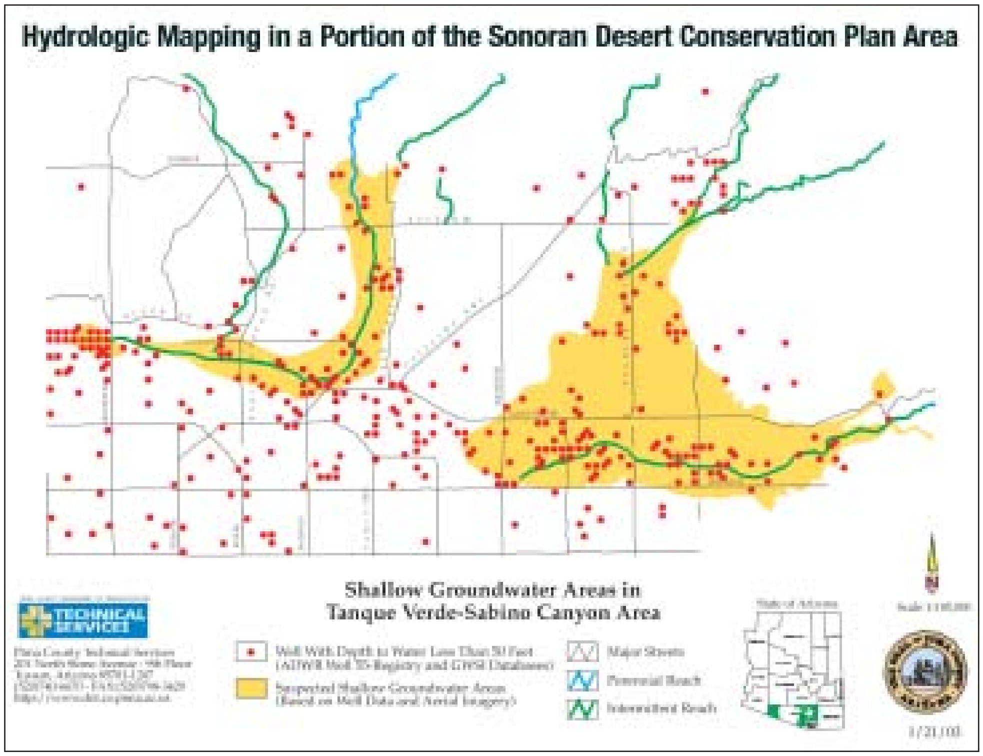
Science, Water, and the Sonoran Desert Conservation Plan

***Barbara Tellman** – consultant on water and environmental history topics*

Pima County in southern Arizona has, for the past three years, been developing the nation's most comprehensive attempt to protect threatened and endangered species, while also accommodating a whole range of human land uses in this area. The resulting Sonoran Desert Conservation Plan (SDCP), still a work in progress, designates areas for environmental and historic preservation as well as areas suitable for human use. Covering more than 9,100 square miles, Pima County is one of the largest counties in the nation and the plan's environmental resource studies encompass the entire area except tribal lands. A full description of the plan is outside the scope of this article, but more information is available on the SDCP web site. CDs containing the major studies are available from the county.

In many similar planning efforts, studies such as this one have been given lower priority than political considerations. One important aspect of the SDCP is the value that political decision-makers have placed on good science.A team of the leading local biological scientists, including representatives of government agencies and the University of Arizona, was assembled to develop the plan and identify the role of water-related studies. The team met regularly to discuss which species should be included, how their habitat needs should be defined, and to recommend the most effective land uses to protect those species and habitats. The team and county staff oversaw the consultants who conducted detailed studies. More than 75 reports resulted from this collaboration.



In addition to the Science Team, a Cultural Resources Team performed a similar role for historical and archaeological resources, also a significant part of the plan. A Ranching Team and a Parks and Recreation Team also provided valuable input. SDCP has been developed under the general oversight of a 75-member Steering Committee that includes ranchers, developers, environmentalists, and others. All team and committee members served as unpaid volunteers.

In this arid region, the importance of water is paramount. The Pima Association of Governments (PAG) conducted one of the earliest water studies, mapping perennial and intermittent streams in the county. PAG also mapped shallow groundwater areas and areas of groundwater pumping to determine the locations most in jeopardy from groundwater pumping. Pima County staff identified previously unmapped springs, and a consulting firm mapped and classified riparian vegetation communities.

University of Arizona researchers studied water resources and water-related legal issues, water conservation, and, with an engineering firm, mapped the distributary flow floodplains. Another study looked at environmental justice issues, including studies of water supply and quality as related to low income and minority populations.

The final land use plan will include riparian areas in special need of protection, along with natural park expansion and wildlife conservation areas. These will be acquired through a combination of outright purchase, conservation easements,

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agreements with landowners and agencies, and conservation banking. The final studies analyze the cost alternatives under different scenarios. In addition to land use decisions, SDCP includes policy changes such as new water conservation requirements. Once the plan is complete and is approved by the Pima County Board of Supervisors, it goes through a final public participation process supervised by the U.S. Fish and Wildlife Service who must approve the plan some time in 2003. It then becomes a formal agreement with the Service. County elected officials have unanimously supported the plan concepts and policies and have respected the recommendations of experts.

For more information and any of the more than 250 reports, visit www.co.pima.az.us/cmo/sdcp/.

International Center for Water Technology Created in San Joaquin Valley

***David Zoldoske** – International Center for Water Technology*

California State University, Fresno (Fresno State) and the San Joaquin Valley Water Technology industry have recently joined together to form a public-private partnership dedicated to the development and promotion of new technologies that maximize the effectiveness of water use for agricultural, commercial, environmental, and municipal applications. The new entity is the International Center for Water Technology (ICWT), a collaborative venture between industry, academia, and public agencies across the country.

The ICWT was formed from the premise that access to useable water is developing into the greatest challenge of this century. The world's ability to find, use, clean, recycle, transport, distribute, sell, tax, and conserve water will determine in large measure whether the world will progress or digress in the next 100 years. ICWT believes that the technology to properly use and manage water is the critical tool to providing sufficient water supplies for the world's major needs.

In addition to providing a technology demonstration facility, the ICWT plans to advance water and fluid science technologies in four primary areas:

- ***Research and Development:*** The R&D Division of the ICWT will incorporate

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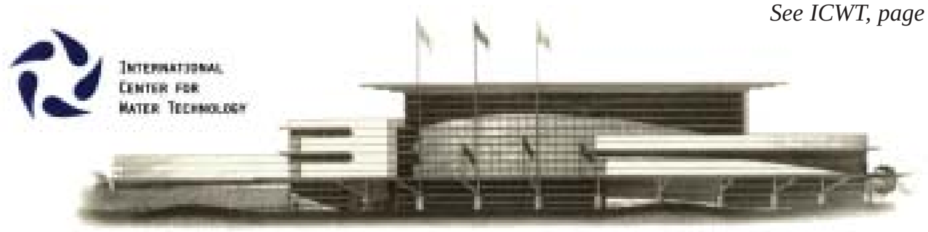

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current research activities of Fresno State's Center for Irrigation Technology, as well as expand its focus to include research and development of urban and environmental water needs. These activities will focus on water/energy efficiency, effective water reuse, conservation, and promoting private and/or public innovation.

- ***Industry Testing and Certification Services:*** The Testing and Certification Division plans to provide the water and fluid science industry with state-of-the-art testing and certification facilities and to conduct testing and certification on water technology equipment and applications. The division will then communicate the results of conducted tests to water users, policy makers, manufacturers, contract customers, and other interested parties.

- ***Public Policy and Education:*** The Public Policy and Education Division will communicate to the public and policy makers the technical aspects of water issues and resulting consequences; educate governments, end users, designers, lending institutions and others in the proper design of water application systems in irrigation, municipal and industrial water applications; and provide a center for continuing education for water industry personnel.

- ***Cooperative Marketing to the Water Technology Industry:*** ICWT will conduct cooperative marketing activities that benefit the water technology industry by increasing water and flow technology use worldwide. Strategies will include development and operation of the Water Technology Exposition Center and trade shows; development and implementation of an international awareness campaign targeting major user groups; and export marketing assistance.

Plans for a $60 million water research and development facility were unveiled in October. Construction on the first phase of the new facility should begin in 2003. When fully constructed, the International Center for Water Technology will house "the best-equipped and most comprehensive testing and certification laboratories in the United States", according to J. Michael Ortiz, Provost and Vice President for Academic Affairs at Fresno State, who added, "It will also be home to an exhibit hall in which water technology companies from around the world will permanently display working demonstrations of their products."

ICWT's public-private partnership is actively seeking funding to establish programs and build a state-of-the-art facility. So far, approximately $1.4 million in grants and contracts has been secured, with an additional $10 million pending. Land for the new facility will be provided on the Fresno State campus. Significant support for the project has been expressed from water and fluid technology companies, public agencies, water districts, and civic organizations.

Visit www.ICWT.net for more information.

Passive Diffusion Bag Samplers: A Cost-Effective Sampling Method for VOCs

***Dee O'Neill** – Columbia Analytical Services and **Hugh J. Rieck** – Arizona Department of Environmental Quality*

Compounds showing good correlations with other methods			
Benzene	Dibromochloromethane	trans-Dichloroethene	1,1,2-Trichloroethane
Bromodichloromethane	Dibromomethane	1,2-Dichloropropane	Trichloroethene
Bromoform	1,2-Dichlorobenzene	cis-1,2-Dichloropropene	Trichlorofluoromethane
Chlorobenzene	1,3-Dichlorobenzene	1,2-Dibromoethane (EDB)	1,2,3-Trichloropropane
Carbon tetrachloride	1,4-Dichlorobenzene	trans-1,3-Dichloropropene	1,1,2,2Tetrachloroethane (PCA)
Chloroethane	Dichlorodifluoromethane	Ethyl benzene	Tetrachloroethene
Chloroform	1,2-Dichloroethane	Naphthalene	Vinyl chloride
Chloromethane	1,1-Dichloroethene (1,1-DCE)	Toluene	Xylenes
2-Chlorovinyl ether	cis-1,2-Dichloroethene	1,1,1-Trichloroethane	
Compounds showing poor correlations with other methods			
Acetone	Methyl-tert-butyl ether (MTBE)	Styrene	Methyl-iso-butyl ketone2 (MIBK)

VOC diffusion correlation with samples taken by other methods. (From Vroblesky and Campbell, 2001 and Sivavec and Bagel, 2000.)

The use of passive polyethylene diffusion bag (PDB) sampler technology in long-term groundwater monitoring projects for volatile organic compounds (VOCs) provides a cost-saving alternative to conventional sampling methodologies, eliminating well purging and decreasing field labor and waste disposal costs. In typical applications, they provide depth-specific, time-weighted samples of dissolved phase VOCs. Like all sampling methods, PDBs have their own characteristic strengths and limitations that determine their applicability given the data quality objectives and contaminant hydrology of the wells being monitored.

Developed and patented by Don Vroblesky of the USGS and Thomas Hyde of General Electric, PDBs are made of low-density polyethylene, acting as a semi-permeable membrane. The membrane is fashioned into a long sealed tube, typically 24 inches long and 1-1/4 inches in diameter, filled with approximately 230 mL of certified, laboratory-grade, deionized water. Different sizes are available to meet sampling requirements. The PDB is lowered into a groundwater well and suspended at a specific depth in the saturated portion of the open (screened) interval of the well. They rely on natural advective movement of groundwater across the open interval and, in the absence of vertical flow through the well, reflect dissolved phase VOC concentrations in the aquifer immediately adjacent to the well screen. Most VOCs, excluding certain ketones, ethers and alcohols, diffuse though the membrane. Diffusion occurs until equilibrium is established between VOC concentrations in the groundwater and those in the PDB. The PDB is then raised to the surface and the contents transferred into vials, which are sent to laboratories for analysis.

In laboratory studies, the VOCs in the table above were shown to exhibit good diffusion and good correlation with samples taken by other methods.

Hydrologic and field data suggest that PDBs be left in place at least two weeks to allow ample time for equilibration of contaminant distribution and restabilization of the well and flow-dynamics to occur after PDB deployment (possibly longer for poorly permeable formations). In quarterly monitoring situations, PDBs are routinely left in wells for the full quarter, allowing sample collection and deployment of next quarter's PDBs to occur during a single field event.

Ions, large or strongly polar molecules, and hydrophilic compounds do not diffuse well across polyethylene. Therefore, some contaminants of interest, like semivolatile organics, oxygenates, metals and other inorganic parameters are not candidates for sampling by PDB technology. However, the diffusion characteristics of PDBs can solve problems that plague samplers of alkaline or turbid wells. Because sediment, including colloidal clay particles, cannot diffuse into PDBs, turbidity and associated matrix interference will cease to be a

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problem. Similarly, the foaming and loss of VOCs that can occur when sampling alkaline groundwater into pre-preserved VOA vials is avoided because alkaline constituents diffuse very poorly, if at all, into PDBs.

Disproportionate contribution from individual aquifer zones lying within or adjacent to the zone of interest is avoided through use of PDBs. Pumping, even by low-flow methods, produces a flow-weighted sample biased toward water from any zone of higher hydraulic conductivity. These effects can cause sample dilution or contamination. Assuming horizontal flow through the open interval of the well, PDB sampling avoids aquifer pumping stress and associated sample agitation, so samples taken through the use of PDB technology are likely to be more representative of aqueous phase VOCs in the aquifer directly adjacent to target interval than samples taken by other methods.

The PDB's ability to reflect dissolved VOC concentrations in the adjacent aquifer allows determination of stratification and vertical concentration gradients of VOC contaminants. Generally, each two foot-long PDB represents not more than five feet of the well screen interval. VOC concentrations may be measured at specific well screen depths by hanging PDBs in tandem. In addition to gaining information about the well's hydrogeological attributes, correct positioning of a future single PDB may be determined.

Cost Savings Can Be Considerable

In a cost evaluation study at McClellan AFB, the costs associated with use of PDBs, passive Diffusion Multi Layer Samplers (DMLS™), low-flow purge (MicroPurge®), and conventional purge sampling methods were compared. The PDB cost $65 per sample, compared to from $308 to $555 per sample for the other methods (Parsons Engineering, Inc. 1999)

In a subsequent study at McClellan AFB, a cost comparison of PDBs, Micropurge, and conventional purge methods was made (McCellan AFB, 2000). The comparison assumed one VOC sample tested per monitoring well per year (exclusive of quality control samples) for 500 wells, tested at a frequency of 125 wells per quarter and 5% field duplicates. Capital costs were $9,000 for the PDB compared to $11,800 to $12,525 for the other methods. One-time costs were $32,500 for both the PDB and conventional purge, and zero for the MicroPurge. Most notably, however, annual recurring costs were $98,000 for the PDB compared to $412,000 for the MicroPurge and $377,000 for the conventional purge (the latter two costs include disposal of purge water).

Additional Efforts

Through the Interstate Technology Regulatory Cooperation's (ITRC) Diffusion Sampler Work Group (DSWG), a wealth of data on deployments and side-by-side comparisons of the use of PDB technology and conventional sampling technologies (purge and bail, moderate- and low-flow-rate pumping, and MicroPurge technologies) has been gathered. It is available on the ITRC's website at www.itrcweb.org under the Diffusion