

Desalination Resources

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General

Access to freshwater is an increasingly critical state-wide, national, and international issue as demand has outstripped supply in many regions. Degradation of water supplies resulting from population growth, pollution, and lack of coordinated management often compounds this pervasive water availability issue. In order to maintain economic development, improve standards of living and health, and minimize future regional conflicts, the state will need to develop sustainable supplies of high-quality water for drinking and other uses. This requires the development of innovative and cost-effective methods to improve water management, water use and reuse, as well as novel technologies that can “create” freshwater from non-traditional sources, such as desalination.

Many desalination resources are available to assist state officials and employees, legislators, planners, engineers, scientists, and economists with general and technical information. In addition to those listed below, an Internet search on ‘desalination’ can provide a wealth of information on the topic.

1 U.S. Federal Government Resources

According to the National Council for Science and the Environment², federal funding of research and development for converting saline and brackish water into usable water began with the passage of the Saline Water Act of 1952 and the formation of the Office of Saline Water (OSW). In 1974, the Office of Water Research and Technology (OWRT) was formed in the Department of the Interior (DOI) through consolidation of the former Office of Saline Water (OSW) and the Office of Water Resources Research (OWRR). The OWRT was abolished at the end of fiscal year (FY) 1982 and the remaining desalination efforts were transferred to the Bureau of Reclamation (Reclamation). During subsequent years, federal budgets contained little or no funds for the water research and development.

In FY 1991, reauthorizations renewed federal desalination research and development for a six year period within Reclamation’s Water Treatment Technology Program. Reclamation’s current Desalination and Water Purification Research and Development (DWPR) Program was authorized by Congress under the Water Desalination Act (Act) of 1996. The Act authorized program funding for six years for \$5 million per year for research and studies, beginning with FY 1997, and \$25 million for the six years for demonstration and development. On July 13, 2001, the Energy and Water Development Appropriation Bill extended authorization of the Act through the end of FY 2004.

¹ United States Bureau of Reclamation

² Mielke, James E. National Council for Science and the Environment. February 19, 1999.

Today, Reclamation is the only federal agency that receives federal funding in support of desalination research and development, and demonstration to develop more cost-effective and technologically efficient means to desalinate water.

Other federal agencies apply desalting technologies only as it applies to performing their mission. As a result, they are dependent upon what is commercially available. Reclamation has the only federal program devoted to reducing the costs of desalination through research, studies, development, and demonstration. Reclamation's program benefits not only other federal agencies in performing their mission, but also private industry and the public, who need additional supplies of clean water.

Following is a list of federal agencies, their mission, and their role with respect to desalination.

Department of Interior (DOI):

In 1996, Congress authorized the DOI as the lead federal department for desalination.

The DOI has launched *Water 2025* - a problem-solving initiative for the American West that will help manage scarce water resources, and develop partnerships to nourish a healthy environment and sustain a vibrant economy. *Water 2025* will encourage voluntary water banks and other market-based measures, improve technology for water conservation and efficiency, and remove institutional barriers to increase cooperation and collaboration among federal, state, tribal, and private organizations. More information can be found at <http://www.doi.gov/initiatives/water2025.html>.

Mission: Protect and provide access to natural and cultural heritages. Honor trust responsibilities to Indian tribes and commitments to islands communities.

Web site: www.doi.gov

The two agencies within DOI involved with desalination technologies are:

Reclamation:

As discussed above, Reclamation manages the DWPR Program (<http://www.usbr.gov/pmts/water/desal.html> and www.usbr.gov/pmts/water/reports.html).

Reclamation is launching a new resource called the Desalination Clearinghouse. A draft web site is available at www.usbr.gov/desal.

Reclamation is also managing the Tularosa Basin National Desalination Research Facility (TBNDRF) design/build contract. Scheduled for completion in January 2005, the TBNDRF will be capable of processing at least 100,000 gallons of water per day at the Tularosa Basin in New Mexico. More information can be found at <http://wrri.nmsu.edu/tbndrc/fdesign.html>.

Mission: Manage develop and protect water and related resources in an environmentally friendly and economically sound manner.

Web site: www.usbr.gov

Geological Survey (USGS):

Mission: Provide reliable scientific information to: describe and understand the earth; minimize losses from natural disasters; and manage water, biological, energy, and mineral resources.

Web site: www.usgs.gov

Department of Defense (DOD):

The Army, Navy, and Marine Corps mission includes: Ensure non-negotiable readiness to fight and win wars.

Army:

The Army has extensive experience in mission-specific basic and applied desalination research and development.

Web site: www.army.mil

Navy:

The Navy has considerable experience with shipboard desalination systems.

Web site: www.navy.mil

Marines Corps:

Web site: www.usmc.mil

Defense Advanced Research Projects Agency (DARPA):

DARPA has experience in mission-related revolutionary desalination research and development.

Mission: Assure lead in applying state of the art technology for military capabilities and to prevent technological surprises from adversaries. Manage and direct selected basic and applied research of technologies where risk and payoff are high for advances.

Web site: www.darpa.mil

Department of Energy (DOE):

Mission: Enhance national security. Ensure integrity and safety of nuclear weapons, and provide safe nuclear power plants for the Navy. Increase domestic energy production, revolutionize conservation and efficiency, and promote renewable and alternative energy sources. Ensure safety legacies of the cold war, and permanently and safely dispose of the nation's radioactive wastes. Sponsor science and technology research and development.

Web site: www.doe.gov

The DOE national laboratories are looking at environmental remediation and waste management technologies. Their work is related to, but not directly supportive of, desalination technologies. Several national laboratories include:

Sandia National Laboratories (SNL):

SNL has experience in research and development related to water security, sensor development, produced waters from energy production, and renewable energy.

Mission: Ensure national security. Complete national defense research and development, energy, and environmental projects. Provide engineering design for all non-nuclear components in nuclear weapons.

Web site: www.sandia.gov

National Renewable Energy Laboratory (NREL):

NREL has considerable experience and expertise in renewable energy sources such as solar power, wind power and fuel cells.

Mission: Develop new energy technologies to benefit the environment and economy. Complete renewable energy and energy efficiency research.

Web site: www.nrel.gov

Lawrence-Livermore National Laboratories (LLNL):

LLNL has worked on revolutionary desalination R & D in capacitive de-ionization.

Mission: Ensure national security. Address problem of proliferation of weapons of mass destruction. Provide leadership in Stockpile Stewardship Program.

Web site: www.llnl.gov

Argonne National Laboratory (ANL):

ANL has considerable experience in cogeneration of water and power.

Mission: Develop nuclear reactors for peaceful purposes. Research in the areas of science, engineering, and technology. Argonne is not and never has been a weapons laboratory.

Web site: www.anl.gov

Los Alamos National Laboratory (LANL):

LANL has experience in increasing energy production without increasing water usage.

Mission: Ensure that the nation's nuclear weapons remain safe, secure, and reliable and to prevent the spread and use of nuclear weapons worldwide.

Web site: www.lanl.gov

National Institute of Standards and Technology (NIST):

NIST's Advanced Technology Program (ATP) bridges the gap between the research lab and the market place, stimulating prosperity through innovation. Through partnerships with the private sector, ATP's early stage investment is accelerating the development of innovative technologies that promise significant commercial payoffs and widespread benefits, including technologies used in the desalination process. The ATP provides a mechanism for industry to extend its technological reach and push out the envelope of what can be attempted. More information can be found at <http://www.atp.nist.gov>.

Mission: Develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life.

Web site: www.nist.gov

Environmental Protection Agency (EPA):

EPA has extensive research and development capability and experience in identifying and regulating contaminants as well as in water safety and security. EPA does evaluate some desalination systems to determine the best available technology.

Mission: Protect human health and safeguard the natural environment – air, water, and land – on which life depends.

Web site: www.epa.gov

National Science Foundation (NSF):

Mission: Promote the progress of science to advance the national health, prosperity, and welfare, and to secure the national defense.

Web site: www.nsf.gov

Desalination contact:

NSF Centers foster the interchange of scientific information among scientists and engineers. These Centers provide an excellent vehicle for basic research work in desalination. The Centers involved in desalination research include:

Center for Membrane Applied Science and Technology (MAST):

The MAST Center, headquartered in Boulder, is a NSF Multi-site Industry/University Cooperative Research Center (MUC I/UCRC), with sites at the University of Colorado and the University of Cincinnati.

Filtration and separation can represent as much as 80% of the operating costs for many industries, and membrane separations are gaining acceptance as a cost effective option in many production settings. Newer, more efficient membrane separation techniques can lead to more streamlined production and produce significant improvements in quality. More information can be found at <http://www.mastcenter.org>.

Center for Biofilm Engineering (CBE):

The CBE, is a NSF MUC I/UCRC located at Montana State University - Bozeman.

The CBE works to advance the basic knowledge, technology, and education required to understand, control, and exploit biofilm processes. More information can be found at <http://www.erc.montana.edu>.

National Technical Information Service (NTIS):

NTIS serves as the nation's largest central resource for government-funded scientific, technical, engineering, and business related information available today. It contains information on more than 600,000 information products covering over 350 subject areas from over 200 federal agencies. NTIS's Research and Development Progress Reports contain detailed information and evaluation of research investigations carried out under contract with the Office of Saline Water (OSW) and its successor, the Office of Water Research and Technology (OWRT) during the years 1954-1983. Copies of many of these reports are available in paper or microfiche from NTIS's Order Department in Springfield, VA 22161. Order information and prices may be obtained by calling NTIS Identification Office - Tel. +1 800 553 6847 or 1 703 605 6000 - Fax +1 703 605 6900.

Mission: Support the nation's economic growth by providing access to information that stimulates innovation and discovery

Web site: www.ntis.gov

Interagency Consortium for Desalination and Membrane Separation Research (Consortium):

Consortium membership is open to federal agencies and employees only. The purpose of the Consortium, established in April 1992 by Reclamation and U.S. Army Tank-Automotive Research, Development, and Engineering Center, is to provide a communications network for the exchange of information between federal government agencies involved in desalination and membrane separation research. Consortium members work together to gain the following benefits: 1) prevent federal duplication of efforts; 2) pool limited federal research funding and other resources to obtain common goals; 3) identify future research needs; and 4) allow for discussion of new technologies with other experts in the field. Annual Consortium meetings are held and the proceedings from the meetings are distributed to update members on current research efforts. For more information, contact Michelle Chapman, mchapman@do.usbr.gov, 303-445-2264.

2 U.S. Associations, Foundations, or Institutes

American Membrane Technology Association (AMTA - formerly ADA):

The leading advocate of membrane processes in the U.S., AMTA is a strong voice for regulatory and legislative reforms essential to the understanding, acceptance and utilization of membrane technologies. AMTA works to provide broad opportunities for the exchange of technical, operational and financial information among individuals and organizations interested in membrane technologies.

Mission: Promote, advocate and advance the understanding and application of membrane technology to create safe, affordable and reliable water

supplies, and to treat municipal, industrial, agricultural and waste waters for beneficial use.

Web site: <http://www.membranes-amta.org>

Southeast Desalting Association (SEDA):

SEDA, formed in 1994, is an affiliate of AMTA (formerly the American Desalting Association). SEDA is dedicated to the improvement of the quality of water supplies through membrane desalting and filtration, water reuse, and other water sciences. SEDA includes members concerned with environmental regulations and legislation, process design, equipment manufacture, plant operations and maintenance, and research and development.

Mission: Promote, both to the public and to elected officials, available technologies that improve water quality education, training and certification of plant operation personnel; effective communication with the membership; development of a meaningful interface with regulatory agencies, technology transfer, and protection of the environment.

Web site: www.southeastdesalting.com

American Water Resources Association (AWRA):

Founded in 1964, the AWRA is a non-profit professional association dedicated to the advancement of men and women in water resources management, research, and education. AWRA's membership is multidisciplinary; its diversity is its hallmark. It is the professional home of a wide variety of water resources experts including engineers, educators, foresters, biologists, ecologists, geographers, managers, regulators, hydrologists and attorneys. AWRA promises a balanced, professional approach to solving water resources challenges in a friendly and comfortable atmosphere.

Mission: Advance multidisciplinary water resources education, management, and research

Web site: www.awra.org

American Water Works Association (AWWA):

AWWA is an international non-profit scientific and educational society. Founded in 1881, AWWA is the largest organization of water supply professionals in the world. Its more than 57,000 members represent the full spectrum of the drinking water community: treatment plant operators and managers, scientists, environmentalists, manufacturers, academicians, regulators, and others who hold genuine interest in water supply and public health. Membership includes more than 4,700 utilities that supply water to roughly 180 million people in North America. AWWA is the authoritative resource for knowledge, information, and advocacy to improve the quality and supply of drinking water in North America and beyond.

Mission: Improve drinking water quality and supply and advance public health, safety and welfare

Web site: www.awwa.org

Texas Section AWWA:

Recognizing a need to share experiences, knowledge, and problems in order to improve their abilities to provide safe and sufficient water supplies to an ever growing region, pioneers in the water profession in the southwest originally created the Southwestern Water Works Association in May 1912. In 1927, the name changed to the Southwest Water Works Association and included water professionals from Arkansas, Louisiana, Oklahoma, and Texas. In the late 1960's, the advantages of a separate section for Texas became apparent to members, and on December 1, 1971, the Texas Section of AWWA was created. Since then, the Section has grown to become the second largest of AWWA's 43 sections, with over 3200 volunteers committed to advancing the technology, science, and governmental policies as water professionals and stewards of the water resources of Texas and the public water supplies.

Mission: The Texas Section of AWWA is dedicated to the promotion of public health and welfare and assuring drinking water of unquestionable quality and sufficient quantity

Web site: <http://www.tawwa.org>

American Water Works Association Research Foundation (AWWARF):

AWWARF is a member-supported, international, non-profit organization that sponsors research to enable water utilities, public health agencies, and other professionals to provide safe and affordable drinking water to consumers. AWWARF was established in 1966 to provide a centralized, practical research program for the drinking water community. Its research program is highly respected as being one of the most scientifically credible and best-coordinated in the world.

Mission: Advance the science of water to improve the quality of life

Web site: www.awwarf.org

Electric Power Research Institute (EPRI):

EPRI was founded in 1973 as a private, independent, non-profit center for public interest energy and environmental research. EPRI's collaborative science and technology development program spans nearly every area of electric power generation, environmental impact and controls, power delivery, and energy use. EPRI manages a far-reaching program of scientific research, technology development, and product implementation. EPRI addresses society's most urgent and important needs and provides strategy and vision for the future. Currently serving more than 1000 energy organizations worldwide, EPRI draws on a global network of scientific, technical, and business expertise. As a nonprofit organization, it is committed to help solve today's toughest energy problems and to provide the strategic vision and planning for a robust energy future.

Mission: Provide science and technology-based solutions of indispensable value to our global energy customers by managing a far-reaching program of scientific research, technology development, and product implementation.

Web site: <http://www.epri.com>

International Desalination Association (IDA):

IDA is a non-profit association of over 1000 members in fifty-eight countries. The membership is comprised of scientists, end-users, engineers, consultants, and researchers from governments, corporations and academia. IDA is associated with the United Nations as part of a growing international network of nongovernmental organizations (NGOs).

The popular *ABC's of Desalting*, a summary of desalination technologies and economics, can be purchased or downloaded at <http://www.idadesal.org/bookstore.asp>.

Information on IDA's international affiliates can be found at <http://www.idadesal.org/affiliates.asp>.

Mission: Committed to the development and promotion of the appropriate use of desalination technology
Web site: <http://www.idadesal.org>

National Ground Water Association (NGWA):

The NGWA is a not-for-profit organization founded in 1948 as the National Water Well Association. Changing to NGWA in 1991, we've grown to include more than 15,000 professionals around the world. NGWA is the hallmark organization for anyone associated with the ground water industry. Headquartered in Westerville, OH, the constituency consists of ground water geologists and hydrologists, engineers, ground water contractors, manufacturers, and suppliers of ground water-related products and services.

Mission: Provide guidance to members, government representatives, and the public for sound scientific, economic, and beneficial development, protection, and management of the world's ground water resources
Web site: www.ngwa.org

National Rural Water Association (NRWA):

NRWA is America's largest utility membership, serving over 23,500 water and wastewater utilities. The NRWA is a non-profit federation of State Rural Water Associations.

Mission: Provide our state associations with support services to meet the needs of their membership
Web site: www.nrwa.org

For information on the Texas section of NRWA, see the Texas listings below.

Texas Association NRWA:

The Texas Rural Water Association (TRWA) is a statewide non-profit educational and trade association dedicated to the improvement of water quality and supply. Founded in 1969, TRWA represents a full spectrum of the drinking water community including: Nonprofit Water Supply and Sewer Service Corporations, Special Utility Districts, Municipal Utility Districts, WCIDs, Small Municipal Utilities and Privately-Owned Water Utilities. Membership includes more than 740 water utilities in Texas who supply water to some 2.5 million people.

Mission: Help water and wastewater systems supply Texans with safe and affordable water and wastewater services
Web site: www.trwa.org

National Water Research Institute (NWRI):

A public-private partnership, NWRI was founded in 1991 by a group of Southern Californian water agencies in partnership with the Joan Irvine Smith & Athalie R. Clarke Foundation to promote the protection, maintenance, and restoration of water supplies through the development of cooperative research work. NWRI has been defined as an institute without walls because of its ability to support a wide array of water research projects without itself having a research staff or facilities. NWRI has also been able to double its research budget by requiring that matching funds be provided by joint-venture research partnerships. These partners come from local, state, and federal governments as well as from private industry, public utilities, and universities.

Mission: Create new sources of water through research and technology and to protect the freshwater and marine environments.
Web site: <http://216.133.236.158/asp/home.asp?main=m1&sub=s0&id=1&display=N>

National Centers for Water Treatment Technology (NCWTT):

The NWRI, in cooperation with Reclamation, established a cooperative program in 1994 called the National Centers for Water Treatment Technology (NCWTT). The Centers are open to investigators interested in pursuing water purification research. Each NCWTT is dedicated to a specific purpose and contains pilot-scale test facilities and research laboratories to conduct basic and applied research. Six facilities across the country are currently designated as NCWTTs:

- Water Quality Improvement Center (WQIC) at Yuma Desalting Plant (YDP) (Yuma, AZ - Irrigation return flows and Colorado River Water - www.usbr.gov/lc/yuma/facilities/wqic/yao_facilities_wqic.html)
- Army Water Quality and Treatment Center (Warren, MI - Surface water treatment)
- West Basin Water Recycling Facility (El Segundo, CA - Seawater desalination and reuse - www.westbasin.com/)
- University of South Florida (Tampa, FL - Estuary and coastal brackish – www.usf.edu)
- Water Factory 21 (Fountain Valley, CA - Reuse for recharge and seawater barrier - www.ocwd.com/html/wf21.htm)
- Aqua 2000 (San Diego CA – Indirect potable reuse)

As discussed previously, when completed, the TBNDRF will serve as the seventh NCWTT. It will be unique in that it focuses on inland groundwater desalination, concentrate disposal, and renewable energy.

More information on the NCWTT program and individual Center's contact information can be found at <http://216.133.236.158/asp/sp.asp?main=m5&sub=s1&id=5>.

National Water Resources Association (NWRA):

The NWRA is the oldest and most active national association concerned with water resources policy and development. Formerly established in 1932, NWRA can trace its origins to the late

1800's. The NWRA is a non-profit federation of state organizations whose membership includes rural water districts, municipal water entities, commercial companies and individuals. NWRA is concerned with the. NWRA works to balance the needs of people and the environment. NWRA has worked closely with the Congress and the Executive Branch for over 50 years, establishing positive relationships with key resource management agencies and departments.

Mission: Monitor appropriate management, conservation, and use of water and land resources on a national scope

Web site: www.nwra.org

North American Membrane Society (NAMS):

Headquartered at the University of Toledo (www.eng.utoledo.edu), NAMS is the only professional society in North America aimed at promoting all aspects of membrane science and technology. This ranges from fundamental studies of membrane chemistry, formation, and characterization to the analysis of new applications and developments in reverse osmosis, electro dialysis, ultrafiltration, microfiltration, gas separations, liquid membranes, membrane bioreactors, hemodialysis, and biomedical devices.

Mission: To serve the synthetic membrane community by fostering the development and dissemination of knowledge in membrane science and technology, and by promoting the collaborative efforts of researchers, technologists and end-users.

Web site: <http://www.membranes.org>

U.S. Desalination Coalition (US Desal):

US Desal is a non-profit District of Columbia trade association consisting primarily of public water agencies throughout the Nation interested in pursuing federal legislation to establish a new program to provide federal financial assistance to encourage the development of seawater desalination projects. US Desal is a national coalition of water agencies and utilities whose mission is to encourage the development of seawater and brackish groundwater desalination projects and raise the visibility of desalination at the federal level as a viable and important option in meeting the future demand for reliable and clean water.

Mission: Develop and pass before the conclusion of the 108th Congress a consensus piece of legislation to assist in funding the planning, design, construction, operation and maintenance of projects to desalinate seawater and convey the treated water for municipal and industrial use. After passage of the legislation, the U.S Desal Coalition will promote the full funding of the new program.

Web site: www.usdesal.org

Water Environment Federation (WEF):

Founded in 1928, WEF is a not-for-profit technical and educational organization. Members are from varied disciplines and they collaborate with staff to realize the WEF vision of preservation and enhancement of the global water environment. The WEF network includes water quality professionals from 79 Member Associations in over 30 countries.

Mission: Develop and promote practices and policies, which assist our members to serve the public interest in providing efficient and environmentally protective water quality and wastewater management services. Deliver high quality products and services to members and stakeholders. Promote scientifically sound environmental practices and regulation. Educate members, the public and policy makers. Promote and advance the water quality profession. Promote public health by preserving and enhancing the global water environment.

Web site: www.wef.org

Water Environment Research Foundation (WERF):

WERF is a not-for-profit organization that funds and manages water quality research for subscribers through a diverse public-private partnership between municipal utilities, corporations, academia, industry, and the federal government. WERF seeks to promote the development and application of sound science to water quality issues. WERF subscribers include municipal and regional water and wastewater utilities, industrial corporations, environmental engineering firms, and others that share a commitment to cost-effective water quality solutions that protect the environment and improve the quality of life for all.

Mission: Dedicated to advancing science and technology addressing water quality issues as they impact water resources, the atmosphere, the lands, and quality of life

Web site: www.werf.org

WateReuse Association (WateReuse):

WateReuse is a non-profit organization. Across the United States and the world, communities are facing water supply challenges due to increasing demand, drought, depletion and contamination of groundwater, and dependence on a single source of supply. Water reuse helps communities address these challenges. WateReuse supports water projects that increase high-quality water supplies, improve reliability, protect public health, and safeguard the environment.

Mission: Help members create new sources of high quality water through water reuse, which is also referred to as water reclamation and water recycling.

Web site: <http://www.watereuse.org>

WateReuse Foundation (WRF):

The WRF is an educational, nonprofit public benefit corporation. WRF's work provides education and research that benefit the environment, sustain agriculture and meet the needs of urban and industrial water users. The WRF was created by representatives of public and private organizations that are concerned with meeting water demands in the 21st century. Its commitment to credible scientific and academic knowledge will expand the use of recycled water.

Mission: Increase public awareness and understanding of recycled water and facilitate the development of technology to improve water recycling

Web site: <http://www.watereuse.org/Pages/foundation.html>

Water Quality Association (WQA):

The WQA is a not-for-profit international trade association representing the household, commercial, industrial, and small community water treatment industry. WQA maintains a close dialogue with other organizations representing different aspects of the water industry in order to best serve consumers, government officials, and industry members.

Mission: Provide a resource and information service, a voice for the industry, an educator for professionals, a laboratory for product testing, and a communicator to the public

Web site: www.wqa.org

3 U.S. Local Governments and/or Utilities

Many local government and/or utilities, in and outside of Texas, have experience in desalination technologies and can provide information related to desalination.

California Coastal Commission:

With population growth and the recent six-year drought contributing to an increase in Californians' concerns about water scarcity, several communities and industries in California have proposed constructing desalination plants to convert saline water (e.g., seawater, brackish water or treated wastewater) into fresh water. Because all or portions of seawater desalination plants will be located in the coastal zone, the facilities will come under California Coastal Act requirements.

The following web site provides a listing of coastal seawater desalination plants in California. Data include technology, capacity, energy use, feedwater source, and size. More information can be found at <http://www.coastal.ca.gov/desalrpt/dsynops.html>.

Mission: Plan for and regulate land and water uses in the coastal zone consistent with the policies of the Coastal Act

Web site: www.coastal.ca.gov/index.html

California Department of Water Resources (DWR):

As an agency in the state government, DWR is responsible for preparing and updating the California Water Plan. DWR plans, designs, constructs, operates, and maintains the State Water Project. DWR protects and restores the Sacramento-San Joaquin Delta. DWR regulates dams, provides flood protection, and assists in emergency management. DWR educates the public on the importance of water and its proper use. DWR serves local water needs by providing technical assistance. More information about desalination efforts in California can be found at http://www.ambag.org/events/archive/desal_fawzikarajeh.pdf.

Mission: Manage the water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance the natural and human environments

Web site: www.water.ca.gov

Metropolitan Water District of Southern California (MWD):

MWD is a consortium of 26 cities and water districts that provides drinking water to nearly 18 million people in parts of Los Angeles, Orange, San Diego, Riverside, San Bernardino and Ventura counties. MWD currently delivers an average of 1.7 billion gallons of water per day to a 5,200-square-mile service area.

Mission: Provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way

Web site: www.mwdh2o.com

Orange County Water District (OCWD):

OCWD was formed in 1933 by a special act of the California Legislature. Created to protect Orange County's rights to Santa Ana River water, OCWD's primary responsibility is managing the vast groundwater basin under north and central Orange County. Orange County's groundwater basin supplies water to more than 20 cities and water agencies, serving more than 2.2 million Orange County residents. OCWD primarily recharges the basin with water from the Santa Ana River and to a lesser extent with imported water purchased from the MWD. Water enters the groundwater basin via settling or percolation ponds in the cities of Anaheim and Orange.

Mission: Manage and protect the vast groundwater basin in northern and central Orange County

Web site: www.ocwd.com

San Diego County Water Authority (SDCWA):

The history of the San Diego region revolves around a never-ending search for a safe, reliable water supply. Today, the SDCWA works with its 23 member agencies to carry out this responsibility. This role links the SDCWA with the Spanish missionaries and soldiers who arrived in the area in 1769, and swiftly realized the local water supply was small and erratic, and began "developing water" (as water industry officials call it).

SDCWA provides the following information about seawater desalting:

Seawater desalination, the process of converting seawater into safe high-quality water for drinking and other potable water uses, is a drought-proof water supply. In the seawater desalination process, fresh water is separated from salty seawater. The remaining water, salts and impurities are then discharged as a salty byproduct, or brine. There are two methods for large-scale production of desalted water—distillation and reverse osmosis.

Seawater desalination now offers compelling advantages for the San Diego region. It produces locally controlled, drought-proof and safe high-quality water that would be managed entirely within the county. It is less affected by natural disasters such as earthquakes that could cut the region off from its imported water supplies. As an alternative water resource, seawater desalination would diversify the county's water supply mix and increase the region's self-reliance. Moreover, several factors are converging to make seawater desalination more

economically feasible-improved reverse osmosis technology, the economies of scale derived from sharing facilities with existing coastal power plants, and funding opportunities created by legislation. More information about seawater desalination can be found at www.sdcwa.org/manage/sources-desalination.phtml and <http://www.sdcwa.org/about/sdcwa-overview-2003.pdf>

Mission: Provide a safe and reliable supply of water to its 23 member agencies in the San Diego region
Web site: www.sdcwa.org

Florida Keys Aqueduct Authority (FKAA):

The FKAA was created in 1937 by Special Legislation of the State of Florida. The FKAA is the sole provider of potable water for all of the residents of the Florida Keys and presently serves over 44,000 customers within Monroe County. Potable water is transported to the Keys through a 130 mile transmission pipeline with an additional 649 miles of distribution pipelines which deliver water to the customer's property. In 1998 and 2002, the Authority's Enabling Legislation was amended to redefine the primary purpose of the Authority to include collecting, treating and disposing of wastewater in certain areas of the Florida Keys.

Mission: Provide safe, high quality water to residents in the Florida Keys
Web site: www.fkaa.com

South Florida Water Management District (SFWMD):

SFWMD is a regional agency of the state of Florida, and is charged with managing and protecting water resources of the region by balancing and improving water quality, flood control, natural systems and water supply. SFWMD's boundaries extend from central Florida to Lake Okeechobee, and from coast to coast, from Fort Myers to Fort Pierce, south through the sprawling Everglades to the Florida Keys and Florida Bay. Today, the SFWMD operates and maintains approximately 1,800 miles of canals and levees, 25 major pumping stations and about 200 larger and 2,000 smaller water control structures. More information on desalination in Florida can be found at <http://www.sfwmd.gov/org/wsd/wsconservation/brackish.html>.

Mission: Manage and protect water resources of the region by balancing and improving water quality, flood control, natural systems, and water supply
Web site: www.sfwmd.gov

Tampa Bay Water:

Tampa Bay Water is a special district created by interlocal agreement to supply wholesale water to Hillsborough County, Pasco County, Pinellas County, St. Petersburg, New Port Richey and Tampa. Tampa Bay Water provides wholesale water to our member utilities, who in turn provide water to more than 2 million people in the tri-county area. Tampa Bay Water was created in 1998, with assistance from the Florida Legislature and Governor, by restructuring the West Coast Regional Water Supply Authority. Tampa Bay Water provides an average of 152 million gallons of water to members every day. That water is provided by our 66 MGD surface water treatment plant and three sources that supply it, six groundwater treatment plants, 13 regional wellfields, a 25 MGD seawater desalination plant and almost 200 miles of pipeline --

130 miles of which is large diameter, ranging from 36 to 84 inches. More information on the Tampa Bay desalination plant can be found at <http://www.tampabaywater.org/facilities/tbdesal.asp> and http://ncppp.org/resources/papers/schiller_desalination.pdf.

Mission: Supply water to the region
Web site: www.tampabaywater.org

Dare County North Carolina Water:

Dare County Water operates four reverse osmosis plants and one ion exchange plant which provide water to communities in Dare County.

Mission: Provide a service to the community that promotes safe, clean, healthy, fresh water for drinking and other purposes, 24 hours a day, for a reasonable cost
Web site: <http://darenc.com/Water/index.htm>

El Paso Water Utilities (EPWU):

EPWU is the largest provider of water and wastewater services in the El Paso region. EPWU is committed to communicating timely information about water and wastewater operations to our customers.

Mission: Provide efficient and effective quality water and wastewater service to our customers at reasonable prices
Web site: www.epwu.org

Texas Water Conservation Association (TWCA):

The TWCA is the leading organization in Texas devoted to conserving, developing, protecting, and using the water resources of the state for all beneficial purposes. TWCA membership encompasses the full spectrum of water use or interests: groundwater users, irrigators, municipalities, river authorities, navigation and flood control districts, industrial users, drainage districts, utility districts, and general/environmental interests.

Mission: Conserve, develop, and protect water resources
Web site: www.twca.org

Texas Water Development Board (TWDB):

The TWDB is the State agency charged with collecting and disseminating water-related data, assisting with regional water planning, and preparing the State Water Plan for the development, management, and conservation of Texas' water resources, as well as administering cost-effective financial programs for the construction of water-supply, water-infrastructure, wastewater-treatment, flood-control, and agricultural water-conservation projects. In April 2002, the Governor of Texas, Rick Perry, directed the TWDB to prepare a recommendation on development of a large-scale demonstration seawater desalination facility in Texas.

Mission: Provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas

Web site: www.twdb.state.tx.us/home

Information on the report to the Governor titled *Large-Scale Demonstration Seawater Desalination in Texas* and about all current desalination-related contracts may be found at <http://www.twdb.state.tx.us/desalination/desal/index.asp>.

4 U.S. Academia

Desalination Online

A University of Hawaii web site containing a variety of information, including membrane desalting plants on the web, desalination research at universities, and other desalination information.

Web site: <http://www2.hawaii.edu/~nabil>

National Drinking Water Clearinghouse (NDWC):

The NDWC at West Virginia University is a public service organization that collects, develops, and distributes timely drinking water-related information. Sponsored through the U.S. Department of Agriculture's Rural Utilities Service (RUS), the NDWC serves as an extension of RUS's commitment to providing technical assistance to America's small and rural drinking water treatment plants. Intended for communities with fewer than 10,000 residents and the organizations who work with them, the NDWC helps small communities by providing needed technical assistance and information.

Mission: Helping small communities by collecting, developing, and providing timely information relevant to drinking water issues

Web site: www.nesc.wvu.edu/ndwc/ndwc_index.htm

National Institutes for Water Resources (NIWR):

The NIWR is a network of research institutes in every state. They conduct basic and applied research to solve water problems unique to their area. The bulk of NIWR funding comes from non-federal sources.

The Water Resources Research Act authorized by P.L. 101-397 provides for Water Resources Research Institutes (WRRI) in each of the 50 states, the trust territories, and the District of Columbia. The programmatic responsibilities stipulated by the Water Resources Research Act provide a unified focus for the federal and non-federal components of the NIWR Program. Under the Act, these institutes are to:

- Plan, conduct, or otherwise arrange for competent research that fosters (A) the entry of new research scientists into the water resources fields, (B) the training and education of future water scientists, engineers, and technicians, (C) the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related

phenomena, and (D) the dissemination of research results to water managers and the public.

- Cooperate closely with other colleges and universities in the State that have demonstrated capabilities for research, information dissemination, and graduate training in order to develop a statewide program designed to resolve State and regional water and related land problems."

Each institute shall also cooperate closely with other institutes and other organizations in the region to increase the effectiveness of the institutes and for the purpose of promoting regional coordination."

The WRI for each state is located at a college or university designated by the Governor or State Legislature. Funding for the Institutes program requires a 2:1 non-federal match and must meet specific criteria.

The state based program promotes research, training, information dissemination, and other activities meeting the needs of the States and Nation, and encourages regional cooperation among institutes in research into areas of water management, development, and conservation that have a regional or national character.

The location of the WRIs can be found at <http://wri.nmsu.edu/niwr/wri.html>.

Web site: <http://wri.nmsu.edu/niwr/niwr.html>

Universities Council on Water Resources (UCWR):

In the early 1960's, a conference was called by water resources professionals concerned about the lack of recognition given to hydrology and water resources planning as bona fide sciences. The focus of the conference was to discuss problems of education and research in these fields. As a result of this meeting, the Universities Council on Hydrology (UCOH) was formed. Soon after, a group of scientists with interests in other aspects of water resources joined UCOH and at its 1964, UCWR was founded.

About 90 universities in the U.S. and throughout the world comprise the UCWR organization. Member institutions engage in education, research, public service, international activities, and information support for policy development related to water resources.

UCWR facilitates water-related education at all levels; promotes meaningful research and technology transfer on contemporary and emerging water resources issues; compiles and disseminates information on water problems and solutions; and informs the public about water issues with the objective of promoting informed decisions at all levels of society.

“Universities united to advance education and research in water resources.”

Web site: <http://ucwr.siu.edu>

5 U.S. Private Sector Companies and A/E Firms

While the private sector does invest in desalination research, many other areas in their businesses return higher short-term profits. A complete list of private sector companies which are members of AMTA can be found at www.membranes-amta.org/members.html

Water Technology On-Line:

A National Trade Publications, Inc. Internet based service providing the latest product and services announcements from manufacturers.

Web site: www.watertechonline.com

6 International Resources

International resources include private companies, agencies, and organizations involved in desalination. Private companies web sites often offer programs related to desalination materials, sizing, or costs.

Desalination Directory Online (Desline):

Desline is an Internet-based, interactive worldwide network listing of government and academic institutions and companies and individuals in the field of desalination and water reuse. Desline database contains over 17,000 entries.

Web site: <http://www.desline.com>

European Membrane Society (EMS):

With a market now close to \$10 billion per year, membranes have become an important industrial activity. Scientifically the field requires integration of knowledge from several disciplines, as especially the market for hybrid membrane processes is developing very fast today. New membrane materials make it possible to extend the use of membranes to new areas of industry where modern tailor-made materials are needed for separation processes with membranes. The EMS exists to promote knowledge and the use of membranes and membrane processes both at universities and in industry. It also aims at promoting contacts between students, researchers and industrialists.

Web site: www.ems.cict.fr

European Desalination Society (EDS):

EDS is a Europe-wide organization for individual and corporate members including universities, companies, research institutes, government agencies and all concerned with and interested in desalination and membrane technologies for water. It is a society uniting Europeans interested in promoting desalination, water reuse, and water technology. All processes are covered and the wide range of roles and activities involved in the desalination field are included: research, applications, consulting, contracting, operation and maintenance, manufacturing, marketing, economics, legislation. Members are welcome from other regions outside Europe. EDS objectives include:

- Promoting awareness of the true value of water and its augmentation by desalination
 - Encouraging research, development, and appropriate use of desalination, desalination technology and water reuse
 - Exchanging, promoting, communicating and disseminating information
 - Encouraging and promoting environmentally responsible and efficient use of the technology
 - Cooperating and communicating with national and international, government and private agencies in the promotion of the technologies and of European interests
- The promotion of European business development in desalination and related technologies

Web site: www.edsoc.com

Middle East Desalination Research Center (MEDRC):

The specific objectives of MEDRC are to conduct, facilitate, promote, co-ordinate and support:

- Basic and applied research in the field of water desalination and related technical areas with the aim of discovering, developing and improving methods of water desalination which are financially and technically feasible.
- Desalination training programs which develop technical expertise and scientific skills throughout the Middle East.
- Information exchange, including electronic networking to ensure global technical information dissemination concerning water desalination methods and research.
- Establish relations with other states, organizations, as will foster progress in the development, improvement and use of water desalination in the Middle East and elsewhere.

Mission: Conduct, facilitate, promote, coordinate, and support basic and applied research in water desalination technology and supporting fields. Raise the standard of living in the Middle East and elsewhere by cost reduction and quality improvement in the technical processes of water desalination.

Web site: www.medrc.org.om

National Water Research Institute – Canada (NWRI):

NWRI is a Directorate of Environment Canada's Environmental Conservation Service. NWRI is Canada's largest freshwater research facility with over 300 staff including aquatic ecologists, hydrologists, toxicologists, physical geographers, modellers, limnologists, environmental chemists, research technicians, and experts in linking water science to environmental policy. NWRI has centres on the shores of the Great Lakes in Burlington, Ontario and in the heart of the Canadian Prairies in Saskatoon, Saskatchewan. From these vantage points, NWRI extends its influence across Canada and beyond, leading world-class research on freshwater issues.

Mission: Conserve and protect of Canada's water resources

Web site: www.nwri.ca/nwri-e.html

Rabin Desalination Laboratory (RDL):

The Technion - Israel Institute of Technology, is one of the major technical universities of the Middle East and is widely recognized as a center of excellence. Its academic departments and research institutes cover all engineering and science disciplines, including architecture and medicine.

The aims of the Rabin Desalination Laboratory (RDL) are centered on the need to advance the theory and practice of desalination technologies. Goals are realized by conducting basic and applied research, and by training of students in desalination and related water technologies. Furthermore the RDL seeks to provide desalination related services to the Israeli industries and national agencies. The laboratory goals are further promoted by initiation and participation in activities such as workshops and conferences, which advance public awareness of the need of large-scale desalination for coping with the acute water shortage of Israel and neighboring countries.

Mission of RDL: Meaningful desalination cost reduction is the key to wider use of desalination for improving the quality of life in water-scarce regions

Web site: www.technion.ac.il/rdl/

Suez:

An international industrial and services Group, active in sustainable development, that provides businesses, public authorities and individuals with innovative solutions in energy and the environment. Suez goal is to imagine, design, implement and operate systems and networks in the fields of electricity, gas, water and waste services.

Mission: Delivering the essentials of life

Web site: www.suez-lyonnaise-eaux.fr/indexUK.php

UNESCO Centre for Membrane Science and Technology:

The Centre for Membrane Science and Technology at the University of New South Wales was originally established as a Commonwealth Special Research Centre in February 1988. The Centre has established a network of technical liaison and collaboration in Australia, including various research groups and other Centres within the University of New South Wales, other Universities and Government research organizations.

Mission: - To foster the exchange of information at an international level on the development and application of membranes for the benefit of all.
- To promote the application of membrane science and technology to improve the quality of life, particularly in developing countries.
- To provide training in research and application of membranes for the next generation of science and engineering graduates from developing countries, in Asia and Africa and elsewhere.
- To conduct research and development which will lead to the next generation of membrane-based devices.

- To foster the exchange of information at an international level on the development and application of membranes for the benefit of all.
- To promote fundamental research into membrane processes, particularly at the molecular level, in both living and synthetic systems.
- To provide a permanent vehicle for the interplay between scientists, engineers and students from various countries, particularly from Asia and developing regions.
- To provide a real sense of the concept of the 'Global Village' - solving common problems using a generic technology which is environmentally friendly and biologically inspired.

Web site: www.membrane.unsw.edu.au

Water Science and Technology Association (WSTA):

The concept of formation of WSTA was the result of individual efforts of some of those concerned with water affairs in the Gulf Cooperation Council (GCC) Countries. The Government of Bahrain consented to register the WSTA in Bahrain, and the WSTA was formally founded in September 1987, to be the first scientific association in the field of water science and technology in the Arabian Gulf region. The WSTA membership is open to all water professionals in the GCC, water-related national and international organizations, educational institutes, consultants, and companies.

Mission: Encourage and promote interest in water science and strengthen scientific ties among water professionals in the GCC countries. Encourage scientific research, training programs, and the development of local capabilities in the different fields of water sciences and technology. Act to conserve water and participate in water awareness campaigns leading to optimum utilization of water.

Web site: www.wsta.org.bh