Arizona Riparian Council

Volume 16, Number 3 November 2003

Arizona Department of Water Resources and Riparian Areas

by Rodney J. Held, Program Manager, Arizona Water Protection Fund

The Arizona Department of Water Resources (ADWR) was created to ensure long-term dependable water supplies for Arizona's communities. ADWR administers state water laws (except those related to water quality), explores methods of augmenting water supplies to meet future demands and develops public policies that promote conservation and equitable distribution of water. ADWR also oversees the use of surface and groundwater resources under state jurisdiction and negotiates with external political entities to protect Arizona's Colorado River water supply.

Specific programs ADWR administers that are either directly or indirectly associated with riparian areas/issues include:

- Arizona Water Protection Fund
- In-Stream Flow Program
- Rural Watershed Initiatives Program
- Active Management Areas
- Recharge Program

ADWR also actively participates in the Multi-Species Conservation Program along the Lower Colorado River.

Arizona Water Protection Fund

The Arizona Water Protection Fund (AWPF) was created to provide a source of funding for implementing projects that maintain, enhance and/or restore rivers, streams and riparian resources in Arizona through a public grant process. The program is overseen by a 15-member appointed Commission, however it is administered through the Department of Water Resources. The AWPF Commission encourages locally led efforts, has funded projects in every county and benefitted more than 1,275 miles of rivers and streams throughout Arizona. Examples of the benefits AWPF grants provide include:

- Protection/Restoration of native riparian vegetation
- Restoration of proper hydrologic conditions/ functions
- Restoration of stream geomorphology/channel characteristics
- Restoration of floodplains
- Restoration of wetlands and backwater areas
- Improved fish and wildlife habitat

The AWPF Commission awards grants in Arizona under three general categories:

1. **Capital Projects**. Projects under this category include on the ground measures that directly maintain, enhance and/or restore rivers, streams and riparian habitats.
2. **Water Conservation Projects**. This category includes measures that develop, promote, and implement programs designed to conserve water for the purposes of directly maintaining, enhancing and/or restoring rivers, streams and riparian habitats outside any of the five Active Management Areas.
3. **Research Projects**. This category include research and data collection measures directly related to the improvement of maintaining, enhancing and/or restoring rivers, streams and riparian habitats. *Cont. pg. 3 ADWR*

Inside This Issue

PRESIDENT'S MESSAGE
THE FUTURE IS HERE

Do you remember the days, not too long ago, when Arizona did not use its full Colorado River entitlement? Well those days are gone. Arizona is now fully utilizing it's entire entitlement of 2.8 million acre-feet. In fact, Bureau of Reclamation records show that for calendar year 2001, Arizona consumptively utilized 2.841 million acre-feet, slightly over the states allocation of 2.8 million acre-feet. Together, the three Lower Basin states (CA, NV, and AZ) utilized approximately 8.4 million acre-feet in 2001, far exceeding the 7.5 million acre-feet allocated to the Lower Basin states.

What does this mean for Arizonans? Combined with current extended drought conditions and continued explosive population growth, you might say we have entered a new era in terms of Colorado River water availability and management. As the largest wholesale water supplier, the Bureau of Reclamation (Reclamation) has recognized the importance of this new era. Reclamation recently hosted a series of public meetings in the Lower Colorado River Basin states to present information on the history and future of the Colorado River management. Not surprisingly the meetings were entitled "The Era of Limited Water Availability." Information and data presented at these meetings does not paint a rosy picture for the health of the Colorado River system. Below are some examples.

- As of May 15, 2003, Lake Powell water levels were at 50% of capacity and Lake Mead levels were at 62%.
- The projected levels for April 2004 are 48% and 57% of capacity for Lake Powell and Lake Mead, respectively.
- Reclamation estimates a 24% probability of filling the reservoirs to 90% of capacity by 2010.
- The Colorado River was allocated based on flows of 15 million acre-feet (wet years). The average annual flow in the Colorado River between 2000 and 2003 has been approximately 10.7 million acre-feet.
- The Upper Basin states are only utilizing only 3.5 million acre-feet of their 7.5 million acre-feet allocation. If the Lower Basin States used only 7.5 million acre-feet and the Upper Basin states used 3.5 million acre-feet, the 11 million acre-feet total use exceeds the current flows in the system.
- There are currently no formally adopted water shortage criteria in place to deal with the over-allocated Colorado River!

Following these meetings, Reclamation hosted additional public meetings throughout the west called "Water 2025: Preventing Crises and Conflict in the West." Do you see a trend developing? The focus of these meetings was to promote public discussion in advance of water crises to develop frameworks for meeting future water challenges. Water 2025 identifies Six Principles for guiding the Department of the Interior in addressing water problems, Five Realities that drive water crises and Four Key Tools for proactive management of water resources. Fortunately for those of us concerned about riparian areas, Water 2025 recognizes the "emerging need" for water for environmental uses. For more information on Water 2025 visit their website at *www.doi.gov/water2025*.

It is becoming quite clear that the future of water management is here, especially for renewable sources such as the Colorado River.

Jeff Inwood, President

ADWR . . . . . from pg. 1

AWPF Grant Examples

Little Colorado River Enhancement Demonstration Project. This grant was awarded to the Apache Natural Resources Conservation District to develop a site-specific concept plan and construct a river restoration demonstration project on a reach of the Upper Little Colorado River. The project incorporated a natural channel approach that demonstrates an effective means for restoring a destabilized stream channel. The demonstration project is on land owned by the Arizona Game and Fish Department and has been used to educate landowners and natural resource managers about stream and riparian restoration techniques. The Apache Natural Resource Conservation District will continue to use the demonstration project as an outdoor classroom to supplement their curriculum on aquatic and riparian systems, biology, and domestic livestock and wildlife interactions.

Watershed Restoration of a High Elevation Riparian Community. This grant was awarded to Northern Arizona University (NAU) to modify upland watershed conditions to increase and sustain water flows into the riparian community at Hart Prairie. In an effort to increase and sustain water flows, researchers from NAU, in conjunction with the U.S. Forest Service and The Nature Conservancy, reduced the density of pines encroaching on the wet meadows by a combination of tree thinning and prescribed burns. Other activities included constructing/repairing fences to manage grazing of large ungulates, removing stock tanks, and restoring a stream channel in the uplands. These researchers have also been conducting vegetation, stream flow and fluvial geomorphology monitoring in the watershed.

Fluvial Geomorphology Study and Demonstration Projects to Enhance and Restore Riparian Habitat on the Gila River from the New Mexico Border to the San Carlos Nation. This grant was awarded to Graham County on behalf of the Gila Watershed Partnership to conduct a fluvial geomorphology study along 100 miles of the Gila River. The study will form the basis for developing demonstration projects that may be implemented at optimum sites along the river to restore riparian vegetation, reduce flood velocities, and create a stable channel.

Willow bundles used for bank stabilization and revegetation..

In-Stream Flow Program

The In-Stream Flow Program was created as a mechanism to help protect adequate stream flows to maintain aquatic and riparian habitats, fish and wildlife, and recreational activities in a particular stream or stream segment through the issuance of an in-stream flow right. An in-stream flow right is a surface water right that remains in-situ, or "in-stream" and will not be physically diverted or consumptively used. The benefits of in-stream flow rights include:

- Improved diversity of riparian vegetation
- Improved fish and wildlife habitat
- Improved water supply for recreational purposes
- Increased groundwater recharge
- Improved flood control

In-stream flow rights may also help protect designated flows from the negative impacts associated with new upstream uses such as development, diversions or transfers.

In-stream flow rights are granted through the issuance of a certificate, which specifies the purposes beneficial uses, amount of water and the date of priority. The appropriation of public water for the purpose of maintaining in-stream flows requires an assessment of the stream flow required for the stated purpose and the measurement of available stream flows to meet that purpose.

Rights to in-stream flows are enforced in the same way as other surface water rights (i.e., the doctrine of prior appropria-

tion) and normally do not affect established uses of other right holders, because water is not removed from the stream channel and there is no consumptive use.

Rural Watershed Initiatives Program

The Rural Watershed Initiatives Program was established to assist rural Arizona watershed partnerships with funding projects and studies pertaining to the understanding, planning, management, and enhancement of water supplies in rural Arizona. Funding for the program is authorized by the State Legislature.

Groundwater Management Code

The Groundwater Management Code (Code) was established in 1980. The goals of the Code are 1) to control severe groundwater depletion and 2) to provide a means for allocating Arizona's limited groundwater resources to most effectively meet the state's changing water needs. Areas where groundwater depletion is most severe are designated as Active Management Areas (AMAs). There are five AMAs: Phoenix, Tucson, Prescott, Pinal ,and Santa Cruz. These AMA's are responsible for implementing the Code.

The Groundwater Management Code also includes provisions for recharge programs. Recharge programs allow the injection of surface water or treated wastewater into an aquifer for storage. Through recharge programs, surplus renewable water supplies can be stored for future use.

Enforcement of the Groundwater Management Code and implementation of recharge programs can help guard against the loss of riparian habitats throughout the state by reducing the impacts of groundwater pumping to rivers and streams that are the lifeblood of these important habitats.

Multi-Species Conservation Program

The Multi-Species Conservation Program (MSCP) is a joint federal/nonfederal environmental compliance program. The goals of the MSCP are: (1) Accommodate current water diversions and power development to the extent consistent with the law and optimize future water and power development opportunities and (2) conserve habitat and work toward the recovery of threatened and endangered species and reduce the likelihood of additional species listings under the federal Endangered Species Act.

ADWR is a member of the MSCP Steering Committee, along with the Arizona Power Authority, Arizona Game and Fish Department, Central Arizona Project and the Yuma Irrigation Districts. These Arizona parties along with the Salt River Project and Mohave County Water Authority have funded the Arizona share of program planning costs. Planning costs are for the services of a technical consultant, hired to analyze the impacts of the "covered actions" for which the parties seek compliance, and formulate the Conservation Plan.

The draft Conservation Plan includes the restoration of approximately 6,000 acres of cottonwood-willow habitat, 1,300 acres of mesquite bosque, 500 acres of marsh and 360 acres of backwater habitat. The Conservation Plan also includes stocking 620,000 bonytail chub and 660,000 razorback sucker as well as measures to maintain existing habitat. The MSCP is a long-term (50 years) program scheduled for implementation in 2005. The program will improve the condition of habitats and the species that rely on those habitats, while establishing a compliance framework that allows the continued use of the Colorado River for water and power production.

The Nature Conservancy Begins Freshwater Assessment

by Jeanmarie Haney

The Nature Conservancy in Arizona is embarking on a statewide Freshwater Conservation Assessment. We hope members of the Arizona Riparian Council will help us frame the issues, devise methodology, provide expert review, and identify audiences for the resultant products.

Our goal is to promote water management that considers ecosystem water needs, by developing a scientific basis for sound decision-making relative to biological diversity and ecosystem services. Freshwater systems, including rivers, streams, creeks, cienegas, other wetland types, and their associated riparian habitats, support a disproportionately high number of species relative to their total extent throughout the state. In

addition, our riparian corridors provide migratory birds, insects and bats critical transhemispheric travel corridors.

It is generally acknowledged (though not well quantified) that substantial surface waters and associated habitats have been lost in Arizona due to hydrologic alteration associated with human activities. The negative impacts of such alteration on aquatic and riparian species and natural communities are understood to be extensive but documentation has been limited (e.g., W.L. Minckley and J.E. Deacon 1968. Southwestern fishes and the enigma of endangered species. *Science* 159[3822]: 1424-1432) and never on a comprehensive, statewide basis.

As Arizona communities struggle to provide sufficient water supplies to burgeoning populations, the potential for additional damage to riparian and aquatic ecosystems is severe, but rarely discussed in the context of water supply management. If a conservationist, policymaker, land manager or interested member of the public wanted to determine the importance of a particular freshwater system in meeting human needs –such as aquifer protection or identify and understand the biological riches a particular system supports–there currently is no single information source available to consult.

A dialogue on the future of Arizona's water resources has begun at federal, state, and local levels. In June 2003, the Department of Interior convened a "Water 2025" forum in Phoenix to encourage stakeholders to begin tackling problems that, left unsolved, will compromise the sustainability of our communities over the next two decades (*www.doi.gov/water2025*). The US General Accounting Office has recently issued a report on states' views on how federal agencies can help them address expected water shortages (*www.gao.gov/cgi-bin/getrpt?GAO-03-514*). The Arizona Department of Water Resources (ADWR) has convened a Drought Task Force to, among other tasks, devise a long-term drought response plan (*www.water.az.gov/gdtf/*). ADWR and the U.S. Geological Survey are working with local communities through the Rural Watershed Initiative in an effort to empower local decision-making pertinent to water resources (*www.water.az.gov/watershed/*).

In each of these statewide efforts, the importance of biological diversity or the ecosystem services that undeveloped lands provide has yet to enter the dialogue. The lack of state mandates or incentives to consider these issues in water management planning is likely the primary reason for the absence of this component. However, the lack of cogent syntheses of available scientific data can limit proactive engagement by local communities and state agencies, alike.

To address the need for useful statewide, freshwater biodiversity data sets, we propose to assemble relevant scientific data and synthesize it in a way that will enable the Conservancy and others to communicate with policymakers, land planners, and land managers. We will turn data from disparate sources into relevant and cogent information to help raise the dialogue on the future use of our freshwater resources.

We will focus on key attributes of freshwater systems such as rare and endangered species, extent of riparian habitat, and changes in the extent of the state's perennial waters to raise the profile of biological diversity and provide context about what's at stake. In synthesizing available information, we will also advance the important concept of ecosystem services and identify needed research to answer critical questions about the importance of healthy landscapes to meet human needs and maintain biological diversity.

To join in this effort or for further information, please contact Jeanmarie Haney at jhaney@tnc.org or 520-622-3861 x3480.

NOTEWORTHY PUBLICATIONS EDITOR NEEDED

Our Noteworthy Publications Editor, Jere Boudell, will be completing her degree soon and will be leaving as Editor. We want to wish her the very best and thank her very much for the detailed summaries she has provided. We are, therefore ,in need of a new editor. This is a volunteer position that is especially suited for someone who may be already reading publications to keep abreast of new developments and for their class and research work, e.g., a graduate student, however, being a graduate student is not required. If you're interested in helping with this feature of the newsletter it would be greatly appreciated! Please contact Cindy Zisner if your interested at (480) 965-2490.

DOES GROUNDWATER PUMPING AFFECT BASIN-MARGIN BEDROCK GROUNDWATER LEVELS?

By James P. Lombard, R.G., 4605 N. Campbell Avenue, #151, Tucson, Arizona

This article summarizes the results of a computer simulation illustrating how groundwater drawdown from a pumping well that is completed in basin sediments can extend into basin-boundary bedrock aquifers. In places, bedrock aquifers are saturated at land surface as evidenced by bedrock springs, seeps, and seasonally persistent baseflow in streams and the riparian ecosystems associated with those features. Simulation results indicate that surface outcrops of groundwater, especially those found in mountain-blocks close to basin margins, could potentially experience groundwater level drawdown that might lead to shortened seasonal flows, decreased discharge volume, or reduced wet streambed length as a result of groundwater pumping in the basin sediments. This article is to encourage land-use planners, groundwater resource managers, and policy makers to request more realistic, complex groundwater modeling to help evaluate potential changes in hydrologic features that sustain the riparian ecosystems sometimes found in basin-margins.

Groundwater in the basin sediments in the Tucson area, and surrounding communities, is hydrologically connected with fractured mountain-block aquifer systems in the foothills of mountains surrounding the basins (Cunningham et al. 1998, Montgomery 2001). Hydrologic connection between aquifers allows groundwater that originated as infiltration of precipitation and snowmelt into the mountain-block aquifers to supply a fraction of the groundwater recharging basin sediments by a process called mountain-block recharge (MBR). Studies of MBR to basin sediments in Arizona (Long and Eastoe 2003), New Mexico (Wilson et al. 2002, Wilson and Gu 2003), Utah (Manning and Solomon in press), and Colorado (Manning et al. 2003) are beginning to quantify the relative contributions of direct, deep, groundwater underflow compared to the streambed infiltration from surface runoff. As measurements of MBR become more widespread, hydrologists can build realistic models of where groundwater pumping in the basin sediments could be changing groundwater levels in the mountain-blocks. Previous groundwater models in the Tucson Basin were not designed to investigate this potential consequence of groundwater pumping.

Take a close look at the edge of the most recent published groundwater model that simulates groundwater flow system in the Tucson basin sediments aquifer system (Hanson and Benedict 1994). Figure 1 shows a map of the active model cells and boundary conditions used in that model. Mountain-block recharge is included in the model where the cells are shaded gray; the model allows water to enter as if there were a hydrologically connected mountain-block source. However, as you can see

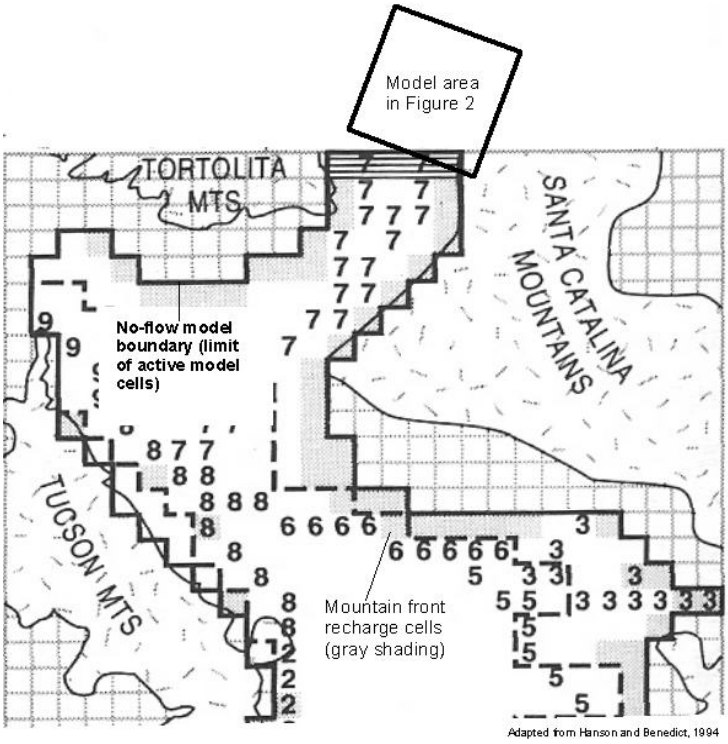

Figure 1. *Model domain for northern part of Tucson Active Management Area model, showing 1 × 1 mile cell size, mountain front recharge cells, and location of model shown in Figure 2.*

in Figure 1, the mountain-front boundary with the alluvial aquifer system is simulated as a no-flow boundary – in other words, the model does not simulate what might happen to groundwater levels outside the model in the mountain-block that is in contact with the basin sediments. Since each groundwater model is designed for a specific purpose, in this case groundwater pumping management, then it makes perfect sense to ignore the bedrock aquifer system where there are no large water supply wells. The water supply wells are located in the basin sediments, and water managers want to know how much drawdown to expect from long-term groundwater mining from those aquifers.

Figure 1 also shows the location of the localized model that I constructed to simulate groundwater level changes in both the basin sediments and the mountain-block along a segment of the Canada Del Oro Valley, flanking the Santa Catalina Mountains. I used MODFLOW96 to run a simulation of drawdown from one well pumping for 100 years at a rate of 430 gal/min. The simulated well is located about ½-mi from the bedrock aquifer that forms the boundary of the basin sediments aquifer. There are three unconfined hydrogeologic units represented in the model, each with different hydrologic properties; basin sediments, basin-margin sediments, and bedrock. The model simulated all three hydrogeologic units as one interconnected aquifer system using 84,240 model grid cells divided into 24 layers ranging from 25ft to 100ft thick; the largest model grid cells are 0.25mi × 0.25mi horizontally. Figure 2 shows the model grid, the model boundary conditions, and the spatial distribution of the three hydrogeologic units. Numerous layers and small grid cells were necessary for this model because the hydrologic parameters for the three hydrogeologic units are very different, and the abrupt groundwater level drop from bedrock to basin sediments that is observed in wells, was difficult to simulate with larger grid cells and layer thicknesses. Figure 3 shows the simulated groundwater table, and illustrates how the model reproduced the abrupt groundwater level drop.

Aquifer hydrologic parameters were chosen for the model that are similar to parameters used in Arizona Department of Water Resources well impact analyses for individual wells in the area (basin sediments [well 55-547494] K=14.2 ft/day, S=0.10, average model-computed b=500ft; basin-margin sediments [well 55-583154] K=1ft/day, S=0.10, average model-computed b=510ft) and within a reasonable range for bedrock (K=0.142ft/day, S=0.01, average model computed b=275ft). (Note: K = hydraulic conductivity; S = storage coefficient; and b = saturated thickness.) I designed the model to receive about 1,630 acre-ft/yr (afa) of total groundwater recharge, compared to about 2,145 afa for the same sized area in the Hanson and Benedict model. Of this total, about 200 afa were supplied to the southeastern edge of the bedrock unit, simulating MBR from higher in the mountains, and about 1,430 afa were supplied to the basin-margin sediments, simulating streambed infiltration along the Canada Del Oro wash and other

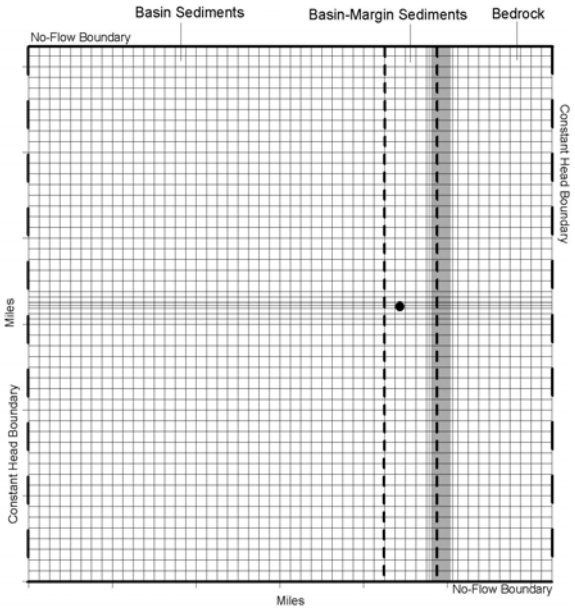

Figure 2. *Model grid, model boundary conditions, and hydrogeologic units (black dot shows well location).*

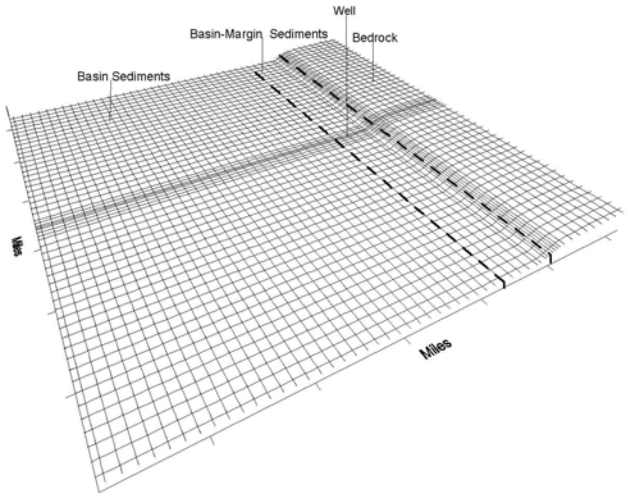

Figure 3. *Simulated groundwater table in the basin sediments and bedrock aquifer system, with model grid superimposed (no vertical exaggeration).*

drainages at the southeastern edge of the basin sediments.

Figure 4 shows the simulated drawdown contours after 10, 50, and 100 years of pumping. The drawdown results shown are the difference between simulated steady-state conditions without any pumping and simulated pumping conditions. Figure 4 shows that the model simulates drawdown in both the basin sediments and bedrock, although, most of the drawdown was in the basin sediments. After 10, 50, and 100 years of pumping, the 1-ft drawdown contour extended about 500-ft, 1100-ft, and 1600-ft, respectively, to the southeast into the bedrock from its edge in the model. The 5-ft drawdown contour extended to the southeast into bedrock about 100-ft, 700-ft, and 890-feet for the same time intervals. Maximum simulated drawdown at the edge of the bedrock unit adjacent to the basin sediments was about 10-ft, 27-ft, and 31-ft after 10, 50, and 100 years. These results suggest that there is potential for groundwater drawdown to occur in the bedrock from pumping in the basin sediments.

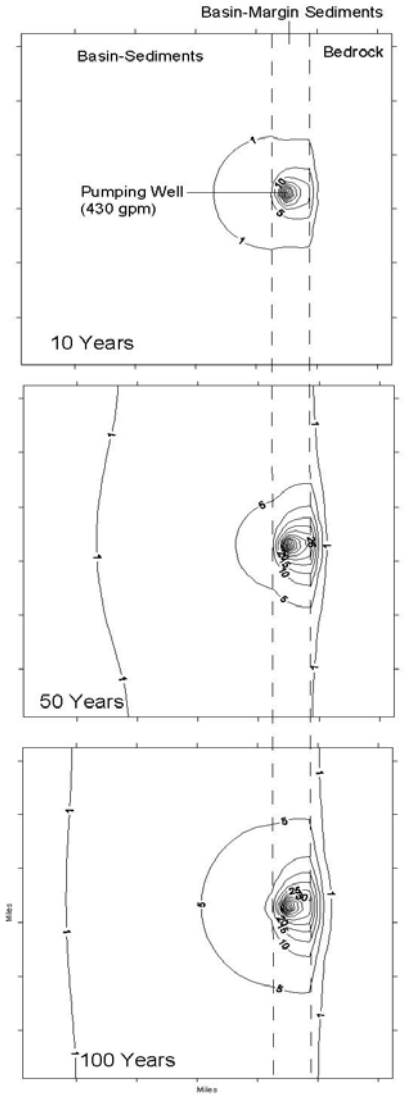

Figure 4. *Simulated groundwater drawdown contours, in feet, from a single pumping well after 10, 50, and 100 years (dashed vertical lines show boundary of hydrogeological units).*

The model results presented here are by no means unique; other combinations of aquifer hydrologic parameters, recharge input volumes, and pumping rates could produce different results. Also, MODFLOW96 is not well suited to realistically simulate the potential impact on individual seeps and springs; instead the simulations represent the average potentiometric head of groundwater in a large volume of fractured bedrock as if the fractures were evenly spaced and interconnected so that the bedrock behaves like a granular aquifer. Nonetheless, these modeling results do indicate that if seeps, springs, or seasonal baseflow streams are located close to the basin sediments/ bedrock boundary, there is potential for some drawdown impact from groundwater pumping.

This work was sponsored by the Canada Del Oro Water Coalition.

LITERATURE CITED

Cunningham, E. E. B., A. Long, C. Eastoe, and R. L. Bassett. 1998. Migration of recharge waters downgradient from the Santa Catalina Mountains into the Tucson Basin aquifer, Arizona, USA. *Hydrogeology Journal* 6:94-103.

Hanson, R. T., and J. F. Benedict, 1994. *Simulation of ground-water flow and potential land subsidence, Upper Santa Cruz Basin, Arizona.* US Geological Survey Water-Resources Investigations Report 93-4196.

Long, A., and C. Eastoe. 2003. Isotopic tracers of the sources, flowpath and ages of groundwater at the basin scale. Online: *www.sahra.arizona.edu/research/TA2/2 6.html*.

Manning, A..H., and D. K. Solomon. In press. Using noble gases to investigate mountain-front recharge. *Journal of Hydrology*.

Manning, A. H., J. S. Caine, and G. P. Landis. 2003. Mountain-block recharge to the western Denver Basin, Colorado. Abstract, *Geological Society of America* Rocky Mountain 55th Annual Meeting, 7-9 May 2003.

Montgomery, E. L. 2001. Verbal remarks given at the Water Roundtable held on March 13, 2001, at the Biosphere 2 Conference Center. Transcripts are found online: *www.sustainableprosperity.org*

Wilson, J. L., H. Guan, and L. B. Goodwin. 2002. Modeling investigation of mountain front recharge from typical mountain blocks. Abstract, *Geological Society of America,* Denver Annual Meeting , 27-30 October 2002.

Wilson, J. H., and A. Gu. 2003. Mountain block recharge. Online: *www.sahra.arizona.edu/research/TA2/2 5.html*

INTERNET ACCESS TO STORM DATA NOW AVAILABLE FROM PIMA COUNTY FLOOD CONTROL DISTRICT

Julia Fonseca, Pima County Flood Control District

The Pima County Flood Control District's Automated Local Evaluation in Real Time (ALERT) Flood Warning System plays a vital role in protecting Pima County residents from the effects of flooding. The ALERT system monitors precipitation, streamflow, and weather. Data generated by the ALERT System is now available on the internet. Users can view ongoing storm data, or view historic data.

The system currently consists of 80 precipitation sensors, 30 stream stage sensors, and four automatic weather stations in eastern Pima County and adjoining counties. Utilizing radiotelemetry, data is sent in real-time to the district office and to the local National Weather Service office, which uses the data to ground-truth radar rainfall estimates and to assist in issuing flood watches and warnings. Data is also useful for reconstructing storm events and is of interest to a broad range of users.

To see precipitation, stream stage (depth), or weather sensor data, go to the District home page at *www.dot.pima.gov/flood*. At the home page, click on Flood Warning System. At the ALERT Flood Warning System introduction page, click on SENSOR DATA to access data.

ARC FALL MEETING 2003

This year's fall meeting was held at Dead Horse Ranch State Park in Cottonwood. It was held in conjunction with Verde River Days. Verde River Days is a community event that celebrates the importance of the Verde River to the community. The Arizona Riparian Council has had our educational display at this event since Verde River Days started some 16 years ago. This year in addition to having our display, two of our members, Kathy Nelson and Diana Stuart, assisted the State Parks personnel by leading nature hikes that were very well attended and a great way to educate the public about riparian areas.

That evening, Max Castillo, Verde River Greenway Program Coordinator, spoke to us about the Greenway , historically and how it is developing. After the presentation we were all ready to relax . Jeff Inwood, our President, is a great hamburger and veggie burger griller! Had a great evening eating good food and visiting. Later we viewed Mars and other astronomical sights through the local astronomy club's telescopes that had been set up for Verde River Days. All in all a good day, short on attendance, but a good time was had by those who did.

Sunday morning we hiked to Tavasci Marsh. Tom Hildebrandt was our guide and he pointed out several things along the way. One of which was where beaver had felled a tree so we could see some of their work. The hike was a good end to a great weekend. If you didn't attend – we missed you!

Tavacsi Marsh

NOTEWORTHY PUBLICATIONS

Jere Boudell, Department of Plant Biology, Arizona State University

Krueper, D., J. Bart, and T.D. Rich. 2003. Response of vegetation and breeding birds to the removal of cattle on the San Pedro River, Arizona (U.S.A.). *Conservation Biology* 17(2): 607-615.

It has long been noted that overgrazing by cattle has lead to the degradation of riparian ecosystems in Arizona. The decline in quality and quantity of vegetation in riparian systems has resulted in the decline of bird species long associated with southwestern riparian ecosystems. As Krueper et al. note, many studies on the effects of cattle removal from riparian areas focus on small study areas for short periods of time. The authors suggest that to understand riparian ecosystem recovery after cessation of cattle grazing, larger-scale and longer-term studies need to be undertaken. Krueper et al. tackled this task with their investigation of vegetation and avian recovery after cessation of cattle grazing on the San Pedro River.

The authors investigated the recovery of the San Pedro Riparian National Conservation Area (NCA), located in Cochise County, which has been grazed since 1694. Cattle were removed from the study area in 1987. The following year, a 15-yr grazing moratorium was initiated. The 5-yr study began in 1986. Twenty-one vegetation communities were identified in the study, which were reduced to three community types: riparian, mesquite grassland, and Chihuahuan desert-scrub. There have been 355 bird species found in the NCA. Of these, 108 use the NCA as breeding habitat and of these, 63 are migrants and 45 are residents. Krueper et al. determined foliage density and conducted bird surveys using the methods as described by Anderson and Ohmart.

The results of this investigation indicated that the herbaceous species of the riparian and mesquite-grassland communities responded quickly to cattle removal. Birds followed closely as the authors found a significant increase after cattle removal in understory, midstory, and upperstory groups. Krueper et al. also found that insectivores, granivores, and omnivores all increased significantly after cattle removal. Neotropical migrants and resident species all increased significantly as well.

As the authors note, the management implications of their results are significant. Riparian ecosystem recovery after years of overgrazing is not a lost cause. Not only did the communities respond to cattle removal, but many different types of birds began to repopulate the study site as well. Six of 11 birds in decline or those extirpated from major river systems were found to significantly increase in the NCA. The results of this investigation suggest that cattle removal is a valuable tool in increasing diversity in degraded riparian ecosystems.

Steed, J.E. and L.E. DeWald. 2003. Transplanting sedges (*Carex* spp.) in southwestern riparian meadows. *Restoration Ecology* 11(2): 247-246.

Montane riparian meadows in Arizona have been degraded due to activities such as overgrazing, water diversions, and road construction. Sedges, common riparian graminoids, perform valuable functions in montane riparian meadows. They stabilize streambanks with their extensive root systems and their cover helps prevent bank erosion during high flows. Sedges are an important component in the restoration of degraded riparian meadows. Steed and DeWald noted a lack of information concerning the revegetation strategies of sedges in restoration projects. The authors conducted a study to determine the establishment success of woolly sedge, Nebraska sedge, and beaked sedge under a range of conditions.

They selected study sites on seven reaches in five montane riparian meadows located on the Apache-Sitgreaves and Coconino National Forests and on the White Mountain Apache Reservation. Ponderosa pine forests were the dominant upland communities. All sites are located in areas undergoing restoration. At each site the authors transplanted plugs of three species of sedges, in both the summer and fall. The plugs were transplanted perpendicular to the stream over a natural declining water gradient. A similar design was setup in a greenhouse to help ferret out responses caused by differences between sites. The authors measured survival, shoot numbers, and shoot heights.

The results of their investigation revealed that the three sedge species responded differently to varying groundwater depths. In other words, each species should be planted within its appropriate range of depth to groundwater. The authors found that larger transplants made during the summer were more successful than smaller ones made during the fall. This comprehensive study lead to techniques that are bound to be useful for those seeking to restore montane riparian meadows.

The Arizona Riparian Council (ARC) was formed in 1986 as a result of the increasing concern over the alarming rate of loss of Arizona's riparian areas. It is estimated that <10% of Arizona's original riparian acreage remains in its natural form. These habitats are considered Arizona's most rare natural communities.

The purpose of the Council is to provide for the exchange of information on the status, protection, and management of riparian systems in Arizona. The term "riparian" is intended to include vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of perennial or ephemeral surface or subsurface water drainage. Any person or organization interested in the management, protection, or scientific study of riparian systems, or some related phase of riparian conservation is eligible for membership. Annual dues (January-December) are $20. Additional contributions are gratefully accepted.

This newsletter is published three times a year to communicate current events, issues, problems, and progress involving riparian systems, to inform members about Council business, and to provide a forum for you to express your views or news about riparian topics. The next issue will be mailed in January, the deadline for submittal of articles is December 15, 2003. Please call or write with suggestions, publications for review, announcements, articles, and/or illustrations.

Cindy D. Zisner
Center for Environmental Studies
Arizona State University
PO Box 873211
Tempe AZ 85287-3211
(480) 965-2490; FAX (480) 965-8087
Cindy.Zisner@asu.edu

web site:
http://aztecfreenet.org/ARC/ARC.htm

The Arizona Riparian Council

Officers

Jeff Inwood, President . . . . . (602) 274-6725
jinwood03@aol.com
Tom Hildebrandt, Vice President (480) 981-9400 X221
thildebrandt@gf.state.az.us
Cindy Zisner, Secretary . . . . . (480) 965-2490
Cindy.Zisner@asu.edu
Theresa Pinto, Treasurer . . . . . (602) 506-8127
tmp@mail.maricopa.gov

At-Large Board Members

Diane Laush . . . . . (602) 216-3860
dlaush@lc.usbr.gov
Julia Fonseca . . . . . (520) 740-6350
JFONSECA@dot.co.pima.az.us
Rodney Held . . . . . (602) 417-2400 X7012
rjheld@ADWR.STATE.AZ.US

Committee Chairs

Classification/Inventory
Roy Jemison . . . . . (505) 766-2017
rjemison@fs.fed.us
Education
Cindy Zisner . . . . . (480) 965-2490
Land Use
Tim Flood . . . . . tjflood@att.net
Protection/Enhancement
Kris Randall . . . . . (602) 242-0210 X250
Kris_Randall@fws.gov
Bill Werner . . . . . (602) 789-3607
bwerner@gf.state.az.us
Water Resources
Julia Fonseca . . . . . (520)740-6350
JFONSECA@dot.co.pima.az.us

CALENDAR

Watchable Wildlife 2003 Conference. November 11-14, 2003, McAllen ,TX. For more information: http://www.watchablewildlife.org; 651-433-4100.

Arizona Riparian Council Spring Meeting, March 12-13, 2004. Mark your calendars! It will be in the Phoenix metropolitan area in the West Valley. The theme will focus on the lower Gila River , so think about those presentations! More information will be forthcoming.

National River Rally 2004, May 21-25, 2004, Wintergreen Resort, Charlottesville, VA. For more information: http://www.rivernetwork.org starting in early January.

The Gulf of California Conference, 2004. June 13-15, 2004, Westward Look Resort, Tucson, AZ. For more information: http://www.gulfconference.org; gulfconference@desertmuseum.org; or Yajaira Gray at 520-883-3018.

BT5 1005
Center for Environmental Studies
Arizona Riparian Council
Arizona State University
PO Box 873211
Tempe, AZ 85287-3211

Printed on recycled paper

If it says PLEASE RENEW or 12/02 after your name please renew your Membership ($20) !!!!