

Groundwater Fix Along Route 66

The legacy of the many gas stations located at one time along Route 66, the once-famous highway for getting your open-road kicks, are abandoned petroleum-contaminated sites that pose an environmental hazard to soil and groundwater.

Located along the route, its gas stations literally fueling the Route 66 adventure, the city of Flagstaff recently received a \$200,000 U.S. Environmental Protection Agency Brownsfields grant to inventory its many contaminated sites and conduct environmental assessments. The funds also will assist the city to develop a comprehensive redevelopment plan and conduct community outreach.

Flagstaff's situation is not unique; other Route 66 towns and cities, including those in Arizona along the state's 200-mile stretch of the highway, confront similar problems. Arizona has gained national recognition in its efforts to cleanup such sites along the legendary highway.

In some ways it is a typical situation. Past, now abandoned activities result in an environmental cost borne later by others. Not all such issues are the same, however; this one is about Route 66, a celebrity road at a time of automotive glamor, an era and experience many now feel nostalgic about.

Those were the days of high-mileage cars and

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Mobil service station at corner of Verde Street and Highway 66, Flagstaff, 1966. Arizona State Library, Archives and Public Records, Archives Division, Phoenix, #98.5327.

Bioremediation — Water Treatment Tool to Fix Pollution Problems

by Joe Gelt

Bioremediation is putting microorganisms to work. "Bio" refers to the biological organisms and "remediation" refers to the job to be done: remediating or resolving an environmental problem caused by toxic chemicals and other hazardous wastes in soil and groundwater.

Biodegradation is a natural process. In a non-polluted environment microorganisms or microbes, including bacteria, algae and fungi, are hard at work breaking down organic matter. Enter an organic pollutant such as gasoline or oil. The result: some of the microbes die while others capable of eating the organic pollutant survive.

Bioremediation speeds the process and increases efficiency by providing pollution-eating organisms with fertilizer, oxygen, and other conditions that encourage their rapid growth. The feeding of the microbes, sometimes whimsically called "bugs," causes more chemicals to be digested and converted into water and harmless gases such as carbon dioxide. The field of bioremediation encompasses numerous strategies to clean up pollution by enhancing the same biodegradation processes that occur in nature.

In exceptional cases, specialized, non-indigenous microbes might be introduced to help degrade the contaminants. This, however, is rarely done as University of Arizona microbiologist Jim Field explains, "That is a misnomer about bioremediation that we use super bugs from the lab, but that is not true. ... Most of the time in bioremediation we provide the conditions that are optimal for degradation rather than providing the microorganisms."

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Bioremediation...continued from page 1

Establishing a bioremediation system is a complicated task requiring an interdisciplinary approach. Hydro Geo Chem's Principal Scientist Harold Bentley explains: "It requires knowledge of chemistry, biology, and hydrology and the flow system, all of those things integrated together. It requires a significant understanding of the site and the ability to use knowledge gained about the site to tune your system."

Bentley says, "There usually is a biological solution to most pollution problems. ... It is finding the right microbe to work against a particular pollutant, with something added to encourage the reaction."

Essential to establishing a bioremediation system is a knowledge and understanding of microbes and their pollution-fighting potential. Northern Arizona University's Bioremediation Initiative or BIORIN is a resource in this area. To promote a better understanding for the potential of bioremediation and to encourage its greater use, BIORIN researchers are identifying microbial processes that actively biodegrade contaminants.

Such basic information is very much needed. Maribeth Watwood, chair of NAU's Department of Biological Sciences, says, "When you want to consider bioremediation as a remediation option at a site, EPA and other agencies require that the best available technology be used. Without having a strong literature base, it is very difficult, no matter how great the idea is, to claim it is the best demonstrated technology."

BIORIN is compiling a database to provide credible documentation work in support of considering bioremediation at contaminated sites with certain characteristics. Bruce Hungate and Egbert Schwartz, both NAU professors, work with Watwood on the BIORIN team. Watwood says, "There is a big push to understand biodegradation processes; we know astonishingly little about the range of capabilities of bacteria. Subsurface microbiology is a new field, relative to other branches of environmental science."

Field also acknowledges the need for much more research. He says, "Of all the microbes that we know exist based on DNA we have only been able to culture about one or two percent of them." Microbes are best studied by culturing.

BIORIN was also established to promote bioremediation in Arizona by providing information about the technique and demonstrating their efficacy. Watwood says Arizona has lagged somewhat in adopting bioremediation technology. "ADEQ is receptive, but they need to see data, to see this actually works before implementing it full-scale." She hopes that such work as is being done at an Arizona Water Quality Assurance Revolving Fund site in Tucson will demonstrate the effectiveness of the biological approaches.

Along with University of Arizona researcher Mark Brusseau,

UA, ASU Bioremediation Projects

Bioremediation work at the University of Arizona includes two projects using elemental sulphur to feed naturally occurring microorganisms that will then degrade pollutants. One of the projects is to remove nitrate from contaminated groundwater. This is a concern in Arizona since about 7 percent of Arizona's groundwater wells exceed the primary maximum concentration level for nitrate. A challenge in developing the project was supplying the naturally occurring microbes with the appropriate food to begin the process of denitrification which converts nitrate to harmless dinitrogen gas.

The conventional approach is to feed the microbes organic food such as acetate, the main constituent in vinegar, or simple alcohols. Using these energy sources, however, has limitations. Along with the high cost, organic residuals and biofouling could result. The project is taking a different approach by investigating the use of elemental sulfur as an inexpensive inorganic food source for the denitrifying microorganisms.

UA's Water Resources Research Center awarded the project Section 104B funds from the Water Resources Research Act, funded by the U.S. Geological Survey.

The UA researchers are using the same technique to treat water contaminated with perchlorate. This is a groundbreaking approach since elemental sulphur has not been used before in a bioremediation process to degrade perchlorate. Hydro Geo Chem, the corporate sponsor of the above two projects, has applied for a patent for this process.

The UA principal investigators are Reyes Sierra-Alvarez and Jim Field, Department of Chemical and Environmental Engineering. Hydro Geo Chem principal investigators are Harold and Richard Bentley.

Researchers at Arizona State University's Bidesign Center also are studying ways to use bioremediation for treating contaminated water. Rather than sulphur, they are using hydrogen to energize the microbes to remove contaminants from the water. Delivering the hydrogen to the microbes safely and effectively, however, was a problem to work out.

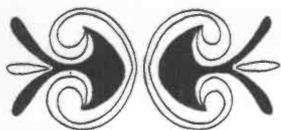
Bruce Rittmann, Director of the Center for Environmental Biotechnology at the Bidesign Institute, addressed the problem by using a membrane biofilm reactor to transfer hydrogen directly to microbes. The microbes then go to work, converting nitrate into nitrogen gas, perchlorate into chloride ions, and other contaminants into harmless forms.

BIORIN researchers are studying the Tucson WQARF site located near Park and Euclid avenues. The site was once the location of railroad yard and dry cleaning operations. Work at the site includes determining what kinds of microbes are in the subsurface, including those within the contaminated plume. Further, tests are being conducted to determine not only what kinds of contaminants the bugs can degrade but whether they are in fact doing it. The researchers are using techniques developed at BIORIN to obtain the information.

Techniques being applied to the site include molecular procedures that identify specific microbes, and enzyme probes and stable isotope approaches that identify specific degradation reactions taking place in the contaminated zone.

Watwood says BIORIN has been able to demonstrate the occurrence of plentiful natural microbial activity that is degrading

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Water Vapors

Water Festivals, Buckets of Fun and Learning

Water festivals provide an occasion to be festive about water. They enable people to come together to celebrate water, have fun with water, observe its varied characteristics and, last but not least, learn about water. The Water Resources Research Center of the University of Arizona's College of Agriculture and Life Sciences coordinates Arizona Make a Splash with Project WET (Water Education for Teachers) Water Festivals.

Conducted at various locations throughout the state, the festivals are annual events involving fourth grade students and their teachers, with sessions organized by Arizona Project WET staff and volunteers.

The festivals offer interactive activities, hands-on engagement, to teach students about such topics as groundwater/aquifers, water use and conservation, water sources, watersheds and the water cycle. Each activity is correlated to state standards and addresses a crucial topic in water stewardship.

Those offering testimony to the benefits of the festival include Felicia from Alpine Elementary School. Felicia says, "I learned how a cloud is made, and I know what a watershed is."

Arizona Project WET is coordinating eight festivals this year, with events scheduled at Avondale, Chandler, Tucson,

Central Yavapai, Flagstaff, Sierra Vista, Yuma and Safford. About 5700 students and 230 teachers are expected to attend the events. Festival sponsors include the U.S. Bureau of Reclamation, the Arizona Department of Environmental Quality, the Arizona Department of Water Resources and the Central Arizona Project along with local sponsors.

Project WET USA provides national leadership in encouraging and promoting Make a Splash water festivals nationwide. For additional information about Arizona Make a Splash with Project WET Water Festivals contact Sandra Rode: 520-792-9591 x24 or srode@cals.arizona.edu.

Conserving Stormwater, Rainwater Conference

The Water Resources Research Center cosponsored the conference, "Looking Ahead: Managing Stormwater and Harvesting Rainwater for Conservation," conducted Oct. 27-28. Presentations focused on satisfying federal stormwater manage-

Date to Remember: WRRC Conference, June 5

Planning has begun for the Water Resources Research Center's annual spring conference, to be held in Phoenix June 5. The title of the conference is "20th Anniversary of the Environmental Quality Act and ADEQ: Assessing, Protecting and Remediating the State's Water Quality. What Future Challenges?" and is cosponsored by the Arizona Water Institute and the Arizona Department of Environmental Quality. To include your name on a mailing list to receive additional information about the event contact us at wrrc@ag.arizona.edu. Check the WRRC web site for conference planning updates.

Previous WRRC conferences have been popular, well-attended events, attracting wide representation from the Arizona water community. The premier water event of the spring season, the WRRC conferences have served as lively forums for participants with varied expertise and backgrounds to present, discuss and debate critical water issues. The upcoming event promises to be no exception.

ment requirements and incorporating Best Management Practices and techniques for the beneficial use of rain and stormwater. Site design, land preparation, roof top collection and groundwater infiltration methods were presented for large and small scale projects. Participants came from eight states and several foreign countries. The event was sponsored by the Southwest Region, American Rainwater Catchment Systems Association (ARCSA) and the Consortium for Action Throughout the Community for Harvesting Rainwater (CATCH Water). Other cosponsors of the event included the U.S. Bureau of Reclamation, ARCADIS, University of Arizona, Pima County, City of Tucson and the Advanced Housing Research Center.



Student learns weight of water the hard way in bucket race.

Photo: Don Tanner



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News Briefs

Plan Notes Ways to Increase Colorado River Supplies

The U.S. Bureau of Reclamation's recently released 2007 Annual Operating Plan for Colorado River Reservoirs includes strategies intending to increase available water supplies. With increased river flows unlikely, the plan relies on better management of the river between Lake Mead and the Mexican border. A study once reported that the United States loses about 500,000 acre feet of river water each year to Mexico due to mismanagement.

One of the strategies is to build a small reservoir to ensure a more a more efficient delivery of water from Lake Mead to downriver farmers or irrigation districts. The way it now works is water released from Lake Mead for downriver agricultural use may take several days to reach its destination. Meanwhile changing conditions such as rain may result in the water not needed. Unclaimed by U.S. agricultural interests, the released water then flows to Mexico.

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. Nevada will pay to construct the reservoir, which is scheduled for completion by 2009, to earn shares of the saved water.

The plan also calls for farm-farrowing, with farmers paid not to plant fields. The water not used would remain in Lake Mead and be available for other uses. Reclamation will contribute funds to farm-farrowing efforts. California has thus far made more use of this strategy than Arizona.

The plan's most noteworthy strategy is to restart the Yuma desalter. Once viewed as a white elephant, a relic of a bygone era, the

desalter now is viewed as a project worth revisiting during drought-struck times. The plan calls for restarting the plant for a 90-day test to determine feasibility of operation and costs. Scheduled to restart in March, the plant would operate at 10 percent capacity.

Operation of the plant was a very controversial issue at one time due to concern its operation would environmentally damage the Cienega de Santa Clara, a Mexican wetland, by cutting off agricultural runoff. In what is considered an extraordinary breakthrough various groups involved in the controversy were able to work out their differences to identify a set of management alternatives agreeable to all.

Well if you put it that way ...

Your golden retriever may drink out of the toilet with no ill effects. But that doesn't mean humans should do the same.

The lead in a July 24 Union-Tribune editorial opposing San Diego's plan to use treated wastewater as drinking water.

During the plant's test run the water quality of the wetland will be monitored, with the Central Arizona Project funding the \$80,000 water monitoring effort.

Robert Johnson, New Reclamation Chief

The U.S. Senate has confirmed Robert Johnson as the 20th person to lead the Bureau of Reclamation. He is well known by water officials in Arizona and throughout the West as Reclamation's Lower Colorado Regional Director, the position he held before becoming Bureau head.

As regional director, Johnson oversaw the last 700 miles of the Colorado River, Hoover Dam, and numerous other Reclamation activities in southern Nevada, southern California and Arizona. In that capacity he initiated and directed significant changes in the management of the Colorado River.

Johnson joined Reclamation in 1975 in the Mid-Pacific Region in Sacramento.

Since then he has held several other leadership positions, including Deputy Regional Director, Chief of Water, Land, and Power Operations Division in the Lower Colorado Region, and a management position in the Commissioner's Office in Washington, D.C.

See Guest View, page 6, for statement from Commissioner Johnson.

New Law Joins Fight Against Exotic Plants

Congress recently passed a bill to strengthen the ongoing battle against nonnative plant species that have damaged river systems throughout the West. The Salt Cedar and Russian Olive Control Demonstration Act will support activities to control these nuisance plants that have challenged all efforts to eradicate them.

The new law directs the Bureau of Reclamation to work with the U.S. Department of Agriculture to conduct at least five salt cedar and Russian olive assessment and demonstration programs. The bill authorizes \$20 million for FY2006 and \$15 million annually from 2007-10 to provide grants to states and public/private partnerships to identify the best ways to eradicate these nonnative species.

The effort to eradicate thirsty nonnative species has gained momentum due to the ongoing drought; a mature salt cedar or Russian olive plant can consume up to 100 - 200 gallons of water a day.

Water supplies may have been the immediate concern but broader environmental purposes also are served. The exotic plants crowd out native trees like willows and cottonwoods, add salinity to the soil, and lower the water table. A dense growth of salt cedar can reroute a river's flow, thus interfering with its ability to control floods and move sediment. Wildlife species are left without the natural backwaters they need.

Removing the plants without causing river bank erosion can improve stream flows and help restore native vegetation. Strategies to eradicate the salt cedar have included bulldozing, chemically treating salt-cedar infested land and releasing beetles that feed on the plant.

Correction

When reporting on the Bureau of Reclamation's effort to have the agency identified as "Reclamation," a News Brief in the September - October AWR stated "Restoration." We regret the error.

More People, Less Water in the Offing

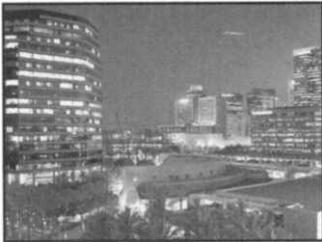
Sustainability and safe-yield, two terms used in reference to water supplies, connote a state of equilibrium, that water resources will not be consumed in excess of renewable supplies. Recent research suggests that meeting that water resource ideal may pose a very vigorous challenge. Arizona population is expected to greatly increase, and Colorado River flow will likely significantly diminish. In the tradition of the Old West a showdown threatens.

Report: Arizona's Population to Double by 2036

With the U.S. population reaching 300 million, population growth is much in the national news. A recent article brings the issue closer to home, at the state level, by projecting Arizona's population growth into 2036. It is a report that will greatly interest water managers.

According to the article Arizona will more than double its population during the next 30 years, with another 8.5 million residents added to the 6 million-plus that presently live here. Population increase will be especially pronounced in the major urban areas: Phoenix is expected to increase its present population of 4 million people to 9.7 million while Tucson, with a present population of just under 1 million, is expected to grow to 1.7 million.

An undoubtedly greatly enlarged Phoenix metropolitan area will account for two-thirds of the total population growth; metro Tucson is expected to account for 12 percent.



Phoenix the Citistate

Checking Census Bureau population estimates the article notes that Arizona was the 17th-largest state in 2005. It progressed to 16th place by mid-2006 surpassing Tennessee. The coming year will likely see Arizona become the 13th largest state by outpacing Indiana, Washington and

Massachusetts. Come 2036, Arizona will achieve top-10 status, in competition for the number 5 ranking.

The report breaks its forecasts into five-year increments, with Arizona's population topping 7 million in 2010 and 8 million five years later. Another 2 million or more people will be added each subsequent decade.

The article also notes research done by the Maricopa Association of Governments that reports population densities will not be confined to the two major urban cores but will stretch from Sierra Vista to Kingman.

According to the article one result of this dramatic population increase is an expansion of current metro boundaries, with population spilling into surrounding counties. Land along I-10 will likely become prime real estate as the two urban centers literally grow closer together. The report refers to a study done by Robert E. Lang at Virginia Tech's Metropolitan Institute stating that Pima, Pinal and Maricopa counties will make up one of the country's ten "megapolitan areas."

The increased population expanded over a greater area of the state means a greater need for regional planning. Taking center stage as the central city in a state that is part of a single global

economic system, Phoenix will become "the Phoenix Citistate."

In a statement water planners would appreciate the article says, "The challenge to plan for and accommodate the tremendous growth yet to come has never been greater."

The article appeared in the October edition of *Arizona's Economy*, a publication of the Economic and Business Research Center of the University of Arizona's Eller College of Management. Marshall J. Vest is the author of the report and director of the center.

Drought May be Way of the Future

Analyses presented at a recent conference does not bode well for future Colorado River basin states' water supplies. Marty Hoerling of the National Oceanic and Atmospheric Administration's Climate Diagnostics Center presented the most dire scenario. He examined 18 different global circulation model outputs and noted that the Colorado River basin and other areas of the interior West will likely be greatly affected by increased temperatures due to global warming.

He calculated that flows at Lee Ferry could be reduced by 40 percent by 2060. In a shorter 25-year period, he suggested that Lees Ferry flows could decline below 12 million acre feet on average. This would be a serious situation considering that Colorado River water allocations among upper and lower basin states was figured in 1922 on an annual river flow at Lees Ferry of 16.4; each basin is to receive 7.5 maf each year. It has been long realized that the 16.4 maf figure was flawed but Hoerling's is a particularly low and unsettling revised calculation.

Almost all the models show a steady increase in temperatures; the models are less in agreement about the effect climate change will have on precipitation.

Other research presented at the conference concluded the expected increased temperatures will result in higher evapotranspiration and less snowpack; less runoff will then occur. Richard Palmer of the University of Washington reported that natural snow pack reservoirs are now diminishing and that the smallest snowpack on record occurred in winter of 2005

An Australian scientist offered what might be viewed as cold comfort to her U.S. colleagues; she said they should treat drought not as an anomaly but as the norm. She offered her country as an example where drought is not considered a disaster but a condition that might be expected as an aspect or characteristic of a very variable climate

Sponsored by the Geological Society of America, the Sept. 18 - 20 conference was titled "Managing Drought and Water Scarcity in Vulnerable Environments: Implementing a Roadmap for Change in the United States;" its intent was to develop a national drought strategy.



Guest View

New Reclamation Commissioner Lauds Arizona Water Progress

Robert Johnson, recently appointed Bureau of Reclamation commissioner, contributed this Guest View. (See News Briefs for story of his appointment.)

It has been my pleasure to be involved in Arizona water issues for the past 27 years. While I have never lived in Arizona, my involvement in the Central Arizona Project and the Colorado River from Reclamation's Lower Colorado Regional Office has provided me with a birds-eye view of the Arizona water scene. I believe I have experienced both the best of times and worst of times with many in Arizona's water community. I must say, the best times far outweigh the worst times. I consider myself lucky to have been a small part of many of the accomplishments that have occurred.

Just to reminisce, during the last three decades, the CAP was constructed, the Arizona Groundwater Management Act was implemented, significant dam safety problems on the Salt River Project were alleviated, divisive litigation over CAP financial and operational issues was settled, and the Arizona Water Bank was established. In addition, interstate off-stream water banking programs were developed and implemented, Colorado River Surplus Operating Guidelines were implemented, California's Colorado River water use was limited to 4.4 million acre-feet, Endangered Species Act compliance for the next 50 years on the lower Colorado River was achieved through the Lower Colorado River Multi-Species Conservation Plan, numerous Indian water right settlements in Arizona were negotiated and implemented, and the Arizona Water Settlements Act was passed by Congress, providing a framework and financial structure to settle remaining Indian claims in Arizona.

Who ever said water issues never get resolved? Arizona water leaders should be proud of this record of accomplishment. In my view, Arizona's efforts to plan for and meet its water needs are outstanding.

There is yet another effort currently underway which is every bit as important as the accomplishments listed above. Reclamation, through a public process that includes consultation with the seven Colorado River Basin States and others, is developing shortage and coordinated management guidelines for the Colorado River. An environmental review process currently underway is expected to be completed in December 2007.

These guidelines, when implemented, will: (1) provide specific criteria for the declaration of shortages to the Lower Division States (Arizona, California and Nevada); (2) provide a new framework for the coordinated operation of Lakes Mead and Powell; (3) implement a mechanism for the storage and delivery of conserved system and non-system water in Lake Mead; and (4) modify and/or extend the interim surplus guidelines through 2025.

Through this action, we anticipate that individual entities in the Lower Basin will be able to develop storage credits through extraordinary conservation as well as augment existing water supplies through interstate water exchange programs. Furthermore,

this action will provide a greater degree of certainty to water users, particularly in Arizona, with regard to future Colorado River water supplies.

The consensus reached by the Basin states and submitted to the Secretary in February is a major accomplishment in the Basin. Through their preliminary agreement, the states have set aside long-standing differences over interpretation of the 1922 Colorado River Compact in favor of pragmatic approaches to operating the river. Under the proposal, all seven states gain practical benefits.

California gains the flexibility to develop storage credits in Lake Mead, allowing water to be stored for future diversion when needed. This will allow water users in California to use Colorado River water in conjunction with other water supplies within the state, ultimately providing the operational flexibility to conserve significant amounts of water.

Through the development of storage credits and exchanges, Nevada obtains a significant benefit in the increased ability to augment its Colorado River water supply to meet its growing needs. This flexibility would allow the state to develop its in-state water supplies, such as groundwater, while also augmenting its supplies through future water exchanges.

The proposed agreement would provide the Upper Division states — Colorado, Utah, New Mexico and Wyoming — with more operational flexibility with Lake Powell. Under current operating guidelines, Lake Powell fluctuates significantly while Lake Mead remains more stable. The proposal by the states will, in simplified terms, allow the two lakes to move up and down together. This will protect recreational uses and power generation at Lake Powell while still allowing the upper basin to meet its compact obligation for water deliveries to the lower basin.

Arizona gains in a number of ways. The development of storage credits and exchanges will help Arizona augment its future water supply needs, especially in times of shortage. And maintaining higher elevations in Lake Powell would significantly benefit recreation in the City of Page and the surrounding area, as well as benefit power users in Arizona who receive a significant share of Glen Canyon Dam's power generation.

Most importantly for Arizona, the states' proposal offers modest and staged implementation of shortages should they occur in the lower basin. Under the proposal, shortages would be incurred when Lake Mead reaches elevation 1075 feet above mean sea level (approximately 145 feet below full), and would be limited to 400,000 acre-feet (less than one-third of the amount Arizona routinely diverts into the CAP each year). If Lake Mead continued to drop, and reached elevation 1025, shortage levels would be limited to 600,000 acre-feet. While the CAP must bear the brunt of lower basin shortages, these amounts are very manageable within its 1.5 million acre-foot normal supply.

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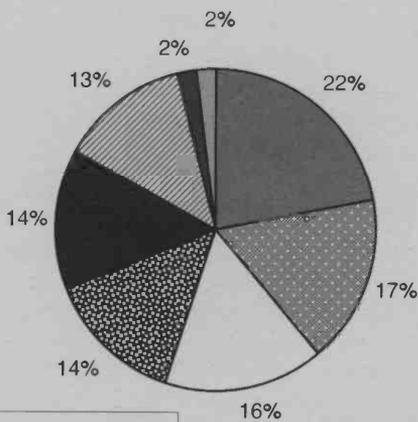
Growing Population, Limited Water Supplies Pose Challenge

Water & Growth Workshop

Questions swirl around water in Arizona: Do we have enough water to keep growing in Arizona? Where will our future supplies come from and who will get them? How much water do we have, what will it cost, and how long will it last?

A recent workshop held June 21st at the Hyatt in downtown Phoenix entitled "Water and Growth: Future Water Supplies for Central Arizona" gave participants an opportunity to debate these questions and more (<http://sustainable.asu.edu/gios/waterworkshop.htm>). ASU's Global Institute of Sustainability hosted the workshop in conjunction

Figure 1: Water Workshop Participants by Sector



- 22% Local government
- 17% Private companies
- 16% State government
- 14% Federal government
- 14% Universities
- 13% Citizen groups
- 2% Elected officials
- 2% Other states

with the annual conference of the Water Resources Research Center held on June 20th. We aimed to move beyond the typical conference and towards a consensus

list on Arizona water issues requiring action in the near future. A diverse group of 134 participants attended the workshop with about 75% from central Arizona (see Figure 1).

The workshop began with the presentation of a background paper on water and growth (see box at right) and presentations by:

- Brad Hill, City of Peoria: "Infrastructure Needs and Building Balanced Water Supply Portfolios"

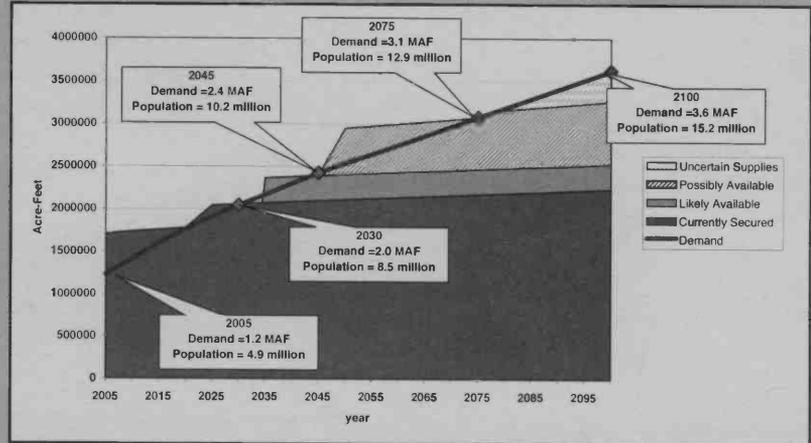
WATER AND GROWTH: FUTURE WATER SUPPLIES FOR CENTRAL ARIZONA

GIOS Discussion Paper #1

Jim Holway, Peter Newell and Terri Sue Rossi

Abstract

This paper, prepared to facilitate discussion, articulates the conventional thinking about future water demands and supplies for central Arizona. It presents a 100-year population and water demand projection and overview of current and potential water supplies. The main finding is that water supplies are likely available to support the projected growth, but significant investments in infrastructure and transferring water from other uses will be necessary.



Based on population projections from the Department of Economic Security, central Arizona will have 10.2 million people by 2045 and, if those trends continue, 15.2 million by 2100. At current water use levels, this increase could result in a demand for 3.6 million acre feet of water for municipal and industrial uses by 2100. The graph above illustrates this water demand and the certainty of potential supplies. Examples of "currently secured" supplies include Salt River Project (SRP) and Central Arizona Project (CAP) allocations. "Likely available" supplies, generally required after 2030, but in some areas much sooner, would include water rights leased from Native American communities or obtained from mainstem Colorado River water users and imported through currently excess CAP canal capacity. Meeting the water demand beyond 2045 will likely require significant changes including: increased reuse of treated effluent, an increase in CAP canal capacity and transferring more "possibly available" water from Colorado mainstem users. By approximately 2075, a significant investment in acquiring additional "uncertain supplies" such as desalinated water, more transfers from the Colorado River, and a new canal to import these supplies would be needed. This paper does not consider potential supply reductions during a long-term drought or the potential impacts of global climate change. Based on comments and workshop results, this paper may be revised and updated and could be used to facilitate additional discussion on future water supply challenges.

Entire paper is available at <http://sustainable.asu.edu/gios/waterworkshop.htm>

Table 1: Exercise 1 – Most Important Water-Management Issues for Arizona (Numbers in parentheses = number of discussion tables where issue was discussed)

<p>Water-Management Planning</p> <ul style="list-style-type: none"> • Linkages between water and growth (12) • Regional/watershed coordination (10) • Hydrologic information/data synthesis (9) • Recovery planning/aquifer management (8) • Agriculture and agricultural water rights (3) <p>Water Management / Legal Framework</p> <ul style="list-style-type: none"> • Regulations needed outside of AMAs (12) • Need to update legal framework (10) <p>Supply Reliability and Climate</p>	<ul style="list-style-type: none"> • Unexpected variability (drought and climate change) (7) • Supply reliability (5) <p>Environment</p> <ul style="list-style-type: none"> • Incorporating environmental quality and ecosystem needs in water policy (11) <p>Public Perception and Education</p> <ul style="list-style-type: none"> • Water-conservation education and incentives (11) • Public perception and education (5) • Need for legislative leadership (2) <p>New Supplies</p> <ul style="list-style-type: none"> • Competition for supplies (5) • Finding the next bucket (5) • Capacity/reliance on CAP (5) 	<ul style="list-style-type: none"> • Effluent and reuse (4) • Energy required to deliver water (1) <p>Financing</p> <ul style="list-style-type: none"> • Funding new supplies (2) • Financing new infrastructure (2) <p>Colorado River Management (8)</p> <p>Water Quality: Salinity Management and Inorganics (8)</p> <p>Infrastructure</p> <ul style="list-style-type: none"> • New infrastructure (5) • CAP canal capacity, reliability, and wheeling (3) <p>Equity Issues (7)</p> <p>Central Arizona Groundwater Replenishment District (9)</p> <p>Native-American Water Issues (6)</p>
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- Guy Carpenter, HDR Engineering: “Political Hurdles and Major Policy Implications”
- Marvin Cohen, Sacks & Tierney: “Future Allocation Mechanisms”

The speakers summarized the major themes from Day 1, identified the challenges and issues pertaining to water and growth in Arizona, and got everyone warmed up for the discussions. After a full day of listening to presentations, the participants clearly came ready to talk! Volunteers at each of the 16 tables facilitated the Day 2 small-group discussions through a series of four exercises.

EXERCISE 1: IDENTIFYING THE ISSUES

In Exercise 1, participants were asked to identify Arizona’s most important water-management issues. This exercise generated a large list of issues that we organized under broad themes (Table 1). Water-management planning and water-management legal framework received the most attention.

EXERCISE 2: DISCUSSING THE ISSUES

In this exercise, participants were asked to discuss the issues of greatest importance from those identified in Exercise 1.

Frequency Analysis of Discussions

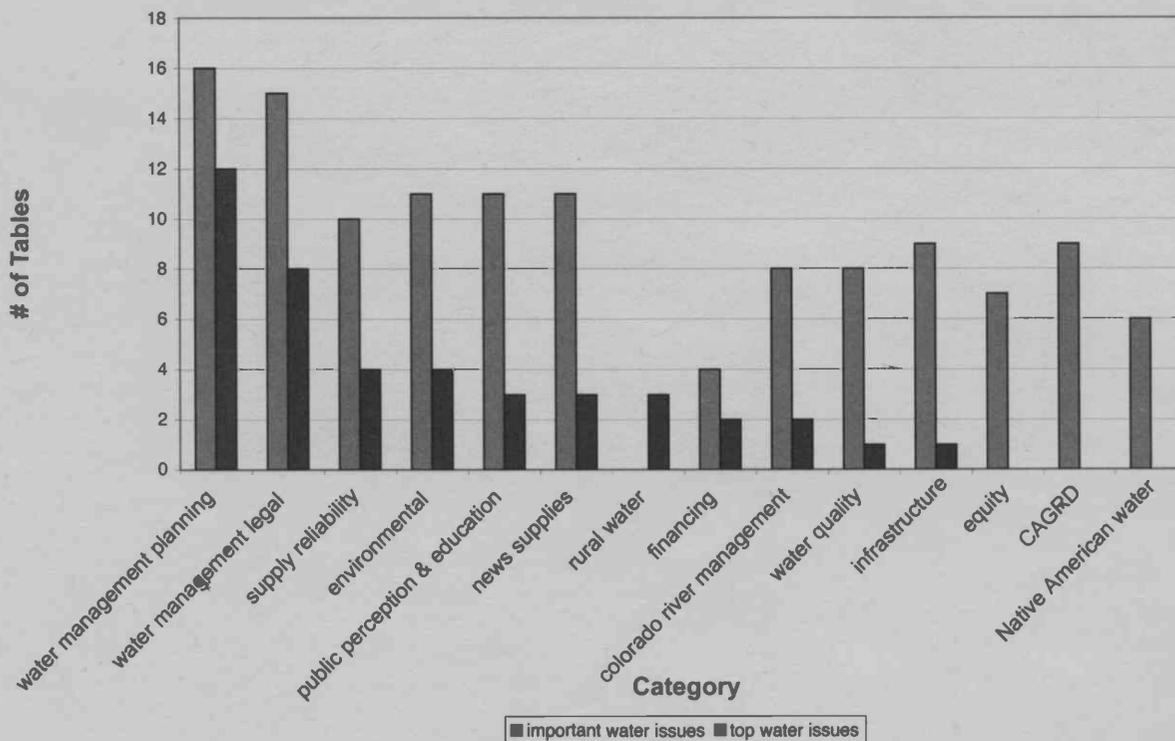


Figure 2: Frequency comparison of “most important water issues” and “top issues” selected for discussion in Exercise 2

These “top” issues were discussed using the following questions:

- Why is the issue critical?
- What are the issue’s key components?
- What public-policy questions need to be addressed to help resolve the issue?
- What else needs to happen to make progress?
- If timing is critical to this issue, what does the timeline look like?

Table conversations ranged from simply listing the top issues with little discussion to in-depth exploration of one or two issues. Water Management Planning and Legal Framework issues again dominated the discussion. The categories of Central Arizona Groundwater Replenishment District, Native American Water and Equity received scant discussion; however a new category emerged focused on rural water. Figure 2 illustrates the number of tables which addressed each of these “top issues” and compares this with the broader initial listing of “important issues” from Exercise 1.

EXERCISE 3: LEGISLATIVE DOCKET

Exercise 3 asked participants at each table to name the top two water-related issues that the Arizona Legislature should address in the next two years (see Table 2). Of particular note, was that in this workshop focused on central Arizona water supplies, the vast majority of the legislative issues identified related to rural water management. The need for water adequacy authority outside of AMAs topped the list of issues needing legislative action followed by related concerns about exempt wells and wildcat subdivisions, then regional water management authorities or statewide water management controls. Several tables also identified related concerns about inadequate attention to water in local planning and in the statewide growing smarter planning requirements. Funding for additional water studies and data collection, identified by 4 tables and legislative reforms to address the legal disconnect between surface water and groundwater, identified by 3 tables also have

1. Water-adequacy authority outside AMAs (8)
2. Disclosure of inadequate supplies (2) and GRD membership (1)
3. Local planning: should consider water (2)
4. Growing Smarter statewide vision (2) or statewide-planning process (1)
5. Exempt wells should not be exempt (7) or lot splits should be limited (4)
6. Statewide uniform water control (1) or regional water mgt. authority (2)
7. Create statewide authority for acquiring and assessing supplies (1)
8. Rethink AMAs and ability to achieve their goals (1)
9. Adequate funding of adjudications (1)
10. Increased funding for ADWR (2) and Arizona Water Institute (1)
11. Fund additional water-resources data collection, monitoring, studies (4)
12. GRD Wet versus paper water and sharing cost of developing and delivering supply (1)
13. Loan program for developing rural water supplies (1)
14. Maintain agricultural land uses (1)
15. Connect groundwater and surface-water laws (3)
16. Protection of stream flow and riparian areas (1)
17. Develop drought triggers and prepare a recovery plan (1)

Table 2: Issues for Arizona Legislative Action in the Next Two Years

relevance in rural Arizona. The complete list of recommendations for legislative attention is contained on the workshop webpage.

EXERCISE 4: NEXT STEPS

In Exercise 4, groups were asked how to best move forward with the dialogue started at the workshop. The consensus was that we need to:

Enhance regional collaboration and coordination

Participants placed a high priority on the need for coordinated efforts to manage the growth of Arizona, with 11 of 16 tables focused on the need to develop regional coalitions. A few groups identified mechanisms to find common ground between diverse



groups in order to work toward sustainable and implementable solutions. These included focusing on common ground, developing trust among stakeholders, and understanding and removing the obstacles to collaboration. Three of the tables also identified a need for statewide water planning.

Advance legislative issues and proposals for legislative action

Over half the tables identified legislative issues and proposals for legislative action. Four tables recommended educating legislators thoroughly on Arizona water issues; others suggested creating an advisory group or think-tank to address specific issues and develop recommendations. This advisory group could identify problems and desired conditions, examine the interaction between water deliveries and quality of life, and consider the environmental impacts of water use. A number of groups also suggested identifying legislative lobbyists who could address specific water management issues at the legislature.

Increase public education and outreach

Half the tables identified public education and outreach

as an important next step. Ideas included using media forums to address pressing issues and raise public awareness. Other tables discussed the need for community and leadership input to drive the conversation and the vision for Arizona's future.

Identify roles for Arizona's three universities

Finally, half the groups examined the role of Arizona's three universities and argued that the universities can play an integral role in continuing the conversation about future water supplies and serving as neutral facilitators. Universities could also assist with data collection, collaborate with practitioners on applied research projects, and disseminate related findings. Suggestions for specific areas of research and data collection included projects similar to the Arizona Hydrologic Information System, as well as researching topics such as desalination, conservation, water economics, water policy and quantifying long-term sustainable water supplies.

Workshop Survey

To understand the workshop's group dynamics, documenters at each table completed a survey at the end of the workshop that asked which issues were passionately discussed and which issues led to consensus or polarization. An observation of particular note is that all 16 documenters indicated there was a clear consensus to some degree on most issues. Only 6 of the 16 identified polarizing issues, which involved: debates over the appropriate management tools and roles of local, state, and federal government; the disconnect between surface water and groundwater; the adjudication and Indian water rights; and the best means to educate the public and decision makers. The documenters indicated that the issues discussed most passionately included regulatory questions (i.e., concerns about rural-water adequacy); institutional considerations (i.e., local control and the Central Arizona Groundwater Replen-

ishment District); and rural-versus urban equity issues and discussions about partnerships and coalitions.

Conclusion

Arizona has faced challenging water issues throughout its history and has developed adaptable programs and institutions to manage its water needs. Today, water managers and community leaders are devising new solutions for an uncertain future. This future water supplies workshop was designed to bring together multiple parties with diverse and sometimes competing interests to engage in a conversation about the pressing water issues facing Arizona. The workshop was effective at achieving consensus on the key water issues that Arizona will need to address in a time of rapid urbanization and competing demands for water and at initiating new conversations. Among the numerous issues which need to be addressed, the results of this workshop suggest beginning with efforts to develop regional collaboration to move towards a common vision.

This workshop was developed and facilitated by the Sustainability Partnership (SP) at the Arizona State University Global Institute of Sustainability. The Sustainability Partnership works to span the boundaries between researchers and practitioners and to jointly engage local and state policy makers, resource managers, industry leaders and university faculty and staff in planning for and responding to the challenges of urban growth, environmental protection, resource management, and social and economic development. SP and Institute staff contributing to this effort included: Jim Holway, Anne Ellis, Pete Newell, Wayne Janis, Lauren Kuby and Estella O'Hanlon. We greatly appreciate the planning and facilitation assistance we received from Teresa Makinen, Terri Sue Rossi, Guy Carpenter, Marvin Cohen, Brad Hill, Ken Seasholes and Kathryn Sorensen. We also could not have conducted this workshop without the student and staff volunteers from ASU and the University of Arizona who documented the conversations at each table.

The Global Institute of Sustainability sparks interdisciplinary research on environmental, economic, and social sustainability. The Institute brings together life, earth, and social scientists, engineers, and government and industry leaders to share knowledge, educate and develop adaptive solutions for an urbanizing world. Beginning in January 2007, the Institute will be offering masters and Ph.D (with bachelors coming soon) programs in sustainability through its new School of Sustainability. The School is educating a new generation of leaders to address the environmental, economic, and social challenges of the 21st century through collaborative learning, interdisciplinary approaches, and problem-oriented training.

GIOS: <http://sustainability.asu.edu>
SOS: <http://.schoolofsustainability.asu.edu>

 GLOBAL INSTITUTE
of SUSTAINABILITY
ARIZONA STATE UNIVERSITY

Complete workshop results and copies of the presentations and background paper are available at <http://sustainable.asu.edu/gios/waterworkshop.htm>



Legislation and Law

EPA Proposes Water Transfer Rule

Some say it poses a threat to water quality

The U.S. Environmental Protection Agency is proposing a new water transfer rule that would allow communities or other entities to move water from one source to another without applying for federal pollution permits to ensure water quality. This would apply whether the water was transferred to irrigate fields, generate power, control floods or provide drinking water.

In effect, the rule would exclude regulating water transfers under the Clean Water Act's National Pollution Discharge Elimination System permitting program.

The proposed rule change has raised the ire of environmentalists concerned about the environmental consequences of water shifted from a polluted lake or river to an unpolluted body of water. They have been successful in winning several court cases that ruled permits are in fact required when water is transferred.

EPA's position is that Congress never intended the agency to regulate water transfers. The agency has only required such permits in response to federal court rulings that required it to take such action. In its proposed rule, the agency stated that requiring such a permit would amount to "unnecessary federal interference."

Uncertainty, however, prevails. In response, Ben Grumbles, assistant administrator in the EPA Office of Water, said the agency's proposed rule will help remove confusion by clarifying the scope of the Clean Water Act.

Attorneys general of more than a dozen states have strongly taken issue with EPA position. In a forcefully worded letter to the EPA, the attorneys general of various states, including New York, Vermont, Connecticut, Delaware, Wisconsin, Illinois, Iowa, Kentucky, Minnesota, Missouri and Pennsylvania, stated that the proposed plan is in violation of the Clean Water Act.

They expressed concern the new policy would result in water transfers with varied harmful environmental consequences, with polluted water transferred into clean drinking water, salt water into fresh water, warm water into cold habitats, and chemical-laden water into irrigation water used for crops. They also argued that unregulated water transfers will further the spread of invasive species.

Western water agencies, on the other hand, are generally supportive of EPA's proposed rule. They say requiring a federal permit to transfer water would be a burdensome and expensive encumbrance resulting in increased water costs to its customers and less secure water supplies.

The West is the land of mighty water projects, with water transferred and transported great distances for irrigation and drinking water. Arizona's Central Arizona Project is a prime example of such a project.

Critics respond by saying that appropriate regulations would not be onerous. They argue that routine water transfers not involving serious pollution issues could get a general permit that could be expediently processed at less cost. ■■

All-American Canal Lining On Hold

Controversy continues to beset plans to line the All-American canal with concrete in an effort to capture about 56,000 acre feet of seepage, with the "saved" water then going to the San Diego County Water Authority. In August, the 9th U.S. Circuit Court of Appeals ordered a halt to work on the project pending the hearing of an appeal filed to block the canal lining.

The development might also be viewed as a setback for Arizona which along with Nevada, another Lower Colorado River Basin State, supported the canal-lining project.

The project had previously surmounted a legal hurdle in July when a federal judge denied a petition by two California environmental groups and a Mexican business coalition to block the project. Their class-action lawsuit claimed that water Southern California gained by the canal lining would be at the expense of Mexican farmers and south-of-the-border wetlands.

Federal Judge Philip Pro rejected this claim as overly speculative. He labeled plaintiff's claims that the relining would "eliminate the source of water for an entire farming community immediately south of the border" as highly speculative.

Many believed that the \$251-million project lining the 23-mile section of the canal near the Mexicali border, a project planned for about 20 years, was then on track when the court of appeals side-railed it by issuing without comment an emergency injunction to halt work on the canal. A hearing is scheduled for early December.

Those favoring the project, which has a deadline of the end of 2008, say the delay will set work back a year. Further, California taxpayers and San Diego County ratepayers will confront higher costs.

Most importantly, if the worst case scenario plays out and the project is unable to proceed, California will lose an important water source intended for use to meet an interstate agreement to reduce its use of Colorado River water. The relining issue thus is of concern to the seven Colorado River Basin States.

California would have to find water from another source. This would bring the state back to the drawing board to again consider redistribution, an issue that was considered settled when the 2003 agreement to reduced Colorado River water use was signed.

More than likely California would have to cover the loss within the state, although other Colorado River Basin States would likely feel nervous that the issue might also affect them.

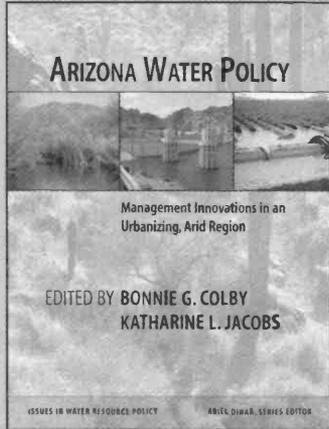
Arizona also is concerned about another possible consequence: an adverse ruling might result in similar challenges to Arizona projects along the Mexican border near Yuma.

Meanwhile two additional cases were recently filed, in federal and state courts, to stop the All-American project pending the completion of a new environmental report. The suits claim that the original 1994 environmental report was outdated by subsequent changes that were made to the project. It is argued that a new environmental report must be drafted. ■■



Publications & On-Line Resources

The Challenge of Managing Arizona Water



Arizona Water Policy: Management Innovations in an Urbanizing, Arid Region

Bonnie G. Colby and Katharine L. Jacobs, editors. *Resources for the Future*, cloth \$65. For information about ordering check: www.rffpress.org

Explosive population growth in a region of limited water supplies poses an obvious dilemma. The water management task is to address the dilemma,

with the understanding that dilemmas are not often totally resolved. Whatever resolution is achieved comes after tensions inherent within a dilemma are measurably reduced by working through complexities and arriving at the most advantageous decision given the situation.

Edited by Bonnie G. Colby and Katharine L. Jacobs, "Arizona Water Policy: Management Innovations in an Urbanizing, Arid Region" provides a broad perspective of the multifaceted water supply/population growth dilemma. What water resources are available to Arizona? What historic, economic and social conditions have determined state water policy? What institutions have been devised to enable Arizona to more efficiently manage its scarce water resources? These are some of the major questions the 15 articles or chapters within the volume discuss.

The chapters emphasize the importance of institutions and institutional arrangements — e.g. laws, regulations and public policy — to ensure that water is efficiently managed to serve the best interest of the state. Analysis is the key, to better understand

the situation or, in the case of the issue addressed in this volume, the dilemma, and to making effective institutional decisions. The essays offer the analysis to help identify good water management practices.

Many water related topics or issues are covered including state and federal laws, drought and climate variability, geographic distribution of supplies, water quality, recharge and recovery, tribal water rights, urban growth and rural water concerns. Each is a facet of the multifaceted Arizona water supply/water use picture. Along with noting a range of issues of concern to water policymakers, the book also describes Arizona's adoption of new and innovative approaches for addressing water problems; e.g. the Arizona Groundwater Management Act and the water bank.

Readers familiar with Arizona water resource issues will recognize the names of most of the contributors to the book. They are people who have long been active in state water affairs, in various capacities, including as researchers, federal and state officials, engineers and attorneys. The authorship is a veritable who's-who roster of Arizona water resource experts.

The book leaves the impression that Arizona water affairs are indeed a very complicated business. If it does not offer a resolution to the state's water resource dilemma — as long as people continue to come to the state and water resources remain limited the dilemma will remain— the book, by raising and discussing critical water issues, points in the direction of wise water management choices.

Work on the book was supported by the University of Arizona, the Technology and Research Initiative Fund, the Water Sustainability Program through the Water Resources Research Center and SAHRA (Sustainability of Semi-Arid Hydrology and Riparian Areas) under the STC Program of the National Science Foundation.

Water Resources Availability for the Tucson Metropolitan Area

Sharon B. Megdal, *University of Arizona's Water Resources Research Center*. Available on the WRRRC web site: <http://cals.arizona.edu/azwater> Click "Papers and Presentations," then "Sharon Megdal."

An agency, town or city taking on the task of water demand planning confronts a set of questions: What are the regions's dependable water supplies? What other water sources are available? How many people can those supplies support? Will sufficient supplies be available to support future population growth? This report takes on those question for the Tucson region. The report includes as part of its analysis of the cost and availability of water in the region illustrative scenarios for the year 2030 showing the number of people that can be served by identified water supplies under varying assumptions. The report calls for a broad approach to water planning, beyond just the involvement of water managers to include business interests and others in the private sector as well the public sector.

Stream Processes for Watershed Stewards

George Zaines and Robert Emanuel, *Cooperative Extension, College of Agriculture and Life Sciences, University of Arizona*. Available at: <http://cals.arizona.edu/pubs/natresources/az1378g.pdf>

This publication can serve as a primer to explain the hydrologic cycle, precipitation and human effects on streams and watersheds. Containing full-color diagrams and illustrations, the publication can be used as a teacher's guide for a variety of class settings, from formal high school science classes to informal volunteer trainings. Issues addressed include the hydrologic cycle, stream channel formation, stream reaches, and life and stream processes.

The publication is part of the Master Watershed Steward Program which is a partnership of the UA Cooperative Extension and the Arizona Department of Environmental Quality. Its mission is to train Arizona citizens as volunteers in the protection, restoration, monitoring, and conservation of their water and watersheds.



Special Projects

GateWay Community College Trains New Generation of Water Workers

Arizona has a special resource to help prepare its students for the increasing number of positions to be opening up in the field of hydrology. In what is a unique commitment for a community college, GateWay Community College in Phoenix offers two water study programs: Hydrologic Studies and Water Technologies. GCC is one of the few community colleges in the nation offering such programs.

GCC got involved in hydrologic studies in the early 1990s when the U.S. Geological Survey provided funding and equipment to enable the school to offer training to help fill the agency's need for hydrologic technicians. In response, GCC developed an Associate in Applied Science Degree in Water Resources Technology. Students were prepared for careers in the USGS, U.S. Bureau of Reclamation, Arizona Department of Water Resources and the Arizona Department of Environmental Quality.

About 1997, in efforts to better respond to expanding training needs, GCC broadened its curriculum, which was highly specialized at that time to serve USGS, to better address the needs of state agencies, municipalities, counties and engineering firms. The curriculum was revised, with the program renamed Hydrologic Studies. A water purification program also was established.

In an effort to further serve emerging needs, GCC established at this time an ultra-pure water program to fill positions in the robust semiconductor industry. The training in membrane and ion exchange technology helped the industry meet its critical need for workers in ultra-pure water plants.

GCC's continued partnership with USGS provides a national scope to the college's program; GCC serves as a national feeder school for the federal agency. GCC Water Program Director Lisa Young says, "Our students work nationwide in hydrology. We have students in North and South Carolina, Wyoming, Colorado, Nevada, California and, of course, Arizona along with a number of other states. We are filling a nationwide need.

"The USGS was here last week and reported a need for hundreds of hydrological technicians over the next five years, and there are only three schools to fill the need with on-the-job training."

The other schools serving a similar need as GCC are Spokane Community College in Washington state and Vermilion Community College in Minnesota. VCC is a sort of sister school to GCC, with USGS having established hydrologic study programs at both colleges. The two schools meteorologically complement each other; GCC is located in the desert and VCC prepares students for work in colder climates.

Young says, "We placed a student in Minnesota who had never been in the snow. USGS paid the student to go there during winter break to experience what it is like to work in the snow. But most of our students are not looking for employment in cold climates. So USGS worked with Vermilion to create a program to fill the needs of the northern US."

Whether it is the warm weather or its distinctive hydrologi-

cal offerings, GCC draws students from around the United States. Young says that although GCC's primary objective is to recruit students from Maricopa County, students come from various areas, including Alaska, Colorado and New Hampshire.

One option GCC students have is to continue work toward a four-year degree. Young says she is working to arrange articulation with NAU and UA, to enable GCC students to transfer directly into upper division course work. She says some of GCC students have transferred into university programs of engineering and geography.

GCC's steppingstone role works two ways, preparing students for upper division work but also providing students who have degrees and want to broaden their educational background a steppingstone for taking GCC courses.

Young says, "What is unique about our program is that often students with biology, chemistry, geography or geology bachelor degrees, even masters degrees — sometimes in natural resources planning — come to us for the application part of it. We fill a need for hands-on training (that) complements their university education."

Young says determining the actual number of students in the programs is difficult since students take different paths, with some

Hydrology – Available Jobs, Good Salary

GateWay Community College is preparing students for jobs with a promising future. An article on CareerBuilder.com lists the top ten jobs offering good employment opportunities and salary. All ten jobs listed by CareerBuilder.com also appeared within the Bureau of Labor Statistics' list of the 30 fastest-growing jobs through 2014. Hydrologist appears on both lists. The median annual salary of a hydrologist is \$60,880 according to Bureau of Labor Statistics data.

working full-time and taking a single class per semester while others attend class full-time. Some students complete a program in one-and-a-half years while others take six years. Many students split the program taking classes in both the Hydrology Program and the Water Technology Program.

GCC is meeting a hydrological training need at a propitious time. A generation of leaders and workers in the water field, making up what is in effect a contingent of baby boomers, will be retiring in the next ten years. Young says the training need is acute; a lot of the folks retiring have upper-level positions, with lots of institutional knowledge.

Young says, "The institutional knowledge that will be leaving when that generation retires is really quite extraordinary. We need to be sure that people are trained and have the time to spend with these people before they retire."

For information about GCC's programs check <http://environment.gatewaycc.edu/> 



Announcements

RFP: Water Resources Research Act, 104(g)

The U.S. Geological Survey in cooperation with the National Institutes for Water Resources requests proposals for the National Competitive Grants Program (Section 104 G of the Water Resources Research Act), to support research addressing water supply and water availability, including investigations of possible new sources of supply, improvement of impaired waters to usable quality, conservation of existing sources and limiting growth in demand. About \$920,000 in federal funds will be available for research. Investigator at an institution of higher learning in the United States is eligible to apply for a grant through a Water Research Institute. (In Arizona it is the University of Arizona's Water Resources Research Center.) Proposals must be filed on the Internet at <https://niwr.net/> by 5:00 PM, Eastern Standard Time, February 16. To obtain a copy of the RFP, go to <https://niwr.org/> and click on "RFP" under the heading "National Competitive Grants Program - 104G."

ADEQ Water Quality Improvement Grants



The Arizona Department of Environmental Quality announced it is accepting Water Quality Improvement Grant applications to allocate \$1.5 million for projects to improve water quality. Available to public and private entities in the state, funds are provided by the U.S. Environmental Protection Agency under section 319(h) of the federal Clean Water

Act. Each applicant must provide 40 percent in nonfederal matching funds to implement an "on-the-ground" project to improve and protect water quality in Arizona by addressing a nonpoint source of water pollution. ADEQ considers its 319(h) resources investment

capital and expects a return from its investments in the form of water quality improvements. Deadline to submit grant applications is Jan. 3, 2007. Grant Manual and application forms can be downloaded from ADEQ's Water Quality Improvement Grant Program web site, <http://azdeq.gov/environ/water/watershed/fin.html>

UCOWR Invites Award Nominations

The University Council of Water Resources has established several awards to recognize current and future water leaders, in the areas of research, education and outreach. The organization asks help in identifying people and organizations whose work deserves to be acknowledged with the following awards: Warren A. Hall Medal, for unusual accomplishments and distinction in the water resources field; Friends of UCOWR, for service to UCOWR; Education & Public Service, to individuals, groups or agencies that have increased public awareness of water development, use or management; and two PhD Dissertation Awards, one in water policy and socio-economics and one in natural science and engineering. (The dissertation award consists of a certificate and a \$750 check, reimbursement up to \$1,000 for travel expenses to the UCOWR annual meeting, and registration fee waiver to attend the annual UCOWR meeting.) For additional information including instructions and deadlines check "Awards" at www.ucowr.siu.edu

American Rivers Photo Competition

American Rivers invites photographers to enter their favorite river image(s) in their first-ever digital photography competition. They are looking for beautiful river photography representing Healthy Rivers, Healthy Communities; digital images of rivers, people, and community involvement are all eligible. Images can be submitted to one of three categories: Best River Photo, Best People & Rivers photo, and Best Wild & Scenic River Photo. Information about submitting photo(s) is available on the American Rivers web site: <http://www.americanrivers.org/site/PageServer> Thirty photos will be selected as finalists, with 10 for each category; each category will have one grand prize winner. The competition is open to amateur photographers age 18 or older. Photo submissions must be uploaded by December 31.

Route 66...continued from page 1

many gas stations along the route to "fill 'em up." Once the glory days of Route 66 faded, many stations went out of business. Underground tanks, that would not be up to today's standards, corroded, leaking leftover fuel into soil and groundwater. Some stations had leaking storage tanks even when operating.

Abandoned sites remained undeveloped, becoming derelict lots, a liability to a town or city. Since ownership of the land would likely include responsibility for cleaning up the environmental hazard interested buyers were understandably lacking.

The Arizona Department of Environmental Quality took action

about two years ago, to fix Route 66, launching a Route 66 Initiative to investigate and clean up the approximately 350 leaking underground storage tank sites reported along the route in Arizona. Progress thus far includes closing 273, with cleanup completed or not needed. About 80 sites, or 22 percent, await further investigation or cleanup. Most are in the Flagstaff, Holbrook and Winslow areas.

By removing the environmental hazard the agency also provides an economic boost to a town or city. The state agency has provided a model to the EPA to use in other states confronting the same problem. About a year ago EPA officially joined ADEQ's efforts to explore ways to assist local communities redevelop and create more businesses along the corridor.



Public Policy Review

by Sharon Megdal

Study of Adequacy of Tucson's Water Supplies Has Broad Application



Arizona's continued rapid growth raises concerns about the connection between growth and water supplies. The issue is on the minds of many; I am frequently asked about the sufficiency of supplies relative to growing demands. After Tucson Water presented its draft long-range plan, *Tucson Water Plan 2000-2050*, representatives of community business groups asked me to help them interpret the plan and

the broad regional water supply picture. Along with explaining aspects of the plan, I also was asked to numerically calculate the number of people able to be supported by known available water supplies in the Tucson region.

Writing a report explaining the context for long-range water planning was an appealing task, although I was at first uncomfortable about the numerical calculation. My concern was that the focus would be on the numbers rather than the context. Nevertheless, I saw the value of providing alternative illustrative scenarios. I agreed to produce the report.

Since the release of *Water Resource Availability for the Tucson Metropolitan Region* this summer, I have presented its findings numerous times. The report appears to have encouraged an understanding of the many factors that help answer questions about the sufficiency of water supplies — and how assumptions regarding these factors affect the conclusions.

What were the report's findings and conclusions? As the Tucson region strives to achieve the statutory management goal of safe-yield, multiple sources of water are available. We are not yet utilizing all of the region's allocated Central Arizona Project water. We use only a small portion of the effluent from the regional treatment plants. More opportunities are available to conserve water. Relying on reasonable assumptions and publicly available information, I concluded that water supplies are more than adequate for the population that the Pima Association of Governments projects will live in the region in 2030: about 1.5 million people. A caveat, however, is that the community needs to make decisions necessary to utilize these supplies, and some water use options could be controversial.

A key factor determining the adequacy of supplies is the rate at which the community utilizes effluent. Effluent will likely be used in the future for more than golf courses and other turf irrigation. Will it be used through recharge and recovery? Will the recovery occur inside or outside the area of hydrologic impact of the recharge? Will effluent be treated using sophisticated and currently costly membrane treatment technology? And a very controversial question: Will the public accept the mixing of treated effluent with potable water? The community has not yet begun discussing these questions as its attention is more focused on the challenge of figuring out the best way to utilize the region's CAP water. But these discussions are on the horizon.

Another important factor is the overall water use of the region, on a per capita basis. Will the mix of commercial activity and the effi-

ciency associated with low-water-using appliances result in a reduction in water use on a per capita basis? Some reduction would be expected, if only because new construction must install low-water use plumbing fixtures. But how much of a reduction? The Tucson Water Plan assumes a gallons-per-capita-per-day (GPCD) total consumption rate of 177 throughout the 50-year planning period. Including all water use in Tucson Water's service area on a per capita basis, this figure was the utility's rate when the plan was formulated in late 2004.

The breakdown of the 177 GPCD is as follows: Residential (indoor + outdoor), 110; Reclaimed water, 4; Commercial and Industrial, 35; and lost and unaccounted for water, 18. I used a GPCD figure of 165 in my report's baseline projections for 2030 and then performed some sensitivity analysis. If consumption were to remain close to the current amount, with population growing 10 percent higher than projected by Pima Association of Governments, water supplies are not expected to stretch much beyond 2030. Remember, however, no projection for 2030 is going to be correct — it all depends on the assumptions!

Findings are consistent with Tucson water managers' views that enough water resources are available to support a substantial increase in the region's population.

Although explaining the regulatory context for water planning, the report did not focus on our region's statutory management goal defined as "safe-yield." Many factors will determine whether the region meets the safe-yield goal, especially groundwater use by the agricultural and industrial water use sectors. Since these sectors operate under a different set of regulations, they could continue to use groundwater for some time. Any reduced water use they achieve does not result in increased water resources for the municipal sector. However, with only 20 years to go to reach the 2025 safe-yield target date, it is more important than ever to keep sight of this goal. And the study did not address the water needs of the environment, a water-using "sector" not recognized by the Groundwater Management Act.

The report's findings are consistent with what water managers in the Tucson region have said for some time: enough water resources are available to support a substantial increase in the region's population. Although the report focuses on Tucson, the methodology applies to any area. The same is true for several of the report's recommendations regarding community engagement in water management planning deliberations. Water management is not just the concern of water managers. This is becoming increasingly evident as we continue to grow statewide and attempt to identify the source of the next bucket of water to meet our ever-growing demand for water.

Water Resource Availability for the Tucson Metropolitan Area is available at the Water Resources Research Center's web site: www.cals.arizona.edu/azwater 

Guest View...continued from page 6

In short, the elements of the basin states proposal offer benefits for all the states and users of the Colorado River system. On behalf of the Secretary, the Department of the Interior is carefully considering the proposal, along with other alternatives, as part of the environmental compliance process. Only after fully evaluating all the alternatives and considering public input will the Secretary be able to select and implement a set of operating

guidelines. A draft environmental impact statement is expected to be published in February 2007. All interested parties are encouraged to review and comment on the proposals.

When the new operating guidelines are completed, we expect they will be another accomplishment to be shared by all the parties involved in shaping water management on the Colorado River. Arizona water leaders should again be proud of the role they have played in this effort. ■

Bioremediation...continued from page 2

some of the main contaminants at the site. This will be an important factor to consider when designing a cleanup strategy.

Bioremediation has wide and varied application. Watwood says, "There is very likely a biological approach that can be the solution or part of the solution for many different contaminated sites. In cases where it is very difficult to stimulate the natural community we look to more heavily engineered systems, possibly relying on the activity of added organisms or systems using genetically modified organisms"

She notes, however, that genetic engineering raises other kinds of problems. Strict federal regulations have to be met when a genetically modified organism is considered. Also genetically engineered organisms are often very fragile and unable to live and function in a natural community.

Bioremediation is a relatively new field, with the first patent issued in the 1970s to stimulate subsurface microbial activity to clean-up gas pollution. The field greatly expanded with the advancement of molecular technologies during the 1980s and 1990s. Scientists were then better able to study the kinds of microbes that existed in the environment.

Many microorganisms remain to be discovered. Field says, "Microorganisms are like stars. ... Microbiologists know of the existence of many microorganisms because of DNA sequences. ... There are probably millions more yet to be discovered. There is an endless capacity of different microorganisms; there is going to be new ones discovered all the time."

For example, University of California, Davis, researchers have recently discovered an organism that eats MTBE. Once added to gasoline to improve air quality, MTBE has contaminated groundwater throughout the country, with no way known to treat groundwater to remove the contaminant. Nicknamed PM1, the newly discovered MTBE-eating organism is present in groundwater but has to be pumped to the surface to multiply and eat MTBE.

Watwood says a great growth potential exists in the bioremediation field, that there are many polluted sites in need of clean up. She also expects bioremediation will be increasingly used for pollution prevention, with waste streams treated before they cause environmental problems. The idea is to eliminate environmental pollution, not just treat it once it occurs.

She says. "That is how I hope the field will evolve." ■



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