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UA Water Quality Center Builds Coalition of Research Interests

The University of Arizona's National Science Foundation Water Quality Center operates on the premise that the most effective approach to resolving water quality problems is building varied, broad-based interest and support. The WQC builds this support by involving the private sector, the public sector, government agencies, and specialists in various water related disciplines. The intent is to form a coalition of interests.

WQC Director Ian Pepper says, "The key to center operations and probably its most novel aspect is the integration of academia, government and the private sector. I think this is a trend you are going to see more of in the future."

The WQC is part of a NSF network of about 50 industry-university cooperative research centers, each with a different area of expertise. The UA program is the only NSF cooperative center to address water quality.

By specializing in water quality, the UA WQC has a broader focus than most other NSF industry-university research centers, most of which specialize in an industry related concern, such as electronics or computers.

Water Quality Center Administrative Offices

The UA research scientists involved in the WQC form an interdisciplinary team, with biologists, chemists, physicists, hydrologists and engineers working together to resolve water quality problems. Along with NSF support, the WQC also receives funds from a variety of companies and agencies interested in specific water quality issues.

This varied source of funding and support is WQC's strength, and accounts for its uniqueness as a research center. It has the operational flexibility to encourage a dynamic relationship between the private sector and the UA, and it promotes university integration with industry and governmental agencies. It is this combination of university expertise and corporate funding that leads to scientific discoveries that can enhance water quality for the community at large.

WQC research areas include potable water management, water security, water reuse, fate and remediation of agricultural, commercial and industrial contaminants, wastewater, and mining discharge.

The WQC administrative center is located within the Environmental Research Laboratory, UA College of Agriculture and Life Sciences. The overall goal of ERL, which is within the Department of Soil, Water, and Environmental Science, is to improve the health, welfare and living standards of communities in desert areas through the application of appropriate and sustainable technologies.

Director's Statement

"Water quality is a critical factor affecting human health and welfare. Any advance in our ability to preserve or enhance the quality of our water supplies is likely to come through state-of-the-art research. The 21st century model to provide this research is through the integration of the government, the private sector, and universities." — Ian L. Pepper

WQC Overall Goals

The WQC strives to achieve various goal. One priority is to improve the flow of scientific knowledge affecting water quality, from the UA to industry, government agencies and the general public. This helps build a coalition of interests and encourages a more informed and educated public with regards to water quality issues. Another WQC goal is to ultimately achieve self-sufficiency by bonding with long-term industry and government partners.

The WQC's goal of developing support for water quality research also benefits students. Graduate students achieve a broad industry perspective; students also benefit from interactions with the private sector that could lead to industry job opportunities. Also students acquire training and experience in research laboratories. Further, they have opportunities to present research at national meetings and publish peer review journal articles. Funds for research also are used to support competitively assigned research assistantships.

WQC Funding and Membership

The National Science Center is the prime federal funding source of the WQC. Funding also comes from varied other sources and sectors including local governments, the private sector and non-government agencies

Annual membership fees account for an important part of the funding. Organizations wanting to actively participate in WQC's operation pay an annual membership at one of three levels: $3,000 for an associate member; $10,000 - $15,000 for an enhanced associate membership; and $30,000 for full membership. Members also might provide additional funding to support specific research projects. Each WQC member appoints one representative from its organization to serve on the WQC Industrial Advisory Board. The board meets twice a year for two days; the first day is devoted to presentations of research project reports and proposals for research. The second day the board votes on which research projects to fund.

Present WQC membership includes eight full members: Brita Products Company/Clorox Company, Pleasanton, CA; Pima County Wastewater Management Department, Tucson; Synagro Technologies, Houston, TX; Triton Systems, Inc., Chelmsford, MA; Tucson International Airport Authority; Tucson Water; and Vortex Corporation, Prescott, AZ. Enhanced-associate members include: Access Business Group, Ada, MI; Amphion International, Columbus, GA; City of Peoria,, AZ; County Sanitation Districts of Los Angeles County, Whittier, CA; Northwest Biosolids Management Association, Seattle, WA; Orange County Sanitation District, Fountain Valley, CA; Philadelphia Water Department; and Resolution Copper Company, Phoenix. Associate members are L'Eau, LLC, South Jordan, UT; Town of Marana, AZ; and Water Quality Association, Lisle, IL. Tohono Chul Park, Tucson, is an honorary member.

Various benefits accrue to WQC members. Members gain recognition and status through their involvement with a National Science Foundation Program. As members they do not pay any indirect cost on membership fees, whereas university overhead is set at 51.5 percent. Also members are able to fund additional directed research without paying any indirect or administrative costs. Further, member's involvement in university research ensures credibility with the local community and general public.

WQC Mission Statement
The objective of the WQC is to investigate physical, chemical and microbial processes that affect the quality of surface and subsurface waters including potable supplies.

WQC Research Approach

WQC Director Ian Pepper views his role as a broker to ensure smooth working relationships among various research interests. He says, "A lot of private sector companies are not set up to do research." What then is needed is a way to work out an appropriate match between private entities and university researchers, and that is where the Center comes in. Pepper says, "I find out about the problems of the private sector." He then approaches UA faculty members with the expertise to take on those problems, and offers WQC support for their research. A private sector interest thus taps into university resources, gaining the services of researchers along with laboratory and equipment.

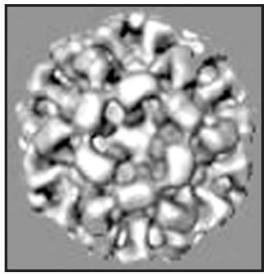
Pepper views the WQC as operating sort of as a "franchise," linked to the NSF national network, but operating independently in meeting local needs and conditions. This enables the Center to focus on immediate issues, of concern to the here and now. Pepper says, "We deal with issues affecting the quality of water people are now drinking. This is not about modeling, about what might happen 30 years from now. We deliberately have a very rapid response to emerging issues, which I think is important."

Multi-University Industry/University Cooperative Research Center

The University of Arizona and Arizona State University are partners in the Multi-University Industry/University Cooperative Research Center. The I/UCRC is based in The University of Arizona's College of Agriculture and Life Sciences (UA WQC) with a partner site at Arizona State University's College of Engineering and Applied Sciences (ASU WQC). The initial I/UCRC was established in 1999 by The University of Arizona. The Multi-University Research Center was established in 2001 in response to the National Science Foundation's interest in multi-university centers.

Emerging water quality issues

–*Naegleria fowleri*, a parasite found in warm bodies of fresh water that causes fatal brain infection. Infections in humans are rare but may occur through water entering the nasal passages and by inhalation. Two deaths were reported in Maricopa County in 2002. A molecular method of detection is being developed.



Norovirus

–Emerging viruses and their concerns including calicivirus-cruise ship outbreaks and fate and transport of the SARS virus.
–Antibiotic resistant bacteria and endotoxin.
–Endocrine disruption activity in waters and wastewaters.
–Land application of biosolids-bioaerosol fate and transport.
–Water security-biological fingerprints of water to monitor for intrusion events.

Current WQC Research

Research is central to the WQC's mission; research topics or areas are sought that have a sufficiently broad application to be useful to a number of WQC participants, including both public and private interests. Current research projects include:

Water Quality Center Laboratory

The Water Quality Center Lab is located in the Fleischmann Building of the Environmental Research Laboratory, an off-campus University of Arizona facility. The Lab focuses on water quality and is equipped to perform state-of-the-art chemical and biological analyses. Chemical analyses include metals, salts, alkalinity, anions and dissolved organic carbon. Biological analyses include bacterial and viral pathogens and indicator organisms. The Lab can also analyze other environmental samples including soils, wastes, effluents, and plant materials.

Water Quality Center Lab

The WQC lab is equipped to perform water, soil, waste, and plant, chemical and physical analyses using state-of-the-art analytical equipment, in the following categories:

- Inorganic analysis of all types of water samples including drinking water and soil/waste/plant extracts; categories include metals, salts, anions.
- Elemental analysis of solid samples such as soil, plant and waste; this includes total carbon, nitrogen, and sulfur.
- Carbon analysis of water samples; this includes alkalinity, dissolved organic carbon.
- Soil/sediment particle size distribution; this includes sand, silt and clay fractions.
- Soil moisture tension measurement.

The WQC lab can also undertake assays for the detection of bacteria and viruses in environmental samples (total coliforms, fecal coliforms, E. coli, salmonella, giardia, helminths).

The faculty and staff associated with the WQC Lab works closely with clients to help them choose their analyses needs.

Biosolids

–Biosolids applications onto mine tailings and agricultural land.
–Development of an injection system for high density biosolids.
–Pathogen reduction in biosolids for land application.
–Antibiotic-resistant bacteria and endotoxins in association with land application of biosolids: possible impact on quality of groundwater supplies and comparison to other routes of work-related and household exposure.

Water Treatment

–Point-of-use drinking water devices for assessing the extent of microbial contamination in finished water and distribution systems.
–Assessment of the amphion international water treatment system for water disinfection.
–Biotechnological exploitation of halotolerant enzymes (NSF Supplemental Grant).
— Demonstration of sustainability of harvested rainwater in arid lands to meet water requirements and to improve quality of runoff.

Pathogens

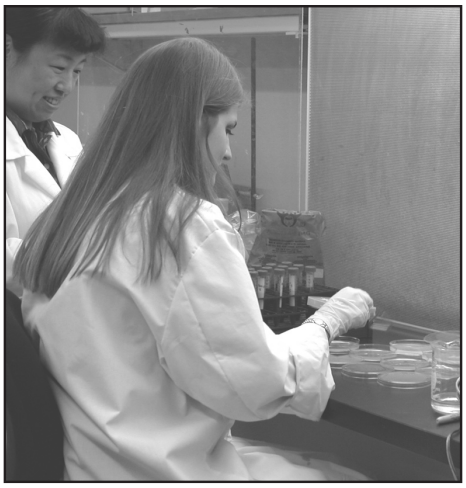
–Detection of noncytopathogenic and treatment resistant human virus populations in drinking water using ICC/PCR.
–Occurrence and control of emerging waterborne parasites in Arizona.
–Detection of viruses in drinking water using raman spectroscopy.

Source Water Evaluation

–Assessment of the microbial water quality of individual and small systems' groundwater supplies in Arizona and appropriate treatment technology for its control.
–Estrogenic activity in reclaimed water and stormwater.
–Quantifying potential endocrine disruption in effluent dominated and effluent dependent waters within Arizona: fish as habit assessment biomarkers.
–Comprehensive watershed management for the Valley of the Sun and Central Arizona.
–Evaluation of the salinity and eutrophication status of the backwaters of the Lower Colorado River for re-introduction of endangered fish species.

Remediation

–Microbial mechanisms for observed rapid and large-scale denitrification in irrigated desert soils: potential low cost methods to remediate nitrate in soil and groundwater.
–Perchlorate removal from ground and irrigation water using low-maintenance biofilters.
–Arsenic mobilization and transport from water treatment residuals in landfills.
–A multi-phased screening approach to the remediation and stabilization of mine tailings.
–Demonstration project for TCE remediation at samsonite building area, Tucson International Airport Superfund Site.



Water Quality Center provides research opportunities for students.

Water Village, Real-World Setting to Study Water Quality at Tap

Water Village, which is partly funded by the University of Arizona Water Quality Center, consists of a cluster of four houses located on the grounds of the UA's Environmental Research Lab. It will serve researchers as a facility that is part real-world and part laboratory. From the outside the houses appear conventional and unremarkable; inside, however, the houses will be equipped to serve the needs of water researchers.

The UA Water Village is expected to play a national role as a testing facility for securing the nation's water supply in three key areas: safety and security, health, and aesthetics. Charles Gerba, UA professor of soil, water and environmental sciences says "It's a platform to deal with emerging issues in water quality."

UA Water Quality Center Director Ian Pepper says, "You can do some things in a laboratory, but at the other end of the scale, there are some things that you cannot do out in the community. You cannot deliberately put contaminants into peoples' distribution systems. This is an intermediate field-scale testing facility, with a closed loop where we can look at the fate and transport of chemical and biological contaminants."

Key features of the Water Village

–Four unique houses each plumbed with unique distribution lines.
–State-of-type-art access for water quality monitoring within the distribution system.
–Modular system to allow for addition of specific compounds or entities.
–Continuous real-time monitoring capability for water quality within the distribution system; e.g. TOC, free chlorine, oxygen, pH, flow rate, pressure.
–Fiber optics for real-time data acquisition and control.

The above adobe structure, the first house in Water Village to be up and operating, is designed for point-of-use testing.

–Capability to change distribution system water quality as needed to allow studies on household water quality at the tap.
–Automated monitoring of water usage at tap outlets.
–Chemical/microbial water quality laboratory for water analysis.
–Water education and training center.

Distribution System Water Quality Studied

Delivering safe water at the tap is viewed as a critical concern. Treatment plants are well regulated and have guidelines to ensure safe water; the distribution system, however, represents an unknown, with studies needed to look at how water quality degrades through the distribution system.

Water Village Key to New UA Homeland Security Center

Substantial funding from the Office of Homeland Security and the Environmental Protection Agency has established an EPA Homeland Security Center at the University of Arizona and five other schools known as the Center for the Advancement of Microbial Risk Assessment (CAMRA). Three UA researchers are recipients of part of the $10 million, five-year grant.

The Water Village at the Environmental Research Laboratory will be a key component of CAMRA which will be the first and only EPA and Homeland Security center of its kind in the country.

The three UA principal investigators are Charles Gerba, professor of soil, water and environmental sciences, Ian Pepper, director of the UA/National Science Foundation Water Quality Center, and Christopher Choi, associate professor of agriculture and biosystems engineering.

"The water quality at the source may have nothing to do with the water quality at the tap," Gerba said. "The idea is to understand the performance of the system and how to better protect it and the public.

"The hardest question is knowing where to look. The second question is how do we clean it up. The third is how clean is clean. We can use the facility to examine emerging technologies for contaminant detection and control in a simulated real-world situation."

Each house will have a specialized purpose. Completed this summer, House One is designed for point-of-entry/point of use testing. Scheduled for completion in February, House Two will be the water intrusion lab. Here experiments will be conducted on how contaminants — either natural, accidental or deliberate — might enter and move through the water supply. Water quality and aesthetics will be the specialty of House Three, scheduled for completion in September, 2006. House Four, to be completed in February 2007, is the water education and training house.

Along with a recently announced Office of Homeland Security/EPA grant (see sidebar), other Water Village funding sources include Prop 301 revenues, the UA College of Agriculture and Life Sciences, the Office of the Vice President for Research and a number of corporations.

Water Quality Center

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