WSP
Water Sustainability Program
Our Water Future

• Innovation • Collaboration • Education • Policy

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SPRING 2009

The Water Sustainability Program (WSP) at The University of Arizona (UA) is creating a collaborative environment to leverage the University's recognized water expertise to resolve water resource challenges. The experience and knowledge of over 300 UA faculty and staff make UA a national and global leader in water research, education and technology development.

WSP facilitates interdisciplinary research, engaging partners from all levels of government, industry and the public, to address the complexities of managing limited water supplies in the semi-arid Southwest and generate innovative solutions.

WSP accomplishments are building on the unique strengths of the five lead UA water centers that serve as the management core for a university-wide, interdisciplinary network: Water Resources Research Center; NSF Water Quality Center; Sustainability of semi-Arid Hydrology and Riparian Areas NSF Center; SRC/Sematech Engineering Research Center for Environmentally Benign Semiconductor Manufacturing; and NIEHS Superfund Basic Research Program.

The Water Resources Research Center delivers on its mission

Water Resources Research Center

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to promote understanding of critical state and regional water management and policy issues through research, community outreach and public education. Funding from WSP helps support the applied research that goes into producing WRRC flagship publications and programs, and many research projects.

We increasingly hear about reclaimed water as the last untapped water supply to meet the growing demands on our limited resources. The issues concerning the use of reclaimed water are complex and controversial, so it is essential that we have an informed public if we are to make full use of this resource. The 2009 issue of the *Arroyo*, an annual WRRC publication, provides unbiased and detailed information on the use of this resource, its history, regulations, the challenges and opportunities. The production of the *Arroyo* is a team effort that includes a summer student intern selected through a writing competition, sponsored by Montgomery & Associates, water resource consultants. This summer, the new intern will help tackle the energy-water nexus, another complicated topic receiving considerable attention.

The WRRC engages in applied research on topics of importance to Arizona and the region. Transferring water from agriculture uses to urban uses is a much debated issue. An article published in the *Water Report*, issue #58, reports on research by WRRC researchers and others and describes the institutional incentives for and barriers to voluntary water transfers in Arizona. The research reviews

survey data from a cross-section of organizations in Arizona and details the mechanisms and pace of transfers of water from agricultural to urban uses.

A long term project is the federally authorized U.S.–Mexico Transboundary Aquifer Assessment Program, which the WRRC is working on in partnership with the U.S. Geological Survey and in collaboration with the UA Udall Center for Studies in Public Policy. This international effort involving entities in Arizona, New Mexico, Texas and counterparts in Mexico, is intended to provide scientific information needed for cross-border water management and policy making.

The WRRC annual conference provides an opportunity to connect with individuals from across the state. This year, drawing over 275 registrations from more than 40 communities, there was a full program of presentations, panels, workshops and posters focused on stakeholder engagement in water planning to develop sustainable water management strategies. ♦

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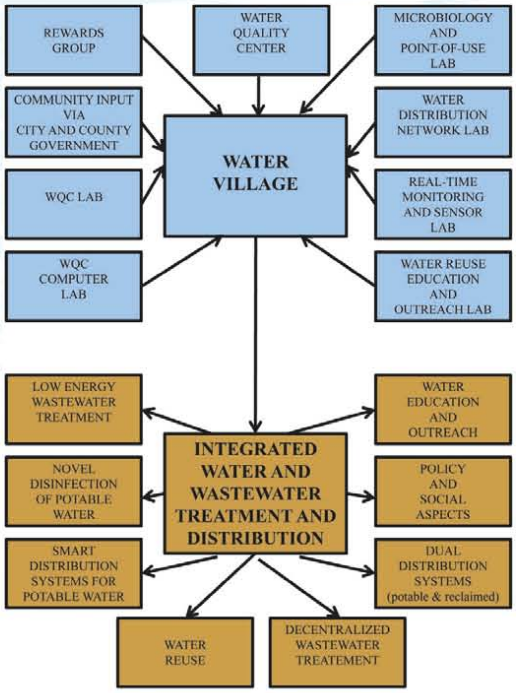
It takes a village – the Water Village –

to improve the quality of potable water that communities drink, whether it is about taste and odor or serious threats to human health. The crown jewel of the Water Quality Center (WQC), the Water Village is an intermediate field-scale testing facility designed to address the many challenges of delivering safe drinking water to the public. It consists of modular buildings designed to develop "Smart Water Distribution Systems" including sensors for real-time monitoring models for contaminant dispersion and transport, novel disinfection technologies and new technologies for water and wastewater treatment. The Water Village has a national and international reputation, securing $13M in external support and interacting with five other universities. The REWARDS Group (Re-Engineered Water and Retrofitted Distribution Systems), made up of twelve faculty from eight departments across campus are powering up the research at the Water Village, under the leadership of Ian Pepper.

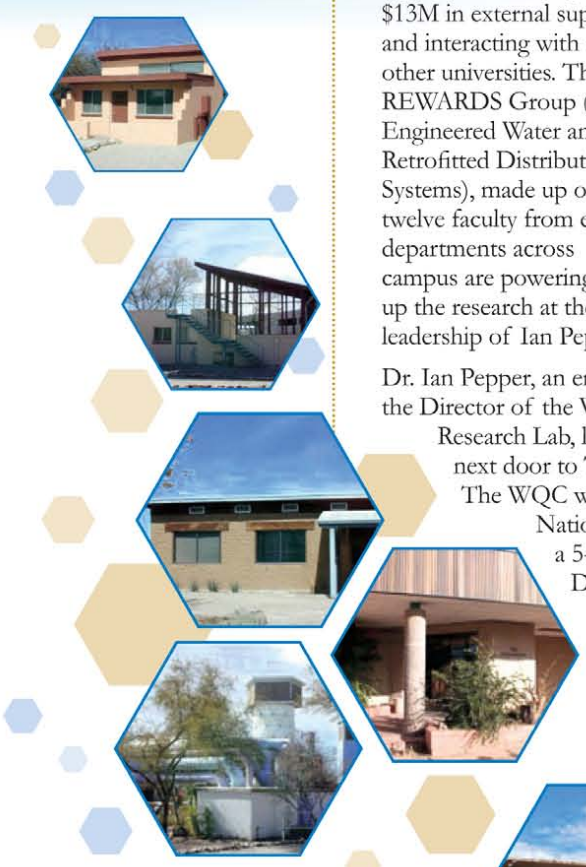


Dr. Ian Pepper, an environmental microbiologist, is the Director of the WQC and the Environmental Research Lab, located on an 8.6 acre campus, next door to Tucson International Airport. The WQC was first funded in 1999 by the National Science Foundation, with a 5-year renewal grant in 2004. During this time the WQC has received additional funding from the private and public sectors, as well as through the Water Sustainability Program.

During the past 10 years, research has focused on the fate and transport of emerging contaminants such as prions, the causal agent of Mad Cow disease, bacterial, viral and protozoan pathogens in water, including *Cryptosporidium* and *Naegleria*, and more recently, chemical endocrine disruptors such as pharmaceuticals and personal care products detected in water supplies around the globe.

A new education center, a collaboration of WSP, WQC, ERC and Arizona Project WET, is under development at the Water Village. Geared for hands-on experiments for K-12 students the facility will demonstrate state-of-the-art technologies as they are being developed by university researchers. It will offer opportunities for integration of research into undergraduate and graduate education and extension of innovative water science to water professionals and the public.

WQC has been refunded by NSF to be part of the new Water and Environmental Technology (WET) Center which consists of Temple University, UA and ASU. Thus the original WQC continues to expand in size and reputation, and spans the nation from coast to coast. WQC looks forward to continued success as part of the Water Sustainabiilty Program. ♦

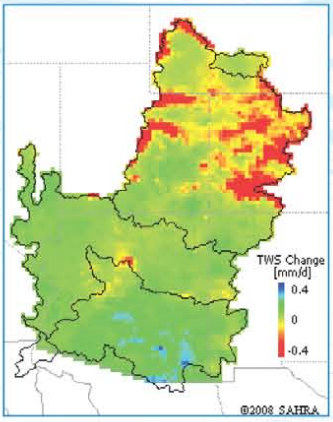


Water Village Buildings

Experimental Setup at Water Village

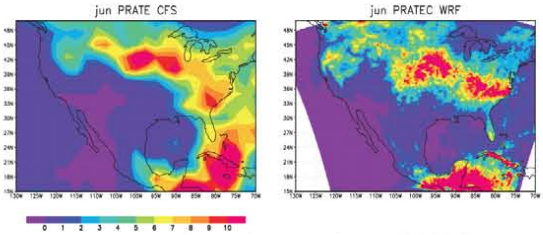
Real-Time Monitoring and Sensor Lab

SAHRA research: helping water managers better understand water availability realities and land/water connections in arid regions



TWS changes in the Colorado River basin

A project, led by Peter Troch, Matej Durcik and funded by WSP is the first to develop a real-time system to estimate changes in terrestrial water storage (TWS) for large river basins—in this case, the Colorado River—using a variety of remotely sensed and land-based data sources. Further investigations into links between TWS changes and Pacific Ocean sea surface temperatures will improve predictions of water availability in surface water, groundwater, snowpack, soils, and plants in drought-sensitive areas like the U.S. Southwest. TWS change estimates for the Colorado River basin and its sub-basins can be found at http://voda.hwr.arizona.edu/twsc/sahra/index.html. ♦



June precipitation in the U.S. shown a) in the original global climate model; and b) after downscaling.

Another project focused on water resources in the Colorado River Basin (led by Francina Dominguez) is downscaling climate data based on future global climate scenarios to be used as input to hydrologic models. This information will improve understanding of the region's water balance for the next 100 years: how much and what percentage of precipitation will run off the land surface, infiltrate into groundwater reserves, or be stored in the soil? The work will provide a proof-of-concept for further modeling efforts. ♦

Margaret Snyder collects a water sample.

Through a Center-Directed Initiative grant combined with grants project funding, Paul Brooks, Kathleen Lohse and colleagues are evaluating the effects of urban land use on runoff and recharge. Although the amount of runoff increases predictably with impervious cover and slope, water quality exhibits complex patterns controlled by land use, channel characteristics, and hydrology. Rocky, vegetated washes appear to attenuate pollutant loads. As land use intensifies, the most pressing water quality concerns are mercury, organic pollutants, and pathogenic bacteria. ♦

WSP funds also helped SAHRA and the Army Corps of Engineers to establish the International Center for Integrated Water Resources Management (ICIWaRM). The Center, whose science node is led by SAHRA director Juan Valdes, will transfer new understanding, methodologies, and science results related to integrated water management throughout the developing world. It is expected to soon become the first U.S.-based center in UNESCO's International Hydrology Program. ♦

SAHRA

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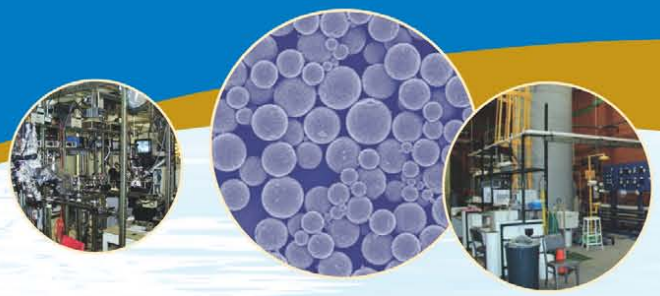
Funded through the state Technology and Research Initiative Fund (TRIF), created by passage of Proposition 301 in 2000.



High Tech – Low Impact

High-tech industry is a leading driver of Arizona's economy and semiconductor manufacturing is a major component. The SRC/Sematech Engineering Research Center (ERC) for Environmentally Benign Semiconductor Manufacturing works closely with industry to reduce the high water and energy inputs needed for chip fabrication processes. Two to three million gallons per day of ultrapure water are typically required for rinsing wafers and cleaning the final products.

Research at ERC is developing a method for cleaning and rinsing that could reduce water usage by over 70%. This is based on a combination of new water contamination sensor technology, a method for local recovery and recycle of water, and a method for avoiding the mixing of wastewater that would make it hard to recycle. This combined approach is now being validated and will be implemented in several sites including plants in Arizona. The savings from this technology would be at least 1 million dollars a year for each site.

On the cutting edge of technology development, ERC is investigating a new area of research on the safety and health effects of nanoparticles, as a byproduct of semiconductor manufacturing. An emerging contaminant of concern to regulators and water providers, nanoparticles, which are between 1 and 100 nanometers in diameter and much smaller than a bacterium, may end up in the wastewater from semiconductor plants. The unique properties of nanoparticles allow for many beneficial applications but the potential environmental and health risk remain to be determined. ERC researchers are characterizing the toxicity of current and emerging nanoparticles and nanoparticle byproducts and developing new rapid methodologies for assessing and predicting toxicity. This new project is co-sponsored by private and public sector investment in addition to WSP funding. The research team has diverse talents across multiple disciplines – chemical and environmental engineering, toxicology, biology, and materials science – and is an excellent example of how collaboration can lead to innovation. ♦

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What's in Your Water? Arizona Laboratory for Emerging Contaminants (ALEC) is now open

The media is peppered with accounts of "emerging" contaminants in our waterways. Chemicals in minuscule concentrations and combinations are being found that have unknown impacts on human health and the environment. Advances in technology have allowed detection of trace concentrations of chemicals as never before, and UA now has that capability. UA has established the Arizona Laboratory for Emerging Contaminants (ALEC) to detect and characterize contaminants that include endocrine disrupting compounds (EDCs), pharmaceuticals and personal-care products (PPCPs), detergents, flame retardants, and many other compounds that are being found in ground water and untreated sources of drinking water on a global-scale.

The UA Superfund Basic Research Program (SBRP), has made substantial contributions through WSP funding, to establish and operate the lab. SBRP investigates the hazardous waste and public health issues currently confronting the Southwestern region of the United States, and is committed to an interdisciplinary approach to environmental research and education.

A cross-disciplinary group of water science and engineering faculty at UA, along with colleagues at ASU and NAU, formally established ALEC, a mass spectrometry facility, in 2008. ALEC is co-directed by Drs. Jon Chorover, Professor, Department of Soil, Water & Environmental Sciences and John Chesley, Research Scientist, Department of Geosciences. In addition to WSP support, the lab has received funding from NSF, the Arizona Water Institute, and four UA colleges. The lab is dedicated to detecting and quantifying trace organic and inorganic contaminants in water, biological fluids, biomass and environmental matrices. One of the goals of ALEC is to develop liquid and gas chromatography tandem mass spectrometry (MS) and inductively coupled plasma MS methods that will help UA researchers to measure down to trace concentrations of contaminants in water and other environmental media. In a new collaborative project funded by the Water Research Foundation, ALEC scientists are testing for the presence of endocrine disrupting compounds in drinking water intakes and wastewater effluents in four US cities: Tucson and Phoenix, AZ, Austin, TX and Boston, MA.

Dr. Leif Abrell and Mary Kay Amistadi, assist and train faculty, students and staff in the analysis of metals and organic micro-pollutants. Methods development, training and analyses are conducted on a cost-recovery basis. For more information, visit the ALEC website: www.alec.arizona.edu ♦

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