National Water Research Institute

Briefings

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Dr. James L. Barnard Awarded the 2007 Clarke Prize

The 2007 Clarke Prize was awarded to James L. Barnard, Ph.D., P.E., of Black & Veatch Corporation, on July 12, 2007, at the Fourteenth Annual Clarke Prize Lecture and Award Ceremony in Huntington Beach, California.

Dr. Barnard accepted the award with heartfelt remarks. "I am very proud of receiving this prestigious prize," he said. "Thank you for the honor — I am very much moved by the recognition."

NWRI established the Clarke Prize in 1993 to recognize outstanding research scientists who have demonstrated excellence in water-science research and technology.

Dr. Barnard, who is a Global Practice and Technology Leader for Black & Veatch Corporation in Kansas City, Missouri, was selected as the 2007 recipient for developing the biological nutrient removal (BNR) process, which uses natural bacteria to remove nitrogen and phosphorous from wastewater to prevent the eutrophication of water resources.

BNR Developed to Prevent Eutrophication

Eutrophication occurs when the accumulation of nutrients such as nitrogen and phosphorous supports the growth of algae, killing fish and contributing to poor water quality. Prior to the development of the BNR process, wastewater treatment plants removed organic pollutants, suspended solids, and pathogens, and converted ammonia to nitrates, but were not removing nitrogen and phosphorous.

"Dr. Barnard is an outstanding selection for the Clarke Prize," said Jeff Mosher, Executive Director of NWRI. "BNR is not only a more economic alternative than traditional chemical treatment, but it also improves the environment by addressing the issue of nutrient control. The Clarke Prize was established to recognize these types of achievements by scientists who have demonstrated excellence in water research."

Dr. James Barnard at the Clarke Prize Ceremony. Photo by Teresa Taylor.

As part of the award, Dr. Barnard presented the 2007 Clarke Lecture on eliminating eutrophication through resource recovery. Some ways to prevent eutrophication, he stated, included recovering and reusing phosphorous and nitrogen found in wastewater and agricultural runoff. Strategies may include employing urine-separating toilets to capture urine and use it as fertilizer or growing algae, which contain high oil content, as an alternative to petroleum-based diesel fuel.

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BNR Presents Environmentally-Friendly Alternative To Traditional Chemical Water Treatments

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The ultimate goal, Dr. Barnard concluded, is that wastewater effluent should be recycled to prevent eutrophication. "Today, we can imitate nature and produce recycled water of the same purity as that falling from the heavens," he said, reiterating the idea that "all wastewater treatment plants should be turned into water reclamation plants to lessen the impact of nutrients of receiving waters."

Dr. Bruce Rittmann, Director of the Center for Environmental Biotechnology in the Biodesign Institute at Arizona State University and the first Clarke Prize winner, introduced Dr. Barnard at the award ceremony following the Lecture.

"When a person's name immediately brings to mind a famous object, then we know that the person has made a notable contribution, a true imprint on society," he said. "Not only is James Barnard the 'Father of BNR,' but several of the processes bear his name. The most famous is *Bardenpho*, which stands for Barnard's Denitrification and Phosphorus removal processes."

"One of the biggest problems in developing countries is that they don't have a mechanism to talk to each other. I'd like to help them make themselves heard to their governments. I'd like to give them a voice."

~ Dr. James Barnard

Dr. Rittmann concluded the introduction with a quote from the nomination of Dr. Barnard for the Clarke Prize. "Rather than on hundreds of academic papers, his signature can be seen on hundreds of treatment plants, and his knowledge has been shared with and applied by thousands of practitioners, creating a lasting legacy that benefits society and the environment."

BNR Treatment Enables Return to Receiving Waters

By using a natural biological process, BNR enables the return of treated wastewater to receiving waters, such as rivers and oceans, with minimal detrimental impact to the environment.

Ironically, wastewater treatment was not originally in the cards for Dr. Barnard.

As a youth, he lived on a small farm in South Africa. His inquisitive nature and interest in learning about how things work led him to study civil engineering at the University of Stellenbosch in the Republic of South Africa.

Dr. James Barnard accepts the Clarke Prize gold medallion from Mrs. Joan Irvine Smith at the award ceremony. Photo by Teresa Taylor.

But it was only after being assigned to wastewater treatment while doing structural engineering work that Dr. Barnard decided to learn more about water and wastewater issues. He soon completed his graduate work in the United States, first earning an M.S. in Environmental Health Engineering at the University of Texas at Austin, and then a Ph.D. in Environmental Engineering and Water Resources at Vanderbilt University in Tennessee.

After graduation, Dr. Barnard returned to his native South Africa to serve as Senior Chief Research Officer at the National Institute for Water Research, where the BNR process was born to salvage scarce water resources.

One of his favorite memories about this time revolved around his daughter, Yvette, then about 10 years old, who would accompany him on his weekend trips to the plant where he would eventually discover the process underlying phosphorous removal. He confessed that part of the incentive for her to spend her Sundays at a wastewater treatment plant may have been his willingness to let her drive the car on the roads around the pilot plant.

Not long after, he was asked by Pieter Meiring to come onboard as Director of Meiring & Barnard Consultants in Pretoria, South Africa. Together, they proposed that new water treatment plants should be built in accordance with Dr. Barnard's BNR technology. The people of Johannesburg welcomed the idea, knowing that the remaining water resources were diminishing in both quality and mass, and required an immediate solution.

Low-Cost Systems Installed World-Wide

As BNR spread to existing and new plants throughout South Africa, Dr. Barnard then proceeded to convert the technology to a low-cost BNR system for the developing country of Zimbabwe. Later, an innovative BNR design in Namibia led to the first instance where effluent was further treated to potable standards.

The first BNR system in the U.S. that Dr. Barnard designed was for the City of Palmetto, Florida, in 1978. The first year of operation was successful, with the system reducing effluent totals of nitrogen and phosphorous well below the required levels. The following decades saw BNR system implemented across the U.S. and Canada, as well as New Zealand, Hong Kong, Brazil, and Singapore. Each time, Dr. Barnard designed and supervised the construction and activation of BNR systems that were adapted to varying climates, infrastructure, and environmental pressures.

In addition to the accomplishment of pioneering a water treatment system that is now used worldwide, Dr. Barnard actively works with the water and wastewater communities through efforts such as serving for 10 years on the Nitrogen Technical Advisory Panel for the New York City Department of Environmental Protection, where he helped guide a $50 million BNR research and development program for the Upper East River and Jamaica Bay areas.

Clarke Laureates at the 2007 Clarke Prize ceremony (from left): Dr. Vernon Snoeyink (2004), Dr. Bruce Rittmann (1994), Dr. Rafael Bras (1998), Dr. James Barnard (2007), Dr. George Tchobanoglous (2003), Dr. Philip Singer (2006), Dr. Perry McCarty (1997), and Dr. Walter Weber (1997). Photo by Teresa Taylor.

Dr. Barnard's current projects include one in Chicago, addressing nutrients in runoff and effluents. He plans to tackle problems at treatment plants and look at under-drainage to reduce nutrient deposition.

"I'm supposed to retire," said Barnard, "but I don't feel like it. I'd like to keep doing what I'm doing, taking part in workshops, teaching, and mentoring younger engineers."

One future goal stems from the valuable experiences he had in South Africa, where a professional group held conferences, lectures, and educational programs that informed citizens and professionals about local water issues. "One of the biggest problems in developing countries is that they don't have a mechanism to talk to each other," he said. "I'd like to help them make themselves heard to their governments. I'd like to give them a voice."

RESEARCH IN PROGRESS

Fecal Indicator Bacteria Source Tracking in the Middle Santa Ana River

Principal Investigator:

Dr. Stanley B. Grant, University of California, Irvine

Dr. Stanley Grant

Southern California's rivers, estuaries, and coastlines are monitored for fecal indicator bacteria (FIB), which can result in swimming advisories and the closure of shellfish harvesting areas. The first phase of the study found that both suspended solids and FIB exhibit unique concentration-versus-flow relationships, indicating that non-human sources contribute significantly to the FIB impairment of storm flows in the Middle Santa Ana River (SAR). The second (and current) phase of the study will investigate the sources of FIB in the Middle SAR during dry weather periods to determine environmental factors that trigger FIB growth and/or resuscitation, with the goal of identifying mitigation strategies likely to reduce FIB impairment.

The Clarke Prize Legacy:
Research and Rewards in Water Science

In 1993, NWRI established the Clarke Prize as an annual award commemorating an outstanding individual who has significantly contributed to the discovery, development, improvement, and understanding of the issues associated with water quality, quantity, technology, or public policy.

Less than a decade later, the International Congress of Distinguished Awards named the Clarke Prize as one of the most prestigious awards in the world.

Many Clarke Prize Laureates have a background in chemical or environmental engineering, and are active in various aspects of water treatment processes. With careers ranging between 20 to 40 years, each recipient draws from a deep well of experience and expertise to contribute to the water community.

"It is always a good feeling to be recognized by your peers for your scientific and professional contributions," said 2006 Prize winner Dr. Philip Singer, whose research was used by the U.S. Environmental Protection Agency to set regulations for the two major classes of disinfection byproducts (DBPs). "Awards such as the Clarke Prize validate the significance of one's work."

Leading hydrologist and Massachusetts Institute of Technology professor Dr. Rafael Bras won the 1998 Clarke Prize, which confirmed his choice of research, accomplishments, and commitment to higher education.

"It cemented my position in the community of hydrologists, water scientists, and engineers," he said, "and encouraged me to work harder to improve our knowledge of water issues around the world."

The award, which includes $50,000 and a 10k gold medallion, enables Laureates to support programs, scholarships, and charities that work toward achieving goals that interest them.

For instance, the 2004 recipient, Dr. Vernon Snoeyink used the award money to set up a scholarship at the University of Illinois for graduate students in environmental engineering and science, while Dr. George Tchobanoglous, the 2003 Clarke Prize winner, invested his award in a Master's Scholarship at U.C. Davis, where he is a professor in the Department of Civil and Environmental Engineering.

The 2001 Clarke Laureate, Dr. Joan Rose, allocated her prize money to fund scientists whose work focuses on microbial water quality and health.

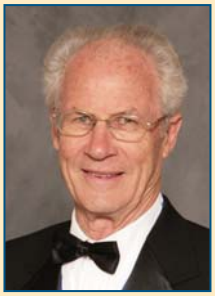
"In some ways, winning the Clarke Prize propels you toward working even harder," said Dr. Rose. "I felt a responsibility to do even better as a result of winning this award."

Future generations of civil and environmental engineers will rely on the research conducted by Clarke Prize Laureates, and the prestige of the Prize itself will draw more attention from the general public — as well as funding sources — to water-related research.

"I really believe that advances in water science and technology are going to be needed as we face an ever growing water crisis in the developing world and in our own backyards resulting from climate change, emerging contaminants (including pharmaceuticals), and aging infrastructure," said Dr. Rose. "This award makes people aware of the importance of water. When there is a prize of this stature, people pay attention. It allows for an opportunity to speak out on the issue and use the funds to promote water science and education."

Dr. Perry L. McCarty Wins 2007 Stockholm Water Prize

NWRI congratulates Dr. Perry L. McCarty of Stanford University, who was selected as the 2007 recipient of the Stockholm Water Prize.



Dr. Perry McCarty

This year's Prize was presented during the 2007 World Water Week in Stockholm, Sweden, on August 16, 2007, by King Carl XVI Gustaf of Sweden.

Dr. McCarty received this outstanding honor for developing and establishing biotechnology systems used in the design and operation of wastewater treatment systems worldwide. A professor and researcher at Stanford since 1962, he is known for his ability to attract and develop outstanding doctoral students.

Dr. McCarty presided as the Director of the U.S. Environmental Protection Agency-sponsored Western Regional Hazardous Substances Research Center for 14 years, as well as serves as a member of the National Academy of Engineering.

Dr. McCarty has a long-standing relationship with NWRI. He won the NWRI Clarke Prize in 1997 for contributions towards understanding contaminant behavior in groundwater aquifers and sediments and currently serves on NWRI's Research Advisory Board.

NWRI Remembers Dr. David C. White

"An uncommon passion for science" would not sufficiently describe the late Dr. David C. White's avid quest to advance microbial science. He sought to understand how the interaction of microbial colonies worked to ensure the success of the whole. In other words, he wanted to describe and explain cooperation on a microscopic level.

Dr. White passed away on October 25, 2006, from complications following an automobile accident at the age of 77. He is survived by his wife, Sandy White, three children, and 10 grandchildren. Services were held in Knoxville, Tennessee in November of last year.

Dr. White's love for science started during his childhood in Rock Island, Illinois, where he inspected nearby fields and creeks with a magnifying glass and collected small treasures in his pockets. He won his first microscope in a school science fair, an apt reward for a man who would later graduate *Magna Cum Laude* as a double major in Chemistry and Geology at Dartmouth College, earn an M.A. and M.D. in Medicine at Tufts University Medical School, and finally a Ph.D. in Biochemistry at Rockefeller University.

After a period with the Navy Medical Corps Aviation, Dr. White was instrumental in educating medical students and in developing biochemistry and clinical programs, first at the University of Kentucky Medical Center, and then later at Florida State University (FSU).

NWRI Executive Director Jeff Mosher (right) presented Sandy White with an NWRI Award of Appreciation in honor of her husband, Dr. David White, in July 2007. Photo by Teresa Taylor.

It was at FSU that his research shifted to microbial ecology, the study of the interactions of microorganisms with one another and with the environment. Dr. White's vision of bringing the power of quantitative analytical chemistry to microbial ecology led to the creation of the science of signature lipid biomarkers.

Lipid biomarker analysis informs researchers of the structure and function of different kinds of cells based on the types of lipids found in the cell. This type of research has many practical functions in various fields, including the medical field, water research, and astrobiology (the study of the living universe).

Dr. David White

The research enabled Dr. White to travel the world, including an excursion to Lizard Island on the barrier reef of Australia, a safari in South Africa, a search of the woods of North America and oyster beds off the coast of Florida, and a visit to Antarctica with a team of ice divers.

In 1986, Dr. White moved to the University of Tennessee, where he founded the Institute of Applied Microbiology and served as Director until 1991. He also served as Executive Director for the Center for Environmental Biotechnology at the University until 1999. During this time, he was selected as the second recipient of the NWRI Clarke Prize for Outstanding Achievement in Water Science and Technology, receiving the honor in 1995 for his groundbreaking approaches and methods towards studying microorganisms in their natural environments.

In 2001, he established the Center for Biomarker Analysis (CBA) to solve pressing microbial ecological problems within soils, sediments, slimes, biofilms, arctic tundra, deep ocean vents, and other environments using of signature lipid biomarker research.

For example, researchers at CBA are working on a project funded by NASA to drill subsurface core samples of the Earth's crust and analyze the samples with biomarker analysis technology. The long-term goal of this project is to develop the proper tools to drill on Mars and to use biomarker analysis technology to measure whether there was ever life on the planet.

Longtime colleague and friend, Dr. Susan Pfiffner of CBA, described Dr. White as a dedicated scientist and a great family man. "He loved science and was avid about learning any new information," she said. "He listened to tapes in his car to keep his medical license active. He would get excited talking about any experiment and loved working with people."

The American Society for Microbiology (ASM) established the David C. White Memorial Award in honor of Dr. White, a Distinguished Scientist and Director of CBA at the University of Tennessee. The first David C. White Memorial Award will be presented to a scientist for notable contributions to research in microbiology at the 2008 ASM General Meeting.

Dr. White served as a member of the ASM and a Fellow of the American Academy of Microbiology. He also helped guide NWRI's research program by serving on the NWRI Research Advisory Board over the past 10 years. He will be greatly missed.

Students Share Advances in Research at the First NWRI Graduate Fellowship Conference

The first NWRI Graduate Fellowship Conference was held on Friday, April 13, 2007, in Orange, California, to showcase the work of graduate students at different universities in the U.S. who are researching topics related to water resources.

Conference sponsors included Boyle Engineering Corporation; Cargill, Inc.; Carollo Engineers; CDM; Kennedy/Jenks Consultants; Malcolm Pirnie, Inc.; and MWH.

Very few conferences focus solely on water topics critical to the water and wastewater communities, and are relevant for a diverse range of attendees, including the public and private sectors, and university and regulatory personnel. In addition, it was free to attend.

Conference presenters (from left): Kris Kuhlman, Melissa Kenney, Kate Meierdiercks, Jeff Nason, Anna Baeza, Ken Mercer, Sandra Connelly, Erik Rosenfeldt, Joan Blainey, Eric Lyster, and David Love. Photo by Teresa Taylor.

Eleven students presented on topics such as water quality modeling and decision analysis, membrane performance, and ultraviolet disinfection. These students, all receiving NWRI Fellowships, represented schools nationwide, from Princeton University to the University of California, Los Angeles.

A goal of the Conference was to highlight research at the university level to update the water and wastewater communities where the next generation of research is headed.

Dr. William Blomquist, a Professor of Political Science at the Indiana University-Purdue University at Indianapolis, said, "Attending the NWRI Fellowship Conference was nothing short of inspiring. Seeing those talented young scholars – most of whom also had great presentation skills – left us convinced that the future of water research is bright indeed."

The student presenters were also able to network within the water and wastewater communities to share information and meet potential employers by providing them with a professional forum to present their work.

Melissa Kenney, a doctoral candidate at the Nicolas School of the Environment and Earth Sciences at Duke University, said that one of the best aspects of presenting at the conference was, "I was able to talk about my research with some of the world's leaders in water research. It was exciting to receive candid praise and critiques and learn of new methods to apply to my current and future water research."

Feedback on the student's research was not the only advantage of presenting at the conference. Kate Meierdiercks, a graduate student in the Department of Civil and Environmental Engineering from Princeton University, was offered a job by a conference attendee (which she may pursue after graduating in a year).

The students were not the only beneficiaries. Don Phipps, Research Director for the Orange County Water District (OCWD) in Fountain Valley, California, said "I was very impressed with the Fellowship Conference and thought the quality of the research and the presentations delivered were quite noteworthy. As our research work at OCWD touches many of the subjects of research by Fellowship students, I found many of the presentations particularly enlightening."

"The conference gives the attendees a look at the hot topics of interest at the cutting edge," added Bruce Macler, Ph.D., of the U.S. Environmental Protection Agency and member of the Conference Planning Committee. "Even without considering the possibilities for subsequent collaborations, it was just fun to listen to them."

Examples of conference presentations included:

- Ana Baeza of North Carolina State University spoke on combining different water treatment technologies to improve the quality of drinking water from sources that are impacted by organic wastewater contaminants.
- Joan Blainey of the University of Arizona spoke about improving field monitoring techniques for directly measuring recharge using a new combination of geophysical measurement methods.
- Sandra Connelly of Miami University spoke on assessing the ability of natural sunlight to destroy human pathogens in freshwater supplies.
- David Love of the University of North Carolina at Chapel Hill spoke about developing a quick, field-portable detection and grouping method for male-specific coliphages in fresh, estuarine, and marine waters.

The 74-page Conference Proceedings are available for download at **www.nwri-usa.org/gradconference**.

NWRI Short Courses Inform Professionals of Current Trends in Water Treatment

NWRI Short Courses are designed to bring together experts and professionals in an interactive forum to learn about the latest advances in water treatment technology.

Membrane Bioreactors: A Promising Technology

NWRI recently held two Short Courses — one in November 2006 in Anaheim, California, and another in April 2007 in Orlando, Florida — on MBR technology.

MBRs are considered a promising technology that uses membrane technology, such as microfiltration or ultrafiltration, to enhance wastewater and reclaimed water treatment processes. At present, MBRs are becoming the process of choice for water reclamation projects with demands for high water quality.

The MBR Short Course was developed in partnership with Cranfield University, MWH, and Trussell Technologies to promote an understanding of the principles and applications of MBR technology through the first-hand knowledge of field experts.

November Short Course participant Ray Trahan, from the Beardsley Water Reclamation Facility in the City of Peoria (Arizona) said, "The course packed more useful information in a short time than most conferences I have attended."

Topics varied from membrane technology fundamentals, MBR design principles, commercial technologies, and case studies.

"The quality of instruction was excellent," said attendee Jeff Noelte of the Inland Empire Utilities Agency in Chino, California.

Teresa Sullivan of Carter & Verplanck, Inc. in Hendersonville, Tennessee, concurred, adding that the instructors were "Highly knowledgeable, especially regarding the domestic MBR market and designs. The Short Course was well run, relevant, informative, and overall, very worthwhile."

Ultraviolet Disinfection: An Alternative to Chlorine

NWRI plans to hold another Short Course series later this year, this time focusing on UV disinfection for wastewater and water reuse.

Rising concerns related to toxicity and disinfection byproduct formation resulting from the chlorination of wastewater, coupled with the increased understanding of the shortcomings of chlorine and chloramines pathogen disinfection, has pushed the wastewater and reclaimed water treatment industries to look for alternative disinfectants to chlorine. Many such alternatives exist, but none are considered as effective or reliable as UV disinfection.

The proposed workshop team includes experts in the regulation, design, operation, and research and development of UV systems of all makes and models.

This depth will allow for discussions on the pros and cons of various UV technologies, such as:

- Low-pressure versus low-pressure high-output versus medium pressure.
- Horizontal lamp orientation versus vertical lamp orientation.
- Open channel versus in-vessel UV reactors.

Collaborating with the International Ultraviolet Association, Carollo Engineers, Black & Veatch, Duke University, and other state wastewater and water reuse associations, NWRI is developing the UV Short Course to provide participants with the tools and resources for consultants and agency staff to implement a cost-efficient and performance-effective UV system.

Become a Corporate Associate and Support NWRI Fellowships

Join the NWRI Corporate Associates Program now and help support a graduate student researching critical water needs.

NWRI Corporate Associates are consulting firms, manufacturers, vendors, and other private sector companies interested in supporting water-science research and education. Membership fees are used to fund NWRI Fellows, who are graduate students researching issues in water supply and technology.

Benefits of Corporate Associates membership include promotion on NWRI's website, flyers, newsletters, and other materials regarding the Fellowship Program. NWRI Corporate Associates are also highlighted as sponsors of NWRI's annual Graduate Fellowship Research Conference.

A brochure about the NWRI Corporate Associates Program is available for download at www.nwri-usa.org/CorpAssociates. If you are interested in joining the NWRI Corporate Associates Program, please contact NWRI's Executive Director, Jeff Mosher, at (714) 378-3278 or jmosher@nwri-usa.org.

NWRI Member Agency Spotlight:

The Irvine Ranch Water District

The Irvine Ranch Water District (IRWD) is one of six government agencies that collaborated to create and govern NWRI for the common purpose of protecting, maintaining, and restoring water supplies through cooperative research work.

Each agency has a representative on NWRI's Board of Directors. Darryl Miller, of IRWD, currently serves as Vice Chair of NWRI's Board.

IRWD is best known for being a worldwide leader in water reclamation and conservation. It was the first water district in California to receive an unrestricted use permit for its recycled water (meaning that the recycled water can be used for any purpose except drinking) and is one of the few water districts in the world that uses recycled water within almost its entire service area.

In addition to celebrating its 45th Anniversary last year, IRWD completed the Irvine Desalter Project (IDP) in collaboration with the Orange County Water District, U.S. Navy, Metropolitan Water District of Southern California, and State of California.

With construction beginning in 2003, IDP was developed in part as a response to the discovery of volatile organic compounds (VOCs) in portions of the groundwater basin beneath the former El Toro Marine Corps Air Station. VOCs are emitted as gases from certain solids or liquids that may have some short- and long-term adverse health effects. Previous disposal and waste management practices left a 1-by-3 mile plume of groundwater contamination. Although the plume does not affect IRWD's drinking water, its growth mandated action to prevent the future contamination of Orange County's main water supply.

IDP consists of two major components. One part of the project uses two purification facilities to remove VOCs from the contaminated groundwater. The cleaned water is used in the irrigation water system.

The second part of the project treats water not affected by VOCs to remove salts caused by natural geology and past agricultural drainage using state-of-the-art technology. This portion of the project is also equipped to remove nitrates, although none yet have been detected in the water. Once the salts have been removed using reverse osmosis, this water provides an additional source of potable water supply.

The IDP received a 2006 Project of the Year Award in the water/wastewater category from the American Public Works Association (APWA). IRWD Board President Doug Reinhart said, "This project represents a win-win situation for the community that will help to ensure a reliable, local water supply. We are honored that APWA recognizes that achievement and has distinguished it as a Project of the Year."

Register Now for the NWRI-EPA Asset Management Workshop

NWRI has teamed with the U.S. Environmental Protection Agency (EPA) to sponsor a "hands-on" Advanced Asset Management Training Workshop for water and wastewater utility managers on September 25-26, 2007, at the Holiday Inn Orange County Airport in Santa Ana, California.

Sound asset management allows public sector agencies to manage assets efficiently by addressing long-range planning, life-cycle costing, proactive operations and maintenance, and capital replacement plans based on cost-benefit analyses.

The workshop is designed to improve asset management assessment skills, raise awareness of the sustainable management of assets among community and decision makers, and address core questions involved in asset management techniques for the purpose of better acquisition, operations, maintenance, and renewal and replacement decisions.

Seating is limited. For more information, including registration details, please visit NWRI's website at www.nwri-usa.org/AssetManagement.

Early Registration Deadline: Tuesday, September 18, 2007

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