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To promote the wise stewardship and ensure the availability of water resources for future generations of New Mexicans through support of community-based planning and creation of inclusive forums for education, communication, and development of common ground.

Changing Waters: Adaptation And Resilience

N.M. Water Dialogue's 18th Annual Statewide Meeting

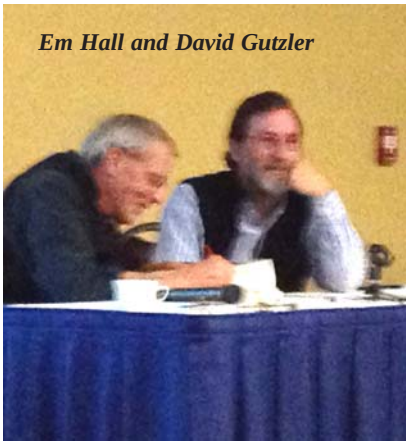
Summary by Lisa Robert

This January, the New Mexico Water Dialogue asked a number of scientists, resource managers, law and policy experts, and advocates of one kind or another to talk about our prospects for attaining resiliency in the all-important arena of water. Webster's unabridged dictionary defines *resilience* as "the act of leaping or springing back; a rebounding; as the *resilience* of a deformed body after the removal of the deforming force…the ability to bounce or spring back into position after being pressed or stretched." Elasticity, it would seem, can't really be achieved until some degree of warping takes place. How fortunate we are, then, in the desert Southwest, that irresistible forces have already begun jostling our paradigm out of shape.

Future Challenges

The Southwest has "a history of great droughts," says *David Gutzler*, professor of Earth and Planetary Sciences at UNM. A reconstruction of Rio Grande streamflow based on tree ring data reveals a mega drought in the16th century that spanned multiple decades, during which annual flows at Otowi fell below 1.5 million acre-feet. Closer to home in terms of human memory is the drought of the 1950s, six consecutive years in the Upper Rio Grande basin that Gutzler characterizes as "bad," but hardly equal in severity or longevity to the monster of the 16th century. What is evident is that big droughts happen once or twice a century "for as far back as the records go," a pattern that can only be aggravated by a trend toward rising temperatures. Warming has "certainly been observed" in the past few years, Gutzler says, and projections based on increasing amounts of greenhouse gases in the planet's atmosphere portend higher temperatures than ever before in the historical record. Warmer temperatures, diminished snow pack, earlier snow melt, and escalating evaporation rates all imply that the next big drought is likely to be more severe than in the past. "Long term warming trends already evident in the data are going to amplify the hydrologic impacts," Gutzler warns, and what we now consider drought could become the new normal. To those who consider this warming in keeping with interglacial temperature swings of the past half-million years,* Gutzler declares with a confidence born of data and peer review: "There is nothing at all cyclostationary about the current increase in greenhouse gases. It is outside—by a long shot—the last half-million years of radiative forcing at the surface. Relative to anything in the recent past; i.e., the last 1,000 to 10,000 years, the rate of change we're likely to see is off the charts. It's *not* stationary and it's *not* cyclic. Radiative forcing due to greenhouse gases is starting to overwhelm all known sources of natural variability on a century timescale." Present models contain plenty of uncertainty, he concedes, "but if you take the numbers literally, the worst case scenario is something close to a 30 percent average reduction in annual streamflow by the late 21st century."

(*See www.abeqas.com/WallaceNewMexicoWaterDialogueCommentary)



Em Hall and David Gutzler

Morning break

CHANGING WATERS—*Cont. on page 3*

DIALOGUE

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Update from the President

by Mary Murnane, President, Board of Directors

I won't give away the ending, so read Lisa Robert's summary of the Annual Meeting in this issue of the Dialogue. I will tell you that the take-home message from the New Mexico Water Dialogue Annual Meeting deserves some serious consideration from all of us concerned about water resources in New Mexico. The theme to this year's meeting was "Changing Waters: Adaptation and Resilience." A bevy of distinguished panelists and speakers provided insight into various aspects of adaption and resilience, from ecological adaptation (or lack thereof), to political and social adaptation and resilience.

At the end of the meeting, I had several people comment on how wonderful they felt the meeting had been, what insights had been provided, and what beneficial information sharing had occurred. Several other people commented that they thought the meeting had been generally unsuccessful (my words, not theirs!) in that there had not been enough dialogue, and that the audience had not seemed especially engaged. I did not quite know what to make of this. So I started to ask around, and to think about my perspective before and after the meeting. I have these observations:

• There were a lot of people who had not attended a Water Dialogue meeting before. I found this to be very positive, because we need increased participation for water resources and water planning to have some clout at a grassroots level.

• There was a sense that we, as participants, need to work to keep water resource and water planning issues and concerns in the public eye.

• In the face of the rather extreme weather and modeling of continued warming in our State, it is easy to become overwhelmed by the number, level and complexity of the issues we face.

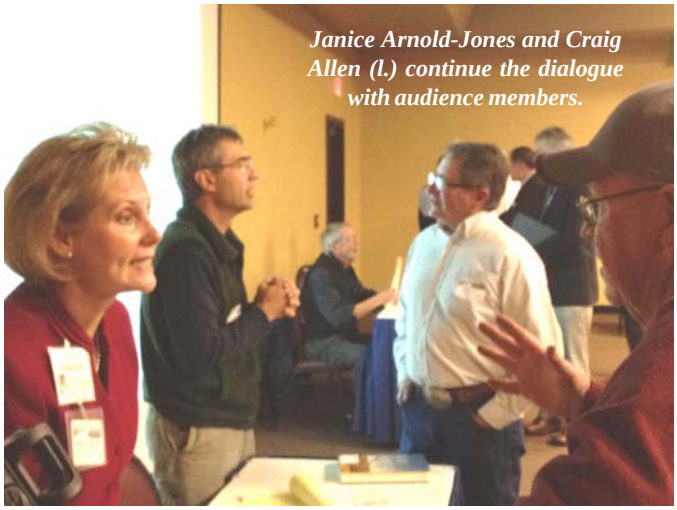
• If I refocus on what I can accomplish, what my role is in solving some part of our water problem, I can keep moving in that direction, and renew my belief that there are solutions that we can collectively achieve.

For all of us, reaching out to involve others in developing a water future for New Mexico that is respectful of our values and aspirations is critical to our creating and maintaining a place for all of us. It will require both adaptation, and resilience, and the courage to face our challenges with honesty and integrity.

CHANGING WATERS—*Cont. from page 1*

Craig Allen, Resource Ecologist with USGS, studies how climate drives vegetation on landscapes through big disturbance processes, such as fire, drought-induced die-off, and interactions between factors like runoff and erosion. With 15 years of data in hand, Allen reports that what physical scientists are starting to see is that gradual change—the slow ramping up of temperatures—can trigger threshold responses. One example of a "tipping point" response to the linear driver of slowly increasing temperature is the nearly "overnight" die-off of about 11 percent of Arizona and New Mexico forests and woodlands, a loss which essentially occurred between 2002 and 2005. Around the world, similar expanses of tree species are succumbing to combinations of dehydration, starvation, and attack from biotic agents such as bark beetles. Ecologists think this "wholesale mortality" is the result of "global change type drought." No one knows precisely how much water stress a tree can endure before its systems collapse, but comparisons of tree ring data to historic precipitation and temperature records indicate that southwestern species such as piñon, Ponderosa, and white pine are very sensitive to temperature: in warmer years, they simply don't grow as well, presumably due to water stress. Another consequence of steadily increasing temperature is more frequent high-severity wildfires. Warmer years cause snow to melt earlier, and soil and vegetation to dry out sooner, so that in many places across the west, fire season is two months longer now than it was a quarter-century ago. That, and a legacy of built-up fuels bequeathed by early forest management practices, is producing larger, more intense wildland fires. "Probably 85 percent of the Cerro Grande fire was a tree-killing fire," Allen says, and species native to the Jemez Mountains did not evolve with that kind of devastation. Ponderosa "depends on having a few mother trees survive to spread seeds," so if stands are wiped out across many square miles, the area regenerates as shrubland, not pine forest. High-intensity fire also disrupts the established hydrology. Changes in vegetative cover significantly alter the water balance at an individual site; albedo (the reflection coefficient), evaporation, transpiration, infiltration, runoff and erosion may all be affected, with consequences throughout the watershed. As temperatures rise, Allen concludes, such transformed landscapes can be expected to increase.

Em Hall, Professor Emeritus at UNM's School of Law and a 40-year veteran in the world of New Mexico water, has been keeping track of institutional responses to the kinds of changes that Gutzler and Allen see coming. Those reactions include the Middle Rio Grande Conservancy District's voluntary reduction in diversions; the "creative accounting systems cooked up by the State Engineer and the Interstate Stream Commission" to provide more water for endangered species through the exchange of Rio Grande compact credits; and a recent 65-page Court of Appeals' opinion on Albuquerque's Drinking Water Project permit. The latter, Hall notes, grapples with one of the basic questions in New Mexico water law: when does a diversion become an appropriation? "You would think we'd have straightened *that* out," he jokes, "but here it is, in 2012!" The issue of water rights is frequently missing from debates about water management, Hall observes. "Most of New Mexico's streams are fully appropriated. There are water rights attached to more than the safe yield of some of those systems. These are *property* rights, and for a long time now, we've chosen in New Mexico to drive water management through a property regime. I'm interested in the capacity of the property rights system to adjust to water supply fluctuations of the kind that are being described today…The nature of that interest is a real restraint to what you can do to adjust those systems." Legendary State Engineer Steve Reynolds liked to say that through adjudication, people's water rights would be "made as firm as title to their houses," but the reality in most New Mexico river basins today is that adjudication is incomplete, or hasn't even begun. Particularly in the Middle Rio Grande, "we have no idea of the nature and extent of property right claims to a water source that has always been stressed, and will be stressed even more." Pueblos in the region have "potential claims to the whole river"; there are other "ancient irrigators" (acequias) whose rights are undetermined; and the Middle Rio Grande Conservancy District may also hold title to a significant share. Aside from such uncertainty, Hall points out that New Mexico's system for managing water "has always been based on the fact that supplies fluctuate. You have to build a legal system that will apportion those varying supplies…and we *have* it: it's called priority. Article Sixteen of the State Constitution formally recognizes that system. The senior water right, the one that was established first, has the right to the fluctuating common source according to when the right was established. That is a system for apportioning short supplies, and it's almost never been used, partially because rights and priorities have never been defined." Ruefully, Hall evokes what hydrologist C.V. Theis told the City of Albuquerque in 1953: *You can pump groundwater…but that water comes from the river*. "We've never honored priorities," Hall declares, "and never honored what Theis said. Whether it's in geologic time or legal time, those chickens are going to come home to roost. The kind of planning that would be good would be to deal with those realities."



Janice Arnold-Jones and Craig Allen (l.) continue the dialogue with audience members.

Janice Arnold-Jones, a current candidate for the U.S. House of Representatives, was a member of the New Mexico Legislature's

CHANGING WATERS—*Cont. on page 4*

CHANGING WATERS—*Cont. from page 3*

House Taxation and Revenue Committee for eight years. She defines a policy maker as "someone elected to spend your money," and few of them are "detail oriented," she warns, despite the fact that attention to detail is critical to making good decisions. "Really good legislation takes time," she says, and at least three years are needed to educate legislators and the public about necessary policy changes. Politicians need to focus on what will sustain the whole state into the future, and naturally, Arnold-Jones reminds, those elected officials come from different backgrounds and perspectives. "Citizens in Albuquerque believe you can buy a house and turn the water on…Many of their representatives have no idea we have towns—not on reservations—that are still hauling water." Similarly, Arnold-Jones notes there are regions in the state with competing water plans, a rivalry she sees as "driven by pure politics…At some point, we have to come together and say what is most important. But the politics of capital outlay is, 'What do I get to take home?' As long as we maintain that mentality, the major questions about water will, in my opinion, not be resolved." Arnold-Jones confesses she doesn't understand all of the current rules regarding water, and fears her decision-making ability may be "seriously flawed" if experts fail to step up and help her learn.

Hon. MatthewReynolds delivers the keynote address.

"You are living with things you see every day that, quite frankly, no longer make sense. You need to tell us! If you don't have the courage to stand up and tell your legislators, the thing you know is wrong will never be fixed…Without context, we make really bad decisions."

Questions and Answers

Additional observations from the panel followed questions from the audience. Asked if the greater public is served by having water rights separated from land ownership rights, Hall noted, "That should never happen, but it does. Once you sever the water rights from land—transfer the irrigation rights to, say, the city of Albuquerque or Santa Fe—then you no longer have the right to use that water on that land *unless you can find another source*. In the Middle Rio Grande, that other source usually ends up being the Conservancy District because nobody knows what rights the MRGCD owns independent of the rights on the land; i.e., individually-owned water rights." Water for urban use comes entirely from historic rights appurtenant to agricultural lands, and the state, in the absence of adjudication, has granted more permission to use water than there is water to fill the promises. Those uses are then considered property rights, Hall points out, essentially protecting "something that doesn't exist." Furthermore, senior water rights are owned by a very small percentage of the population, while the majority of voters are junior users. "That's a collision waiting to happen…The system is set up in such a way that sometimes junior rights holders will not have water. To maximize beneficial use, you want to have juniors who can use the water when it is available. That's the way prior appropriation works." Comments about the larger issues at stake also emerged during the Challenges session. "People who come to water meetings are some of the most pessimistic, paranoid, provincial people around," one participant noted. "Instead, we should be futurists. One of the most optimistic things I've heard from anyone today was from Dr. Allen, who said that butterflies and birds are lucky: they can go elsewhere…In the past when there were droughts, people moved." Another summarized, "Two conversations seem to be happening. One is about the natural world, the ecological system, and another is about the social-political-economic system. I'm wondering if we can bring those conversations together in some way." Arnold-Jones agreed. "Policy makers see technical presentations like the two this morning and wonder, 'What do I do about it?' It's like drinking from a fire hose." The same question is discussed widely in the scientific community, admits Gutzler. "Scientists struggle over how to interact with policy makers. The unfortunate thing, from my perspective, is that we are very often simply ignored; we live in a society that, for whatever reason, doesn't value our input." Hall suggests broadening the range of scientific considerations the State Engineer uses. "It's not that they're not interested in science. It's that the nature of the questions they ask is very narrow."

***Keynote:* How We Can Prepare for the Great Drought of the 21st Century**

In his keynote address, Seventh Judicial District Court Judge *Matthew Reynolds* points to signs across the state "of the adaptation and resilience of those who came before us" in response to changing climate. One example of such resolve can be seen at the Gila Cliff Dwellings, where during a great drought in the 13th century, people took refuge near the headwaters of the Gila River, inscribing the canyon walls with pictographs of rainfall in hopes that wetter times would return. "By telling their stories and outlasting the drought, these people bounced back to enjoy the land," Reynolds says, and "we must do no less." He believes the New Mexico State Water Plan is a plumbing blueprint for surviving the drought of the 21st century, and that the Appropriative Rights Model Water Code, published by the American Society of Civil Engineers in 2007, provides a "how-to plumbing manual" for getting water to all the places that will need it. Reynolds believes a comprehensive review of New Mexico's water laws is needed to ensure conformity with the State Water Plan, and "as solid a legal structure as possible" for allocating water in times of coming shortage. The Model Water Code, which incorporates the expertise of engineers, lawyers, hydrologists, environmen-

CHANGING WATERS—*Cont. on page 8*

—Reports from the Regions—

Sandoval County's Brackish Water Initiative

by Guy Bralley, Water Resources Administrator, County of Sandoval

Sandoval County's population has grown more than 46 percent since 2000, making it the fastest-growing county in New Mexico according to the 2010 census. Dealing with the potential for high continued growth rates inspired the County to try to get ahead of a fast-moving problem. Acting to address future water demand became part of the plan to stay in front of growth.

In 2006, the County was approached by a developer with a master plan for a community in the Rio Puerco Valley west of Rio Rancho and east of the Laguna Pueblo. Recorp Partners' proposal was for 23,352 to 29,434 dwelling units on an approximately 11,650-acre parcel.

While the County approved the request, construction can't begin until the County Commission approves a subdivision application. This application must show, in accordance with Appendix B to the Sandoval County Subdivision Ordinance and to the satisfaction of the Office of the State Engineer (OSE), that the area has a 100-year water supply. At this point in time (March 2012), there has been no application, no approval, and no demonstration of the 100-year supply. The proposed development is and has been an entirely commercial undertaking, though the County and the developer signed a memorandum of understanding and a development agreement to jointly create a wholesale water utility if a brackish water supply could be identified and treated to meet this demand for water.

At the time these efforts began, New Mexico statutes provided an exemption from Office of the State Engineer control for non-potable water from aquifers greater than 2,500 feet below the surface (72-12-25 NMSA which was amended in 2009 returning more control to OSE). This was interpreted as exempting brackish waters from existing water rights policies and presented an opportunity to reduce water resource expenses. Notices of Intent (NOI's) were filed, and permits were issued by OSE to drill six deep wells —three in Sandoval and three in Bernalillo County. Only two of the three in Sandoval were drilled. Well locations were selected based on studies funded by Recorp.

As no wells had been drilled to qualifying depths locally, hitting water was uncertain. The County Commission dedicated $6 million toward finding that answer. In June 2007, a two-well project was begun. Drilling began mid-month, and on July 13th, water came up the well from 3,704 feet. Further drilling discovered more water between 3,772 feet and 3,776 feet. A well was completed at 3,850 feet. The drilling rig was moved about 4,000 feet to the west and another well was drilled.

This second well also encountered water in the San Andreas/Glorieta formations at similar depths; both wells flowed artesian (with no pump) though the first well (Well 6) at higher rates than the second (Well 5). This second well was completed in the Biotite Granite formations at a total depth of 6,450 feet. The reason for going to these depths (50 feet into the granite) was to identify formations possibly favorable for further evaluation as re-injection sites.

Both wells were completed in accordance with the OSE permit: cemented to 3,000 feet, both bond and temperature logs, and specifically identified pipe casings. The exploratory area is highly faulted, making general geological assumptions problematic. While not required by the permit, geophysical logs were run in the bore prior to the casings being installed. This allowed recording and evaluation of formation characteristics of these previously understudied areas. The cutting samples taken for each 10 feet of drilling and the geophysical logs were placed on file at New Mexico Tech, allowing future use of those data. It is interesting to note that the water in these wells was over 160ÚF at depths of about 3,200 feet and that when the wells were shut in (valves closed) the pressures were 150-160psi (artesian pressures). Water quality was 12,000 parts per million (ppm) of total dissolved solids (TDS) and contained high levels of arsenic, iron, radionuclides and hardness. Most will have to be removed in treatment to make this resource potable (less than 1,000 TDS, and arsenic levels at or below 10 parts per billion (ppb).

A 30-flow-day test supported estimates that there may be 500,000 to 2,500,000 acre-feet of brackish water available. This is considered a conservative estimate, but you can only reach so far on two wells' data. Additional testing and drilling may provide more accurate estimates of capacity.

In 2009, a pilot demonstration was conducted using Well 6 water. A trailer-mounted system provided proof of concept for multi-step treatment at low volumes and rates. The results of this testing were reported to OSE and the New Mexico Environment Department (NMED) in the Preliminary Engineering Report. This report was funded by legislative action. It has been approved by NMED and is available on the County's website (downloadable at no cost). This pilot demonstration project was recognized by two engineering associations with annual awards for R&D (2011).

In conclusion, the County's investment of $6 + million confirmed:

- A deep brackish water resource lies beneath the Puerco Basin.
- This water can be treated to achieve potability standards.
- It will cost more than most current water sources.
- Additional drilling and testing will add knowledge about this resource.

The agreement between the developer and the County became contentious and ultimately ended as a mediated settlement agreement which has yet to be fully executed or complied with. The County is proceeding under the assumption that the terms of the settlement agreement will be complied with, which includes compensation to the County for its investment (see $6 million above). Development of the resource is still being pursued by some developer entities.

Court Rules on Quantity of Irrigation Water for the Lower Rio Grande

by Gary Esslinger, Treasurer-Manager of Elephant Butte Irrigation District

In August 2011 in the Lower Rio Grande (LRG) Stream Adjudication, District Judge Jerald Valentine ruled on one of the basin-wide issues known as Stream System Issue/Expedited Inter Se 101. The ruling set the quantity of irrigation water for farmers in the LRG.

This article explains some of the provisions of the ruling, which is made up of the court's order (that is binding on all parties to the adjudication) that adopted the settlement agreement of the four major participating parties—the State of NM (OSE), NM Pecan Growers, NM Diversified Crop Farmers Association, and Elephant Butte Irrigation District (EBID).

For irrigation rights, quantity is defined by two values, the farm delivery requirement (FDR) and the consumptive irrigation requirement (CIR). The FDR is the amount of water that enters the head gate of the parcel of land to be irrigated, or the quantity of water delivered to the land. As water is applied to a field, a portion of it is consumed, either through uptake by a plant or through evaporation, and the rest either soaks into the water table or runs off the land. The amount of water consumed through the irrigation is the CIR. The court set the FDR at 4.5 acre feet per acre per year (afy); the CIR for irrigation at 4.0 afy, and for transfers out of irrigation to other uses at 2.6 afy.

In setting a FDR and CIR, three categories of irrigation water rights were established for the LRG:

a) Surface-water-only rights. In the LRG, surface-water-only water users are members of the Elephant Butte Irrigation District;

b) Groundwater-only rights; and

c) Combined surface-water-and-groundwater rights. This occurs where irrigators with surface rights have developed wells to supplement the surface water.

Surface-water-only users are those without access to, or a demonstrated historic use of, groundwater. These are farmers that receive only the EBID allotment. In years of abundant supply, farmers in this category, and the combined surface and groundwater use category, are not limited by the 4.5 FDR. For example, if EBID allots 7 acre-feet in a high water year, farmers may, and are encouraged to, use the entire 7 acre-feet of surface water made available. This provision allows the FDR to "float" to a higher amount in years of high water supply. However, in years where EBID has a much more limited supply of water, such as 2011 when there was only 4 acre-inches per acre available, farmers in this category are limited to the available surface water. They may transfer surface water from other fields to obtain an amount of water sufficient to grow a crop, but they may not use groundwater.

Groundwater-only rights are those water users that do not have a surface water right. The FDR, or maximum allowable pumping, for these farmers is 4.5 afy.

For acreage that has both surface and groundwater, 3.024 is adjudicated as a "supplemental groundwater" right to the surface water right. The additional 1.476 afy of water that it takes to get up to the 4.5 FDR is adjudicated as a "primary groundwater" right. Thus for combined surface and groundwater users, if EBID has an allocation of 2.0 acre-feet in a given year, farmers within EBID may pump an additional 1.024 acre feet up to 3.024 as "supplemental" to the surface supply, then may also pump the 1.476 up to the 4.5 FDR. Additionally, in years of abundant surface water supply, the 1.476, called "primary groundwater," may still be diverted such that much more than 4.5 may be used. Thus, in the example given above, a 7 acre-foot allotment is given by EBID, and combined surface and groundwater users may also pump the additional 1.476, so the total water delivery for that year would be 8.476 acre feet. In order to take advantage of this provision, farmers must make sure they have supplemental groundwater included in their offer of judgment; i.e., they must show a history of groundwater use whether from an onsite well or a neighboring well (or otherwise).

Other provisions in the settlement allow irrigators who can show additional beneficial use of water above 4.5 afy to claim an FDR of up to 5.5 afy. These are called the "prove up" provisions and they allow farmers to prove a higher FDR based upon beneficial use if they can show a history of higher use and if they meet court ordered deadlines included in the final order.

Finally, the court order and accompanying settlement recognize EBID's long standing policy allowing movement of groundwater within the EBID system and stacking of water rights by members. This recognition will ensure that EBID's ability to be flexible with management of the resource will continue into the future and flexibility is important to maintaining a competitive advantage in the agricultural industry, especially during drought. Overall, the framework for the determination of FDR and CIR is a victory for conjunctive management as it encourages use of surface water in years when there is plenty, and allows for flexibility in groundwater use in years of less surface supply. This settlement and court order will go a long way to protect one of Doña Ana County's most important industries; agriculture not only continues local food production, but brings in over one half billion dollars to the economy of Doña Ana County each year.

From Hubris to Humility: Lessons for Citizens of the Anthropocene Epoch

Reviews by John R. Brown

A Great Aridness,Climate Change and the Future of the American Southwest, by William deBuys
Oxford. 369 pp. $27.95
Reining In the Rio Grande, People, Land, and Water, by Fred M. Phillips, G. Emlen Hall, and Mary E. Black
University of New Mexico Press.
252 pp. $34.95

A decade ago, in *High and Dry*, Em Hall wrote of long-time State Engineer Steve Reynolds: "Natural processes were good in his view only by virtue of what they could do for man. Water that was left in a stream helped no one and water that was left in the ground remained hidden. [He] fought the increasingly popular notion that water in rivers—'instream flows'—deserved legal protection because he believed so fundamentally that the operative term in 'beneficial use' was 'use.'" (G. Emlen Hall. 2002. *High and Dry: the Texas-New Mexico struggle for the Pecos River*. Albuquerque, University of New Mexico Press. 118.)

Of course, Reynolds was not alone during the mid-20th century in asserting the primacy of explicitly human interests in "reining in" nature. But he was unusually effective in putting his utilitarian views into practice, even as the ruthless "scientific management" paradigm justifying the work of making the Río a more efficient means for delivering water was coming under increasing scrutiny. In *Reining In the Rio Grande*, Hall and his co-authors situate Reynolds historically in a centuries-long saga of human actions on the landscape that have affected the course, flow, and even the contents of the river, whether these results were intended or not. Some were the accidental by-products of unsustainable grazing, farming, and timber-cutting practices begun under Spanish rule but greatly accelerated, with the aid of the railroad, by waves of western-bound migrants bent on fulfilling America's and their own "manifest destiny." But others, dating from as early as 1882 in Colorado's San Luis Valley, involved deliberate attempts to engineer the river itself, often to undo the destructive effects of previous such attempts, but always with an eye toward "improving" it.

Part of the book's strength draws from its broad historical sweep. The narrative is grounded in the facts of place, as those facts have evolved over geological, as well as human, time. Although pre-European inhabitants adapted their livelihoods and life ways with respect to water to those facts, recent arrivals have tried the opposite approach, with varied degrees of immediate success and often at high long-term costs to local economies, social cohesion, and the sustainability of fragile ecosystems.

These consequences are stated even-handedly, as matters of fact. Turning the river into a "tightly controlled device for delivering water where and when needed" [my emphasis] was an engineering achievement. What Reynolds and other engineers failed to see was the extent to which "needs" would grow to transcend legal obligations to farmers, or Compact delivery requirements. The authors conclude that water management remains crisis-oriented rather than "addressing the ultimate sustainability of the riverine system."

Here for me *Reining In the Rio Grande* falters a bit. The penultimate chapter on managing conflicting demands is largely an annotated list of well-rehearsed issues and proposals for addressing them. It's a good list, but breaks little new ground in assessing the current state of things or offering critical insights from its historical review. The authors reinforce the lesson that we must live within our means rather than engage in the fantasy that we just haven't yet found the right technical "fix." If we don't already know that, we should. Somehow I was hoping for more.

Where *Reining In* notes at points the exacerbating effects of climate change on the historical trends it discusses, the subtext for all the stories in William deBuys's *A Great Aridness* is the complex interaction of people with each other and with the climate that both nourishes and threatens them. The book is organized thematically rather than chronologically, and deBuys is careful to note that it is not comprehensive. Nonetheless its scope is broad. In each chapter he takes us on a journey to a different place (and time, often) in a "greater" Southwest—a territory that encompasses the Sonoran and Chihuahuan desert lands of Mexico as well as their counterparts north of la Frontera—that illustrates particular aspects of the daily encounters between people and their environment. In some of these stories deBuys's guides (often but not always prominent scientists) make clear the implications of climate changes for the fate of human, animal, and plant communities. Others require the reader to do some work to complete the connections.

If *Reining In the Rio Grande* can be said to demonstrate the truth of Hardin's "first law of ecology": You can't do just one thing, providing examples of "enlightened" humans failing to appreciate the downstream consequences of their actions, then *A Great Aridness* argues persuasively for its corollary: No big thing happens for just one reason. Seemingly robust ecosystems have reached "tipping points" and have flipped into new states over eons without human intervention. But, especially in the final decades of the 20th century, humans have introduced a new variable, already evident in big ecological changes in the semi-arid lands of our Southwest: the heating, drying, and weather-intensifying effects of increased concentrations of greenhouse gases in Earth's upper atmosphere. *A Great Aridness* makes us acutely aware of the complex challenges we face in the new "Anthropocene epoch." The great water projects on the Colorado and the Rio Grande that have made it possible for millions of people to live here in relative comfort are already taxed beyond their capacity to sustain that life for much longer. Both of these important books ask, "How will we adapt and live?"

CHANGING WATERS—*Cont. from page 4*

talists, and policymakers nation-wide, could be helpful in modernizing New Mexico's water statutes, says Reynolds, who acknowledges that progress has already been made via legislation like the Groundwater and Storage Act, the Water Project Finance Act, and the mandate for a Comprehensive State Water Plan. In 2007, legislators also directed the Administrative Office of the Courts and the State Engineer to study the laws of neighboring states in regard to stream adjudications, but the recommended changes have not been forthcoming, despite the fact that New Mexico "lags far behind" those adjacent states in completing the adjudication process. Reynolds cautions, "Until such an adjudication takes place, there is no certainty for any water user in a basin as to the legality, extent, and priority of his or her use of water…If ten thousand people are demanding emergency relief during a lengthy, severe drought, and their water basin has not even begun to be adjudicated, the loss of legitimate rights is likely." But adjudication statutes are just one part of New Mexico's water law and they will have to be coordinated with other statutes in order to be effective. We have a "historic opportunity" Reynolds believes, "to examine our water laws as a whole" and to prepare for severe drought. New Mexico's existing Water Code was adopted in 1907, during an era of federal incentives that encouraged states and territories to amend their old laws, recognize the public ownership of water, and to promote expansion and development of the west through large-scale irrigation projects. Now Reynolds questions whether those 100-year-old statutes can guarantee fairness in times of scarcity. "We ignore water rights to the peril of our state's economic health," he says. New Mexico, like the rest of the nation, is facing a "job crunch, a money crunch, and an uncertain future," and those pressing matters have caused "an air of despondency" when it comes to water. "We face a disaster if we don't move quickly and consistently with solutions to our outstanding water issues before the great drought of the 21st century." Those outstanding issues include integrating water quality and water quantity; updating statutes that govern special districts; and ensuring that water and land use laws mesh. "These are things we *can* do," Reynolds says, by employing the how-to manual of the model Water Code, and the blueprint of the State Water Plan. "Now is the time for us to take the collective wisdom of the past century, and the new tools at our disposal, and put them to good use to finish this project of determining everyone's water rights… We must end this cycle of apathy in the wet years, and panic in the dry… We must break through the crust of other statewide financial anxieties and demonstrate our resilience to long-term drought by thoughtfully and methodically revising our laws, and channeling our collective resources toward protecting New Mexico's water future." To do this, Reynolds advocates asking the legislature to fund a symposium of citizens to review current statutes and propose modifications to the state water code.

Claudia Borchert

Toward Adaptation and Resilience

Claudia Borchert, Water Resource Coordinator, City of Santa Fe Water Resource Division, approaches the subject of adaptation and resilience from the standpoint of "a municipality with a water utility," and says she speaks "from the weeds," where most local entities inevitably work. Climate change has implications for "three worlds" she notes: the physical system (as addressed by Gutzler and Allen); the arena of mitigation, which is concerned with energy, transport, buildings, etc., and what can be done to limit or prevent the emission of greenhouse gases; and the realm of adaptation, which includes water resources, ecosystems, forest and coastal systems, food supply, industry and human health. In regard to adaptation, Santa Fe has long-range planning strategies that embrace conservation, cost incentives to reduce water use, rainwater harvesting, wastewater reuse, ecosystem protection, monitoring assessment, regional perspectives, cooperation, forest management, and green energy for water production—all things that make sense, no matter what the future holds. Borchert says such "no-regret actions" can be identified by asking, 'Is the opportunity there to do it? Is there a high rate of success? Is there manageable risk associated with choosing this action?' Anything that falls within such a framework "probably ought to be done sooner, and more effectively," she believes, given the concerns of climate change. Recently, in conjunction with the Bureau of Reclamation, the city and county of Santa Fe embarked on a project called the Santa Fe Basin Climate Change Study, to identify ways to better manage water resources in a climatically altered future. The study will re-evaluate the firm yield of the San Juan-Chama Water Project, and system simulation maps will be used to determine coping strategies, given the projected impacts of temperature and precipitation changes on streamflow in the Santa Fe Watershed, the Upper Rio Grande Basin, and the San Juan Basin. Borchert believes there are tactics that will become increasingly important, such as managing entire watersheds. "That's the system unit that's really going to matter in the future," she says. Another valuable tool will be scenario planning. Last year, Santa Fe's Buckman Diversion began drawing San Juan-Chama water from the Rio Grande for municipal consumption. One scenario that had been prudently envisioned was how the diversion would accommodate excessive storm flows; what had *not* been predicted, however, was the enormous volume of ash fouling the river following the Las Conchas Fire. That, along with several other unanticipated situations that occurred in the diversion's first year, made Borchert realize the city's scenario planning hadn't been as "out

CHANGING WATERS—*Cont. on page 9*

CHANGING WATERS—*Cont. from page 8*

there" as it should have been. In the future, she says, planners will need to think more about what "off-the-wall ideas" are possible.


John Leeper

John Leeper, formerly of the Navajo Nation's Water Management Branch, says in order to talk about water projects and water resources, you have to start by talking about *people*. "Lack of infrastructure, lack of economic development, and poverty are closely related," he says, and common to much of rural America, including Indian tribes. According to the 2010 census, population growth on the Navajo Nation is negative, and Leeper says what might seem to be optimistic signs—the San Juan Settlement, the Gallup-Navajo Water Project, the Farmington-Shiprock Water Project, and new enterprises such as casinos and factories— may be "an aberration." Climate variability will make the "tough situation tougher," he believes, because the Navajo Nation lies in the heart of the Colorado River Basin, where, according to USGS, average temperatures have increased by several degrees in recent history, precipitation has decreased, and changes are occurring in the timing of spring thaws. Desert soils and sand dunes like the ones common to much of the reservation remain stable as long as a 30 percent ratio is maintained between precipitation and evapotranspiration. If, however, that ratio dips below 10 percent, "things become unstable," resulting in immense dust storms that can adversely affect communities in the immediate vicinity, and distant watersheds as well. "Two dozen Navajo Chapters are named after lakes or water features that are bone dry," Leeper notes, and he sees a clear connection between the red dust generated by storms like the one in 2009, and "people in Boulder, Colorado, who complain about dust on their cars, and folks in Santa Fe who divert water from the San Juan-Chama Project." Those connections are evident right now, he says, yet there is no "sense of urgency" among relevant federal agencies, and insufficient support for tribal programs that might address the problems. A fairly small percentage of land is generating 90 percent of the dust, he says, and those areas should be targeted for watershed restoration and dune stabilization projects. Instead, Leeper refers to the $2 million dollars the Bureau of Reclamation is spending on a Colorado River Basin Study. "We *know* what the conclusions of that report are," he says. "Almost all of the modeling you're going to see will show there's a statistically significant chance of shortages in the Colorado River Basin within the next 60 years…We should be asking, 'Will this report result in useful recommendations? Will it result in useful actions?' That's what we've got to get to, and quickly…because it's about people."

Paul Tashjian, hydrologist with the Water Resources branch of U.S. Fish & Wildlife Service says, "You don't have to imagine what loss of ecologic resiliency looks like." At Creede, Colorado, the Rio Grande is "not too unlike what it was a hundred years ago. It's a pretty well-functioning system." At Albuquerque, in the reach known as the Middle Rio Grande, the channel that once meandered back and forth across the floodplain is today locked in place, and a system of drains have emptied most of the historic wetlands. "There are a lot of alarm bells going off," Tashjian warns, citing little regeneration in "the cottonwood Class of 1942," the aged canopy forest known as the bosque; increasing frequency of large fires that were "never part of this ecosystem"; and a fish species, once as prevalent as the common crow, that is "barely hanging on." At Las Cruces, Tashjian hears "relatively few alarm bells. They have already been sounded, a long time ago, and now those species and ecosystem functions are no longer available," because wetlands and riparian habitat have been largely denuded in the reach. Finally, at El Paso, he says it is difficult to imagine a river that once ran two miles wide. "In just a few generations, this narrow concrete band is what people think of as the Rio Grande. *This* is loss of resiliency. This is what it looks like." At two New Mexico wildlife refuges, work is currently underway to restore resiliency, particularly to drought. Bosque del Apache National Wildlife Refuge is located below San Acacia Dam, the last diversion in a reach of the Rio Grande where sediment from upstream tributaries and high-water deposition from Elephant Butte Reservoir have preserved some of the river's historic dynamic, including a connected floodplain, channel mobility, and their "associated processes and ecology." The 80 miles of river between the dam and Elephant Butte Reservoir would regularly go dry were it not for supplemental flows meant to sustain silvery minnows and western willow flycatchers. "These endangered species are here," Tashjian says, "because some sort of ecological resilience still remains in this reach." On the refuge, historic wetlands are being mimicked "in a farm-field setting," providing habitat for numerous species, and opportunities for eco-tourism. Over the last decade, the refuge has restored 3,000 acres of floodplain formerly infested with saltcedar and other non-native vegetation, but there are concerns about the future water supply—and thus the resilience of—these patches of reestablished marsh. At Bitterlake National Wildlife Refuge in the Pecos River Basin, resilience also hinges on water. The 75-year-old ref-


Paul Tashjian

CHANGING WATERS—*Cont. on page 10*

CHANGING WATERS—*Cont. from page 9*

uge supports one of the Southwest's most diverse native fish populations, and *the* most diverse collection of dragonfly species in North America. Refuge managers have experimented with drying up the wetlands in summer in an effort to return to a more natural hydrograph, of which drought is an important part. In 2000, many believed the Pecos Basin had finally begun to regain its hydrologic balance after decades of shortfall, but since then, spring flow in the region has been dropping. "We don't know what's causing the downswing," Tashjian says, "but some sort of base level is needed for resiliency in those springs. If they fall below that, they dry out." Overall, Tashjian believes drought is "a great time to do restoration." He sees hope in the state's Strategic Water Reserve, a fund administered by the ISC to encourage the movement of water rights to an environmental flow bank, and he believes that system resiliency can also be supported by "defining breaking points" in order to decide what to manage *for*.

Yvette Tovar, Executive Director of the New Mexico Water Collaborative, a non-profit that helps fund qualifying communities to implement water conservation and reclamation technologies, says the premise of the group is that we are in a water crisis that is shared across the socio-economic spectrum. At the low end of that range,

John Leeper and Yvette Tovar

people are "dealing with issues of survival: how to pay the rent, how to feed their children…It doesn't mean they don't care about water, but they're limited in their opportunities for effecting change." The Water Collaborative therefore concentrates on traditionally underserved populations. The program has a sliding scale for fees. At one end, it can fund up to 99 percent of a community's implementation project costs; at the other, it partners with for-profit businesses that want to adopt more sustainable, green technologies. As a 501(c)3 organization, the Water Collaborative uses the tax-deductible portion of fees it derives from for-profit business to fund projects for entities at the lower end of the economic scale. One current conservation project involves a non-profit that runs 12 group homes in the Albuquerque area. High water bills accruing from some 70 loads of laundry per home each week prompted an upgrade to new Energy Star washing machines, and because the Water Collaborative acknowledges a link between energy and water, new electric driers are also being installed. Antiquated toilets were replaced with new, 1.28-gallon models, a change that will save 3.2 million gallons annually. "The goal for the Water Collaborative is that we're conserving that water, we're not pumping it. At the same time, there's an economic benefit for the group-home organization because they get a $200 rebate on their water bill." The electric bill should also be lower once the upgrade is complete. In the reclamation category, the Water Collaborative is working with the Sawmill Community Land Trust in Albuquerque and a non-profit dance company that is building a community arts center there. The center plans to capture and store rainwater in cisterns for its landscaping, reducing dependence on the community water system, and the building is being plumbed to recycle greywater from bathroom sinks, drinking fountains, and two washing machines. Adjacent to the site is a 2.1-acre retention pond that serves 35 acres of the Sawmill Land Trust. The cavity is engineered to accommodate a six-hour, 100-year storm, and the Water Collaborative has proposed to "create an amenity" for the Sawmill community by planting the ponding area as a mini-bosque, fed by the arts center's greywater through a subsurface release system. Tovar appreciates the creativeness of such plans but adds, "In my mind, what would really be great is if we were recycling *wastewater*. There are so many things we could be doing. There's no silver bullet that will fix all our water problems. We have to start effecting change one project at a time: reducing water footprints; reducing how much fresh water is pumped; using water more than once…" Toward that end, part of the Water Collaborative's mission is education. Tovar says we need to accept that "we are in an arid climate…That means there are limited natural resources, and limited natural resources mean there should be constraints on our development and expansion." The Sawmill arts center will incorporate that educational element, offering displays to explain the building's reclamation system, and real-time digital readouts of water levels in the cisterns.

Retired hydrologist John Hawley offers a comment.

Questions and Answers

Public comments centered on the efficacy of water conservation. One participant noted that even without the likelihood of drought and climate change, conservation by itself is insufficient to the challenge of achieving resiliency in our over-appropriated state, and other adaptive actions could be taken, such as modifying OSE guidelines to reduce the amount of drawdown currently allowed in areas where aquifers are being depleted, or extending the 96-hour rule for holding storm water to allow for more infiltration. Another noted the persistent failure of policymakers and administrators to link water and land use.

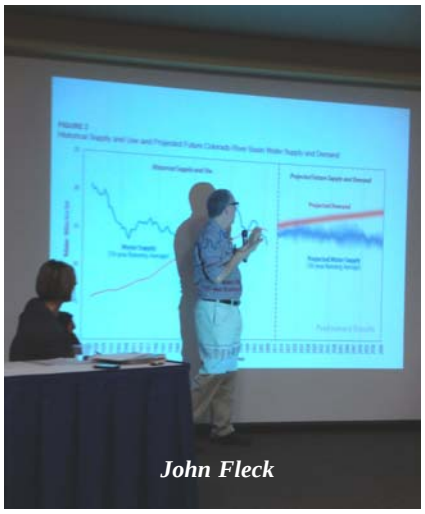
CHANGING WATERS—*Cont. on page 11*

CHANGING WATERS—*Cont. from page 10*

In one fast-growing New Mexico county, subdividers are required to demonstrate a 100-year assured water supply, but, says the entity's water resource manager, "Maybe a hundred years is not enough." Europe, with its strict land use codes, might serve as a model for establishing "the kind of balance between open space, food production and development we're seeking," observed panelist Claudia Borchert. In Germany, for every parcel of land that is developed, an equal parcel is set aside, in perpetuity, for conservation or a similar use. Last but not least, Dialogue participants acknowledged the hot potato of carrying capacity. "There are still so many blinders as to what the limits are," says one regular attendee. "It's not a good idea in a desert climate—even with conservation—to court population growth."

Water Administration—What's Next?

Amy Haas, General Counsel for the Interstate Stream Commission, outlined a number of "hot topics" in various basins around the state. In the **Middle Rio Grande**, a "consultation" is in progress under Section 7 of the Endangered Species Act, with the goal of developing a new Biological Opinion regarding two federally listed species. The present BO expires next year. The ISC and the Attorney General's Office represent New Mexico on the longstanding Middle Rio Grande Endangered Species Collaborative Program, and ISC director Estevan Lopez is the program's non-federal co-chair. Now, Haas says, there is a "current move" to change the Collaborative's focus from "mere avoidance of jeopardy" to that of "recovery" by converting it to a Recovery Implementation Program, or RIP. (Haas did not explain the nature of the "hot topic" here, leaving one to imagine possible misgivings about that acronym.) In the **Lower Rio Grande**, the federal Rio Grande Project historically operated to "deliver equal amounts of project water to every irrigated acre, irrespective of whether that acre was in Texas or New Mexico." Since 2008, however, as a result of a legal settlement, irrigators in Elephant Butte Irrigation District have experienced a 30 percent annual decrease in allocations, while downstream, El Paso District 1's allocation increased by as much as 46 percent. When the disparity became even more pronounced last year (22 to 78 percent), New Mexico's Attorney General sued the Bureau of Reclamation, partly over the 2008 agreement, and partly because of a BOR redistribution of Rio Grande Compact credit water. The Middle Rio Grande Conservancy District and the City of Las Cruces have intervened on behalf of the state, and the AG's office joined both irrigation districts as party defendants. The ISC is providing technical and legal support to the state. In the **Pecos basin**, a 2003 settlement agreement had at last begun to be implemented by 2009. The state had satisfied its "conditions precedent" by purchasing 405,000 acre-feet of rights in the Carlsbad Irrigation District, and 7,500 acre-feet in the Roswell-Artesian basin, and last March, pumping began to augment river flows. But 2011 turned out to be one of the driest on record, and ISC is "having a hard time keeping up" in terms of settlement pumping targets, Haas says. Fortunately, the basin has a compact credit, and the Vaughn Conservation Pipeline, an ISC implementation project that added 1,500 acre-feet of pumped water to the Pecos River last year, is helping the Bureau of Reclamation meet its ESA flow targets. In the **Gila basin**, under terms of the Arizona Settlements Act of 2004, New Mexico's 30,000 acre-feet of Lower Colorado River water was supplemented by an additional 14,000 afy, and up to $128 million "to be used for construction of a New Mexico unit, or other water utilization alternatives." ISC and a panel representing various state agencies are currently evaluating water management proposals, and a fund was established by the 2011 legislature to serve as a repository for the $6.6 million New Mexico receives annually under the settlement. On the **Canadian River,** construction was authorized in 2009 for the Ute Pipeline, designed to supply up to16,500 afy of potable water from the ISC-owned Ute Reservoir to communities in eastern New Mexico. There is no federal funding for the project, but some design and implementation work is nonetheless underway. ISC has a Shoreline Management Plan for the reservoir, and an MOU with State Parks and Game & Fish "in terms of respective management responsibilities." Discussions are ongoing with Fish & Wildlife regarding monitoring of the threatened Arkansas River shiner. According to compact, New Mexico's share of annual consumptive use in the **Upper Colorado Basin** is 11.25 percent, or 7.5 million acre-feet. In 2007, however, a hydrologic determination (signed by the Secretary of the Interior to ensure sufficient water for the Navajo Settlement) acknowledged that the Upper Basin's annual yield is closer to 5.76 million acre-feet. That means that between the Navajo Settlement and the San Juan-Chama diver-



John Fleck

Craig Allen, John Fleck, and Amy Haas

CHANGING WATERS—*Cont. on page 12*

CHANGING WATERS—*Cont. from page 11*

sion, "New Mexico has almost fully developed its Upper Colorado allocation." In 2005, the legislature created an **Indian Water Rights Settlement Fund** to ensure sufficient monies for New Mexico's cost share of three federally authorized Indian water rights settlements: Navajo, Aamodt, and Taos (also known as the Abeyta Settlement). In 2011, $15 million was allocated to the fund, with $5 million expected to go to the Navajo Settlement. The ISC is recommending an annual appropriation of $15 million, says Haas. "We've got big obligations," with $50 million owed to both Navajo and Aamodt, and $20 million to Taos.

Bruce Thomson, director of UNM's Water Resources Program and Professor of Civil Engineering offered his thoughts on the future of water resources management in the Rio Grande basin. He believes that New Mexico faces a "slow motion train wreck" involving five different trains. "About 20 years ago, the State Engineer started giving communities a permit to pump water based on a promise that they would acquire water rights at some point in the future. That debt is coming due right now, and I think we all know that those water rights are not to be had." The second train involves "resolution of Pueblo water rights. There are 18 Pueblos in the Rio Grande basin; we've settled with five, and it's cost us something on the order of three hundred and some million dollars." Then there is the increasing demand represented by population growth, and water to meet endangered species and other environmental needs. "It's not clear to me where that water is going to come from," Thomson says. And underlying all of these claims and requirements is the shadow of climate change: "That's a big, big, big uncertainty," Thomson says, and we'll have to figure our how to work with those challenges. The implementation of present water law is incomplete, and there is little linkage between planning, development and water resources at state, county or community levels. "Subdivision ordinances say you have to have at least a 40-year water supply, but nobody enforces that. They look at it as one subdivision, not recognizing there are subdivisions all around with impending development." Thomson's list of afflictions continues: water managers have few tools to work with; Active Water Resource Management has been blocked; the Middle Rio Grande has not been adjudicated; the State Engineer has authority on paper, but little in practice; and, "there is no new water. You hear talk about saline water, but that's baloney. That's not sustainable. What lending institution is going to provide mortgages for houses knowing that about the time the mortgage comes due, the water supply will be dried up?" In the long run, Thomson believes "there won't be any winners. There are going to be losers and big losers," and it will likely take a catastrophe to force us to have a serious dialogue about living within our means. "But catastrophe will give the politicians cover," he chides, so his advice is, "Pray for drought."

Aron Bolok and Bruce Thomson

Craig Allen, speaking as private citizen rather than a USGS scientist, says that even if greenhouse gas inputs were halted altogether, a significant amount of warming will still occur this century. "What are the obstacles to us addressing this as a society? One of the big ones is inertia, at a couple of different levels: personal, institutional, and cultural—as in societies as a whole." Allen illustrates individual inertia with a cartoon weather forecaster predicting "global warming and the catastrophic end of the human race" in the long term, but for the weekend, "sunny skies, mild temperatures and a general apathy toward environmental concerns." On the institutional level, "we can be trapped," he says: consider the Forest Service icon, Smokey the Bear, trying to figure out what his mission is now that the agency's fire suppression approach has been supplanted by the philosophy that fire is necessary. "All scientific information is subject to revision," Allen warns, and in the face of mounting evidence that a course change is necessary, institutional inertia is often due to political theater. Process requirements, tradeoffs and risks, short-term thinking, and public literacy can also influence an institution's ability to evolve, and so can the provisional nature of science itself, although Allen distinguishes between the latter and "hiding behind uncertainty in a disingenuous, delaying kind of a fashion, because there *are* interests that prefer the status quo." He suggests that further studies can be used as a delaying action, and that "from the international perspective, there is some sense that this is the way the United States has been dealing with climate change." Competitive self-interest, mistrust, cultural filtering and flat-out denial also figure into the resistance to change. "People tend to *partition*-ness," Allen observes, but in terms of global systems like water and air, "what happens in China affects what happens here." Only by "being open to learning and to dialogue" can we hope to adapt to the changes that are coming.

Aron Balok, of the Pecos Valley Artesian Conservancy District and a board member of the New Mexico Water Dialogue, recalled a man who was in charge of horse teams at the beginning of World War II, and essentially out of work by the war's end. As he told Balok, "I've seen a lot of changes in my life, and I've been against every one of them." That's most people's knee-jerk reaction, Balok observes, but there are models for accomplishing tremendous change if you look around the state. "In the Pecos, a few with a vested interest in the valley took some real pro-active steps a long time ago, before a lot of people thought it was necessary. They prompted the adjudication process; they willingly submitted to the notion that they were going to be forced to meter all their water; and they created the Pecos Valley Artesian Conservancy Dis-

CHANGING WATERS—*Cont. on page 13*

CHANGING WATERS—*Cont. from page 12*

trict to better the livelihoods of everyone in that valley because they knew that water was their lifeblood." Balok thinks the future could be "pretty optimistic" if other populations would adopt a similar mentality.

John Fleck, science writer for the *Albuquerque Journal*, notes that among the 87 water-related stories he did last year, the most recurrent themes were climate, wildfire, and legal issues such as the ones addressed by Em Hall and Judge Reynolds. He believes "we lack the legal, political, institutional and policy tools to really grapple with the conflicts we face in regard to looming shortage," but also admits to hearing "a lot of really optimistic things" among the day's presentations. Those encouraging particulars include Claudia Borchert's description of "relative success at having a community water ethic drive a new approach to thinking about water, and a reduction in water use"; Paul Tashjian's reference to the Rose property north of San Antonio, NM, where a coalition of government agencies and private interests are doing preservation work on what Fleck calls a "gem" of riverine habitat; and Amy Haas' mention of negotiations underway with Mexico in regard to sharing the limited water supply of the Colorado River Basin. Fleck offered a few optimistic tales of his own, beginning with a graph released last December as part of the Bureau of Reclamation's Colorado Basin Study. "It was an eye-opener," he says, "not for what it shows, but because the BOR was willing to put it down on paper." On the graph, the basin's demand curve has been extended upward, based on what the seven compact states expect to use in the future. At the same time, the supply curve has been run out, too, using mid-range temperature and precipitation averages forecast by climate models. The result is an impossibly widening gap, but Fleck says he has hope about "our ability to cope with that problem," given just a couple of examples of human adaptation. Up until 2002, California was using "substantially more water than it was entitled to" under the Colorado River Compact. As Arizona began taking its full share, California struggled to come up with a plan for reducing its use, but failed, and on January 1, 2003, the Secretary of the Interior cut California's diversion back to authorized levels. "Nobody thought this would happen," Fleck says. "The expectation among the other basin states was that California would pull this out politically and get to keep that water." Equally unexpected, he says, was the fact that "all of the shortage was taken up by the urban centers in southern California." Imperial, Cochella, and Palo Verde farmers were not deprived of their senior rights; instead, water to San Diego and Los Angeles was cut in half, literally overnight. "And they're still there," Fleck points out. "What you saw was that when communities are faced with actual shortage, the cities we live in can use substantially less water." Fleck's second optimistic story involves a hydrologist in Rio Rancho who built his home off the water grid. Weary of waiting for municipal services to be extended down the dirt road in front of his lot on the city's far west side, the retired "tinkerer" built a typical, large, middle-class American home with 4,000 square feet of roof area to catch runoff, cisterns to store it, and a pump and filter system. "He is living off what falls on his roof," Fleck reports, and against all odds, he made it through last year's drought with no inflow of water from December through July. "We're not all going to do what Carl did, but as we move through the 21st century and water gets more and more scarce, if we're faced with a choice of abandoning a city that we love or becoming far thriftier with our water, it *is* a solvable problem."

Facilitator Lucy Moore fields questions.

Even in abridged form, public reaction to the day's presentations tells a cogent story. Fewer and fewer are skeptical about the need for transformation. Even so, the prospect of change can look like the end of the world, and overcoming knee-jerk response is the first and maybe the biggest challenge ahead. Whether the catalyst is authority, such as California cities forced by the federal government to tighten their water belts, or administration in the Pecos basin, it seems wiser to do than to wait. There are measures to be taken that are "just good to do," regardless of what the future holds, and in fact, "doing what we can with what we have" is as practical a formula for agility as any. Toward that end, make use of available formats and forums. Choose communication over separation. If what the North is saying doesn't match what you know in the South, speak up. Be a resource to your legislators. Convene that assembly to review the state's water code, but first familiarize the participants with existing law and the fundamental remedies it contains. If something essential is missing, muster the nerve to invent it. And just as science adheres to the principle that every fragment of data must be subject to update and reassessment, so should a society be obliged to re-evaluate its philosophy, its policies, and its goals. That way lies resilience.

Thanks to our New and Renewing Contributors

The Board thanks all the individuals and organizations that support the New Mexico Water Dialogue and make our work possible. Despite cut backs in foundation funding, Board members have taken on more responsibility and there hasn't been any impact to our work or the quality of our work.

Because our funding sources are shrinking, as well as to maintain our independent voice, we must rely more on the generosity of our donors. The more of you who contribute annually – even small amounts – the stronger the Dialogue becomes.

If you can, please send the Dialogue a tax-deductible donation to go toward our work, which includes the annual statewide meeting, the *Dialogue* newsletter, and other events and activities.

We now have a system for collecting annual membership fees, contributions,

and meeting registration fees online via credit card to make it easier for individuals and groups to make donations to the Dialogue. We encourage all readers of *Dialogue*, even if you're already on the mailing list, to "join" the Dialogue by paying the $20 membership fee and, if you can afford to, making an additional contribution. You can also choose to join as an official representative of an organization, governmental agency, or business. It costs a bit more, but if your organization can afford it, please consider that option. By filling out the membership form, you automatically subscribe to *Dialogue*. You can choose to receive it electronically by checking a box. Next year, you will get a renewal notice. If you want to pay by purchase order or check, the system generates an invoice for you and tells you where to send your payment.

We also use the system to process online early registrations for the Annual Statewide Meeting. Meanwhile, we urge you to become a member. To join or contribute, go to http://nmwaterdialogue.org and click "Join/Contribute" on the navigation bar.

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