

## **Advancing the Science of Water: AwwaRF and International Collaboration**

To give subscribers the greatest possible return on their investment in drinking water research, AwwaRF partners with other organizations, both in North America and abroad, to augment the resources available for specific projects. In recent years, nearly half of AwwaRF's new research projects have involved partnerships, and about half of these collaborations are with institutions outside the United States.

AwwaRF's international partnerships began with a 1984 project conducted in cooperation with the Dutch research organization Kiwa. Since then, the foundation's international perspective on drinking water research has continued to expand. Approximately 10 percent of AwwaRF's subscription income now comes from water utilities outside North America, and its bylaws mandate that at least one member of its board of trustees represent international members.

AwwaRF has also taken the lead in facilitating the coordination of drinking water research on a global scale. Since 1981 it has regularly sponsored seminars allowing researchers from across the globe to discuss the latest advances in water treatment technology. Eventually, AwwaRF's commitment to international cooperation led it to form a worldwide coalition of research organizations focused on various aspects of the water cycle, including drinking water, wastewater, and water reuse.

Coordinating drinking water research globally has multiple advantages. "The main advantages are leveraging resources—both funds and expertise—and eliminating duplication," said Jim Manwaring, who was AwwaRF's executive director for 25 years. "With multiple organizations working toward the same goal, you get cooperation and you can take advantage of the expertise and experience available throughout the world. These benefits pay for the effort."

In 2002, for example, AwwaRF's investment of \$2.6 million in international partnerships yielded more than \$16 million in research value, according the November/December 2003 issue of *Drinking Water Research*. Since AwwaRF's partnership program was formally adopted in 2000, partnership projects have produced \$52,554,000 worth of research in return for AwwaRF's investment of \$16,552,000.

"All of us who are interested in safe drinking water and are conducting research to help decision-makers know there are more issues that need to be resolved than any single

group can address on its own," said Fred Hauchman, director of the Microbiological and Chemical Exposure Assessment Research Division of the U.S. Environmental Protection Agency (USEPA). "By partnering, we're able to tackle these issues in a more concerted way, and we avoid duplication of effort. Dividing the work can allow you to be more efficient and make the dollar—or the euro—go farther."

AwwaRF's major contributions to fostering worldwide collaboration on drinking water research include:

- Recognizing that approaches to water treatment and public health protection are similar worldwide.
- Awarding competitive contracts for individual AwwaRF projects to investigators outside the United States.
- Forging collaborative agreements allowing internationally renowned research institutions to co-sponsor AwwaRF projects by contributing funds and expertise.
- Sponsoring Emerging Technologies Seminars enabling the world's foremost drinking water researchers to discuss current challenges confronting water suppliers and to share information about cutting-edge technologies to address these concerns.
- Establishing the Global Water Research Coalition (GWRC), a network of 14 organizations from five continents that collaborate on water research projects and support a managing director who coordinates these projects.

### **The Impetus for Forming International Partnerships**

Manwaring's primary goal for AwwaRF was to make sure it produced something of value for subscribers. For him, the key question was: "How can we spend our limited resources to produce something more valuable than the amount of money we put into it?" He felt that as a nonprofit organization supported by subscribers, AwwaRF needed to produce value that exceeded what it could glean merely from direct investment in research. Partnering with other research institutions brought in the additional funding and expertise he sought.

One of Manwaring's first activities as AwwaRF's executive director was to find out what was going on in other organizations engaged in drinking water research. "We had a pretty good handle on the research being conducted in the States," he said. "Then I looked at Europe and realized these folks were more advanced than we were in several areas—ozone disinfection, the use of granular activated carbon. I thought, 'Why re-invent the wheel? Let's integrate some of that expertise into what's going on here.'"

Manwaring also wanted to produce something subscribers could use immediately. "The answer at that time was not to develop new research but to collate what was already out there in pieces and present it in a consistent format," he said.

## **AwwaRF's Early International Collaborations**

The model for AwwaRF's international partnerships grew out of its 1984 collaboration with Kiwa (Project 34, "Occurrence and Removal of Volatile Organic Chemicals from Drinking Water: Activated Carbon in Drinking Water Technology," funded and published 1984, order number 90502). This was a joint effort to produce two manuals—one on volatile organic compounds, the other on granular activated carbon.

"We put together two utility-based committees, which included university professors, and these committees wrote the two manuals," Manwaring said. "This became the model for how we cooperated to develop a project outline, fund the effort, and produce something useful for the drinking water industry.

"Kiwa was the guinea pig," Manwaring said. "I was eager to work with this organization but reluctant to suggest the idea because AwwaRF was a fledgling organization with very little money and little expertise in house. Our first two international partners—Kiwa and the German organization TZW—had in-house research capability, unlike AwwaRF. Despite this, Kiwa was willing to recognize AwwaRF as an equal."

AwwaRF's first collaboration with TZW resulted in another manual, this one on controlling internal corrosion in water distribution systems. The original version, published in 1985, was updated a decade later through another partnership with TZW (Project 725, "Internal Corrosion of Water Distribution Systems, Second Edition: A Cooperative Research Report," funded 1991, published 1996, order number 90598). Like the original report, the updated edition was produced by a volunteer committee of American and European corrosion experts.

One reason for the success of these early partnerships was that both Kiwa and TZW were committed to applied research. "These organizations are closely aligned with their utilities," Manwaring said. "Kiwa does all its research with utilities and on behalf of utilities." This approach matched the research paradigm AwwaRF had chosen for itself.

"The European research organizations don't have the university alliances we have in the States, but they have the ability to conduct research in house," Manwaring said. "This makes sense in many European countries because they may have to deal with only three or four types of water quality. A centralized research effort doesn't make sense in the United States because the country is too big and the water supplies are too diverse. Our system of diversified research centers located at various universities works better for us."

Manwaring considers the corrosion control manual AwwaRF produced with the Germans one of the most significant international collaborations in terms of subscriber value. "It gave subscribers something that was useful then and is useful now," he said. "The VOC and GAC project with Kiwa was groundbreaking because it showed we could work on a cooperative basis."

In addition to these projects, Manwaring cited three other early international collaborations that proved particularly valuable to subscribers. "The taste and odor manual we produced with Lyonnaise des Eaux [now part of Suez Environment] was excellent," he said. (This handbook was the product of Project 118, "Identification and Treatment of Tastes and Odors in Drinking Water," funded 1985, published 1987, order number 90518.) "The ozone project with Compagnie Générale des Eaux [now part of Veolia Environment] has stood the test of time as being useful for practitioners," he continued, referring to Project 421, "Ozone in Water Treatment: Application and Engineering," funded 1988, published 1991, available from Lewis Publishers (800-272-7737) as catalog number L474LAFD. The third project he emphasized was AwwaRF's work with the Japan Water Works Association on the use of computer technology in water systems (Project 434, "Instrumentation and Computer Integration of Water Supply Operations," funded 1988, published 1993, order number 90588).

Over the years, AwwaRF has entered into partnerships with some three dozen other organizations. Fifteen of these are located outside the United States—three in Canada, three in Australia, two in the United Kingdom, and one each in Germany, Italy, Japan, the Netherlands, Singapore, South Africa, and Switzerland. Of the more than 140 universities that have collaborated on AwwaRF research projects, 23 are outside the United States—10 in Canada and 13 in Australia, the British West Indies, Europe, and Israel. More specific information about AwwaRF's partner organizations is available on the foundation's Web site, [www.awwarf.org](http://www.awwarf.org).

A brief overview of AwwaRF's research with three of its international partners illustrates the scope of subjects investigated through these cooperative efforts over the past 23 years. With Australia's Cooperative Research Centre for Water Quality and Treatment, AwwaRF has studied water main replacement (Project 462), water quality improvements during aquifer storage and recovery (Project 2618), surface water pathogens in watersheds (Project 2694), and numerous aspects of taste and odor control (Projects 2789, 2881, 2942, 2976, and 2996). Detailed information on these projects is available at <http://http://www.awwarf.org/theFoundation/ourPrograms/PartnerDescription.aspx?partnerid=0005111>.

Completed studies with the Drinking Water Inspectorate in the United Kingdom focused on *Cryptosporidium* viability and infectivity (Project 395) and monitoring low-pressure membrane integrity (Project 2681). Current studies are examining such diverse topics as treatment plant security (Project 3044), disinfection of viruses (Project 3134), risk management communication strategies and tools (Project 4001), desalination (Project 4006), current methods and strategies for monitoring *E. coli* and total coliforms (Project 4024), and the effects of distribution system lining materials on water quality (Project 4036). Particulars on these projects are available at <http://www.awwarf.org/theFoundation/ourPrograms/PartnerDescription.aspx?partnerid=0006780>.

AwwaRF's collaborations with UK Water Industry Research have covered topics such as water quality in finished water storage facilities (Project 254), tastes and odors

originating in distribution systems (Project 365), water reuse criteria (Project 2968), and the design, operation, and maintenance of membrane plants (Project 3039). Ongoing projects are studying automatic meter reading (Project 4000), fracture failures in large-diameter cast-iron water mains (Project 4035), and water infrastructure management (Project 4108). Additional information on these projects is available at <http://www.awwarf.org/theFoundation/ourPrograms/PartnerDescription.aspx?partnerid=0007441>.)

## **Emerging Technology Seminars**

When Manwaring began investigating what the European water researchers were doing, he was surprised to discover they weren't communicating with one another. He thought it would be advantageous to convene some kind of forum that would enable leading researchers from various countries to discuss emerging issues of concern to water suppliers. "I wanted to determine what we could work on now that would be useful to our subscribers in the future," Manwaring explained.

The first Emerging Technology Seminar was held in 1984 in Amsterdam. "We sent invitations to all the research organizations we'd been dealing with, either directly or indirectly—the Europeans, Japanese, South Africans—asking them to attend an informal get-together to talk about drinking water research issues," said Manwaring. "What was critical was the opportunity for people to say, "OK, I see what you're working on. I'm working on the same thing. Let's work together."

The success of the first Emerging Technology Seminar prompted AwwaRF to continue producing these forums every two years. Seminars covered the most important topics of the day and were often hosted by the country in which research on the chosen topic was particularly advanced. Get-togethers generally included formal presentations as well as tours of research facilities and utilities that were applying the latest findings. France hosted the gathering on membrane technology. A meeting in the Netherlands focused on assimilable organic carbon. A seminar on algal toxins was held in Australia.

"Using the emerging technology gatherings as a springboard, we developed a lot of cooperative agreements," said Manwaring. "We established partnerships with Japan and with the research groups of the privately owned French utilities. Next we started putting together two-and three-party groups, then five-party groups. The seminars cost very little to produce—a little staff time, a little money—and we were getting a big return on our investment. But after about 15 years of this, I realized AwwaRF was using a lot of staff time coordinating all of these efforts. That's when I got the idea of forming the GWRC."

## **The Global Water Research Coalition**

Again, AwwaRF took the initiative, proposing that a group of international organizations support the coordination of water research projects through a central clearinghouse. After several years of development, the GWRC became official in 2002 and currently includes 14 member organizations from North America, Europe, Africa, Asia, and Australia.

Through these institutions, GWRC represents the interests and needs of more than 500 million consumers and has access to annual research funds totaling more than \$150 million.

The coalition's mission is to serve as the focal point for coordinating and collaborating on water research issues of mutual interest to developed nations and countries in transition. Its motto is "global cooperation for the generation of water knowledge."

A governing board oversees the coalition's activities, and each member institution has a seat on this board. Because the member organizations' primary interests include drinking water supply, sanitation, wastewater treatment, and renewable water resources, the coalition strives to advance scientific knowledge about the entire urban water cycle.

Current GWRC member institutions are:

- AwwaRF (United States)
- Cooperative Research Center for Water Quality and Treatment (Australia)
- EAWAG, the Swiss Federal Institute for Aquatic Science and Technology (Switzerland)
- Kiwa Water Research (the Netherlands)
- PUB, the national water agency of Singapore
- STOWA, the Foundation for Applied Water Management Research (the Netherlands)
- Suez Environment—CIRSEE, the International Research Center on Water and the Environment (France)
- TZW, the Water Technology Center of the German Waterworks Association (Germany)
- UK Water Industry Research (United Kingdom)
- Veolia Water—Anjou Recherche (France)
- Water Environment Research Foundation (United States)
- Water Research Commission (South Africa)
- WateReuse Foundation (United States)
- Water Services Association of Australia

Descriptions of these organizations are posted on the GWRC Web site at <http://www.globalwaterresearchcoalition.net/gwrcmembers.htm>.

Each member organization focuses on national and regional research issues as well as participating in GWRC projects. "Research areas are selected democratically by the body, and members participate in specific projects within a research area they consider relevant to their concerns," said Manwaring. "For a given project, one member takes the lead in developing a research plan, and the other members who choose to take part in that project volunteer a certain amount of money or research effort."

In addition to its member institutions, the GWRC currently has two partner organizations—USEPA and the U.S. Centers for Disease Control and Prevention. Partner organizations do not participate in the coalition's governance, but as Hauchman explains,

"We are full partners in its discussions of research topics and priorities, and we have the same opportunities as the GWRC member organizations to participate in projects of mutual interest."

AwwaRF single-handedly funded initial development of the coalition to demonstrate that the concept would work. Since 2002, member institutions have contributed equally to the coalition's administrative budget. "AwwaRF was the driving force in forming the Global Water Research Coalition," said Manwaring. "But now it's simply another voting member, and that's the way it should be."

"AwwaRF has been out in front in catalyzing these international connections," said Hauchman. "The coalition has been good for its members and partners and for the people served by these organizations around the globe."

The GWRC benefits from the expertise and support facilities of the International Water Association (IWA), headquartered in London. IWA's network of water and wastewater professionals provides additional input for determining a global water research agenda. Results of GWRC research projects are presented at IWA conferences and seminars, facilitating their dissemination outside the GWRC framework.

GWRC managing director Frans Schulting, based in the Netherlands, coordinates coalition activities and provides oversight and guidance for its research projects. "Our joint research agenda started with water quality issues such as endocrine disruptors, pharmaceutical products, and waterborne pathogens," said Schulting. "Now it has expanded into other research areas—asset management, online monitoring, water reuse, and energy and resource recovery during wastewater treatment with membrane bioreactors. New projects in the water quality area include algal toxins and nitrosamines. As a result of the coalition's joint efforts, ten research projects are currently under way, and 25 state-of-the-science and research reports have been produced," he said.

The logistics of time and distance sometimes pose challenges to international collaboration, and so do language differences. "Another consideration is that each organization coming to the table has its own board of directors to answer to and its own particular circumstances and research priorities," said Hauchman. "This is not a barrier to collaboration, but it's easier to talk about joint funding when all parties have the same level of interest in the same topics. Some GWRC members are interested primarily in drinking water; some are interested in wastewater issues; others deal with the entire water cycle; and some deal with specialized interests like water reuse. Sometimes it's a challenge to find common ground," he said.

"The GWRC is still a young organization, but we've covered a lot of territory," Hauchman continued. "We've had some success in bringing parties to the table to talk about research priorities, and we've held a number of workshops on high-priority topics of interest to many of the members. In some areas—for example, the coalition's research on endocrine disruptors—most would agree there's been a real value added."

Manwaring also noted GWRC's studies of endocrine disruptors as a significant scientific contribution. "When AwwaRF began putting together international partnerships, we didn't intend to develop new research," he said. "Our goal was to integrate existing knowledge that our subscribers could use immediately and in the future. But now GWRC has moved to creating new science."

GWRC's ongoing examination of the behavior of endocrine disrupting compounds (EDCs) in the water cycle involves workshops as well as specific research projects. Known as AwwaRF Project 2914, "Cooperative Research on Endocrine Disruptors," this collaborative undertaking was funded in 2002. Four interim reports from this research became available to AwwaRF subscribers in 2005: "A Priority List of EDCs," "An Overview of Sources and Biological Methods for Measuring EDCs," "Knowledge Gaps and Research Needs," and "Occurrence of EDCs in Water Systems."

A GWRC project dealing with algal toxins is also under way (Project 3148, "Guidance Manual for the Management of Toxic Algae," funded 2005). This project will culminate in the publication of a handbook consolidating 20 years of international research on managing cyanobacteria and the toxins they produce. Research partners are TZW (Germany), the Water Research Commission (South Africa), and the Cooperative Research Center for Water Quality and Treatment (Australia).

"In addition to its joint research activities, the GWRC supports the exchange of information, which has proved to be of great value," said Schulting. "When a new issue emerges, members rapidly collate the relevant knowledge about possible risks to public health and give the water utilities involved solid information for addressing the issue," he said.

By leveraging funding and expertise and centralizing management of its research projects, the GWRC aims to provide broad-based scientific advances to water supply practitioners, regulators, and policy-makers across the globe. Through these mechanisms, it also intends to foster a spirit of cooperation, avoid duplication of effort, and design research projects based on the actual needs of its member organizations and their stakeholders.

"Today, the strength of the coalition depends on input from all its members," said Schulting. "But without the vision, leadership, and support of AwwaRF during the initial phase of development, the GWRC would never have been established."