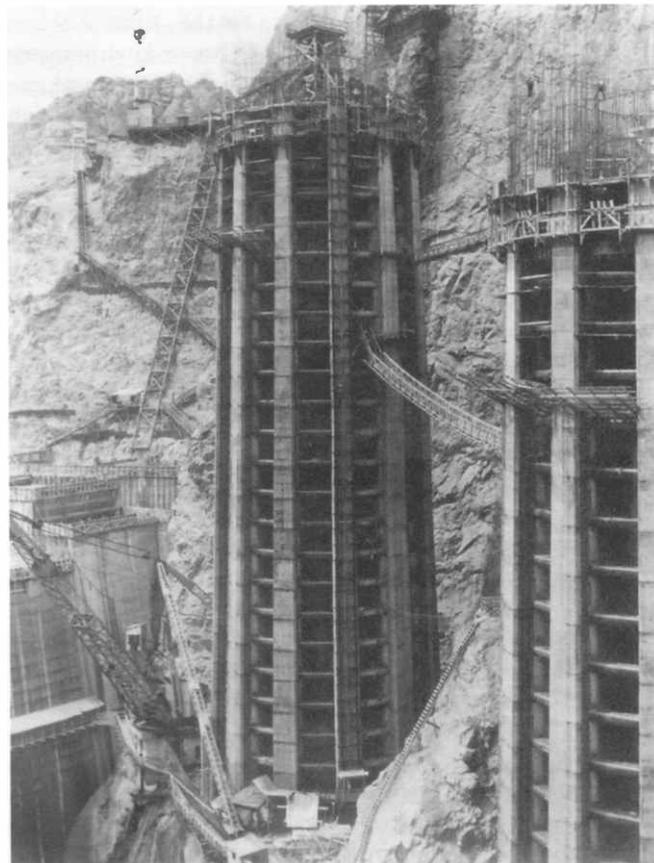
Hoover Dam still fascinates, even now when dams generally have a bad name. This is partly because its construction is the stuff of legend. Built during the depression, at a time when rivers were for taming, the project took on both natural obstacles and engineering risks, to create the mightiest dam of its time.

This book provides cause to appreciate Hoover Dam, this time from an aesthetic perspective. The U. S. Bureau of Reclamation assigned Ben Glaha to photograph the dam during construction and to capture scenes justifying the project to politicians and the American public. Providing much more than the intended propaganda, Glaha's photographs display an aesthetic appreciation of the construction site. When focusing on the dam as a work in progress, Glaha found design and beauty in the scaffolding and the tunneling of the project and dignity among the workers.

The photographs represent a documentary of the project,

from an image of Black Canyon before the dam to Roosevelt delivering a dedication address. The most impressive photos, however, are those that bring out the inherent beauty of a well designed, engineered project, during construction and at completion. For example, the photos show the monumental grandeur of intake towers and diversion tunnels.

The photos also demonstrate dams as cultural phenomenon. From a different time and era, Hoover Dam has stature. Closer to our time and constructed under much different circumstances, Glen Canyon Dam generally does not. Efforts to raise Glen Canyon Dam to an object of veneration and aesthetic regard would likely meet with stern resistance.



*The Nevada Intake Towers at Boulder Dam before 1935. Photo by Ben Glaha*



## Special Projects

### ASU Program Stresses Ecological Approach to City Planning

With one acre of desert land developed every hour in the Phoenix metro area, preserving open spaces is an important and timely issue. In a cooperative effort to meet the challenge, Arizona State University's School of Planning and Landscape Architecture (SPLA) is providing a valuable community service by integrating ecological thinking into the urban planning process.

The City of Phoenix Parks, Recreation and Library Department (PRLD) contacted SPLA when it began work to develop 12,000 potential preserve acres in North Phoenix. North Phoenix was rapidly growing, raising fears the encroaching sprawl would overtake the entire area.

At the time little was known about the biota in the area to be preserved in North Phoenix. In 1996, PRLD requested SPLA to conduct a study of the area, to determine preservation boundaries consistent with the existing ecology of the Cave Creek Wash and adjacent landscape. SPLA Professor Joseph Ewan coordinated the project with the City of Phoenix.

A team made up of ecologists, landscape architects and planners inventoried and assessed plant communities within and along the wash corridor. Using vegetation data collected from the field, maps were created, and the team classified four plant communities. With this information researchers then developed three recommended alternative preservation boundary scenarios: maximum, moderate and minimum preservation. Each included goals and concepts, a boundary map, suggested acreage for preservation and a list of benefits and constraints.

In recommending preservation boundaries consistent with the existing ecology of the wash system and the adjacent lands, the researchers were breaking new ground in Phoenix. Boundaries traditionally were set with reference to topography, i.e. visual landmarks like slopes, hillsides and mountains or land ownership. Not reflecting the ecological systems within a landscape, the boundaries were thus established without due consideration of the impact of preserve size, shape, connectivity to other preserved open space and other factors impacting plant and wildlife habitats.

In its review of the submitted report, PRLD acknowledged that it learned that "the process of establishing preserve boundaries should be based on scientific understanding of the natural systems instead of property ownership and topography, as was commonly done in the past." Responding to the SPLA recommendations, both the Parks Board and the City Council endorsed the maximum recommended preservation scenario of 4,500 acres of land along Cave Creek Wash.

In 1997, SPLA began the next phase of the study. Study areas



Faculty and students from ASU's School of Planning and Landscape Architecture survey vegetation along Skunk Creek. Photo Joseph Ewan

included Apache Wash, Skunk Creek Wash and its tributaries, and Deadman Wash. Completed in November 1998, this study complemented the Cave Creek Wash study by completing the inventory of all major washes in the north area. After vegetation sampling was completed, vegetation was categorized on the basis of the sampling, aerial photographs and field observations, and mapped using GIS. Vegetation was classified according to vegetation composition and landscape physiognomy. A separate "damaged" classification was established for areas sufficiently damaged by human interference that vegetation could not be characterized.

Researchers also studied wildlife populations on Cave Creek and Skunk Creek washes, to identify wildlife species and distribution. This survey enabled them to determine which areas of the wash and adjacent uplands are important to native species.

The next phase, to begin in the spring, is to conduct a habitat suitability study. This study will work out correlations between the vegetative and wildlife inventories, to be used in future planning. Information gathered in the various separate studies will thus be integrated into a single study encompassing approximately 25 square miles.

Graduate and undergraduate students involved in this project acquired valuable real-world, hands-on experiences, by working in the field, studio and lab, and collecting and analyzing data. For example, a vegetation management class participated in vegetative sampling and developed management plans for the washes. Two landscape architecture students received national recognition by winning a first place design award in a American Society of Landscape Architecture competition for their concepts on developing the preserve edge.

Persons involved in the above project have organized the North Sonoran Collaborative. This is an informal discussion group, its participants including municipal planners, developers, Arizona Game and Fish officials and ASU personnel. Its next scheduled meeting is January 20.

For additional information about SPLA's involvement in the above work contact Joseph Ewan at ASU, phone: 480-965-7167; email: joseph.ewan@asu.edu



## Announcements

### Small Drinking Water/Wastewater Systems Symposium

On January 12-15, 2000, NSF International and the Rural Water Research and Education Foundation will host a symposium entitled "Small Drinking Water and Wastewater Systems: Technology for the 21<sup>st</sup> Century" in Phoenix. The symposium will address the special challenges facing small water systems in providing both drinking water and wastewater treatment. Small water systems encounter special challenges in providing both drinking water and wastewater treatment. These issues include planning and managing complex water and wastewater systems with limited funds and small staffs. Emerging technology is the key to meeting the challenges of the 21<sup>st</sup> century. The conference will focus on emerging technologies that are assisting water professionals in managing complex water systems with limited staff and budget. Persons interested in presenting, exhibiting, or attending are encouraged to contact: Joe Cotruvo, NSF International; phone: 202-289-2140; email: cotruvo@nsf.org; web site: <http://www.nsf.org/symposium/>

### New Publication Calls for Papers

In January 2000, the National Small Flows Clearinghouse (NSFC) will combine its two publications, the *Small Flow* newsletter and *The Small Flows Journal* into a single publication, the *Small Flows Magazine*. The new magazine is presently accepting papers concerning small community wastewater topics to publish in their juried article section. Papers in the following categories will be considered for peer evaluation: technology, research, operations and maintenance, regulations, management, finance, and public education. For additional information about the magazine,

manuscript submissions, guidelines, and publication deadlines contact: Cathleen Falvey, National Small Flows Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064; phone: 800-624-8301 or 304-293-4191 ext. 5526; email: cfalvey@wvu.edu

### Arizona Small Utilities Assoc. Conference

The Arizona Small Utilities Association is hosting its 10<sup>th</sup> Annual Technical Conference at the Flamingo Hilton in Laughlin, Nevada on February 8-10, 2000. The conference will feature workshops, exhibitions, and seminars focusing on the impact of rapidly changing technology on small water utilities. Issues receiving attention include capacity development, perchlorate effects on children, wetland development and customer billing software. Professionals from small water systems, wastewater plants, municipalities as well as officials local from local governments are invited to attend. For conference information contact: Arizona Small Utilities Association, 1955 W. Grant Road, Ste. 165, Tucson, AZ 85745; phone: 520-620-0230; fax 520-620-0601

### Land Stewardship Conference

A "Conference on Land Stewardship in the 21<sup>st</sup> Century" will be held at the Plaza Hotel and Conference Center in Tucson, March 13-16, 2000. The purpose of the conference is to increase awareness by exploring and evaluating global, national, and regional perspectives concerning the potential contributions that watershed management will make to ecosystem-based land stewardship in the 21<sup>st</sup> century. The conference will consist of two-and-one-half days of synthesis papers presented in plenary sessions and prepared by invited speakers from public and private research, management and educational organizations. For additional information contact: Peter F. Ffolliott, The University of Arizona, School of Renewable Natural Resources, Tucson, AZ 85721; phone: 520-621-7276; fax: (520) 621-8801; email: ffolpete@ag.arizona.edu; web site: <http://www.srn.arizona.edu/>

#### *Bubbler...continued from pg. 6*

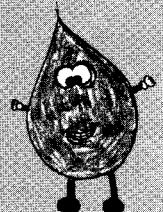
- Bubblers are visible and problems are noticeable – drip emitters and drip problems are invisible.
- Bubblers require minimal filtration – soil, calcification, and bacteria clog drip emitters.
- Bubblers do not degrade in heat – drip emitters degrade in heat and flow increases.
- Bubbler flow rate and wetted area are easy to adjust – drip flow rates are difficult to adjust.
- Bubblers are durable and require little maintenance – drip emitters are fragile and require far more maintenance.
- The bubbler irrigation/water harvesting system is attractive – buried drip irrigation systems are attractive.

However, I do recommend drip irrigation for vegetable gardens and steep slopes.

#### *Drip...continued from pg. 6*

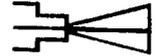
maintaining and enlarging basins involves close encounters with trees and shrubs (thorny); and bubbler irrigation does not rule out the possibility of ants (bitey).

Peter Waller has destroyed the expectation that drip irrigation systems will last forever and be maintenance free. Additionally, he has brought to the forefront the desperate need for drip irrigation installation standards, certification of designers and installers, and on-site inspection of during system installation. We have no problem with the findings of this study, but to condemn drip irrigation entirely as an irrigation method, is throwing the baby out with the bath water.





## Calendar of Events



### RECURRING



**Arizona Hydrological Society (Flagstaff).** 2nd Tuesday of the month (during the school year), Meeting times and locations may vary, NAU, Southwest Forest and Science Complex, 2500 S. Pine Knoll Dr., Room 136, Flagstaff. Contact: Abe Springer 520-523-7198, email: abe.springer@nau.edu.

**Arizona Hydrological Society (Phoenix).** Usually 2nd Tuesday of the month. Contact: Christie O'Day 602-379-3087 ext. 224.

**Arizona Hydrological Society (Tucson).** Usually 2nd Tuesday of the month. Contact: Laura Davis 520-326-1898.

**Arizona Water Banking Authority (Phoenix).** Next quarterly meeting will be held on Mar. 15<sup>th</sup> at the ADWR in Phoenix. Contact Nan Flores 602-417-2418. Special meeting is scheduled for Jan. 26<sup>th</sup> to discuss interstate water banking.

**Arizona Water Protection Fund Commission.** Contact: Irma Lisa Horton 602-417-2400 ext. 7016.

**Arizona Water Resources Advisory Board.** Contact: Kathy Donoghue 602-417-2410.

**Central Arizona Water Conservation District.** Usually 1st and 3rd Thursdays of the month, time to be determined one week before. CAP Board Room, 23636 N. 7th St., Phoenix. Contact: Ardis McBee 602-869-2210.

**City of Tucson Citizens Water Advisory Committee.** Usually 1st Tuesday of the month, 7:00 - 9:00 am 310 W. Alameda, Tucson. Contact: John O'Hare 520-791-5080 ext. 1446.

**Maricopa Association of Governments/Water Quality Advisory Committee.** Contact: Lindy Bauer 602-254-6308.

**Maricopa County Flood Control Advisory Board.** Usually 4th Wednesday of the month, 2:00 pm, 2801 W. Durango, Phoenix. Contact: Kathy Smith 602-506-1501.

**Phoenix AMA, GUAC.** Scheduled monthly, please call. Conference Room A, 500 N. 3rd St., Phoenix. Contact: Mark Frank 602-417-2465.

**Pima Assoc. of Governments Water Quality Subcommittee.** Usually 3<sup>rd</sup> Thursday of the month, 9:00 am 177 N. Church St., Suite 405, Tucson. Contact: Greg Hess 520-792-1093.

**Pinal AMA, GUAC.** Usually 3<sup>rd</sup> Thursday of the month, 2:00 pm. Pinal AMA Conference Room, 1000 E. Racine, Casa Grande. Contact: Randy Edmond 520-836-4857.

**Prescott AMA, GUAC.** 2200 E. Hillsdale Rd., Prescott. Contact: Phil Foster 520-778-7202.

**Santa Cruz AMA, GUAC.** Usually 3<sup>rd</sup> Wednesday of the month, 9:00 am, Santa Cruz AMA Conference Room, 857 W. Bell Rd., Suite 3, Nogales. Contact: Kay Garrett 520-761-1814.

**Tucson AMA, GUAC.** Usually 3<sup>rd</sup> or 4<sup>th</sup> Friday of the month, 9:00 am, Tucson AMA Conference Room, 400 W. Congress, Suite 518, Tucson. Contact: Kathy Jacobs 520-770-3800.

**Tucson AMA, Safe Yield Task Force.** Every Wednesday. Contact: Kathy Jacobs 520-770-3800.

**Verde Watershed Association.** Contact: John Parsons and Tom Bonomo, VWA Newsletter Editors, Verde Watershed Association, P.O. Box 4595, Camp Verde, AZ, 86322. 520-567-2496. Message phone: 520-649-9978, email: obarc@sedona.net; website: <http://www.vwa.org>

**Water Users Association of Arizona.** 2nd Friday of the month at noon (except in September). Call for reservations and exact location. Contact: Paul Gardner, 480-987-3240.

**Yavapai County Flood Control District Board of Directors.** Contact: Ken Spedding, 520-771-3197.

### UPCOMING



**April 3-5, 2000, Southwest River Management and Restoration Nonstructural Approaches** This conference is sponsored by numerous Arizona water and environmental organizations and will explore the changing role of watercourses in Arizona's communities. The conference will be held at Crowne Plaza North in Phoenix, Arizona. For additional information contact: Valerie Swick, 602-506-4872 or visit web site at [www.azfma.org](http://www.azfma.org)

**November 20-23, 2000, Hydro 2000: Third International Hydrological and Water Resources Symposium** will be held in Perth, Australia and will focus on such issues as the impacts of dams, groundwater contamination, flooding, climate change, and water quality. Abstracts and expressions of interest are currently being accepted. For more information contact: Congress West Pty Ltd., PO Box 1248, West Perth, WA 6872, Australia; phone: 61-8-9322-1734; email: [conwes@congresswest.com.au](mailto:conwes@congresswest.com.au); web site: [www.ieaust.org.au](http://www.ieaust.org.au)

*Submit calendar, announcement, or publication information to Joe Gelt, WRRRC; phone: 520-792-9591 x16; fax: 520-792-8518; email [jgelt@ag.arizona.edu](mailto:jgelt@ag.arizona.edu)*

*Court Action.... continued from page 1*

"It's certainly a victory for the Native American position," said Marvin Cohen, an attorney who represents the city of Tucson in water disputes.

Chris Avery, Tucson's senior assistant attorney, stated that if the ruling holds it could "hasten the decline of the era of cheap groundwater."

The ruling displeases powerful interests including cities, farms, and the mines, who may request a rehearing or appeal to the U.S. Supreme Court. Some attorneys have pointed to apparent inconsistencies between the Arizona Supreme Court decision and the Wyoming Supreme Court's 11-year-old *Bighorn decision* as grounds for appeal.

Others believe the ruling will support the federal government's efforts to broaden its enforcement of the Endangered Species Act. They say federal officials could claim groundwater pumping depletes flows necessary to ensure the survival of an endangered species and then act to restrict such pumping. Federal water claims, whether as a reserved right for tribes or to uphold the ESA, will prevail over state laws.

"I have seen this coming for a long time. What is happening — and a lot of people tend to agree with this — is that the federal government, with this ruling, is in a better position to exert its claim to water rights, both groundwater and surface water, based on violation of the ESA," says Don Young, principal of Westwater

and recently retired from the Arizona Attorney General's Office.

Young views the recent decision in light of *Cappaert v. United States*. This case involved a pool, located on federal land, that was the only remaining habitat of the Devil's Hole pupfish. A nearby pumper, who was in compliance with Nevada law, caused the water level to drop, threatening the pupfish. The U.S. Supreme Court enjoined the pumping, claiming the water in the pool was set aside for a federal purpose and was therefore protected, regardless of state law.

"In *Cappaert* pumping was restricted to protect a surface water species in a fairly localized area, and we have the same thing on a much broader scale on the San Pedro," says Young. He expects environmental groups will soon file suits based on the recent Arizona Supreme Court ruling.

The San Pedro, a river of controversy, has been the focus of varied law suits. Its flow threatened by pumping, the river provides habitat for many species. Recently Interior Secretary Bruce Babbitt threatened federal intervention if the state did not take more effective action in preserving the San Pedro River.

Arizona's failure to define the interconnection between groundwater and surface water puts the state at risk of federal agencies taking the initiative, to better enable officials to determine when groundwater pumping is dewatering a surface water source. Determining when underground water would be considered a subsurface flow of a stream is a hotly and long contested issue in Arizona courts.

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