



# ARIZONA WATER RESOURCE

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Agricultural field growing broccoli in Palo Verde Valley, Calif. Source: Jeremy Cusimano, University of Arizona

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## Registration Open



Register now for the WRRRC's Annual Conference at the University of Arizona on April 8, 2014, organized in collaboration with the Arizona Department of Water Resources (ADWR). Be a part

of the conversation on Closing the Gap Between Water Supply and Demand and help us celebrate our 50th Anniversary.

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## Publications

The Water Resources Research Center produces research reports, outreach materials and regular publications, including the Weekly Wave e-news digest, quarterly Arizona Water Resource newsletter and the Arroyo, an annual publication focusing on a single water topic of timely concern in Arizona. **Sign up online to receive WRRRC newsletters, event updates and more at: [wrrc.arizona.edu/subscribe](http://wrrc.arizona.edu/subscribe).**

## Arizona Irrigation District Tries Land Fallowing Water Transfer

by Lucero Radonic, WRRC Graduate Outreach Assistant

In January 2014, Arizona will begin its first farmland fallowing and forbearance project. Unlike similar fallowing programs in the West, this project does not transfer the water conserved in the agricultural sector to the municipal sector. For the time being, this program seeks to conserve water in the Colorado River system. The saved water will be maintained in Lake Mead, increasing its dwindling levels and helping forestall shortages to water users in the Lower Colorado River Basin. Since 2000, water levels in Lake Mead have fallen by an alarming 100 feet. If the lake's elevation falls by another 30 feet, users in the lower basin would face reductions in water allocations.

According to a 2006 article by UA professor Bonnie G. Colby and colleagues, the rationale for encouraging fallowing as a conservation measure is that an estimated 20,000 to 60,000 acre-feet of Colorado River water could be saved through forbearance of a small fraction (4 to 11 percent) of water allocated for agricultural irrigation in California and Arizona.

*Arizona Fallowing continued on page 4*

## Study Finds Land Fallowing Improves Soil Quality in PVID

by Jeremy Cusimano, MS, UA Department of Soil, Water, and Environmental Science, Sharon B. Megdal and Jean E. McLain, WRRC, and Jeffrey C. Silvertooth, UA Department of Soil, Water, and Environmental Science

The Palo Verde Irrigation District in California sees extra benefits for transferring water through the use of land fallowing—soil quality and crop production go up. Growing population in the Southwest and increasing probability of Colorado River water shortages have many regions considering options for meeting current and future water demands. One option to address urban water demands in the Lower Colorado River Basin is the transfer of water from agricultural areas to highly populated urban areas, otherwise known as ag-to-urban water transfers. By definition, water transfers include voluntary

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Fallowed field in the Palo Verde Valley, Calif.  
Source: Jeremy J. Cusimano

agreements that result in a temporary or permanent change in the type, time, and/or place of use of water. In a 2012 report, the Western Governors Association wrote, “Water transfers can be local or distant; they can be a sale, lease, or donation; and they can move water among agricultural, municipal, industrial and environmental uses.”

One option that has been implemented in Southern California involves the transfer of water that has been “saved” by agriculture through conservation measures. To accomplish these Colorado River water savings, management strategies, such as fallowing or idling land, shifting to crops that consume less water, or pumping groundwater for irrigation, are commonly used. Fallowing, defined as arable land not under rotation that is set at rest for a period of time ranging from one to five years, is often the method of choice when it comes to water transfers in the Desert Southwest, where crop production is particularly water intensive due to climate, irrigation method and crop selection.

It should be recognized that large-scale, long-term water transfers that utilize fallowing have the potential to impart significant changes to local soil quality and crop production. Studies have shown that land fallowing is beneficial to soil quality, crop production and overall long-term sustainability. Therefore, land fallowing associated with ag-to-urban water transfers can be viewed as a sustainable land management practice that can be employed to reverse some of the negative effects of continued soil cultivation.

A crop rotation and water supply program implemented by the Palo Verde Irrigation District (PVID) and Metropolitan Water District (MWD) includes fallowing a large proportion of arable land within the Palo Verde Valley, Calif. each year as part of the agreement between the two agencies. The 35-year program transfers up to 118,000 acre-feet of Colorado River water annually to MWD through fallowing of up to 28,000 acres annually in the Palo Verde Valley. Under the program, water normally used to irrigate farmland within the valley

portion of PVID is “saved” through land fallowing, and an equal amount of water is made available to MWD.

The effects of short-term land fallowing on soil quality and crop growth following the completion of this water transfer had not been studied in the region until recently. A study, funded by UA Technology and Research Initiative Fund, Water Sustainability Program, and conducted by Jeremy Cusimano for his UA master’s thesis, aims to quantify the effects of short-term fallowing on soil quality and agricultural productivity within the Palo Verde Valley. Working with local growers, the PVID, and the University of California Cooperative Extension in Blythe, the study examined differences in soil fertility, microbial communities, and crop growth and development between fallowed sites and cultivated sites throughout the Palo Verde Valley.

For the study, composite soil samples were systematically taken from numerous fallow and arable fields throughout the Valley. Soil samples were analyzed for plant-available nutrients, salt content and organic matter; while analyses of microbial functionality and diversity provided insight into biological shifts in the soils. The same fields were then planted in the fall with broccoli, which was used to compare the effects of fallowing on plant growth. Results revealed significant differences between fallow and arable fields in the Palo Verde Valley.

The study found that short-term fallowing had increased the quantity of carbon, or soil organic matter, and nitrogen,

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**Arizona Water Resource**

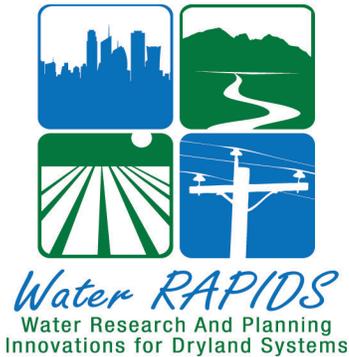
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## Environmental Water Program Becomes Water RAPIDS



The WRRCEnvironmental Water Program has changed its name to Water Research and Planning Innovations for Dryland Systems (Water RAPIDS). The new name fully encompasses the program's focus on developing new approaches to water resource management that integrate traditional natural resources planning with land use planning. Planning for people and natural resources together can lead to a more sustainable future by strengthening local and regional economies while supporting the natural resources that contribute to quality of life. Water RAPIDS' goal is to help communities balance secure water supplies for residential, commercial, industrial and agricultural sectors with the water demands of the natural environment. To this effect, the Water RAPIDS team offers a range of services, including assistance with watershed management and planning that integrates natural resources,

water resources and community development. The team can also help with designing and facilitating stakeholder engagement processes for communities seeking feedback on water resources issues or experiencing water-related conflicts. In addition, the program supports innovative approaches and tools for increasing household water conservation, while building awareness of the relationship between natural resources and water use. A geographic information system (GIS) provides analysis of water and natural resource issues.

## WRRC's New Water Fountain Saves Water, Energy and Waste

The WRRC's lobby features a new resource efficient fixture. The new ELKAY EZH20 water fountain doubles as a bottle filling station. The bottle filling station is quick, clean and, most importantly, easy to use. The fill rate is three times faster than a traditional drinking fountain and users do not need to find the perfect angle in order to fill their bottles. They can just place the bottle upright under the electronic sensor and water starts flowing into the bottle, not around it. The fountain also displays a digital counter that shows how many bottles have been filled and, accordingly, the number of disposable water bottles not used. 🏠

*Fallowing and Soil continued from page 2*

which has beneficial effects on soil quality and crop production. However, it was also found that fallowing increased salinity by approximately 35 percent in PVID soils. Such an increase in soil salinity would be of concern, but producers can reduce salinity buildup by applying excess (5-20 percent) irrigation water to leach salts from the soil. The project also revealed that microbial communities in fallowed soils had significantly greater microbial diversity and functionality, indicating that microorganisms had benefitted from the period of rest. Such increased microbial diversity can lead to improved nutrient cycling and concomitant benefits to crop production. Lastly, improvements in soil quality associated with fallowing enhanced the growth and production of the fall broccoli crop. Marketable yield and total plant biomass were both significantly higher after fallowing, with fallowed fields producing on average an additional 30 cartons of broccoli per acre when compared with fields that had been continuously farmed.

The study indicates that the PVID-MWD water transfer has been beneficial to soil quality within the PVID. Local growers and land managers agree, stating that fields have shown a positive response after just a few years of fallowing. According to longtime PVID farmer Bart Fisher, "Those of us who farm in the Palo Verde Irrigation District have been very pleasantly surprised by the noticeable increase in productivity of fields that have been in fallow for two to five years. At this point, fallow has become an integral part of our crop rotations, and we use it as a productive soil management technique."

The beneficial effects of fallowing on nutrient dynamics, microbial communities and crop growth, however, may be short-lived, and possibly affected by grower management

decisions. Therefore, it is important that growers and land managers understand the mechanisms driving improvements in soil quality following fallowing, as these fluctuations may require a change in soil management strategies.

Furthermore, additional irrigation water is needed to leach salts that accumulate during the fallow period. For example, an alfalfa crop grown in the PVID would require approximately 12 additional acre-inches of water applied throughout the growing season, although the quantity of additional water needed is largely dependent on the crop, soil characteristics, and other environmental conditions. Consequently, the need for supplementary irrigation water supplies in the PVID may arise.

The study, while limited in scale, shows that water transfers that include the use of land fallowing have the potential additional benefit of inducing significant improvements to soil quality and crop production. With the likelihood that fallowing programs will be adopted in Arizona in the near future, the information from this study highlights the importance of considering the implications of fallowing. The results of the study provide a foundation for further research concerning water transfers and their implications on soil quality and crop growth.

For further information on this study, contact Jeremy Cusimano at [jercusimano@email.arizona.edu](mailto:jercusimano@email.arizona.edu).

\*The authors would like to acknowledge Ed Smith, Dr. Vonny Barlow, Bart Fisher, Jack Seiler, and Chad Elliot for help with implementation of the study. 🏠

Arizona's new three-year project was agreed upon by the Yuma Mesa Irrigation and Drainage District (YMIDD) and the Central Arizona Groundwater Replenishment District (CAGRDR). Per the agreement, volunteer farmers will be paid not to grow crops and, thus, the district will not divert Colorado River water that otherwise would be used to irrigate the fallowed lands. Known as "America's Winter Vegetable Capital," the Yuma Valley has more than 50,000 acres of farmland and uses approximately 370,000 acre-feet of Colorado River water per year. With mild winter temperatures and plenty of sunshine, Yuma County has the longest growing season in the country, making it the source of 90 percent of all leafy vegetables produced from November through March in the United States. But with less than three inches of rain per year, to make this possible, water needs to be brought into the area from the Colorado River. Praised as an engineering marvel when it was completed in 1912, the underground Yuma Siphon continues to deliver Colorado River water to the Yuma Valley. Today, Yuma's agriculture industry represents more than one-third of Arizona's annual gross economic returns from Agriculture.

Through the fallowing program, CAGRDR seeks to fallow a maximum of 1,500 acres of land per year in the YMIDD. This is less than 10 percent of the district's total irrigated surface area, which is dedicated to growing mostly citrus, lettuce, cotton, alfalfa and wheat. To accomplish this goal, CAGRDR will pay volunteering farmers a base rate of \$750 per acre of fallowed land. In order to qualify, the land to be fallowed has to receive water from the Colorado River. It must have produced irrigated crops in four of the last five years and must total a minimum of five contiguous acres. In addition, no one landowner can put more than 18 percent of his or her land into the program. Program guidelines also stipulate that participating landowners must control weeds and dust on their fallowed land and maintain the ditch structures within the privately owned irrigation system so to avoid prejudice to downstream users. Participants must also continue paying the district assessments on their land.

If the program is extended beyond three years, landowners can remain in the program, but they must fallow a different sector of their property. Enrolled land cannot be permanently taken out of agricultural usage during the time of the agreement. Also, property owners cannot sell the land for residential development, as has been common for many years. In the last decade, about 5,000 acres of farmland in the YMIDD have been converted into tracts of suburban housing.

As stipulated by state law, CAGRDR is obliged to replenish groundwater in an amount equal to the replenishment obligations of its members, i.e., subdivisions, cities, towns or water companies in Pima, Pinal or Maricopa counties. The CAGRDR is actively seeking new sources of water supply to meet its replenishment obligation. The fallowing project is the glimmer of a supply acquisition strategy for groundwater replenishment. The notion is controversial and if the project is a success, fallowing may gain support among skeptics.

Cropland fallowing is neither a new concept nor an uncommon practice in the agricultural world. In arid climates, farmers regularly fallow lands for one season to conserve soil moisture and nutrients for a subsequent growing season. Letting land fallow for extended periods rebalances soil nutrients, re-establishes soil biota, accumulates soil moisture, and breaks

crop pest and disease cycles (see companion fallowing study article, this issue). However, fallowing land means foregoing crop production and, hence, income from that land.

Supporters of fallowing agreements like the one undertaken by YMIDD present it as a win-win process. From the municipal water manager's perspective, this approach reduces water extraction and is a cheaper alternative than converting salty water into potable supplies or building new pipelines to bring water from distant sources. Farmers are said to benefit from a guaranteed paycheck and soil regeneration in their fallowed fields. The district views the agreement as a strategy for prolonging citrus growth by rejuvenating the soils, providing revenues for farmers to replant old citrus trees, ensuring long-term water availability, and fostering friendly relationships between farmers and other conservation-minded stakeholders.

Critics of fallowing programs argue that they have a negative impact on the local agriculture-based economy. Businesses will see a reduction in demand for their goods and services. If closures result, remaining farms may experience difficulty obtaining the goods and services they need to remain productive, and rural communities will be harmed. In addition, these agreements are viewed by some as a slippery slope toward transfers of agricultural water rights to cities.

Over the last decade, fallowing agreements have become popular across the West as a strategy for adjusting to decreasing water supplies in stressed river basins. In Southern California they have been particularly popular. They have also been controversial for redirecting agricultural water to the municipal sector. In 2003, the Imperial Irrigation District and San Diego County Water Authority entered into a 45-year water transfer agreement establishing that the San Diego region would receive up to 200,000 acre-feet of water per year from the irrigation district. Fallowing is listed as a permitted method for saving water only for the first 15 years; afterward, the district must have efficiency-based conservation measures in place to produce the water. Similarly, in 2004 the Palo Verde Irrigation District and the Metropolitan Water District signed a 35-year agreement to allow for agricultural-to-urban water transfers in the area. Per the agreement, in any year Palo Verde farmers fallow between 7 and 28 percent of their lands at the request of the Metropolitan Water District, making saved irrigation water available to urban Southern California.

A much smaller pilot fallowing project was undertaken in 2009-2010 by the U.S. Bureau of Reclamation in Arizona. Because of the small scale of the project, it was not possible to quantify how much Colorado River water could be saved by leaving fields idle for a season. The three-year agreement between YMIDD and the CAGRDR is intended in part to help determine the actual amount of water to be conserved through rotational fallowing. It is estimated that the program will result in water savings of about 9,000 acre-feet per year. While this is a relatively small quantity, it represents a significant step when considering the alarming water levels to which Lake Mead has fallen since 2000. 🏡

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## NAU Receives EPA Funding for Solar Water Heating System

As part of the Environmental Protection Agency's (EPA) People, Prosperity and the Planet (P3) Phase I grants, Northern Arizona University (NAU) received a \$15,000 grant to design an ultra-low cost, non-polluting solar water heating system for consumer use. The NAU research team is one of 40 teams nationwide to receive the grant for research proposals that develop solutions to real-world environmental challenges. The funded projects cover a variety of environmental and health topics, such as the creation of additives that allow for eco-friendly degradation of mulch, a sustainable water treatment facility for communities with arsenic in their groundwater, mobile phone apps for citizen scientists to monitor the health of habitats and streams, and biodegradable food packaging. Each team will use the award to develop their projects throughout the academic year. In the spring, they will travel to Washington, D.C., to participate in the annual National Sustainable Design Expo. While at the Expo, teams will share their designs and compete for EPA's P3 Award and a Phase II grant of up to \$90,000 to further develop their projects.

## Pima County RFCD Green Infrastructure Project Receives EPA Assistance

Pima County Regional Flood Control District was selected as a community partner in the EPA's Technical Assistance Program, intended to encourage and support local community projects that address technical, regulatory and institutional barriers to green infrastructure. Pima County was one of six community partners selected by the EPA in 2013. The partner communities will receive technical assistance totaling \$400,000 for green infrastructure projects at a range of scales, urban contexts, and climates. Pima County will use the EPA's assistance to complete a green infrastructure guidance manual addressing selection, design, construction and maintenance of green infrastructure practices and helping to assess the costs and multiple benefits of these practices in a desert environment.

## Tucson is Declared "Emerald City"

Tucson is the newest "Emerald City" profiled in the Natural Resources Defense Council's most recent update of its report *Rooftops to Rivers*. Previously updated in 2011, the report highlights cities that are using green infrastructure to solve their stormwater pollution and water scarcity problems. This latest update reveals that over the past two years, cities across the country have made significant progress in implementing green infrastructure programs. Examples include green roofs, street trees, increased green space, rain barrels, rain gardens and permeable pavement.

In *Rooftops to Rivers*, NRDC identifies six key actions that cities should take to maximize green infrastructure investment

and become "Emerald Cities." Tucson earned two Emerald City points. The first point was for its new retention standard. Under its new Green Streets Policy, Tucson requires that all publicly funded roadway development and redevelopment projects integrate stormwater harvesting features like vegetated basins. The second point was for its increased incentives for private parties to use green infrastructure, specifically via rebate programs. The city rebates the costs of qualifying rainwater harvesting systems to a maximum of \$2,000. Similarly, households that install a permanent gray water irrigation system can apply to Tucson Water's Single Family Residential Gray Water Rebate Program for up to \$1,000. In addition to the ongoing actions, in November 2013 Tucson voted to replace its 2001 General Plan with "Plan Tucson," which has a focus on green infrastructure.

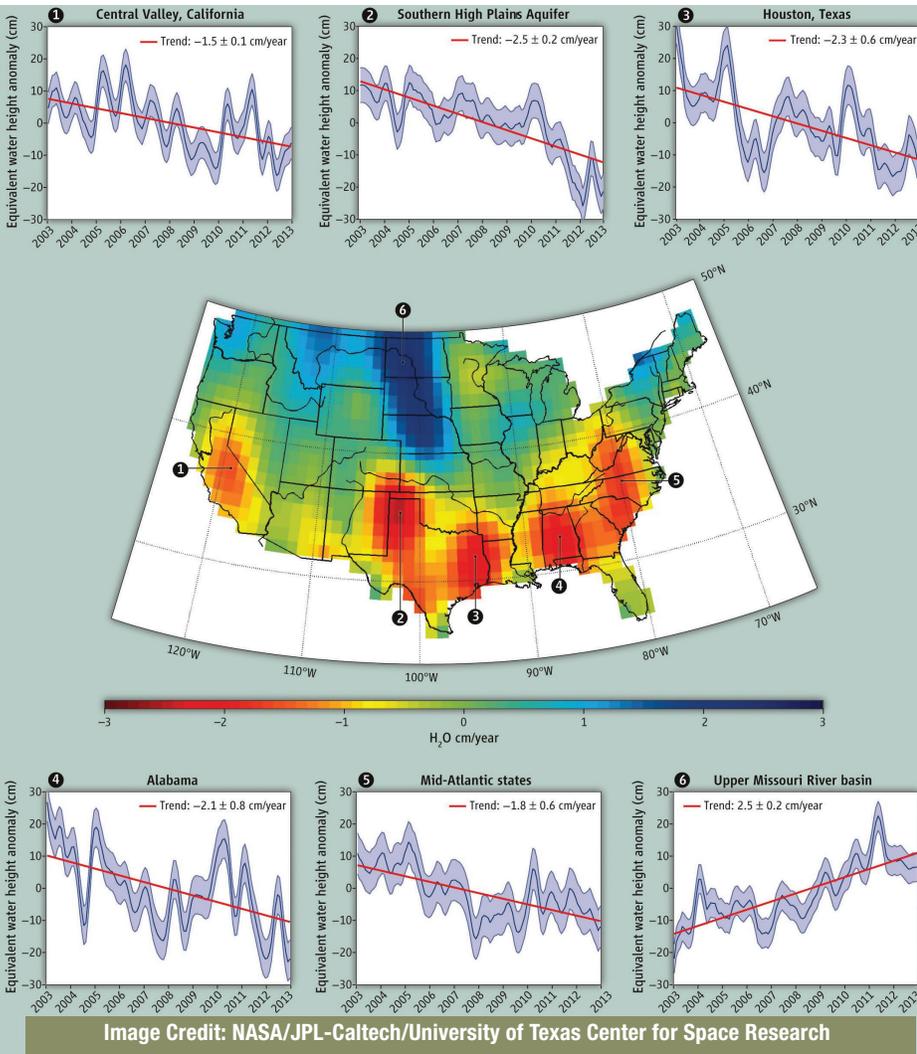
## USGS Develops National Water Census

In early September, the U.S. Geological Survey led a congressional briefing focused on the National Water Census, called for by the SECURE Water Act of 2009. The briefing featured state and regional water stakeholders who spoke about the need for comprehensive water information to be gathered under the water census. The National Water Census will quantify water supply and demand consistently across the entire country, fill in gaps in existing data, and make that information available to aid water resource management decisions. The USGS envisions the National Water Census to be an ongoing activity that, like the population census mandated by the Constitution, supports national decision-making in different ways. In developing the National Water Census, the USGS is working in coordination with other federal and non-federal agencies, universities and private organizations. Collaboration across agency boundaries ensures that information produced by the USGS can be aggregated with data on other types of physical, social, economic and environmental factors that affect water availability.

## WIFA Awarded \$26 Million from EPA for Water Quality, Public Health

The EPA awarded the Water Infrastructure Finance Authority of Arizona (WIFA) a \$9 million grant for its Clean Water State Revolving Fund and a nearly \$17 million grant for its Drinking Water State Revolving Fund for water pollution control and drinking water infrastructure projects. WIFA will use the funds to provide low-cost loans for drinking water and wastewater infrastructure upgrades. WIFA's Clean Water State Revolving Fund (SRF) provides financing for municipal wastewater treatment projects, while its Drinking Water SRF provides financial assistance for supporting drinking water infrastructure systems. Projects previously funded using SRF loans include a water reclamation expansion for the City of Casa Grande which now produces A+ quality water for reuse, as well as a water line replacement plan for Mt. Lemmon's Summerhaven, a town devastated after losing 75 percent of its rate base as a result of the 2003 Aspen Fire.

*News Briefs continued on page 6*



## Satellite Data May Help Improve Management of Groundwater Reserves

Since it was launched in 2002, NASA's GRACE (the Gravity Recovery and Climate Experiment) satellite has been making detailed measurements of Earth's gravity field, leading to an enhanced understanding of changes in the planet's natural systems. As James S. Famiglietti and Matthew Rodell explained in a recent article for *Science*, GRACE functions as a giant scale. By weighing the total amount of water (snow, surface water, groundwater and soil moisture) each month, it supplies the data to identify changes in water storage with an accuracy of 1.5 cm equivalent water height. At a global scale, the analysis of GRACE data has revealed significant groundwater losses in the world's major aquifer systems, highlighting the critical need for groundwater monitoring and regulation. The depiction here shows changes in water storage from 2003-2013 in the United States, with graphs of trends for six regions. 📊

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## Corporate Leaders Discuss Conservation at Denver Summit

The first "Business of Water Summit" was held in October in Denver, Colo. The summit sought to build consumer and business support for water conservation. The two-day event was hosted by Protect the Flows, a network of 1,000 businesses advocating for protection of the Colorado River. At the summit, Colorado Senator Mark Udall presented a pro-business case for conservation. He remarked that population growth, drought and increasing water demand are challenging the Colorado River and threatening Western economies and outdoor lifestyles. In order to meet these challenges, he argued, it is time to acknowledge that the current management and use of the river is unsustainable. More than 30 businesses came together to share innovations and strategies for better water management. Speakers offered concrete strategies they are using to protect water and educate consumers on its value. For example, George Wendt from OARS urges the 3,000 people a year who float his rafts down the Colorado River to support conservation, and White Wave Foods informs consumers

about water savings from its plant-based drinks, which require 77 percent less water than cows' milk.

## Rising Temperatures Challenge Salt Lake City's Water Supply

According to an article published in *Earth Interactions*, every degree Fahrenheit of warming in the Salt Lake City region could mean a 1.8 to 6.5 percent drop in the annual flow of streams that provide water to the city. Findings from this new research resonate with results from previous research on water in the Interior West, which point out that warmer temperatures alone will cause more of the region's precipitation to fall as rain rather than snow. This, in turn, will lead to earlier runoff and less water in creeks and streams in the late summer and fall. The research team relied on climate model projections of temperature and precipitation in the area, historical data analysis, and a detailed understanding of the region from which the city utility obtains water. The study also used NOAA stream flow forecasting models that provide information for Salt Lake City's current water operations and management. 📊



You are invited to attend the Water Resources Research Center's (WRRRC) Annual Conference at the University of Arizona on April 8, 2014, organized in collaboration with the Arizona Department of Water Resources (ADWR). Be a part of the conversation on Closing the Gap Between Water Supply and Demand and help us celebrate our 50th Anniversary.

The Colorado River Basin faces a large and growing gap between water supply and demand. In Arizona, water demand exceeds renewable supplies by a margin that is estimated to grow to 1 million acre-feet by 2060. The WRRRC's 2014 Annual Conference will explore a range of options to balance the scales of water supply and demand in Arizona. In addition, we are pleased to announce that we have invited Senator Jon Kyl to engage in a luncheon discussion. Please join us for a day of informative presentations, lively discussions and a special poster session that will include a celebration of the WRRRC's 50th Anniversary.

7:30 - 8:15	<b>REGISTRATION &amp; BREAKFAST</b>
8:15 - 8:30	<b>Welcome</b> Sharon B. Megdal, Director, Water Resources Research Center (WRRRC), University of Arizona (UA) Shane Burgess, Dean, College of Agriculture and Life Sciences, UA
8:30 - 9:00	<b>Session 1 - Opening Keynote</b> Sandy Fabritz-Whitney, Director, Arizona Department of Water Resources (ADWR)
9:00 - 9:30	<b>Session 2a – Closing the Gap Basin-Wide Keynote</b> Kay Brothers, Co-Chair, Colorado River Basin Study Next Steps Working Groups Coordination Team
9:30 - 10:30	<b>Session 2b – Closing the Gap Basin-Wide Panel</b> Moderator: Tom Buschatzke, Assistant Director Water Planning Division, ADWR Healthy Flows –Taylor Hawes, The Nature Conservancy Agricultural Conservation and Water Transfers – Reagan Waskom, Director, Water Resources Research Institute, Colorado State University Municipal & Industrial Conservation and Water Reuse – Carol Ward-Morris, Program Manager, Demand Management and Sustainability, Arizona Municipal Water Users Association (AMWUA) Colorado River Basin Tribes Partnership (TBD)
10:30 - 10:45	<b>BREAK</b>
10:45 - 11:45	<b>Session 3 – Closing the Gap: A Menu of Options</b> Moderator: Michael Fulton, Director, Water Quality Division, Arizona Department of Water Quality Conservation – Brad Hill, Utilities Director, City of Flagstaff Transactions – Nathan Bracken, Legal Counsel, Western States Water Council Reuse – Tim Thomure, Water Reuse Practice Lead, HDR Engineering, Inc.
12:00 - 1:45	<b>LUNCHEON (Sponsored by Arizona Public Service &amp; Salt River Project) &amp; POSTER SESSION</b> <b>A Water Dialogue with Senator Jon Kyl (invited)</b>
1:45 - 3:15	<b>Session 4 - Closing the Gap: Arizona Perspectives Panel (Q&amp;A)</b> Moderator: Bruce Hallin, Director, Water Rights and Contracts, Salt River Project Joe Gysel, President of Epcor Water, USA Maggie Gallogly, Director, Fennemore Craig Kathryn Sorensen, Water Services Director, City of Phoenix Tom Davis, General Manager, Yuma County Water Users Association Kelly Mott Lacroix, Water RAPIDS, WRRC
3:15 - 3:30	<b>BREAK (Sponsored by Montgomery &amp; Associates)</b>
3:30 - 5:00	<b>Session 5 – Closing the Gap: How Can We Do It? (Q&amp;A)</b> Moderator: Sharon B. Megdal, Director, WRRC Kathy Ferris, Executive Director & Legal Counsel, AMWUA Mike Lacey, Deputy Director, ADWR Rick Lavis, Executive Vice President, Arizona Cotton Growers Association Jennifer McCloskey, Deputy Regional Director, Lower Colorado Region, U.S. Bureau of Reclamation David Modeer, General Manager, Central Arizona Project
5:00	Closing Comments and Student Poster Award Presentations

## Q & A with Raanan Adin, CEO, Adin Holdings Ltd.

**Interview by Ann Posegate, Water Sustainability Program Graduate Outreach Assistant**

Raanan Adin, CEO of Adin Holdings Ltd. (adinholdings.com), an Israeli international water consulting and solutions company, met at the WRRC on November 22 with more than a dozen invited guests interested in commercializing water technology for a presentation and roundtable discussion. WRRC Director Sharon B. Megdal invited Adin to Tucson after meeting him in October at WATEC, a water technology exhibition and convention in Israel. Roundtable guests included representatives from local start-up companies, the City of Tucson, and UA's Tech Launch Arizona and Research Parks. Adin spoke about technologies such as desalination and wastewater reuse that have significantly increased water resources in Israel and how new technologies can help ensure future water safety and security. Adin also described how innovation is nurtured from idea to commercialization and presented several forms of technology incubation, with various case studies of start-ups in the water arena.

*In your presentation, you provided background on Israel and where you get your water. What would you say is the state of Israel's water?*

The main water resources of Israel in its early years were surface water, which are lakes and rivers, and groundwater. Yet the location of the largest surface water resource, Lake Kinneret [Sea of Galilee], is far from the main population centers. To overcome this, Israel built its first big water project, called the National Water Carrier, that connected Lake Kinneret and major aquifers to Central and South-Central Israel. It started operating in 1964 and enabled the growth of the population in Tel Aviv and vicinity. This is the main commercial center of Israel, where there are more than 2 million people out of 8 million in the country. It also increased water quotas for agriculture in the southern, arid parts of the country.

Israel's rapid population growth required more water than the natural water resources could provide. This drove the development of new water resources—treated wastewater and desalination. The largest wastewater project takes 160 million cubic meters (MCM) of treated wastewater from the Tel Aviv metropolitan area (Dan Region), treats it to the highest quality standard, and pipes it to the dry south of Israel—the Negev desert—for agricultural irrigation. Population has continued to grow rapidly and reuse of wastewater has reached 80 percent, the highest in the world. In addition, a series of years of drought led to fast decision-making by the government, which resulted in a national desalination plan. From 2014, about 600 MCM per year of water are supplied by large reverse osmosis desalination plants along the coast of the Mediterranean Sea and many smaller inland ones. Almost 500 MCM per year are supplied by treated wastewater, and the rest of the current demand of 2,100 MCM per year is satisfied by the natural resources.

*What do you think the main challenge is to water in Israel?*

Israel is not fighting water scarcity anymore. There is

enough water—enough good quality water, even to supply its neighbors. The challenge is to manage it optimally in a sustainable way considering cost, energy, climate change and impacts on the environment. There are several other issues articulated in Israel's long-term master plan for water, including returning some water back to the environment—parks, rivers and groundwater. Continuous improvement in water governance is always needed.

*What roles do water innovation and technology play?*

Innovation and technology are a response to Israel's need to supply water to people and agriculture in the desired quantity, quality, location and time. This has not changed. Innovation and technology will continue because we always want to do things more effectively. Part of the value of desalination, for example, is that the water is generated in Israel very close to the populated areas along the coast. The result is that energy of transporting it from the desalination plant to the populated areas is smaller than bringing it from Lake Kinneret. In addition, the use of novel technologies enables energy recycling in the plants. This compensates for some of the cost of energy spent in the process of desalinating. The water industry in Israel wants to continue growing, so it must innovate non-stop in order to sustain itself, for application in Israel and export to the world. To realize this, innovation is treated as a continuous process from idea to commercialization. Israel's authorities, academic institutions and commercial companies team up to nurture a practical innovative atmosphere, with results well known.

*How are water in Israel and water in Arizona similar? What do you think Arizona can learn from Israel?*

Basically, water scarcity is something that Arizona and Israel have in common. We both have more demand than supply by nature, which forces us to generate new water sources. So in Israel, it is wastewater reuse, which is also done in Arizona. From what I understand, it is done but can be done much more.

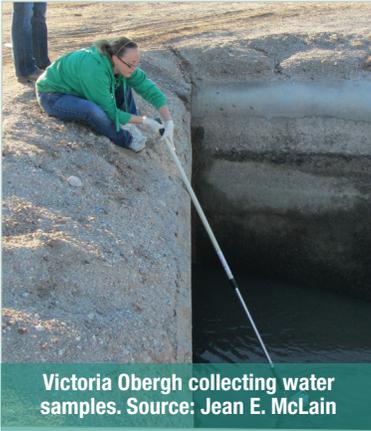
As to desalination, there is no sea in Arizona, yet the possibility exists to desalinate brackish groundwater. Some of the groundwater in Arizona has high salinity and would require desalination. Desalination of wastewater is also becoming an option. This is a technology that we can share. The issues of water transport are very similar. Where we have Lake Kinneret, Arizona has the Colorado River, which is not very close to the populated area. Therefore, there is a water carrier in Arizona that operates similarly to the National Water Carrier in Israel.

The roundtable was primarily about how to commercialize ideas in order to help us address our challenges. Obviously, it makes sense to discuss these things together—Israel and Arizona—because eventually we're talking about similar types of problems and similar types of solutions.

I believe that learning more about Israel's innovation, product development and commercialization programs will nurture such roundtable discussions in Arizona to find the best ways to implement such programs in your country. I believe we can nurture these processes and generate more ideas or more ways to implement good methodology that will work better here.

*Guest View continued on page 9*

## Victoria Obergh, UA Soil, Water, and Environmental Science (SWES)



Victoria Obergh collecting water samples. Source: Jean E. McLain

A first year master's student in SWES, Victoria Obergh received a Bachelor of Science in Health Sciences with a major in Physiology from the UA in May 2013. Originally interested in the medical professions, Obergh intended to pursue a career as an anesthesiologist. However, her interests shifted to environmental microbiology shortly after her senior-year

employment as an undergraduate student lab technician working under WRRC Associate Director Jean E. McLain. As she gained experience in the application of microbiological laboratory techniques to environmental samples and had the opportunity to assist graduate students in the field, Obergh found a passion for research on the environment and water quality.

Obergh's graduate research is focused on food safety, allowing her to integrate her field and laboratory experience with a continued interest in public health. Recent large-scale outbreaks of foodborne illness have brought food safety concerns to the forefront of public health research, as scientists develop methods for food production and storage that decrease the risk of illness resulting from contamination of food crops. Obergh's research is focused on Yuma, Ariz. and the Imperial Valley in California, which together supply 90 percent of leafy greens produced in the United States during the winter. This area is crisscrossed by miles of irrigation canals that carry water from the Colorado River to the agricultural fields. The natural waters of the Colorado enter the canals laden with silt, which settles to the bottom and would eventually fill the canals if it were not removed periodically. Canal maintenance, performed several times yearly, involves the use of heavy machinery to scour and remove settled sediments and algae. Such canal maintenance events, by their very nature, disrupt bacteria-laden sediments, causing adverse water quality impacts downstream.

About two years ago, concerned growers approached

McLain, SWES associate professor Channah Rock, and Yuma Agricultural Center Director Kurt Nolte. The growers, who monitor canal irrigation water quality on a regular schedule, were finding periodic unanticipated spikes in bacteria and suspected that canal maintenance might be the culprit. However, no data existed on the effects of canal maintenance on downstream water quality. With funding from the Arizona Department of Agriculture, Obergh is quantifying the suspension of bacteria in irrigation water due to canal maintenance. During each maintenance event, she collects water and sediment samples from the irrigation canals to quantify bacterial groups commonly implicated in foodborne illness outbreaks, including *E. coli* and *Salmonella*. She also collects environmental data such as water temperature, pH and turbidity to identify factors that may promote or inhibit bacterial survival in water. The ultimate goal of this research project is the development of best management practices that growers can utilize to identify post-dredging conditions and keep irrigation water within acceptable water quality guidelines.

Obergh finds that growing up in Benson, Ariz. has helped her brave the summer heat of Yuma fieldwork. Sampling days are intense and demanding on her arm and back muscles, as she collects dozens of water and sediment samples using bottles suspended on the end of a long metal pole. Because water quality guidelines dictate that samples must be analyzed for *E. coli* within six hours, field collections are rushed back to a laboratory (at the Yuma Agricultural Center or even in a local hotel room) where subsamples are processed for enumeration of *E. coli* and placed in an incubator. The remainder of each sample is transported back to the McLain Laboratory in Tucson, where Obergh concentrates, then extracts bacterial DNA for identification and enumeration of *Salmonella*.

Obergh's research study and her master's-level coursework have focused on learning more about crop production, food safety practices, and the importance of water and soil quality in preventing contamination of crops. In the future, she hopes for a career as an environmental engineer to use her knowledge of water and soil quality in the development of solutions related to public health. Overall, Obergh's Bachelor of Science in Health Sciences and her work toward a Masters in Soil, Water and Environmental Science have given her a strong insight into the vital connections between water and soil quality, their impact on food safety, and how research results can be utilized to improve public health. 🏡

*Guest View continued from page 8*

*What do you think the future holds for water?*

First of all, let's talk about the main trends that we're experiencing. The main trend that is leading the needs of the water industry is urbanization. Urbanization poses big challenges in bringing water to a populated area, water that needs to be generated or transferred from elsewhere. It requires handling the wastewater more effectively. Both supplying the water and wastewater and treating them require energy; this is the water-energy nexus. In most of the urban areas, we see new neighborhoods built around a very old city, telling us that the basic system is very old infrastructure. In some cases it's

historical, so we sometimes need to find ways to live with that old infrastructure. There are technologies for dealing with that as well. The whole system turns more and more complex as the city expands, requiring more sophisticated water management—a holistic management.

Integrative multidisciplinary work, as done in the WRRC, and international collaborations, such a roundtable event as one example, are necessary methods of work and organization that enable optimal access and use of knowledge for attending to the evolving reality in water. 🏡

## The American Southwest: Are We Running Dry?

*A film by Jim Thebaut. Hosted and narrated by Jane Seymour, 2013.*

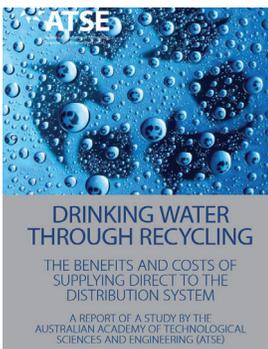


Filmed at diverse locations including the Navajo and Hopi reservations, Capitol Hill and Las Vegas, this documentary chronicles the use of water in the Southwest and ultimately asks the question, “Are We Running Dry?” The film explores

how water policy and land use planning affect the water needs of diverse stakeholders across the American Southwest. It documents how drought and record low precipitation have depleted water levels in vital resources such as the Sacramento-San Joaquin River Delta system, the Rio Grande and the Colorado River. The film also includes discussion of water crisis solutions such as desalination, rainwater harvesting, green infrastructure, individual conservation choices and shared community efforts. Interviews with key policy makers, members of Congress, water authorities and scientists on a looming water crisis make for absorbing and thought-provoking viewing. The documentary is available at: <http://www.runningdry.org/americansouthwest/america.html>.

## Drinking Water Through Recycling: The Benefits and Costs of Supplying Direct to the Distribution System.

*Australian Academy of Technological Sciences and Engineering, Melbourne, Victoria, Australia, 2013.*

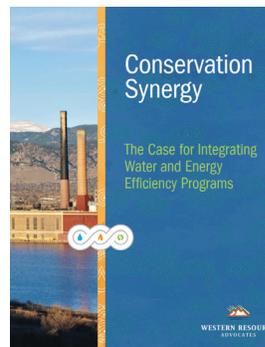


The report provides a comprehensive look at the potential role of direct potable reuse (DPR) in Australia and internationally. The report suggests that potential benefits of DPR include significantly lower energy requirements, construction costs and operational costs, but that public perception and acceptance are significant obstacles to its implementation. To encourage the use of DPR, the report makes

the following five recommendations. First, regulate drinking water quality based on health concerns and standards. Second, harmonize guidelines to improve management and regulation of DPR projects. Third, implement external auditing of water quality management. Fourth, enhance the capabilities and powers of regulators; and fifth, improve water treatment process reliability, monitoring and validation. The report is available at <http://apo.org.au/research/drinking-water-through-recycling-benefits-and-costs-supplying-direct-distribution-system>.

## Conservation Synergy: The Case for Integrating Water and Energy Efficiency Programs

*Western Resource Advocates, Boulder, Colo., 2013.*

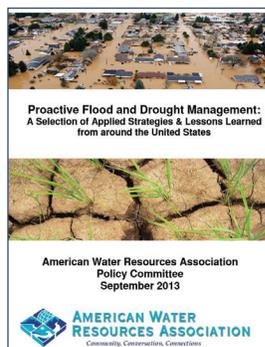


The nexus between water and energy has been understood for several years, yet only a handful of utilities have fully capitalized on this knowledge by combining their water and energy efficiency programs. A new report by Western Resource Advocates (WRA) articulates the reasons for collaboration and the pathways utilities can use to achieve conservation synergy. The report features examples of collaborative

programs implemented by utility companies, such as joint rebates, joint audits and joint building efficiency upgrades. In addition, it offers a four-step guideline to the collaborative process. Free WRA informational pamphlets about saving water and energy can be adopted by utilities to advance their own programs. The report states that utilities implementing collaborative programs have found them to be a good business decision, with benefits that include higher participation rates, increased customer satisfaction, and an improved reputation from working smarter. The report is available at [http://www.westernresourceadvocates.org/water/pdf/Conservation%20Synergy\\_WRA.pdf](http://www.westernresourceadvocates.org/water/pdf/Conservation%20Synergy_WRA.pdf).

## Proactive Flood and Drought Management: A Selection of Applied Strategies and Lessons Learned from around the United States

*Lauren Dennis, American Water Resources Association Policy Committee, Middleburg, Va., 2013.*



A report of the American Water Resources Association Policy Committee presents a series of case studies that are both unusual and outstanding in their success at integrating flood control or drought mitigation with other water resources objectives. Each case describes widely different institutional and regulatory barriers and driving forces affecting the choice of water resources management strategies. Together the

case studies provide evidence on how multiple agencies and public policy objectives can be combined in a proactive flood or drought management program. The report is divided into three sections. First, the introduction describes proactive management and other key terms, and explains how the case studies were

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## Key Messages for CRWUA Highlight Arizona's Achievements, Yet More Efforts Are Needed

By Sharon B. Megdal



The Colorado River Water Users Association (CRWUA) Annual Conference, held December 11-13, 2013, had “Colorado River—Committed Collaboration” as its theme. Each year water users and officials from throughout the Colorado River Basin convene in Las Vegas to discuss the current status of Colorado River management and policy. An integral component of the conference is the state caucus breakfasts held prior to the Thursday

plenary sessions. Almost 200 people participated in the Arizona breakfast, where a new 15-minute movie about Arizona water accomplishments was shown and updates on some key water matters were provided.

A very interesting document, entitled “Arizona Key Messages for CRWUA,” was shared at the breakfast. This unsigned and undated document reflects the messages that Arizona’s water leadership would like shared both within and without our state’s boundaries. The following nine points are reproduced for your consideration.

1. *Arizona, along with the other six Colorado River Basin States, may be facing short-term water supply shortages and long-term future water supply and demand imbalances. Arizona has prepared for these realities for decades and has demonstrated leadership in water management for over a century. With more than 125 years of experience in adapting to one of the most arid climates in the US and due to our junior priority status on the Colorado River, Arizona has been proactively building resilience and implementing innovative water management strategies to secure dependable water supplies for our future.*

2. *Arizona leads the nation with rigorous water conservation and sustainability laws that protect Arizona water users and reduce reliance on the use of unsustainable groundwater supplies in the State’s most heavily populated areas. With its requirement of a 100-year renewable water supply for all new development, together with water conservation mandates for municipal, industrial and agricultural water users, through oversight of the Arizona Department of Water Resources, Arizona’s comprehensive 1980 Groundwater Management Act is known as one of the most robust water management laws in the United States.*

3. *Since implementation of the 1980 Groundwater Management Act, agricultural water users in Central Arizona have taken significant steps to dramatically improve irrigation efficiency. In the CAP service area, agricultural water users exceed the State of Arizona’s mandatory 80% efficiency target through lining of canals, laser-leveling of fields, conversion from flood irrigation to sprinkler and drip systems, and use of automated and real-time delivery systems. These water users have invested*

*more than \$750M to improve irrigation efficiency (~\$3,600/ac).*

4. *Municipal water users have also heavily invested in the implementation of water conservation strategies resulting in part from the adoption of the 1980 Groundwater Management Act. Over 80 percent of Arizona’s population resides in active management areas with statutorily mandated water conservation requirements. In the areas served in whole or in part by the Central Arizona Project and the Salt River Project, over 90% of the population is served by cities that have implemented Best Management Practices.*

5. *Water conservation is not limited to Central Arizona. Water providers throughout the state are statutorily mandated to adopt water conservation and drought plans and to submit those plans to the Arizona Department of Water Resources. Moreover, in the Yuma area where up to 90% of the Nation’s leafy vegetables are produced between the months of November and March, increases in irrigation efficiencies have allowed agricultural water users to increase production all while using the same amount of water that was used in 1970.*

6. *Arizona also leads the nation in the implementation of water efficient reuse programs. More than 95% of treated wastewater generated within Central Arizona (including areas served by the Central Arizona Project and the Salt River Project) serve beneficial uses including agriculture, municipal, groundwater recharge, power generation, industrial, and turf irrigation. Additionally these water supplies support ecologically vital wetland restoration that benefits our unique southwestern flora and fauna, as well as helping to achieve the State of Arizona’s water management goal of Safe-Yield for the Phoenix and Tucson Groundwater Basins.*

7. *Arizona’s engagement in collaborative long-term planning and comprehensive strategies has allowed for the underground storage of over 3.2 million acre-feet of water to provide back-up supplies to Arizona’s municipal, industrial, and Native American water users in times of shortages on the Colorado River. Arizonans have invested more than \$250 million to build facilities and to deliver and store water underground through the Arizona Water Banking Authority for use in the CAP and Mohave County Water Authority service areas. Equally significant investments in underground water storage have also been made by water providers and private entities to store additional water supplies underground to reduce their vulnerability to shortages. However, a shortage in the near-term on the Colorado River ... will directly curtail the water supply available to Central Arizona Project agricultural water users.*

8. *Arizonans are committed to collaborating with the Basin States, Mexico and Federal partners to implement proactive measures to reduce the near-term risks caused by the drought as well as address water supply deficits and long-term imbalances between supply and demands in the Colorado River system.*

9. *No single action or project will address the imbalances. Arizona’s water management leaders are committed to continuing to be proactive in developing and enhancing conservation and reuse opportunities as well as exploring the development of new water supplies through augmentation and desalination. New infrastructure, bold investments, and collaboration are essential for Arizona to continue to secure its water supply future.*

These messages point to both our accomplishments and our challenges. Arizona must address its water challenges so that 50 or more years from now, a list of accomplishments—*not failures*—can be circulated to future CRWUA attendees.

As we prepare for our April 8, 2014 conference on Closing the Gap Between Water Supply and Demand, I am interested in hearing your reactions to these talking points. Please take a few minutes and email your thoughts to me at [smegdal@email.arizona.edu](mailto:smegdal@email.arizona.edu). 📧

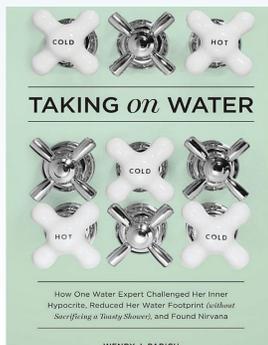
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Resources continued from page 10

chosen. Next, the report features eight case studies of local efforts —four focused on flood management and mitigation, and four focused on drought management and mitigation. Finally, the report closes by identifying emerging themes and lessons learned from these case studies. A compendium of additional resources for designing drought and flood management strategies is included. The report is available at <http://www.awra.org/webinars/flood-drought.html>.

## Taking on Water

Wendy J. Pabich, Sasquatch Books, Seattle, Wash., 2012.



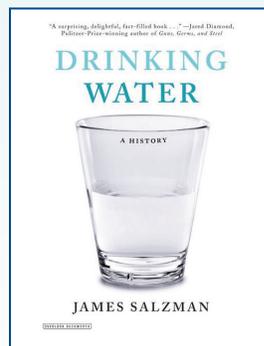
*Taking on Water* is the story of the author's personal quest to implement day-to-day solutions to reduce water use in her life. Her quest started when she received a monthly water bill for 30,000 gallons of water for a household of two. She realized that in her average American lifestyle she was consuming 100 times more water than a typical Mozambican household. As an environmental scientist and a water activist, she

set out to examine the water footprint of the products she consumes and change her behavior. Changes included processing her own wastewater onsite, revamping the water and energy systems in her home, and making major lifestyle modifications. She describes metrics, both serious and

humorous, that track her progress, and offers guidelines for the general public who want to make changes in their own lives. Part memoir, part investigation, part solution manual, the book is filled with ruminations on philosophy, science, facts, figures and personal behavioral insights.

## Drinking Water: A History

James Salzman, Overlook Press, New York, N.Y., 2012.



In *Drinking Water*, Duke University professor and environmental policy expert James Salzman sets out to show how drinking water highlights the most pressing issues of our time and how humans have been wrestling with these problems for centuries. The author addresses current debates ranging from globalization to community rights, conspicuous consumption to poverty, terrorism to public health, and environmental

protection to economic growth. Concerns over drinking water are a significant component in all of them. He goes on to illustrate this point with stories from across the globe and through history, arranged around his major themes. Salzman is a good story teller. His book shows, in a provocative, insightful and entertaining way, how complex a simple glass of water can be. 