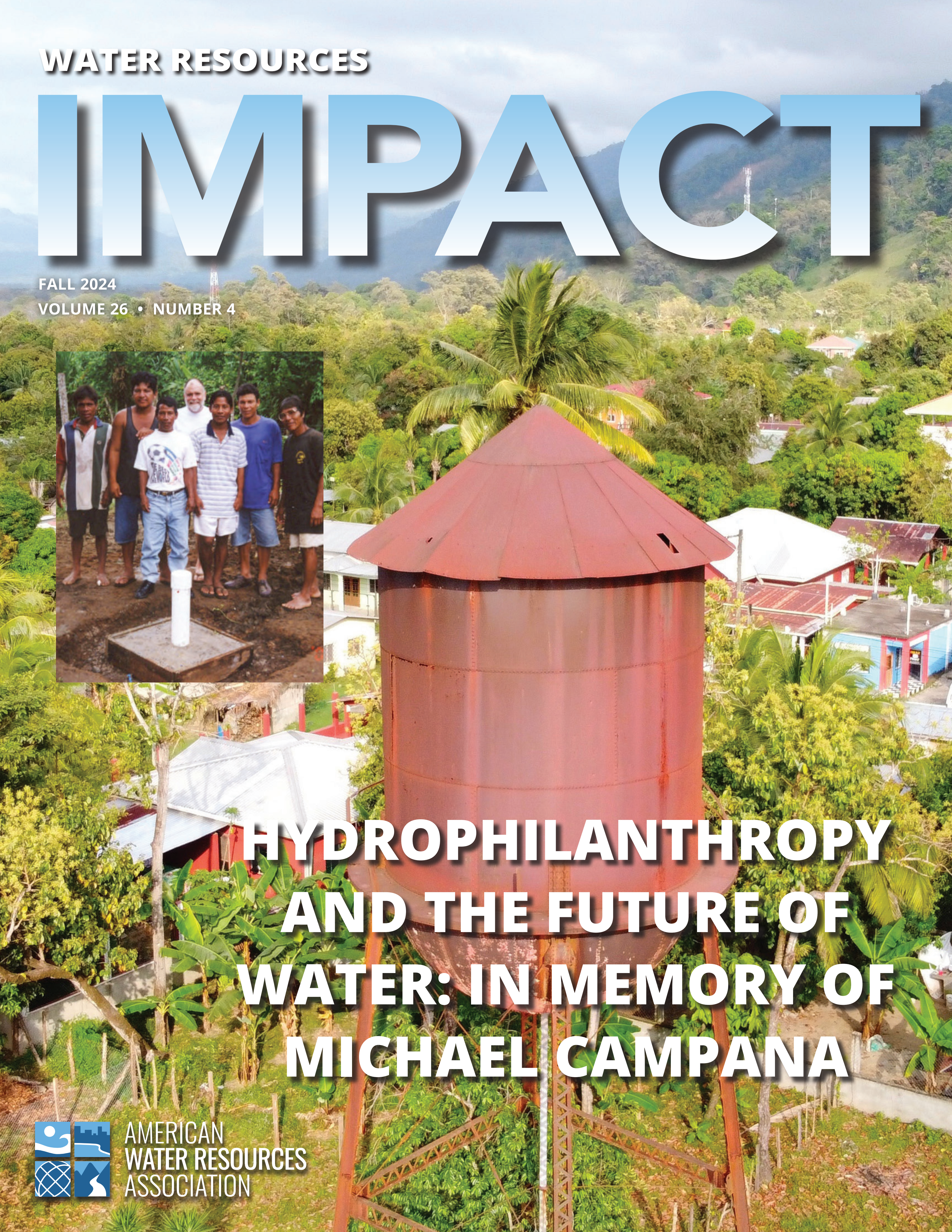


WATER RESOURCES

IMPACT

FALL 2024
VOLUME 26 • NUMBER 4

HYDROPHILANTHROPY AND THE FUTURE OF WATER: IN MEMORY OF MICHAEL CAMPANA

AMERICAN WATER RESOURCES ASSOCIATION

DEAR AWRA MEMBERS,

It is with deep regret and sorrow that we inform you of the passing of our beloved colleague, friend, long-term AWRA member, and past AWRA president (2011), Dr. Michael E. “Aquadoc” Campana. He passed away on August 25 from injuries sustained in a car accident.

We want to express our deepest condolences to the Campana family, especially Michael’s wife, Mary Frances, at this time and acknowledge with gratitude and honor, the incredible volunteer, mentor, scientist, and person he was.

Michael was professor emeritus of hydrogeology and water resources management at Oregon State University and professor emeritus of hydrogeology at the University of New Mexico. He joined Oregon State University in 2009 and also directed the Institute for Water and Watersheds there. Prior to that, he had a long and successful career at the University of New Mexico’s Water Resources Program. He received a doctorate in hydrology from the University of Arizona and conducted extensive research on water resources internationally—notably in Central America, the South Caucasus, and Central Asia—as well as on transboundary water resource issues, water allocation and availability, and related topics. Michael served on a number of federal research committees, was chair of the 10,000-member Association of Ground Water Scientists and Engineers, and participated in many other national and international water research and management initiatives.

Michael was also a passionate student of the natural world and a scientist at heart. He earned a BS in geology from William and Mary in 1970, an MS in hydrology and water resources science from University of Arizona in 1973, and a Ph.D. in hydrology and mathematics from the University of Arizona in 1975.

Michael was a familiar figure at AWRA, and many of us enjoyed his company at AWRA events. His many decades of selfless service and dedication to AWRA are legendary. He was a member of AWRA for over 37 years and contributed thousands of volunteer hours to support the mission and vision of the organization. He served on the AWRA board from 2008 to 2009, was president-elect in 2010, and president in 2011. He was also the AWRA technical director for eight years and editor-in-chief for *IMPACT* magazine. He served as conference chair and conference technical director for more than 15 national and international AWRA conferences.

Michael received numerous awards and honors in his lifetime, including the International Service Award from the U.S. Chapter of the International Association of Hydrogeologists for Outstanding International Contributions in Hydrogeology (2015) and the President’s Award for Excellence from AWRA two times (2013 and 2019). He also received AWRA’s Fellows Award (2021) and Icko Iben Award (2009). In 2022, he was honored by AWRA with the creation of a new award in his name: The Michael E. Campana Emeritus Award, which confers use of the title “AWRA director emeritus” on the recipient. Michael was the first AWRA director emeritus (2022).

In addition to his roles in AWRA, he was past chair of the Scientists & Engineers Division of the National Ground Water Association (NGWA), past president of the nonprofit NGWA Foundation and president and founder the nonprofit Ann Campana Judge Foundation, an organization involved with WaSH (water, sanitation, and hygiene) in Central America. He served on the steering committee of the Global Water Partnership (GWP).

At the Annual Conference in St. Louis, we set up a memorial table with his pictures and a memory book, and we remembered him in many talks during the conference.

Remembrances may be made to the Ann Campana Judge Foundation. Michael started the foundation in honor of his sister, the former travel department head of the National Geographic Society, who was killed in the September 11, 2001, attacks. The foundation has been supporting life changing water and sanitation related projects in Guatemala, El Salvador, Honduras, Panama, and Nicaragua. More about the foundation and giving can be found here: http://www.acjfoundation.org/index.html

Our deepest condolences,
The AWRA Board of Directors and Staff

CONTENTS

About This Issue

Hydrophilanthropy and the Future of Water: In Memory of Michael Campana

GUEST EDITOR

Lisa Beutler
(lisa.beutler@stantec.com)
A senior principal at Stantec, a global engineering firm, where she helps communities and organizations reach decisions and create effective public policy.

The first *IMPACT* issue featuring hydrophilanthropy topics appeared in 2010, the same year the United Nations General Assembly recognized a human right to water. This 2024 issue, originally to be edited by Michael Campana, sought to chronicle the state of hydrophilanthropy today. Dr. Campana was sadly unable to complete this task, but we picked up where he left off, revisiting some of his earlier pieces on the subject. Lisa Beutler provides context with a brief history of the topic, offers a list of current best practices, and suggests hydrophilanthropy may be more widespread than many realize. Then Campana's long-time friend and colleague, David Kreamer, explains how his thinking on the subject has evolved and asks the reader to think about it more broadly. The issue is rounded out by Elaine Hanford providing an inventory of water sources, with a focus on saline water, and Stuart Mitchell discussing AI in water management.

Messages

About the cover: Larger image: An old water tank in Cuyamel, a village in the county of Omoa, Honduras. Our late editor-in-chief Michael Campana frequented this region as a volunteer, first with his students and later through the Ann Campana Judge Foundation. Smaller image: Michael Campana and local indigenous villagers stand behind a finished well in Honduras.
Image sources: Adobe Stock and AWRA

FEATURE ARTICLES

VOLUME 26 • NUMBER 4 • ISSN 1522-3175

PUBLISHED BY

AMERICAN WATER RESOURCES ASSOCIATION

AWRA PRESIDENT

Rabia Ahmed

Principal Economist and Partner
Greene Economics

rahmed@greeneeconomics.com

EDITOR-IN-CHIEF

Michael E. Campana

Professor Emeritus, College of Earth,
Ocean & Atmospheric Sciences
Oregon State University

aguadoc@gmail.com

MANAGING EDITOR

Krysia Wazny McClain

krysia@owleyeedits.com

Water Resources IMPACT is owned and published bi-monthly by the American Water Resources Association, 1440 W Taylor St., #447, Chicago, IL 60607 USA. The single copy digital purchase rate is $17.00 (USD).

IMPACT is a magazine of ideas. Authors, guest editors, and the editor-in-chief work together to create a publication that will inform and provoke conversation. The views and conclusions expressed by individual authors and published in *Water Resources IMPACT* are their own and should not be interpreted as representing the official policies, either expressed or implied, of the American Water Resources Association.

Mention of any trademark or proprietary product in works published in the *Water Resources IMPACT* does not constitute a guarantee or warranty of the product by the American Water Resources Association and does not imply its approval to the exclusion of other products that may also be suitable.

Contact the AWRA HQ office if you have any questions pertaining to your membership status. For information on advertising rates and deadlines, contact info@awra.org.

SUBSCRIPTION RATES

Water Resources IMPACT

SINGLE DIGITAL
COPIES AVAILABLE

$17.00 (USD)

DESIGN AND LAYOUT:
The MPX Group

PUBLISHED Fall 2024/AWRA

Have Questions About *IMPACT*? Contact AWRA HQ
540-687-8390, Fax 540-687-8395
info@awra.org, www.awra.org

PRESIDENT'S MESSAGE

Rabia Ahmed, AWRA 2024-25 President

Michael Campana in his element at an AWRA conference several years ago. Source: AWRA

DEAR AWRA MEMBERS,

This past summer, we lost a titan of our community, and of this magazine in particular, in the form of Michael Campana. Michael was a beloved colleague and friend to so many of us here at AWRA: he was a past president of the organization (2011) and contributed thousands of volunteer hours to its mission over his 37 years as a member. Those hours included many contributing to *Water Resources IMPACT*, first as technical editor and then editor-in-chief. In thanks for that work, and all that he represented, we dedicate this edition of *IMPACT* to his memory.

As you will read in these pages, Michael was a dedicated proponent of what he called hydrophilanthropy. He was also an enthusiastic practitioner of this idea. In his roles as professor, researcher, funder, and volunteer, he tirelessly supported and led efforts expanding access to water and water knowledge. We have republished his three articles on hydrophilanthropy here, and together they tell the story of how Michael's understanding of this work deepened over years of experience and relationships with local communities, as well as with other practitioners. We have also published an article by David Kreamer, who first coined the term hydrophilanthropy for Michael and who worked closely with him his entire career.

Finally, this issue expands to other water resources topics of pressing concern, including how much drinkable water we have left (and how to measure it), as well as how AI can help us predict water loss before it is otherwise detectable.

For the last several years, this magazine has existed largely through Michael's tireless contributions. His loss will be felt keenly in coming issues, and we hope this retrospective of his work may be a fitting remembrance, as well as a balm in challenging times.

At a personal level for me, he was someone I loved connecting with as a friend, mentor, and fellow Pacific Northwesterner whom I could openly discuss ideas and issues with. While it is impossible to capture in a few paragraphs, please read more about Michael's life and achievements earlier in this issue as part of the official announcement from AWRA. We miss you, Aquadoc! ■

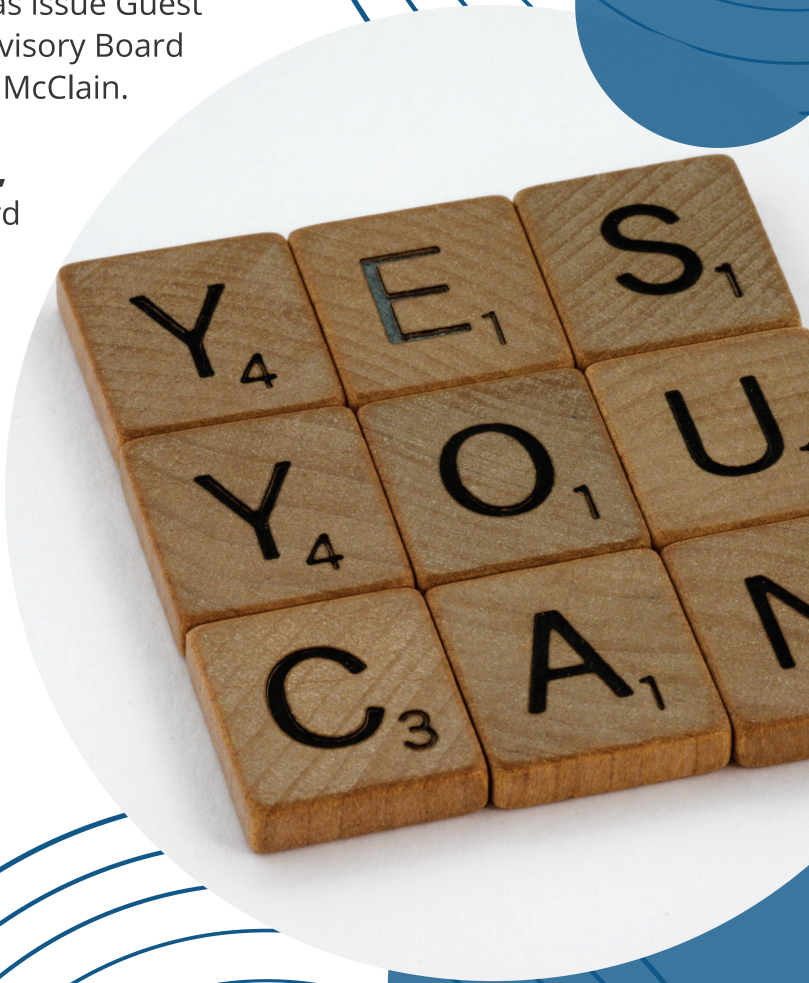
Kind regards,
Rabia Ahmed

WATER RESOURCES IMPACT

DO YOU WANT TO HAVE AN *IMPACT* ON AWRA?

***Water Resources IMPACT* is a gem that other societies can only dream of**. It is a bimonthly magazine that features short (c. 1500 words) articles on a common theme crafted by experts in a conversational style. It attracts those who want to learn things that may be important to them but need just a basic understanding as opposed to a deeper “expert” understanding - one that might be found in JAWRA (*Journal of the American Water Resources Association*).

We seek AWRA members who wish to help us assemble six issues annually by serving as members of the *IMPACT* Advisory Board. You will be asked to propose issue themes, solicit authors and articles, review articles and serve as issue Guest Editors. Advisory Board members will assist Advisory Board Chairs, and our Managing Editor, Krysia Wazny McClain.



In keeping with our **commitment to Diversity, Equity, and Inclusion (DEI),** our Advisory Board will be selected with that in mind. Advisory Board members must be AWRA members from any category while on the Board. Terms will be three years, with members eligible for reappointment by the AWRA President. Meetings will be quarterly, usually by phone or online. On rare occasions in-person meetings may be held, typically during an AWRA conference.

If you want to **assume an active role** in AWRA by helping to maintain the high standards of *Water Resources IMPACT*, we'd love to hear from you.

Learn more online or contact:
Lisa Beutler
lisa.beutler@stantec.com

AWRA 2024 Award Recipients

Dr. Sharon B. Megdal
Fellow Award

The AWRA Fellow Award recognizes an AWRA member with an eminent record in some branch of water resources science and technology. To be selected as a fellow, an individual must have also been a member of the association for at least 10 consecutive years, and served in an official capacity on its committees or in the organizational leadership.

Only granted periodically, this distinction was given to Sharon B. Megdal in 2024. She serves as the director of the University of Arizona Water Resources Research Center (WRRC), a Cooperative Extension center and a research unit in the College of Agriculture, Life & Environmental Sciences. Her other primary titles include professor and specialist in the Department of Environmental Science, C.W. & Modene Neely Endowed Professor, and distinguished outreach professor at the Institute for Food, Water, and Energy Security. She also holds a role as an ex officio member of the Leadership Team for the Colorado River Basin Water & Tribes Initiative.
In May 2023, Megdal was appointed to Governor Hobbs' Water Policy Council. Recent professional service includes serving for 12 years as a popularly elected director for the Central Arizona Project, the board of directors for the American Water Resources Association, and board president for the International Arid Lands Consortium. She was a member of the University of Arizona Presidential Advisory Commission on the Future of Agriculture and Food Production in a Drying Climate, which published its report in August 2023. Megdal has served on numerous Arizona boards and commissions, including the Arizona Corporation Commission, the State Transportation Board, and the Arizona Medical Board.

Megdal aims to bridge the academic, practitioner, and civil society communities through water policy and management research, education, and engagement programs. The geographic scope of Megdal's work ranges from local to international. Applied research projects include analysis of water management, policy, and governance in water-scarce regions, groundwater recharge, and transboundary aquifer assessment. She is the lead editor of the book, Shared Borders, Shared Waters: Israeli-Palestinian and Colorado River Basin Water Challenges. She has guest edited several special journal issues, the most recent entitled "Advances in Transboundary Aquifer Assessment." Megdal also teaches the graduate course "Water Policy in Arizona and Semi-Arid Regions." In 2020, she was awarded the Warren A. Hall Medal for lifetime achievement in water resources research and education by the Universities Council on Water Resources. In 2023, she was named a University of Arizona Woman of Impact. In 2024, she received the "Salt of the Earth" award from the Multi-State Salinity Coalition.

She holds a Ph.D. degree in economics from Princeton University.

Dr. David Wunsch
Henry P. Caulfield, Jr., Medal for Exemplary Contributions to National Water Policy

The Henry P. Caulfield, Jr., Medal for Exemplary Contributions to National Water Policy recognizes an individual who has achieved an enduring status of eminence in shaping national water policy. To receive the medal the recipient must be one whose record of achievements in setting, designing, and/or implementing water resources policies at the national level is extraordinary, and the individual's contributions to the wise use of the nation's water resources must be of an exceptional nature.

This year's highly deserving recipient is David Wunsch. His career as a water resources policy champion began in 1985 when he served as the coordinator of the Kentucky Geological Survey's coal-field hydrology program, focused on mine hydrology and reclamation. In 2000, he was appointed state geologist and director of the New Hampshire Geological Survey, and after 10 years he became the director of science and technology at the National Ground Water Association, where he served in the capacity of scientific liaison between the association and government agencies, international organizations, and NGOs. He assisted the Government Affairs Program with research, litigation preparation, and representation in Congress. Since 2011, he has been the state geologist and director of the Delaware Geological Survey.

Wunsch has volunteered time and expertise throughout his career promoting water policy and resource management. Beginning in 1998, as the first American Geological Institute Congressional Science Fellow, he worked as a science advisor to

Congress. He was a founding member of the Advisory Committee on Water Information's Subcommittee on Groundwater, a co-author of the framework document for the design of a national groundwater monitoring network and has twice testified before the U.S. Senate in support of the SECURE Water Act, which established the National Groundwater Monitoring Network. A few of his contributions to and service in the water sector include the Delaware Water Supply Coordinating Council, the governor's representative and principal to the Advisory Committee to the Delaware Office of the River Master, the New Hampshire Water Well Board, the High Plains Aquifer Forum planning committee, and the Bureau of Ocean Energy Management Central Intergovernmental Renewable Energy Task Force. He has served as president of the American Association of State Geologists, president of the American Geosciences Institute, and on the board of the Scientist and Engineer's Division of the National Ground Water Association. He is a Geological Society of America fellow.

Wunsch is a faculty member at the University of Delaware and has been an adjunct assistant professor at the University of New Hampshire and the University of Kentucky and a visiting scholar at Dartmouth College. He has published over 70 professional papers and abstracts and presented lectures and short courses on water policy and water-related issues. He was a co-author of the National Academy of Science report "Coal Waste Impoundments: Risks, Responses, and Alternatives" and a peer reviewer of the report "Future Water Priorities for the Nation: Directions for the U.S. Geological Survey Water Mission Area." He was selected as a Special Consultant for the U.S. Department of State through the U.S. Water Partnership, Southeast Asia Groundwater Forum, and a recipient of the John C. Frye Award in Environmental Geology and the American Geosciences Institute Award for Public Understanding of the Geosciences.

Kenneth O. Slattery

Mary H. Marsh Medal – Exemplary Contributions to the Protection and Wise Use of the Nation's Water Resources

Named for a long-time AWRA officer and pioneer at the St. Anthony Falls Laboratory, interdisciplinary fluid mechanics research lab and educational facility at the University of Minnesota, this award recognizes an individual who has achieved a status of eminence in some aspect of public service related to water resources education and/or management. The individual chosen for this award must be one whose record of extraordinary achievements include: setting, designing, influencing, and/or implementing water-related policies, practices, or programs at the national, state, or local government level. Contributions must have been sustained over time and the individual's contributions to the wise use of the nation's water resources recognized as of an extraordinary nature.

This year's recipient is Kenneth O. Slattery. Among his accomplishments, Slattery's worked resulted in recognition that instream flows must be protected in the FERC licensing process, per the federal Clean Water Act. His quest to protect these waters began during the small hydro boom in the 1980s to '90s. Slattery, who then worked at Washington Department of Ecology Water Resources Program, asserted his understanding of the Clean Water Act was correct and must be reflected in the FERC license. One of the applicants for a hydropower license on the Dosewallips River, Tacoma Power, appealed the instream flows on the FERC license. The appeals went all the way to the U.S. Supreme Court, where the court ruled in favor of Slattery's approach (rather than the merely advisory status of recommendations to FERC with FERC having final discretion on instream flows).

Slattery's proposal changed how hydro projects are licensed throughout the U.S., giving authority to the state water quality agency to determine how much water must be left in the stream or river to protect the aquatic environment. His contributions have also been recognized by the Instream Flow Council.

Slattery began his career in the Water Resources Program, which he eventually led, of the Washington Department of Ecology, and now serves as a director of the Washington Water Trust. He holds a degree in geography from Western Washington University.

AMERICAN WATER RESOURCES ASSOCIATION

AWRA 2024 Award Recipients

California Department of Water Resources

Sandor C. Csallany Institutional Award – Exemplary Contributions to Water Resources Management

Named for AWRA's founder, this award recognizes a water resources institution that has achieved a status of eminence in some aspect of managing the nation's waters.

This year's recipient, the California Department of Water Resources (DWR), being among the first water resources management agencies to recognize climate change as a threat to its mission of sustainably for the state's water resources, developed a comprehensive climate action plan (CAP).

DWR operates a multipurpose water storage and delivery system, referred to as the State Water Project, which serves 27 million Californians, 750,000 acres of farmland, and supports an economy with a gross domestic product (GDP) surpassing $2.3 trillion. The project also supports the full-time employment of over 8.7 million individuals. The State Water Project service area would be the world's eighth largest economy if it were its own nation. As a result, the CAP has far-reaching impacts well beyond DWR.

As an early actor to develop a CAP, DWR did not have models to emulate in this process, nor a dedicated budget to implement it. Rather, using existing resources and staff, DWR was able to iteratively develop all three phases of the CAP. Furthermore, DWR engaged outside experts to help fill knowledge gaps and provide novel perspectives on developing solutions. Beginning in 2012, Phase I established a plan to aggressively reduce the emission of greenhouse gases (GHGs) to mitigate the impacts of climate change. Developing a baseline against which reductions and effective strategies were measured against, Phase I is periodically updated (most recently in 2023) to align with changes in markets, technologies, and policies.

A 14-member scientific advisory group representing a diverse area of expertise in climate science, known as the Climate Change Technical Advisory Group, provided guidance on Phase II, released in 2018. Phase II established a process to complete a climate change analysis in project planning and determining the level of climate resilience to be built into the project. This consistent screening and review approach ensures appropriate fit-for-purpose climate considerations.

Phase III is comprised of the Vulnerability Assessment released in 2019, and the Adaptation Plan released in 2020. The Vulnerability Assessment is noteworthy in its breadth of quantitative assessment of risks in addition to its qualitative aspects. Similarly, the Adaptation Plan is unique in its approach, applying adaptation strategies that are flexible and subject to periodic review and adjustment as needed.

Integrating all three phases into one exhaustive plan that mitigates GHGs, aligns climate change analysis, and provides an overview of DWR vulnerability and its adaptation strategies bolsters its response to a changing climate.
DWR has received numerous national awards in recognition of these accomplishments.

Florida Gulf Coast University AWRA Student Chapter

N. Earl Spangenberg Outstanding Student Chapter Award

The Student Chapter Award is given each year to recognize an AWRA Student Chapter that has provided outstanding service in the furtherance of the association's objectives. It is name in honor of an AWRA Past President N. Earl Spangenberg, who formed the first student chapter of AWRA at the University of Wisconsin - Stevens Point. He was a teacher, mentor, guide and resource to thousands of water professionals, not only at UWSP but through his many activities within AWRA. He was also a longtime Editor-in-Chief of Impact.

This year's recipients, The Florida Gulf Coast University AWRA Student Chapter proves year after year how much they are dedicated to water resources education. Chapter members organize speakers, lectures, field trips, and service-learning opportunities for students with a passion for water resources. Their value on FGCU expands yearly as they bring more students into the chapter and hydrology research on campus and all it has to offer. The chapter guides many field trips each year to teach students about the history and current topics of Southwest Florida Water Issues. Their footprint reaches beyond the water school as students from other departments join in their activities.

North Carolina State Section
Outstanding State Section Award

Often among the most competitive of the awards, the Outstanding State Section Award is given each year at the AWRA Annual Water Resources Conference in recognition of an AWRA State Section that has provided outstanding service in the furtherance of the association's objectives. The North Carolina State Section (NCWRA) received the 2024 top honors. The section has consistently proven itself to be one of the most impactful state sections under the AWRA umbrella.

NCWRA embraces the motto "Join the Conversation" by holding three to four Luncheon Forums annually to educate and engage members on current water resources topics with subject matter expert presentations, active Q&A, and open discussion of the issue at hand. NCWRA also hosts at least one workshop annually to deep dive into a particular water resources topic. This year's was on "The Challenges of Urban Stream Management & Restoration." NCWRA partners actively with the NC Water Resources Research Institute to develop the program for and host the annual NC WRRI conference. In 2023, NCWRA hosted the AWRA Annual Conference right here in Raleigh. NCWRA board members and active regular members contributed countless hours of time to develop the program for and host the successful Annual Conference.

California Flood-MAR Network
Integrated Water Resources Management Award

An integrated water resources management (IWRM) approach has been a hallmark of AWRA since its establishment in 1964. This award recognizes outstanding IWRM teamwork on a complex water resources effort. The project chosen for this award must be representative of a team representing multiple disciplines and have developed a common project mission with defined responsibilities and collaboration to achieve a water resources management objective organized around IWRM principles. The award is only conferred after the recommendation of AWRA's IWRM Technical Committee.

The award recipient, the California Flood-MAR Network, has worked to marshal a broad diversity of interests, organizations, and expertise toward next-level integrated water resources management. Using floodwaters for managed aquifer recharge, or "Flood-MAR," is a climate adaptation that uses one challenge, flood events, to solve another challenge, groundwater overdraft. As the urgency of California's drought and flood challenges has grown in recent years, so too has the energy to expand Flood-MAR. Central to much of the progress has been the Flood-MAR Network (www.floodmar.org). For the past five years, this group of Californians, who work for the state, local public agencies, universities, nonprofits, federal agencies, businesses, and who manage private and public land, have worked together to make Flood-MAR a prominent water resources management strategy, particularly in the Central Valley. The pace at which the practice of Flood-MAR has advanced in California is testament to the power of integrated water management, collaborative action, and how innovation and opportunity can drive rapid transformation. This collaboration is putting California on track in addressing the worsening problems of flooding, drought, ecosystem decline, and water storage under a changing climate.

AWRA Honorary Member Award
A. Pouyan Nejadhashemi

First presented in 1966, the AWRA Honorary Member Award is the oldest of AWRA's awards. Election as Honorary Member in AWRA recognizes an individual who has obtained acknowledged eminence in a branch of water resources science and technology. A. Pouyan Nejadhashemi has achieved that distinction. Holding the prestigious University Foundation Professorship in both the Department of Biosystems and Agricultural Engineering and the Department of Plant, Soil and Microbial Sciences, he earned his Ph.D. from the University of Maryland in bioenvironmental and water resources engineering. At Michigan State University, he directs a multidisciplinary team pioneering an ecosystem-centric approach to resolving water resource challenges. He also directs the Decision Support and Informatics Unit alongside the Center for Intelligent Water Resources Engineering. Nejadhashemi has secured over

$41 million in grants as a principal or co-principal investigator. His expertise is globally recognized, with numerous international agencies seeking his team's advice on water management and climate change. An author of more than 140 peer-reviewed articles, he has held board positions in several top journals and delivered over 190 presentations at conferences worldwide.

Dr. Marie Garcia
Icko Iben Multidisciplinary Communications Award

The Icko Iben Award recognizes people who have made outstanding contributions in promoting communication among the various disciplines concerned with water resources issues. This year's awardee, Marie Garcia, is a postdoctoral fellow at Wayne State University in the department of Civil and Environmental Engineering. Originally from Corpus Christi, Texas, Garcia obtained a bachelor's degree in marine biology and a master's degree in marine resources management degree from Texas A&M University in Galveston. Garcia earned her Ph.D. from Texas A&M University in water management and hydrological science, focusing on multidisciplinary water issues (especially around the Colorado River). She focuses on key topics such as water conservation, climate change, water planning, and financing state water projects. Garcia strives to communicate with communities in terms that they can understand and without the use of technical jargon. She notes, "If people don't understand what it is we're asking them to do or why, then they're not going to do it."

Effective communication and community engagement are some of the cornerstones of Garcia's work leading a diverse group of resident watershed planners in creating the first ever Detroit River Watershed Management Plan. In addition to working with residents, Garcia presides over the steering committee and technical team facilitating productive conversations about components of the watershed management plan.

The Communications Award honors the late Icko Iben, a co-founder of AWRA, who during his lifetime contributed extensively toward improving the understanding and communication among those involved in the diverse disciplines related to water resources.

Daniel Schroeder
William C. Ackermann Medal for Excellence in Water Management

Given annually, or at such time as qualified candidates are identified and nominated, this award goes to an individual who has achieved a status of eminence in the design and/or implementation of exemplary water management practices at the state, regional, or local government level. Particular consideration is given to those who have put into operation nontraditional practices for managing water resources.

Daniel Schroeder was selected to receive the award for 2024. He works as a Civil Engineering Manager in Southwest Florida. After gaining a bachelor's degree in civil engineering in 2009 at the Florida Gulf Coast University (minoring in environmental engineering), he gained a master's degree in sustainable water engineering in 2021 at the same institution. During his postgraduate studies, he published three articles in the Desalination and Water Treatment Journal and one article in the journal Water. Schroeder's engineering project experience over the past 16 years includes water quality improvement, flood mitigation and stormwater storage solutions, hydrologic and hydraulic modeling, GIS database management, and hydrologic and ecosystem restoration. He has received the Engineer of the Year for the ASCE FL Southwest Branch (2024), the ACEC FL Engineering Excellence Honor Award for the West Harns Marsh Preserve project (2019), and the ASCE FL Southwest Branch Sustainable Project of the Year for the Caloosahatchee River Estuary Storage & Treatment project, Phase 3 (2024). Schroeder has successfully led the implementation of several prominent stormwater retrofit, flood mitigation, and ecosystem restoration-type projects in Southwest Florida. Together with innovative technologies, his water management strategy includes multi- benefit functionality to serve a diversity of stakeholders. Combining the trifecta of flood mitigation provision, nutrient removal benefits, and passive recreational amenities has yielded a track record of grant-funded and award-winning water management projects.

Rachael Taggart

The A. Ivan Johnson Award for Young Professionals

This award recognizes and encourages young professionals as the future leaders of water resources research, management, and education. Candidates are young professionals who have demonstrated outstanding achievements, talents, and leadership potential through their professional activities related to water resources. This year's awardee was Rachel Taggart. Rachel joined ATM (a Geosyntec Company) in February 2022 to provide technical assistance on complex water resources projects. She possesses strong computer, statistical analysis, and modeling skills and has experience in numerous stormwater modeling applications and engineering design software. She prepares engineering specifications and reports and provides overall project QA/QC.

The award is named for a former Chief of the National Water Resources Division Training Center and 1972 AWRA president, A. Ivan Johnson. At the training center several thousand individuals from USGS, other federal agencies, cooperating agencies, and from foreign countries studied under Ivan's leadership. Ivan was a hands-on leader. He made the effort to meet every student. His influence on young water resources professionals was outstanding and far reaching.

JAWRA AWARDS

JAWRA
Journal of the American Water Resources Association

The Journal of the American Water Resources Association (JAWRA) publishes original research that examines the multidisciplinary and complex issues surrounding water resources. Papers often cover the topics of recent AWRA conferences such as riparian ecology, geographic information systems, adaptive management, and water policy.

JAWRA has significant reach. In 2023, articles received nearly a quarter million full views, and the journal achieved one of the best citation rates of journals in its category.

The association offers two JAWRA-related awards. The Boggess Award was established by AWRA in 1973 to honor the author of the best paper published in the Journal of the American Water Resources Association during the previous year. The award was established to honor William R. "Randy" Boggess, a charter member of AWRA, one of the first directors, a past president of the association, and a former JAWRA editor.

The Lanfear Award was established by AWRA in 2020 to recognize the author(s) of an outstanding technology-related paper published in the journal during the previous year. The award honors Ken Lanfear's distinguished contributions to the field of water resources technology and the success of JAWRA, as well as his contributions advancing cutting edge water resources technology systems at the U.S. Geological Survey (including the use of GIS and posting real-time streamflow data). In addition to being a long-time distinguished editor of JAWRA, Lanfear is also an AWRA past president.

William R. "Randy" Boggess Award

"Near-Term Forecasts of Stream Temperature Using Deep Learning and Data Assimilation in Support of Management Decisions"

Authors: Jacob A. Zwart, Samantha K. Oliver, William David Watkins, Jeffrey M. Sadler, Alison P. Appling, Hayley R. Corson-Dosch, Xiaowei Jia, Vipin Kumar, and Jordan S. Read
Deep learning models can ingest real-time observations to make forecasts with associated uncertainty to aid in decision making about releasing water from drinking water reservoirs. The paper's lead author, Jacob Zwart, works within the USGS Data Science Branch of the Water Resources Mission Area to develop aquatic ecosystem modeling techniques that provide timely information to stakeholders about important water resources across the nation. He uses his expertise in computational modeling, data assimilation, and limnology to help produce short-term forecasts of water quality at regional scales to aid in water resources decision making. Zwart's research themes are:

1. Improve understanding of aquatic biogeochemical processes and predicting how these processes may respond to future global change
2. Develop techniques to inject scientific knowledge into machine learning models to make accurate predictions of environmental variables (also known as "knowledge-guided machine learning"), and
3. Advance methods for assimilating real-time observations into knowledge-guided machine learning models to improve near-term forecasts of water quality.

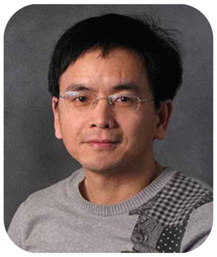
Zwart also serves as a peer support worker at USGS, promoting awareness and education on topics and USGS policies for antiharassment, discrimination, biases, and scientific integrity, as well as providing peer-to-peer support for USGS employees.

Dr. Cydney K. Seigerman
Kenneth J. Lanfear Award for Outstanding Technology Paper in JAWRA

"Operationalizing Equity for Integrated Water Resources Management"
Authors: Cydney K. Seigerman, S. Kyle McKay, Raul Basilio, Shelly A. Biesel, Jon Hallemeier, Andressa V. Mansur, Candice Piercy, et al.

This paper offers pragmatic responses to four common barriers to including social equity in standard water resources planning and management practices. Lead author Cydney K. Seigerman earned their Ph.D. in integrative conservation (ICON) and anthropology in April 2024. Their dissertation, entitled "Fluid Inequities: The Dynamics of Water Relations and Water Insecurities in Ceará, Northeast Brazil," explores how socionatural (i.e., interrelated sociopolitical, environmental, and technological) processes shape and are shaped by the lived experience of water insecurity in the semi-arid region of Ceará, Brazil. Seigerman is currently a postdoctoral scholar on the Human Dimensions of Climate Smart Agricultural Practices project with Jennifer Jo Thompson in the Department of Crop and Soil Sciences at UGA. They are researching the social dimensions of climate smart agricultural practices by small commodity farmers in the U.S., projects funded by the USDA.

Zhenxing "Jason" Zhang
AWRA President's Award



The AWRA president confers this award to recognize a person that has made significant contributions in the betterment of the association.

President Rabia Ahmed selected Zhenxing "Jason" Zhang as the 2024 award recipient. Zhang is an associate research scientist at the Illinois State Water Survey, Prairie Research Institute, University of Illinois Urbana-Champaign, where he is an engaged researcher at the Net-Zero Center for Excellence, and an affiliate at the Construction Engineering Research Laboratory, U.S. Army Corps of Engineers. Zhang is the immediate past president of AWRA and a former member of its board of directors. He is also a member of the board of directors of Chinese American Water Resources Association. And an associate editor for the Journal of Hydrology, JAWRA, and Earth Science, Systems and Society. He obtained bachelor's degree in environmental planning and management from Wuhan University, a master's degree in environmental science from Peking University, a master's degree in applied statistics from Syracuse University, and a Ph.D. degree in water resources engineering from the State University of New York College of Environmental Science and Forestry. Zhang is a licensed professional engineer and professional hydrologist, and he has published over 60 peer-reviewed journal papers. He collaborates with water resources professionals and scientists nationally and internationally on addressing sustainability challenges in a changing world.

The Hydrophilanthropist in Your Neighborhood

Lisa Beutler

UNDER THE EDITORIAL GUIDANCE OF MICHAEL CAMPANA, the first *IMPACT* issue featuring hydrophilanthropy topics appeared in 2010, the same year the United Nations General Assembly recognized a human right to water. This principle, affirming that everyone has a right to clean, safe, affordable, and accessible water for drinking, cooking, and sanitation, is far from fulfilled. Today, one in four, or around 2 billion people, lack access to safe drinking water, and approximately 3.6 billion people—46% of the world's population—lack adequate sanitation services. Of those, more than two million Americans live without running water and basic indoor plumbing, and many more without sanitation.

For decades, hydrophilanthropy—combining water access and philanthropy—has been a critical focus of governments and organizations striving to realize the human right to water issue. The 2010 *IMPACT* issue recorded the rise of new and expanded approaches to deliver this right. Michael Campana and David Kreamer (who coined the term "hydrophilanthropy") promoted "a flexible, open-minded approach to the description of hydrophilanthropy and its attributes, a definition that includes many diverse activities and practitioners who advance the sustainability of clean water in the world."

Kreamer explains that the definition was intentionally broad, incorporating donations of time, money, and effort into a central, unifying theme, particularly when good works and resources were directed at those in need. Professors Campana and Kreamer asserted hydrophilanthropy should include "initiating and sustaining educational efforts in water and pollution and building capacity by teaching the public and creating new water scientists and engineers in regions with few resources." Furthermore, with this broad definition, if not you, at least one of your coworkers or even your neighbor is already a hydrophilanthropist.

Rethinking Hydrophilanthropy

As Campana and Kreamer began advancing their views on ways the water sector might approach the topic, a widely publicized and controversial 2010 essay by Ned Breslin, the then CEO of Water For People, called into question the way charities and governments provided assistance. He asserted that simply funding projects was often ineffective, then demonstrated his point by quoting International Institute for Environment and Development (IIED) reports that a "catastrophe" is spreading across Africa. IIED found that 50,000 rural water points were broken and a $215–360 million investment wasted because of poor programming and careless implementation. Breslin then backed these numbers with a list of similar, credible studies that came to the same conclusion.

These statistics as well as their own experiences informed the thinking of water professionals. As Dr. Campana was known to say, "The next time you see an ad for a water charity featuring a cute, dark-skinned child and a deep-voiced announcer who says, 'Last year, we drilled 50 wells in Terra Buena and one was in Rosa's village,' you need to ask, 'How many of those wells are still working?'"

Breslin made a similar observation, even going a step further, by illustrating how the then current approaches could be decapacitating. He tells the story of a woman walking slowly past a broken handpump, on her way to and from that scoop hole or dirty puddle that she once hoped would never again be part of her life then sadly commenting, "The broken handpump is a constant reminder of our inability to escape from poverty."

The introduction of sustainability as a success measure changed the way many hydrophilanthropists approached water and sanitation projects. In doing this the goal of hydrophilanthropy expands to not only supplying water and sanitation but to ensuring that these solutions are sustainable, equitable, and environmentally responsible. It is a long-term approach that goes beyond simple charity, aiming to address the root causes of water scarcity and contamination in the world's most impoverished areas.

A sample review of researchers and other writers on the topic found common threads in the lists of best practices going forward. Stephan Elizander Przybylowicz, in a 2011 University of Arizona Water Resources Research Center article, offered a useful list. He proffered that successful projects tend to share some of five important characteristics:

1. Local partnerships
2. Community involvement
3. Education (ensuring communities understand proper hygiene techniques (handwashing, toilet use, etc.) & training in the repair and maintenance of the technology)
4. Simple local technology (possible to repair locally with tools and parts easily available to the community at low cost)

5. Monitoring and evaluation (requires long-term commitment and measurement of years the technology continues to achieve its goals)

Breslin described potential water supply sustainability measures as being based on water quality, household water quantity, days operable/non-operable, and number of users per access point. For long-term financial sustainability he suggested performance be measured over time as:

- **3 years** following completion—money is available for repairs; repairs are happening; and the account is well managed.
- **6 years** following completion—money is available to replace the most expensive part of the system.
- **10 years** following completion—money is available to replace the entire water system.

CASE STUDY: Your Neighborhood Hydrophilanthropist—The Local Rotary Club

Beyond financial contributions, engaging in hydrophilanthropy may be more widespread than many realize. In addition to faith-based organizations, local Rotary Clubs have emerged as key players in supporting water-related sustainable development projects that reflect the best practices and philosophical approach described by Przybylowicz and Breslin.

Although the Rotary, like other service organizations, has declined in membership, it still maintains a significant presence in many communities and over 200 countries. A non-partisan, non-religious organization, it focuses on promoting peace, fighting disease, providing clean water, supporting education, and alleviating poverty. The club's motto, "Service Above Self," reflects its commitment to helping those in need through volunteerism and community-based projects.

Rotary has been involved in numerous initiatives aimed at improving access to safe water, building sanitation infrastructure, and promoting hygiene education for nearly four decades. They combine financial support, volunteer work, and technical expertise to ensure that water projects are sustainable and effective. This begins by working with local communities to design solutions that are appropriate for the specific needs of each area. Sample projects the Rotary has supported include:

1. Clean Water Access Initiatives

These initiatives include projects to help install wells, hand pumps, and gravity-fed water systems in rural villages that lack reliable water sources. Projects like these can be life changing as they reduce the distance people need to travel to fetch water.

2. Sanitation and Hygiene Education

Understanding that in many regions, waterborne diseases are prevalent due to poor sanitation, Rotary places a strong emphasis on sanitation and hygiene education. They use water, sanitation, and hygiene (WASH) programs to teach communities about the importance of safe water storage, proper handwashing, and the construction of latrines. This approach has dramatically reduced the spread of waterborne diseases in several countries.

3. Water Resource Management

Rotary also promotes practices that improve water resources efficiency by promoting rainwater harvesting, development of water catchment systems, and maintenance of water supply systems.

4. Emergency Water Relief

Rotary has played a pivotal role in providing emergency water relief during crises. As an example, Rotary may work to quickly install temporary water filtration systems and provide bottled water to affected populations to provide immediate relief and help reduce the spread of disease during disaster recovery.

Sustainable Impact: A Long-Term Vision

Rather than simply providing aid, Rotary designs its projects to be long-term solutions. In their view, the key to this approach is local involvement and ownership. Rotary ensures that community members are trained to maintain the water systems and sanitation infrastructure, empowering them to manage their resources in a sustainable manner.

Rotary's commitment to monitoring and evaluation ensures that each project is effective and meets its goals. Regular assessments allow for adjustments and improvements, ensuring the continued success of the initiatives.

The Role of Partnerships in Rotary's Water Projects

Rotary's hydrophilanthropy leverages the efforts of other organizations, both governmental and nongovernmental and local and international. In some cases, Rotary works with corporations to secure technology and expertise, helping to implement cutting-edge water filtration or desalination solutions. Collaboration and partnership increase the reach and impact of Rotary's projects and help ensure that resources are used efficiently.

Overcoming Barriers

The Rotary works to address a range of barriers including:

Physical: Rugged terrain or lack of infrastructure can make it difficult to install water systems.

Climate Change: Changing weather patterns, including droughts and floods, can affect the availability of water resources.

Cultural: Cultural beliefs or a lack of awareness may create resistance to new water technologies or sanitation practices.

To address barriers, Rotary adapts its projects to local contexts, ensuring that solutions are culturally appropriate and that the community is engaged in the process from the start.

Creating a Legacy

In conversations with volunteers participating in hands-on hydrophilanthropy, they often describe it as a life-changing experience for both themselves and the receivers. My very last conversation with Dr. Campana was about a hydrophilanthropy project he was shepherding in Honduras. He was particularly excited about the growing capacity of his local points of contact to carry out his vision and make enduring change. He always understood that hydrophilanthropy is more than just providing water—it is about creating lasting change and improving the overall quality of life. By combining his role as an international water leader with philanthropy, innovation, and local engagement, he was able to advance a future where safe, clean water is a right, not a privilege, for all people. His efforts created an enduring legacy worthy of emulation.

Note: To learn more about Rotary's water initiatives or to get involved in supporting their efforts, visit Rotary's website or reach out to your local Rotary Club. ■

Lisa Beutler (lisa.beutler@stantec.com) is a senior principal at Stantec, a global engineering firm, where she helps communities and organizations reach decisions and create effective public policy. A past president of AWRA, earlier in her career she was a land manager overseeing 500,000 acres of real property including forest, minerals, and grazing lands. Prior to coming to Stantec she served as the associate director of the Center for Collaborative Policy at Sacramento State University.

FEATURE

The Unseen Undercurrent of Hydrophilantropy

David K. Kreamer

Various sessions of the groundwater modeling course in Niamey, Niger. Source: Author

LAST JUNE, DR. MICHAEL CAMPANA ASKED ME TO WRITE *an article for this* Water Resources IMPACT *issue on hydrophilanthropy. We were friends since we were in graduate school together at the University of Arizona and interacted a lot through the years, particularly discussing our work in other countries. Almost 20 years ago, in a conversation, I called him a hydrophilanthropist, a term I had made up, and he became very enamored of the word. Mostly on Michael's initiative there followed sessions on hydrophilanthropy at conferences, articles on the topic, and organized discussions. Michael and I both did work overseas, seeking to augment clean water to low-income communities, but he always went beyond. When his sister, who worked with the National Geographic Society, was tragically killed on 9/11 when her plane went into the Pentagon, he created the Ann Campana Judge Foundation, an organization dedicated to overseas hydrology work in poor communities.*

Michael and I contributed to each other's publications. I wrote articles on hydrophilanthropy for AWRA's Water Resources IMPACT *issues in 2010 (Vol. 12, No. 5) and 2016 (Vol. 18, No. 1) that Michael edited, and he contributed articles on the topics of hydrophilanthropy and "water and international security" in volumes 145 (2010) and 149 (2012), respectively, of the* Journal of Contemporary Water Research and Education*, which I guest edited. His blogs "Waterwired" and "Campanastan" were read around the world.*

I sent Michael a draft of the article below, which he read and gave comments and suggestions on. He told me this was probably the last edition of AWRA's Water Resources IMPACT *that he would edit. That sadly became more than true when he was killed in a car accident a month later. Michael was the finest teacher, hydrophilanthropist, friend, and human being that I have even known. With his legacy in mind:*

I used to think hydrophilanthropic efforts had to always be demonstrably sustainable. My view on efficacy has changed. The effects of hydrophilanthropy have to do with the human spirit and desire to do good things in the world. I believe there can be an unseen long-term undercurrent to even short-term hydrophilanthropic acts. One year

The course faculty out in Niamey, Niger. Source: Author

ago, I was teaching a multiweek numerical groundwater modeling course to scientists, engineers, and heads of ministries in Niamey, Niger. These weeks of instruction came after more than four years of hydrologic investigation in the country, including everything from using satellite imagery and gathering well information on over ten thousand wells to conducting hydrological investigations in the field.

This final groundwater modeling class was filled with men and women eager to learn how to predict the impact of groundwater pumping on well water levels, streams and ecosystems, and subsurface pollution movement, as well as to plan optimal spots for future irrigated agricultural development. I really hadn't recently reflected on whether or not our teaching, research, and field efforts (and by analogy, some of the normal work that many other water professionals undertake) must be long-lived to be considered effective. I did not reflect on this, that is, until I returned home to learn that a military junta had overthrown the democratically elected government just after we left.

We had an excellent team for the Niamey groundwater modeling course: professors Valerie Plagnes and Daniele Valdes from the Sorbonne Paris, professors Alexandra Lutz and Susan Rybarski from the Desert Research Institute in Reno, Nevada, and professor Yahaya Nazoumou from the University of Abdou Moumouni, Niamey. The curiosity and enthusiasm of the Nigerien professionals taking the course was evident as they asked great questions, and they developed and ran groundwater models for areas in Niger on their personal computers. By the end of the course there was a friendly, almost celebratory atmosphere among the participants. Most of the participating Nigerien professionals had positions in the government or academia, but the instruction team learned, after we returned, that many of those positions were not guaranteed with a change in government. The sponsoring Nigerien agency responsible for funding our research and educational efforts was disbanded several months later. The fate of the official scientific reports that we had submitted over the years remains uncertain.

Many have advocated for a broad definition of hydrophilanthropy that embodies many different kinds of acts that promote the wise use and protection of water resources. I had come to believe that certain elements were required for the most effective water research, field work and installations, and educational efforts of water professionals. I thought this work typically should have a demonstrable element of long-term sustainability and avoid the missteps of naïve, if well intentioned, altruists. But I've come to realize there is a hidden, long-term undercurrent to even brief efforts to ensure clean water. Many hydrology projects have less-visible, underlying benefits and connections, which water professionals, absorbed in their work, may not realize.

Hydrology is basically an interdisciplinary science, with ties to geology, biology, mathematics, chemistry, engineering, microbiology, education, space imagery and sensing, social justice initiatives, resource management, public policy, law, and international relations. However, a researcher immersed in following their hydrological curiosities in one of these water-related subfields may not regularly step back and consider other connections. A field practitioner may not habitually look for other links in their labor. A water manager or policy maker may never meet those who implement their work, or benefit from it. But those connections exist, whether completely realized or not. And the quiet, muted legacy of these invisible linkages constitutes a continuing, sustained, and powerful theme. I am now convinced that conjoining these disciplines, actions, and actors through time is an unrealized act of hydrophilanthropy.

In the case of our work in Niger, much of our past work will eventually find its way into publications. Wells will be installed, structures built. My graduate students are now extending the research, using the data to model transboundary groundwater flow between Niger and Nigeria.

These efforts can inform resource management strategies and reduce the possibility of international misunderstanding and conflict. Therefore, I am confident that the Niger work and important extensions of that research will see the light of day. But there is a subtler form of longevity to the work, which can be felt by all working water professionals.

Some legacies are the continuing results of teaching and installation of structures to provide clean water, but all include a lasting resonance of human interaction. Educators know that the results of their work may not be manifest for years or even generations, through the actions of their students or readers of their publications. Physical

The site of groundwater field work in Niger. Source: Author

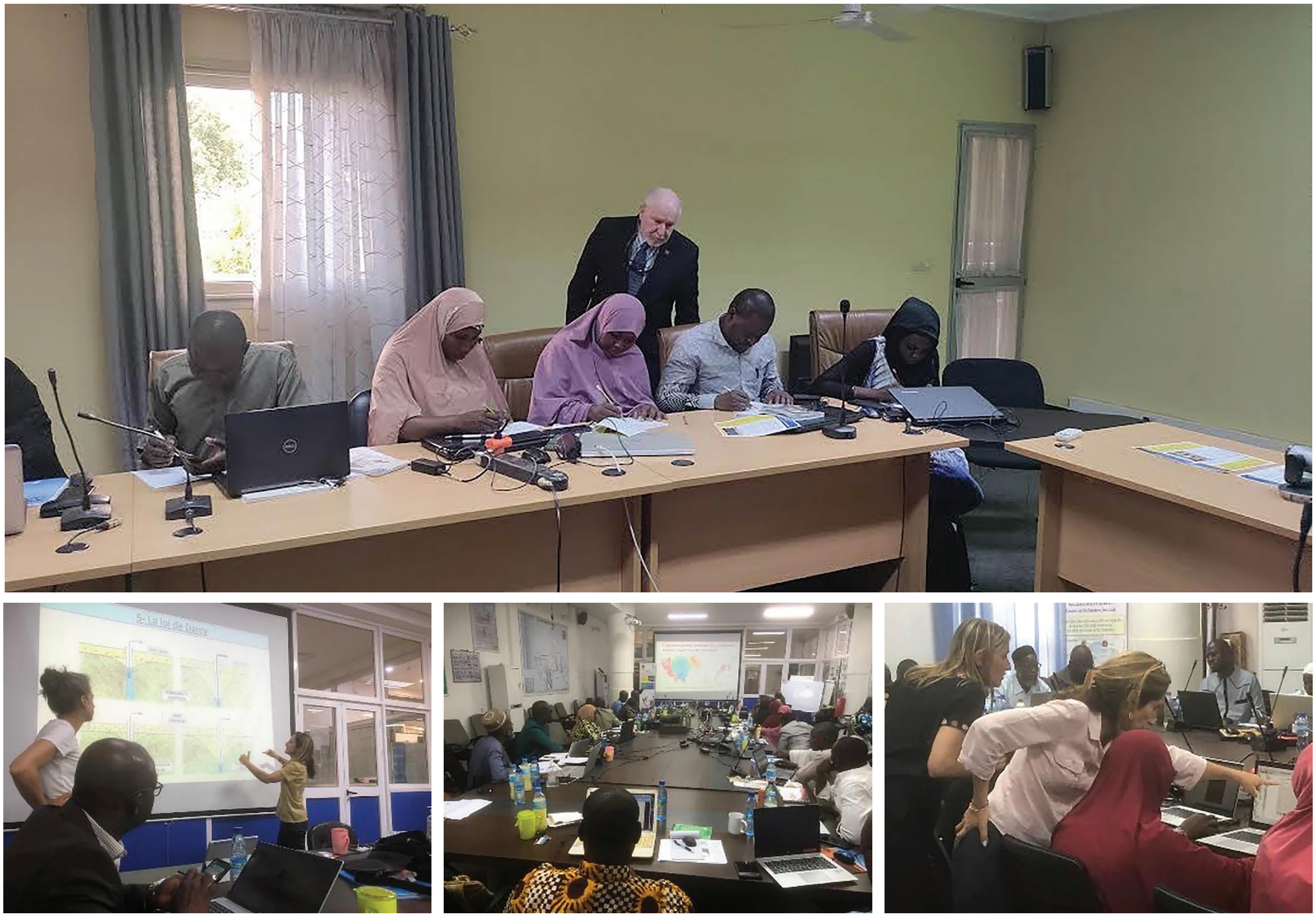
structures can be seen, but construction of wells, water conveyance systems, canals, water treatment facilities, and monitoring systems all need an element of maintenance and stewardship—person-to-person responsibility, accountability, and communication. And the underlying current, and the motivation of this particular human interaction, is to make the world a better, more livable place.

Niger will continue to have resource challenges beyond political instability. In this "frying pan of Africa," approximately 80% of the landmass is covered by the Sahara and Ténéré deserts. It has the youngest population in the world, with half of its people younger than 15 years old. The country is expected to double in population in about 18 years. There is a lack of food security. Almost half of young children must work, not allowing steady education, and estimates are that only about 56% of the population has direct, nearby access to clean water.

Even so, today there are a few more people in Niger who know the basics of numerical groundwater modeling. And I'm sure many of the readers of this article have their own stories to tell— their own legacies. Water professionals have an ability, if not a predilection, to improve societal conditions and the environment. Their projects can lead to a long term hydrophilanthropic understanding, to friendship and progress. If we become more cognizant of the constant undercurrent of human connection in our hydrologic pursuits, advancement could be an overriding, enthusiastic, and motivating force.

Our modeling team received the following text in an email from one of the participants, a message similar to those undoubtedly received by many readers of this article.

"Merci pour votre générosité sans limite, votre disponibilité et votre façon de faire qui est bien apprécié par le Niger.



Various sessions of the groundwater modeling course in Niamey, Niger. Source: Author

Merci bien, vos bonnes actions ne seront jamais oubliés. (Thank you for your limitless generosity, your availability and your way of doing things which is well appreciated by Niger. Thank you very much, your good deeds will never be forgotten.)"

And the thoughtfulness of our Nigerien colleagues and friends will never be forgotten. Regardless of other positive outcomes, this collaborative, cooperative spirit is the unseen undercurrent of hydrophilanthropy. ■

David K. Kreamer (dave.kreamer@unlv.edu) is a professor emeritus of geoscience, a graduate faculty member in civil and environmental engineering, and past director of the interdisciplinary Water Resources Management Graduate Program at the University of Nevada, Las Vegas. He serves as past president of the International Association of Hydrogeologists and has served as a professional consultant and expert witness in legal proceedings concerning groundwater. He has given over 200 invited lectures, seminars, and workshops in recent years in Europe, Asia, the Caribbean, Australia and the Pacific island nations, South and North America, Africa, and the Middle East, also addressing the General Assembly of the United Nations and U.S. Congress.

2024 DEI & Professional Development Scholarship Winners

MARIA DEL ALMA CONCEPCION RODRIGUEZ
Ph.D. Student – Civil Engineering (Water Resources)
Polytechnic University of Puerto Rico

Throughout my educational journey and early career experiences, I have witnessed firsthand the transformative power of DEI initiatives. Participating in DEI initiatives has not only broadened my understanding of different perspectives but has also enriched my personal and professional growth in multiple ways. On a personal level, engaging in DEI initiatives has deepened my empathy and compassion for others, as I have learned to recognize and challenge my own biases and assumptions. These experiences have equipped me with the skills and mindset necessary to navigate diverse environments with humility and respect, fostering meaningful connections with individuals from all walks of life. I've gained valuable insights, developed empathy, and enhanced my leadership skills by embracing diversity, equity, and inclusion. Moving forward, I'm committed to leveraging these experiences to drive positive change in my career, fostering inclusive environments where everyone feels valued and empowered to succeed.

VISHWA SHAH
Ph.D. Student – Civil & Environmental Engineering
Virginia Tech

Vishwa Shah is currently pursuing her PhD in the Department of Civil and Environmental Engineering at Virginia Tech. Her academic journey began with a B.E. in Civil Engineering from The M.S. University in Vadodara, India, in 2013, followed by an M.S. in Environmental Science from the New York Institute of Technology in 2016. She further enhanced her academic credentials with an M.Eng in Environmental Engineering from the Stevens Institute of Technology in 2019. Her research endeavors focus on exploring the intricacies of water quantity and quality within urban watersheds, particularly examining the impacts of climate change and land use dynamics. Utilizing a multi-model ensemble approach, Vishwa employs a combination of simplistic, complex, and hybrid models, integrating geospatial, quantitative, and statistical methodologies to provide comprehensive water quality simulations.

Vishwa is an active member of AWRA and AWWA. Leveraging her expertise in hydrologic modeling and her involvement in these societies, she aspires to pursue a career in academia, where she intends to delve deeper into her passion for hydrologic models, particularly exploring the applications of deep learning techniques.

WUHUAN ZHANG
Post Doctoral Scholar in Civil & Environmental Engineering

As a postdoctoral scholar, participating in AWRA DEI initiatives holds immense significance for both my life and career trajectory. Growing up in a multicultural environment and navigating through academia, I have developed a deep appreciation for diversity and equity. Participating in AWRA DEI initiatives will not only align with my personal values but also enrich my professional journey.

Engaging in DEI initiatives will expose me to diverse perspectives, experiences, and ideas. This exposure will broaden my understanding of various social issues and help me develop empathy and cultural competence, which are crucial skills for effective collaboration and leadership in any field. Working within diverse teams fosters collaboration and innovation. By participating in AWRA DEI initiatives, I will refine my ability to collaborate across different backgrounds, ultimately strengthening my teamwork and communication skills. In today's globalized world, organizations value individuals who can navigate diverse environments and contribute to inclusive practices. Actively participating in DEI initiatives demonstrates my commitment to creating inclusive spaces and can enhance my competitiveness for future career opportunities, whether in academia, industry, or non-profit sectors. Engaging with DEI initiatives allows for personal growth and self-reflection. It challenges me to confront my own biases and assumptions, fostering a continuous learning mindset and promoting self-awareness.By contributing to AWRA's DEI efforts, I have the opportunity to make a tangible difference within my academic community. Whether through organizing events, advocating for policy changes, or supporting underrepresented groups, I can actively contribute to creating a more equitable and inclusive environment for all.

Overall, participating in AWRA DEI initiatives is not just about advancing my career but also about embodying my values and making meaningful contributions to society. It will empower me to become a more effective researcher, collaborator, and advocate for diversity and inclusion in both my professional and personal spheres.

FEATURE

Hydrophilanthropy and Experiential Learning in Honduras

Michael E. Campana

Images of the author's students working on various projects in Honduras. Source: Michael Campana

REVELATION

It was not a dark and stormy night but rather a hot and sticky one. In January 2001, I traveled to northwestern Honduras (Puerto Cortés area) with colleague Loring Green to investigate a potential Lifewater International project, but after just two days it was apparent that the proposed work was not within our repertoire. With five days left before departure, Rolando López, our Catracho (slang for Honduran person) escort who had requested Lifewater's assistance, filled our time with visits to other potential Lifewater projects, none of which turned out to be feasible.

The morning before our departure we hiked for an hour or so into the Sierra de Omoa, a rugged mountain range that trends SW-NE parallel to Honduras' northwestern coast from the Guatemalan border east to the Puerto Cortés area. Rolando wanted us to see a community water project being implemented by a friend, Alex Uriel del Cid. This was my last full day in Honduras, perhaps forever, and Rolando was certain I would enjoy what I was about to see. He was right.

Upon reaching the village of Miramar, Rolando, Loring, and I observed Alex instructing the villagers how to organize a junta de agua (water committee) that would maintain and operate the water system, collect revenue, shut off delinquent users, and plan for expansion. Alex had the villagers' rapt attention. He held my attention too, even though I barely understood the Spanish he spoke. His charisma was evident to all those who came in contact with him.

When Alex was finished, he came over and Rolando introduced us. Alex explained that his approach was the same in each village. The villagers first had to establish a junta de agua and develop a plan for the water system. The village had to own or have written permission to access the water source, dam/tank site, and pipeline route. They also had to have effective sanitation, such as latrines. If none of the above was met, Alex would not work with the village until all criteria were met. He was a tough taskmaster. He also relished working in remote areas where no one else—government or NGO—would tread.

I realized my students and I could learn much by working with Alex and the villagers. I had been doing hydrophilanthropy for several years and was starting to introduce it to my students. With Loring, Rolando, and Alex standing around, something came over me and I said to no one in particular, "I'd love to bring my students here to work with Alex this summer." Rolando immediately translated this into Spanish, and a big smile spread across Alex's face.

I should add that I had made no mention of bringing students down here for hydrophilanthropic work. At the time I directed the University of New Mexico's (UNM)

Water Resources Program (WRP) and its Master of Water Resources (MWR) degree, and had occasionally thought about taking students to developing countries but had usually dismissed it as being far too much trouble. In fact, at the Houston airport while I awaited the flight to San Pedro Sula, standing amidst the legions of red- and yellow-shirted aid and mission workers, I noticed a college professor escorting his students to Honduras and thought to myself, "That guy has to be crazy." Little did I know that his affliction was contagious.

We would be partnering with the Honduran national water authority SANAA (Servício Autónomo Nacional de Acueductos y Alcantarillados), which would provide the pipe for the water system and certify that the system design and operation met its standards. SANAA would require all parties to sign an agreement defining the responsibilities of each. I would sign the agreement on behalf of UNM, although I was unsure exactly to what I was committing UNM, but I recalled the aphorism, "It's easier to ask forgiveness than permission." SANAA's main responsibility was to provide support for completed systems, primarily through its circuit rider program, whereby a trained worker would periodically visit each village to assist villagers in maintaining their system. I returned home favorably impressed with SANAA's approach and felt confident that sustainability would be ensured.

Reality

And so it had been decided: we would work with Alex in Miramar, a community of several hundred residents. The UNM MWR graduate students and instructors would live in the village, in the vacant old schoolhouse, and pay some of the villagers to cook for us. We would be in-country about ten days.

> *After I made the decision to implement this course, I specifically remember thinking to myself as I flew back to the USA, "This will either be the dumbest thing I've ever done or the smartest thing." Fortunately, thanks to luck and some truly remarkable students and Catrachos, it turned out to be the latter.*

Thus began trips to Honduran villages each June from 2001 through 2005. Graduate students from the MWR program would spend their required capstone field course helping to build water and sanitation systems in Honduran villages and would complete a joint project.

Since the trips were part of a required course, I raised all funds to pay for the trips, about $115,000 for 74 people traveling over five years. For each year except the last, Dr. Michele Minnis, one of the WRP's instructors, would serve as co-instructor. Sixty-five students participated.

We prepared the students for the different culture they would encounter, and cautioned them against "ugly American" syndrome. We educated them on the history, government, culture, economics, and sociology of Honduras. The concept of hydrophilanthropy was also introduced. Books such as *Don't Be Afraid, Gringo: The Story of Elvira Alvarado* by Medea Benjamin (1989), *The United States, Honduras, and the Crisis in Central America* by Schulz and Schulz (1994), and *Water, Culture, and Power* by Donahue and Johnston (1998) were very useful. Personal safety was discussed. We also provided each with a popular tourist guide (Moon Handbook) to Honduras.

Course materials became more sophisticated with time. By the 2003 trip, I had prepared a packet of materials derived mainly from Lifewater International (reissues of USAID technical documents), the journal *Waterlines*, *Engineering in Emergencies* by Davis and Lambert (2002), and *A Handbook of Gravity-Flow Water Systems* by Thomas Jordan (1980). This packet covered WaSH (water, sanitation, and hygiene) issues as well as gender, governance, and other issues.

Each year we worked in a different village in the same general area. After the 2001 trip we split the students into two groups and had them work sequentially (i.e., one group went down to work for ten days, then the other group would go down and the first group would return home). The two groups would overlap in-country for about three days, which we spent at Copán Ruinas, the resort town near the Mayan ruins of Copán near the Guatemalan border. We gave the outgoing students time to unwind, clean up, and visit with the incoming students, who received a briefing from them. It also promoted bonding among the students.

Later course projects were better defined than the early ones. We generally left it to the students to decide for themselves (with our approval) the nature of the project. We selected two students who would serve as project leaders/report editors and lead the students in identifying a project. To the extent possible, the decision on the nature of the project was made before the trip, although flexibility was permitted because of the changing situations in-country. Projects dealt with such things as source water protection plans, education and outreach programs, and watershed management plans. One student even created an ingenious Spanish-language board game to teach children about environmental stewardship. For more details on the trips and the course, see my article in the *Journal of Contemporary Water Research and Education.*

Recollection

The trips generated a lot of buzz. Even before the first trip, I received inquiries from non-MWR students as to whether they could join the trip. In a few cases, parents called me seeking to send their high-school-age children on the trips. In two of these cases, it was apparent to me that the parents wanted these trips to "straighten their kid out" and expected me to assume the role of boot-camp drill instructor. Needless to say, I declined such requests, even foregoing a large donation in one instance.

Many of the 65 students underwent a transformative experience, as manifested by joining Peace Corps, working with faith-based and secular NGOs, and doing WaSH work in developing countries.

No student ever asked to opt out of the course. It was a required course, but had a student expressed real reservations about the trip, I would have made other arrangements. During pre-trip orientation I stressed to the students that anyone with safety, health concerns, or health conditions should not take the trip. Safety was not a real concern; the villagers had a very protective attitude toward all of us. When I asked one campesino why he was bringing a rifle to a swimming hole, he replied, "jaguar." I later learned that he was concerned about banditos. To my knowledge, that was the only such incident in five trips.

The trips were discontinued after 2005 because I left UNM for Oregon State University. However, had I remained at UNM, I likely would have suspended the trips for several years to rethink my approach.

The UNM trips to Honduras were very popular. They generated a lot of favorable publicity for UNM and the MWR degree program. The now defunct Albuquerque afternoon paper, *The Tribune*, featured a story titled "Benevolent Voyagers" in the local news section. Dedicated students sought to matriculate to work in developing countries. With respect to the latter, I designed a track in the MWR curriculum for those interested in focusing on developing countries. I left UNM before I implemented it.

I gradually introduced the concept of hydrophilanthropy into the MWR curriculum, using various opportunities to discuss this type of work. Articles and book chapters dealing with work in developing countries were also featured not only in my courses but also in the MWR introductory core course and the field course.

The fact that the students and instructors knew each other fairly well was a definite strong point. The students had also been through a number of courses with each other. I often wondered how the trips would have unfolded had the students been self-selected and I had not been familiar with them.

Reflection

With few exceptions, those who took the course had positive comments on what they did and learned. Of the 65 students, only one had a negative experience; it just was not her "cup of tea."

For me, the course was a wonderful and transformative experience. What I enjoyed the most was seeing students rising to the occasion without complaint when conditions dictated an increased level of effort. The ingenuity and industriousness of the students were sources of inspiration to me. The fact that we all lived together in the village enabled us to know each other and the villagers.

But once the euphoria dissipated, reality arrived. Were the trips "feel-good" or "do-gooder" trips (or perceived as such) in which the gringos benefited far more than the villagers and implemented unsustainable projects (see articles by Christine Casey Matute and Stephanie J. Moore as well as Edward Breslin)? Did the projects impart some lasting benefits to the recipients? Did we do enough to build capacity? Is it sufficient that the donors benefited? These and other questions must be addressed before initiating future trips and projects.

After I made the decision to implement this course, I specifically remember thinking to myself as I flew back to the USA, "This will either be the dumbest thing I've ever done or the smartest thing." Fortunately, thanks to luck and some truly remarkable students and Catrachos, it turned out to be the latter. In my 17 years at UNM, the course trips and the students who took them constitute my fondest memories and what I miss the most about UNM. I am grateful, for they have revealed much and left me with many things to ponder.

Editor's note: This article by Michael Campana appeared first in Water Resources IMPACT*, volume 12, number 5 (September 2010).* ■

Michael E. Campana (aguadoc@gmail.com) was editor-in-chief of *Water Resources IMPACT* and held forth on assorted water, climate, and environmental issues as a professor emeritus at Oregon State University as well as on his blog, WaterWired.

2024 Richard A. Herbert Memorial Scholarship Winners

MARIEL FIRPO

Undergraduate Candidate, Environmental Engineering
City College

Mariel Firpo is an Environmental Engineering student at City College. Originally from the Dominican Republic, Mariel is interested in equitable and sustainable developed specially for underrepresented communities.

TYLER KLEINSASSER

Graduate Candidate, MS, Hydrologic Science
South Dakota School of Mines and Technology

Tyler Kleinsasser is a dedicated student at the South Dakota School of Mines and Technology, pursuing degrees in Civil and Environmental Engineering and Engineering Management. With a perfect 4.0 GPA, Tyler has demonstrated academic excellence and a strong commitment to his field. He has also passed the Fundamentals of Engineering (FE) Exam and has been inducted into the Order of the Engineer. Tyler's interest in water resources is fueled by a desire to develop innovative solutions for environmental sustainability. His academic and extracurricular activities have focused on enhancing his knowledge and leadership in water management. He has held significant roles in organizations such as Chi Epsilon Civil Engineering Honor Society, the American Society of Civil Engineers, and Tau Beta Pi, which have provided him with invaluable experiences in his chosen field. Looking ahead, Tyler aims to pursue a challenging and rewarding career that combines his educational background with his professional ambitions. His ultimate goal is to establish his own consulting firm by 2034, continuing his family's legacy of entrepreneurship. This firm will aim to positively impact the field of water resources, with a focus on innovative and sustainable solutions.

PHILIP PITTS

Graduate Candidate, MS, Water Policy
Oregon State University

Philip 'Henry' Pitts grew up on the banks of the Black Warrior River in the southeastern United States, and currently live beside the Willamette River in the Pacific Northwest. Philip's recent water interests have been around the spiritual aspects of transboundary rivers, but is currently work on a collaborative governance project in the high desert of eastern Oregon! Philip is working towards an MS in Water Policy, and will start a PhD in Geography this upcoming fall. He's a triplet, and spent a significant amount of time with family in Ireland as a child. In his free time, he loves brewing kombucha, trail running with his boyfriend, and hunting for Joni Mitchell albums in local record stores.

MOAYAD YACOUB

Graduate Candidate, Ph.D., Environmental Science
Ball State University

Moayad Yacoub is a Ph.D. candidate in Environmental Science at Ball State University, focusing on the impact of microplastics in the White River Upper Watershed. With a solid academic foundation from Jordan University of Science and Technology, where he earned both his bachelor's and master's in Soil, Water, and Environment, Moayad has consistently demonstrated a commitment to environmental science.

FEATURE

Hydrophilanthropy in Honduras: A Potable Water System Partnership for Rural Mountain Communities

Michael E. Campana

Source: Michael Campana

RECOLLECTION

Few politicians and agencies find it worth their while to help the residents scattered among the rugged Sierra de Omoa in northwestern Honduras with their potable water problems. Nongovernmental organizations (NGOs) find the topography and limited access challenging, with a high risk of project failure—anathema to donors. Politicians find the sparsely populated region infertile ground for votes. Many rural communities (populations about 100 to 400) have been without reliable, safe potable water supplies for their entire existence.

To help address the problem, I have worked in the area since 2001 assisting Hondurans Rolando López, Alex del Cid Vásquez, and local villagers in constructing community water systems in the Municipio (similar to a county) de Omoa, a jurisdiction of about 30,000 residents. These water systems are simple gravity-flow systems that distribute water from high elevation

Rolando López (left), Roberto Mejias, and Jorge Chávez at the Los Mejias tank. Alex del Cid Vásquez (right hand on pipe) and Los Mejias villagers. Source: Michael Campana

springs to a 5,000- or 7,500-gallon chlorinator-equipped ferroconcrete tank via PVC and/or GI (galvanized iron) piping and then to individual households to provide each residence with a tap. Water is for household use only; irrigation using project water is proscribed. Villagers build the systems themselves, with guidance from Alex del Cid Vásquez.

University of New Mexico students worked in these areas with me from 2001 through 2005. Each of the five student cohorts spent time each June during those years working side-by-side with villagers building the water systems. The students' work in-country and additional tasks formed the basis for the capstone field course in the Master of Water Resources (MWR) degree. Money to fund the trips was raised from a variety of sources. Detailed descriptions of these trips can be found in this magazine (January 2016) and the *Journal of Contemporary Water Research and Education*.

Reality

The last of the aforementioned student trips ended in 2005; I moved to Oregon State University (OSU) in May 2006. Had I remained in New Mexico, the trips would not have continued. I had concerns about sustainability and other issues. I worried whether we were "do-gooders" who did not contribute much to the well-being of the villagers. Another unexpected issue would also arise, one that I had not imagined. More on that later.

During the period from 2006 to 2010, I made few trips to Honduras because I had no projects there. The Ann Campana Judge Foundation (ACJF), which I founded in 2002, had accrued adequate funds to enable me to support the work of other groups, mainly in Honduras (Texas Water Mission, PREDISAN, Northlake Church of Christ, Living Water) and Nicaragua (El Porvenir, Agua Para La Vida). Note that the ACJF did not support the student trips.

As the first decade of the 21st century ended, I was considering resuming student trips to Honduras. The ACJF was now in a financial position to support the construction of potable water systems in Honduras. I had satisfied myself that the work was sustainable and a real contribution to the well-being of the rural hondureños and hondureñas. I had also received many inquiries from students around the country asking when I would start the trips again, including many inquiries from those at OSU.

One inquiry was particularly intriguing. It came from an engineering professor at a U.S. public university. She wanted to know if I would take six to eight junior engineering majors to Honduras to work on a water project of my choosing. Her school would pay our expenses. An offer I could not refuse! But that "unexpected issue" to which I alluded earlier arose: taking students to Honduras became almost impossible because Honduras had the highest murder rate of any country on Earth. Unbeknownst to me, Honduras had claimed the #1 spot, and had become a pariah for university administrators. To make matters worse, San Pedro Sula, the country's economic hub and the city into which I flew, had the world's highest murder rate. An official at the U.S. Embassy in Tegucigalpa strongly advised us not to bring students. Even Peace Corps was abandoning Honduras.

With no students, my wish to continue helping to build potable water systems was a nonstarter. Or was it?

Redux

While I pondered my future in Honduras from the comfort of the U.S., things besides the murder rates were on the move in Honduras. Rolando López was adding more contacts to his already-prodigious list. He is a superb facilitator and manager. The Municipio de Omoa had a new mayor: Prof. Ricardo Alvarado, a teacher. Alex del Cid Vásquez was elected to Omoa's municipal council, and it was Alex who convinced Mayor Alvarado that it was in his best interests to bring potable water to his constituents. Not only was it a vote-getting strategy, but it also would burnish his reputation as a "man of the people," which could lead to a higher political office. It would also enhance his stature among women, who would benefit most from potable water systems. The mayor was indeed convinced; he even formed a municipal Office for Women (Oficina de Mujeres) that dealt with all women's affairs, not just water and sanitation.

With Alex and Rolando's help, the ACJF partnered with Omoa and Mayor Alvarado to bring potable water to three communities: Brisas del Rio Cuyamel, Los Mejias and Las Palmas. Rolando López and Alex del Cid Vásquez continued to play major roles: the former as a manager and facilitator, and the latter as the project engineer/trainer and Omoa municipal councilor (through 2014). Mayor Alvarado marshaled the forces of the municipal government to provide transportation, road maintenance, human power, and assistance with other jurisdictions. The director of the Oficina de Mujeres was an ally in promoting community water systems; she knew how much women and girls were adversely impacted by unsafe water and a lack of sanitation. The successful work in the aforementioned villages prompted Mayor Alvarado and the ACJF to continue their partnership. The agreement to do so was made by handshake; no written agreement exists.

The ACJF-Omoa partnership village water projects worked as follows. Each village must request a system and exhibit strong support for same; no village is forced to accept a water system, nor will a village receive one without overwhelming community support. Before a project is started or even designed, the community's residents are organized, a junta de agua (water committee) formed with tasks, training, financing and responsibilities identified. Watershed stewardship and elementary sanitation (latrines, etc.) are also introduced. At that point, SANAA (Servicio Autónomo Nacional de Acueductos y Alcantarillados), the Honduran government agency responsible for rural water supply, approves each project and agrees to provide support (via its circuit rider system) after the project's completion to ensure a measure of sustainability.

The partnership provides benefits beyond potable water. For example, road maintenance needed for equipment access assists villagers in getting their products to market; students traveling to school; and transportation and commerce in general. Politicians benefit by acquiring political capital. In particular, they are seen helping their constituents obtain one of the necessities of life, a reliable supply of potable water.

The ACJF has started working in the Municipio de Choloma, a large (c. 225,000 residents) municipality north of the city of San Pedro Sula. Both Omoa and Choloma are municipalities in the Departamento (equivalent to a U.S. state) de Cortés. Choloma also has villages in the Sierra de Omoa. We have recently finished a project in the village of El Tamarindo and are contemplating a project in another Choloma village but do not yet have a partnership with the Municipio de Choloma. Talks are in progress. We are also considering more projects in Omoa as well.

Reflections

The partnership with the Municipio de Omoa has worked well. It is based upon mutual trust among individuals; it is not institutionalized. Elections in November 2014 could possibly change things. Alex del Cid Vásquez is no longer on the municipal council, but is working for Mayor Alvarado, who was reelected in 2014. Rolando López and others in the region aligned themselves with a new political party, the PAC or El Partido Anti Corrupción (Anti-Corruption Party), that ran against the mayor's party. As of this writing I am unsure how this will affect the partnership. I am optimistic.

Rolando López and I are also looking beyond Omoa and Choloma. We are developing plans to once again include students in the projects to provide experiential learning and cross-cultural experiences for both U.S. and Honduran students. Security issues continue to hamper efforts to bring U.S. students to the area. Our vision extends to the establishment of a school, Escuela Técnica de Agua Potable (ETAP), or Technical School for Drinking Water, to train local students to meet rural potable water needs in Honduras. Such a school exists in Nicaragua, as part of Agua Para La Vida's operations there. There is ample need for such a school in Honduras, which would enable Hondurans to solve their own rural water problems. After all, building capacity is really what our work in Honduras is all about.

Is there an ETAP in Honduras' future? Both Rolando and I hope that at least one more partnership involving the establishment of an ETAP is in the offing. ¡Buena suerte!

Editor's note: This article by Michael Campana appeared first in Water Resources IMPACT, volume 18, number 1 (January 2016). ■

Michael E. Campana (aguadoc@gmail.com) was editor-in-chief of *Water Resources IMPACT* and held forth on assorted water, climate, and environmental issues as a professor emeritus at Oregon State University as well as on his blog, WaterWired.

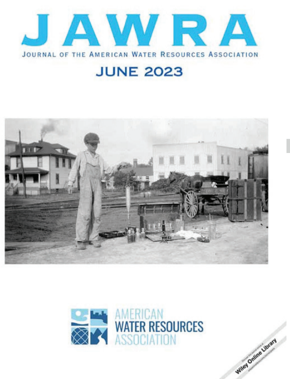
JAWRA

JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION

ABOUT JAWRA

JAWRA publishes papers on broad multidisciplinary water resources issues. Papers cover the topics of recent AWRA conferences, such as riparian, ecology, geographic information systems, adaptive management, and water policy.

LEARN MORE



JOURNAL METRICS

- Citescore 5.8
- Impact Factor 2.695
- 5-Year Impact Factor 3.032
- Journal Citation Indicator 0.59

EASY SUBMISSIONS

You'll benefit from our streamlined submission system, which offers easy production tracking for your paper.

PUBLISH OPEN ACCESS

You have the option to publish Open Access which can increase the visibility of your article 400%.

GLOBAL AUDIENCE

Your paper will reach a broad global audience of water resources experts.

Find out more about JAWRA, or sign-up for email alerts to receive notifications when new articles and issues are published, at https://bit.ly/JAWR_submit.

AMERICAN WATER RESOURCES ASSOCIATION

AWRA CAREER CENTER: FOR EMPLOYERS & JOB SEEKERS

AMERICAN WATER RESOURCES ASSOCIATION

Employers can...

- post jobs
- manage apps
- search resumes

Job seekers can...

- post resumes
- apply for jobs
- get job alerts

AWRA is a member of the Engineering & Science Career Network.

https://careers.awra.org

Employers: AWRA's Career Center can help you tap into a talent pool of candidates with the experience, training, and education needed for long-term success.

Job Seekers: Use the AWRA Career Center professional services to help you build and manage your career for maximum success!

FEATURE

Hydrophilanthropy: I Can't Define It, But I Know It When I See It

Michael E. Campana

Past covers of *Water Resources IMPACT* issues on hydrophilanthropy.

THIS ISSUE OF *WATER RESOURCES IMPACT* IS THE THIRD to feature the topic of hydrophilanthropy. I have edited all three of these issues—in 2010, 2016, and 2022—and this will likely be my last. The cover of the 2010 issue introduced me to the concept of "poverty porn," as some call it. (Notice that the current issue's cover avoids that type of imagery.) So the title of this article is my tongue-in-cheek definition of hydrophilanthropy taken from former Supreme Court Justice Potter Stewart. In the early 1960s, the Supreme Court was dealing with cases related to pornography and protected speech. Stewart wrote that even if he couldn't define hard-core pornography, "I know it when I see it."

Despite the title, here are my definitions of hydrophilanthopy. You may have your own.

1. Altruistic concern for the water, sanitation, and related needs of humankind, as manifested by donations of work, money, or resources.
2. Use of water to express kindness or benevolence, such as the healing of psychological, spiritual, and other wounds.

It was not until 2005 that I heard the term "hydrophilanthropy," in a phone conversation with Dave Kreamer, who has written articles for all three hydrophilanthropy issues of *Water Resources IMPACT*. He did not define it at the time. But my own experience with hydrophilanthropy started long before that.

The Journey Begins

My hydrophilanthropy odyssey began about 30 years ago, when I was an academic at the University of New Mexico. I thoroughly enjoyed my work, but something was missing. I started thinking about those who did not have access to clean water and sanitation.

When the time came for a sabbatical, I wanted to go to a developing country that might use my skills. I received a Fulbright teaching fellowship to go to Belize, an Anglophone country (formerly British Honduras) on the Caribbean side of Central America. I was supposed to teach two courses during the spring term, but the University College of Belize forgot to schedule my second course, so no one registered and it was canceled. My first faculty meeting consisted of a discussion about where the faculty-staff party would be held. That was the shape of things to come.

I had time on my hands—I was teaching just one course in watershed hydrology with six students—so I made contact with local government workers and got the Belize environmental agency's consent to submit a proposal that I would write to the Inter-American Development Bank. The project would assess the groundwater resources for the northern 40% of Belize, which was an extension of the carbonate hydrogeology of the Yucatan Peninsula. The work would also identify potable water supplies for underserved communities—that was the hydrophilanthropic connection. I had a handshake agreement that, if funding materialized, I would supervise the work, which was scheduled to begin after I returned to the United States. All the agency had to do was affix a signed cover page to the proposal and submit it to the bank.

The upshot: I never heard from the agency. A friend informed me that the agency had never submitted the proposal. It was not a complete bust; I met some folks from Honduras and Nicaragua who were intrigued with my skills and interests and thought they could use them at some point. But that seemed to be a common refrain: people told me what they thought I wanted to hear so as not to offend me.

Back in the USA

After returning from Belize, I began searching for a nonprofit that could use a volunteer hydrogeologist interested in WaSH (water, sanitation, and hygiene) work in the developing world. I must have contacted 15 organizations (CARE, Save the Children, and the International Rescue Committee among them). Virtually each contact unfolded the same way: initial enthusiasm on their part, maybe a phone call, then nothing. Why? A British hydrogeologist at a conference explained to me that NGOs had their own paid staffs and did not like to use volunteers because they don't follow "the way we do things."

He also enlightened me in another way. With his beautiful accent, he pretended be the narrator for a commercial featuring a Latin American girl. After a few seconds of the commercial came "the voice": "This is Rosa, who lives in the village of Santa Cruz in Costa Pobre. She is smiling because last year we drilled 50 water wells in her village to provide clean, healthy drinking water. No longer will the water make her sick."

Then he added: "Before you give money to this organization, you need to perform due diligence and ask: How many of the wells are still working? Is the water potable? Who maintains the wells and water system? Is source water protection practiced? Do the villagers pay for the water, or is it free? Who manages the system and makes decisions?"

He sure caught my attention. I was rapidly becoming discouraged.

Then someone told me about an organization called Lifewater International, based in San Luis Obispo, California, which trained volunteers to do what needed to be done in developing countries and underserved U.S. areas. Lifewater got projects from inquiries to its website or by fax. The catch was that Lifewater was for evangelical Christians, and the organization was reluctant to take on volunteers from outside the fold. I was not of that belief system.

Getting Vetted by Lifewater International

Still, some friends of mine encouraged me to pursue the Lifewater connection. They sang the praises of Bill Ashe, Lifewater's founder. I got calls from several colleagues, one of whom was in the leadership circle. He and the others agreed to sponsor me, despite my religious shortcomings.

Then I got a call from one of the directors, who introduced himself and explained that my membership would be considered at the next board meeting. Nothing happened for a few weeks, and I got nervous. Friends told me not to worry.

One day I got a call from Bill Ashe. I had heard so much about him. Bill and his wife, Lorraine, lived in Southern California, where they ran a business that catered to people in the water industry. Their story was inspirational. Beginning in the 1960s, the Ashe family

> *I once asked my supportive and perceptive wife, Mary Frances, "Where have all these hydrophilanthropy people been?" Her reply: "They've been there all the time. You just weren't looking for them."*

Loring Green (white shirt) instructs the Embera Indian drilling team on drilling with the LS-100 rig. Source: Michael E. Campana

took outings into Baja, Mexico, to help orphanages, camps, and churches install new water systems. The family's water business was prospering, and Bill and Lorraine wanted to teach their children that such a blessing brought with it an opportunity to give. Soon his friends joined the Ashe family on their trips. Then some of them encouraged Bill to formalize their work.

The Lifewater International name was established in 1977, and a board of directors was elected in 1979. Lifewater became a California nonprofit corporation on April 26, 1984, and was granted tax-exempt status as a 501(c)(3) corporation in February 1986.

Bill and I talked for perhaps an hour. We had a conversation, not a Q&A session. He was curious about my reasons for wanting to join Lifewater and what I wanted to accomplish. At the end, Bill thanked me for my time and said: "Our annual meeting is in Pasadena this coming fall. I hope you'll come to meet our volunteers and directors. Would it be possible for you to talk about the work you do and how it relates to our mission? I will be happy to show you around."

I went to the meeting and was thrilled to meet so many motivated people. A former student of mine, John Nadolski, was in a leadership position. I ran into a number of people whom I knew and worked with, but I hadn't known of their interest in hydrophilanthropy. Never was there a word about my religion.

I had found a hydrophilanthropy home!

My Lifewater International Years

I was active in Lifewater International for about 10 years, from 1996 to 2005. Lifewater did development, not relief, work. The two are quite different. Some people think that if you can do one, you can do the other. Not so. During Hurricane Katrina a number of us were asked (not by Lifewater International) whether we wanted to join a relief team. I declined, but a few of my Lifewater friends went to New Orleans. They had a miserable experience and returned after a few days.

I attended two workshops conducted by Living Water International (LWI), a Houston-based NGO that often worked with Lifewater. One was the "care and feeding" of 10 common hand pumps. I learned how to tear them down and make repairs. I also took a workshop on drilling with the LS-100 portable drilling rig. The chief instructor was Harry Westmoreland, inventor of the LS-100 and owner of Lone Star Bits. He soon asked me to be an instructor, and I gladly accepted. These workshops were conducted at the Living Water International site on a lake near Cleveland, Texas. It was a beautiful facility, owned by Rosemary and Larry Laird, our hosts, and even in the sweltering Texas summers the hospitality and camaraderie were palpable.

I headed a project that Lifewater International approved for a water system in the southern Darien Province in Panama. Loring Green (geologist turned financial adviser), Robert Jarrett (engineer), Craig Woodring (engineer), and I went to the Embera Indian reservation in a remote section of Panama. There were no roads leading to the area. We could fly there (three flights a week via the Panama City municipal airport) or take a freighter from Panama City (not recommended for passengers). I made some recon visits hosted by Bob Runyon, an ex-Air Force man who lived in Punta Gorda, Florida, worked with the Embera, and had earned their trust. I visited some suppliers in Panama City to see what they had (not much).

The Peace Corps was present in Panama but had withdrawn from the Darien Province, which bordered Colombia. At this point the Pan-American Highway had about a 70-mile gap (the "Darien Gap"), its only break in about 19,000 miles. The gap is a dangerous area, not only for the natural environmental hazards but also human ones. When we were there, Colombian guerrillas—the Fuerzas Armadas Revolucionarias de Colombia, or FARC—posed an even greater threat than the usual banditos. They supposedly had several training areas and supply caches there.

With Bob's help we were ready to begin working in spring 1999. The Embera drilling team members were quick studies and installed two wells and pumps. The Peace Corps returned around 2008. A Peace Corps volunteer contacted me to tell me that the Embera were still drilling wells. I have since tried to return there to no avail.

The Embera Indian drilling team stand at the finished well with Michael Campana. Source: Loring Green

Closing the Circle

My Lifewater International years were some of the best years I remember. I found out what camaraderie was. My colleagues were humble and driven to make the world a better place. Virtually all of them were motivated by religious reasons; that was not true in my case, but I enjoyed being in their company.

One night a group of us sat around a table talking shop. One man's wife, a medical doctor, listened intently. During a lull in the conversation, she spoke: "I really envy you guys. You have the power to keep people from getting sick. By the time I'm called in, it's usually too late."

Lifewater International has changed. The volunteer model has been replaced by a reliance on professionals. But they still do great work, and I support them financially.

One interesting phenomenon: being in Lifewater International serendipitously exposed me to other hydrophilanthropy folks and events. I found a lot of academics doing hydrophilanthropy on their own, working with students and colleagues, with no LI or LWI as a support group. It did not take long to find or create professional meetings with hydrophilanthropy sessions. Quite a network was there!

And my work with Lifewater helped set me on a continuing path of hydrophilanthropy. In what began as a potential Lifewater trip for a Honduran project that proved to be not viable, my host, Rolando López, and I conceived a plan to begin taking my University of New Mexico students to Honduras for a summer field class from 2001 through 2005. Twenty years ago I founded my own 501(c)(3) hydrophilanthropy, The Ann Campana Judge Foundation, to honor my younger sister, murdered by five Saudi Arabian terrorists who crashed her plane into the Pentagon.

I once asked my supportive and perceptive wife, Mary Frances, "Where have all these hydrophilanthropy people been?" Her reply: "They've been there all the time. You just weren't looking for them."

Now I know where the hydrophilanthropy folks are: everywhere!

Editor's note: This article by Michael Campana appeared first in Water Resources IMPACT*, volume 24, number 4 (July/August 2022).* ■

Michael E. Campana (aguadoc@gmail.com) was editor-in-chief of *Water Resources IMPACT* and held forth on assorted water, climate, and environmental issues as a professor emeritus at Oregon State University as well as on his blog, WaterWired.

AWRA 2024 WEBINARS

MONTHLY EDUCATIONAL WEBINARS GIVE YOU...

- Cutting-edge information from recognized industry leaders.
- Free registration for AWRA members.
- Live and on-demand learning with archived recordings.
- Self-reported CEU/PDH/CM credits.

WEDNESDAYS

1:00 PM ET

SEE THE SCHEDULE

AMERICAN
WATER RESOURCES
ASSOCIATION

REGISTER ONLINE:

WWW.AWRA.ORG/WEBINARS

Water, Water, Everywhere

Elaine J. Hanford

Table 1. Salinity Ranges for Water

Water Salinity	TDS in ppm	Notes
Freshwater	Less than 1,000	Potable & palatable for drinking
Slightly saline	1,000–3,000	Used for domestic supply where better quality water is not available & can be used for irrigation
Brackish (moderately saline)	3,000–10,000	Generally too "salty" for drinking but can be sipped in small quantities without regurgitation
Saline water	>10,000	Too salty for human consumption
Sea water	Average ~35,000	
Hypersaline	>35,000	

Table 1. Salinity Ranges for Water Source: Compiled by author

***IN MEMORIAM TO MICHAEL, A VALUED LIFE-LONG** colleague and friend who was a water wizard extraordinaire. May we each emulate his wit, wisdom and dedication to the world of water and hydrophilanthropy.*

"Water, water, everywhere, / Nor any drop to drink," admonished Samuel Taylor Coleridge in 1798 in "The Rime of the Ancient Mariner." The quote references situations in which we are surrounded by abundance but are unable to benefit from it.

Water is abundant on Earth, playing a critical role in almost every natural process, and is absolutely essential for life. Despite this, we take water for granted. Decisions are made that result in the degradation and depletion of this resource. As the population of the world continues to grow at an exponential rate, inadequate efforts have been made to preserve and restore the quality of this most essential and precious resource.

To truly appreciate water, we must understand how much water is present on and in the Earth. More importantly, we need to understand the character of water—that is, its salinity—and thereby the very limited amount that can be consumed by humans to sustain life. By exploring these concepts, we can better appreciate the value of water and the need for hydrophilanthropy to ensure that people have access to adequate and safe drinking water.

The Salinity of Water Is Defined Relative to Human Needs

Salinity refers to the amount of total dissolved solids (TDS) within the water, measured as parts per million (ppm) or milligrams per liter (mg/L). A proxy for TDS is electrical conductivity (EC), which is measured in micro-Siemens per centimeter (μS/cm) and reflects the action of ions dissolved in the water that conduct electricity. Salinity ranges from freshwater to brackish to saline (Table 1). Let's briefly discuss these in reverse order.

Saline Waters

The saltiest surficial body of water on Earth is Don Juan Pond in Antarctica. This small (less than 75 acres),

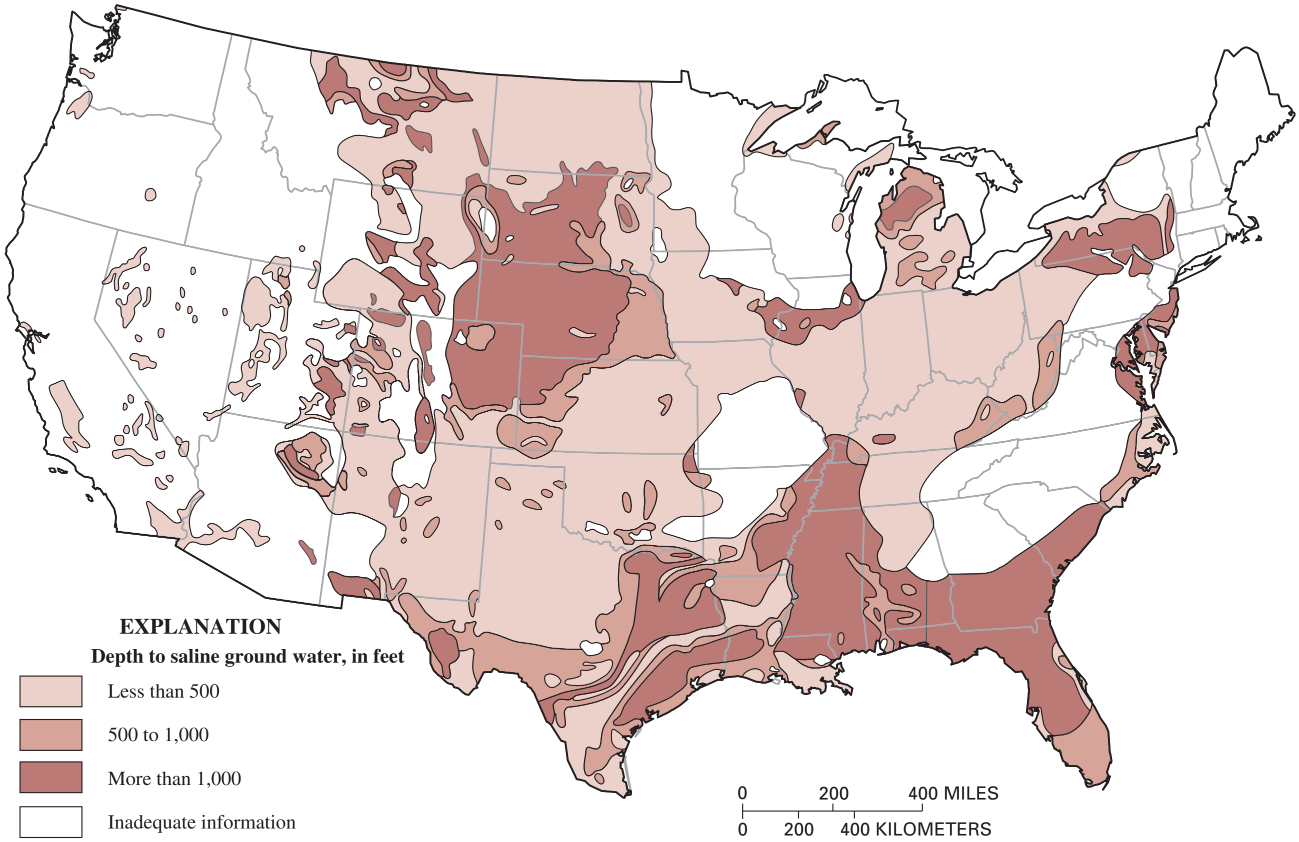


Figure 1. Saline groundwater in the conterminous United States. Source: USGS

shallow (less than 2 feet deep) hypersaline pond is located in the McMurdo Dry Valleys, with calcium-chloride brine salinities that can exceed 400,000 ppm. The salinity significantly depresses the freezing point, allowing waters in the pond to remain liquid as temperatures plunge to almost 60 degrees below zero.

The Dead Sea is the second saltiest surface water body in the world with a salinity almost 10 times that of sea water. It is uniquely characterized by "salt fingers." In the summer, a warm top layer of water overlies a colder, denser bottom layer. When the surface waters are disturbed, tiny parcels of warm water move downward and cool as they descend. Salt precipitating out of these warm salt fingers is deposited on the lakebed.

Deep hypersaline anoxic brines (DHABs) are found at depth in the ocean. DHABs result from the dissolution of exposed evaporite formations to seawater, thus creating lenses of saturated brine on the ocean floor. The density of these brine pools precludes mixing with overlying seawater. The largest known brine pool is the Orca Basin in the northern Gulf of Mexico that encompasses about 46 square miles and is up to 720 feet deep, underlying roughly 7,900 feet of sea water. Three DHAB lakes discovered in the eastern Mediterranean Sea (Atlantic, Urania, and Discovery) are associated with the Messinian evaporites.

Brines that are not derived from seawater (athalassohaline) are all endorheic (closed basin) systems and are a product of regional geologic dissolution. These systems are generally alkaline soda or sulfate lake systems but can also be highly acidic, especially in volcanic regions. Endorheic systems include playa remnants of the Pleistocene pluvial lakes, like Mono Lake (remnant of Lake Russell) in California, with a salinity averaging 85,000 ppm, and the Great Salt Lake (remnant of Lake Bonneville) in Utah, which has a salinity that varies between 50,000 and 270,000 ppm.

Saline groundwater underlies about two-thirds of the conterminous United States (Figure 1). Most research characterizing saline groundwater was done in the 1950s through the 1970s. Forty chemical types of mineralized groundwater have been recognized, but sodium-chloride dominates and is almost the only type found where salinities exceed 20,000 ppm. Disposal of volumes of

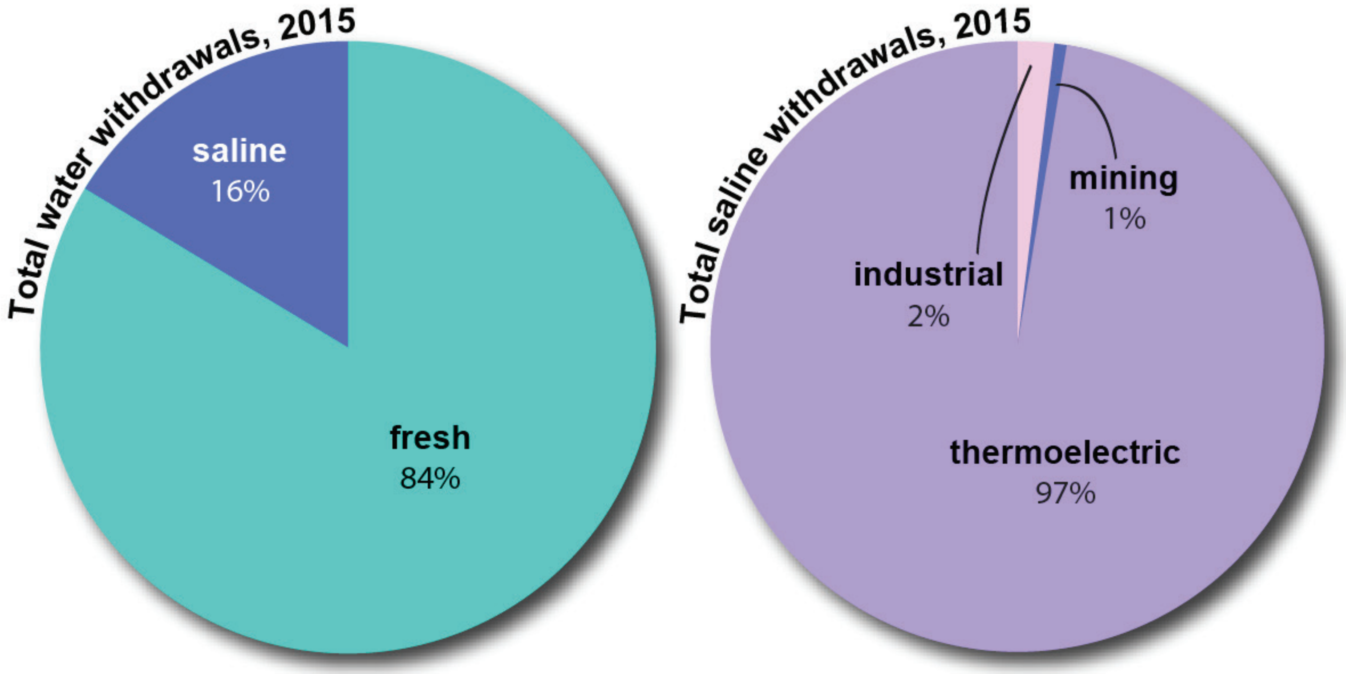


Figure 2. Total water withdrawals and categories of saline water use in the United States. Source: USGS

brine resulting from desalination, as well as drilling for oil and gas production, is typically accomplished by deep underground injection.

Roughly 16% of withdrawn groundwater is saline and is used primarily (97%) by the thermoelectric-power industry to cool generating facilities (Figure 2). Less than 3% of withdrawn saline groundwater is used for mining and industrial purposes or desalination.

Brackish Water

Brackish water is intermediate between the salinities of freshwater and saline water, having a range between 3,000 and 10,000 ppm and making the water distastefully salty. Salinity will vary depending on environmental factors and represents a transitional condition where freshwater meets seawater. Brackish water salinity can vary considerably over space and/or time. It may result from the mixing of freshwater and seawater in coastal estuaries or it may occur in fossil aquifers. Human activities can produce brackish conditions, such as construction of dikes and flooding of coastal marshlands to produce brackish pools for aquaculture. Over-pumping of coastal freshwater aquifers can induce seawater intrusion. If this process is reversed, the salts remaining in the intruded aquifer can produce brackish conditions.

Well-known brackish water bodies include the Baltic Sea, the Black Sea, the Thames River Estuary, and the Caspian Sea. The Baltic Sea, an arm of the Atlantic, is the largest pool of brackish water in the ocean, with sills that inhibit the flow of heavy salt water. In the Black Sea basin, deep waters coming from the warm, salty waters of the Mediterranean do not mix with the generally cooler, less dense, and less salty waters fed by large river systems. The Thames River flowing through London, England, is a tidally influenced estuary. The Caspian Sea, the world's largest lake, contains brackish water with salinity ranging up to about 12,000 ppm that is believed to have accumulated from continental runoff.

Depth to brackish groundwater is generally shallower in the southern Great Plains and the Ohio River Valley (Figure 3). Brackish groundwater is directly used for cooling water for power generation, aquaculture, and for drilling, enhancing recovery and hydraulic fracking in the oil and gas industry. Desalination can improve the quality of brackish water and make it suitable for municipal and domestic use. Figure 4 reflects the use of saline (including brackish) groundwater by county across the United States. The State of Texas, for example, has developed a manual for planning groups, to guide the use of brackish groundwater.

Can you drink brackish water? In general, the taste is

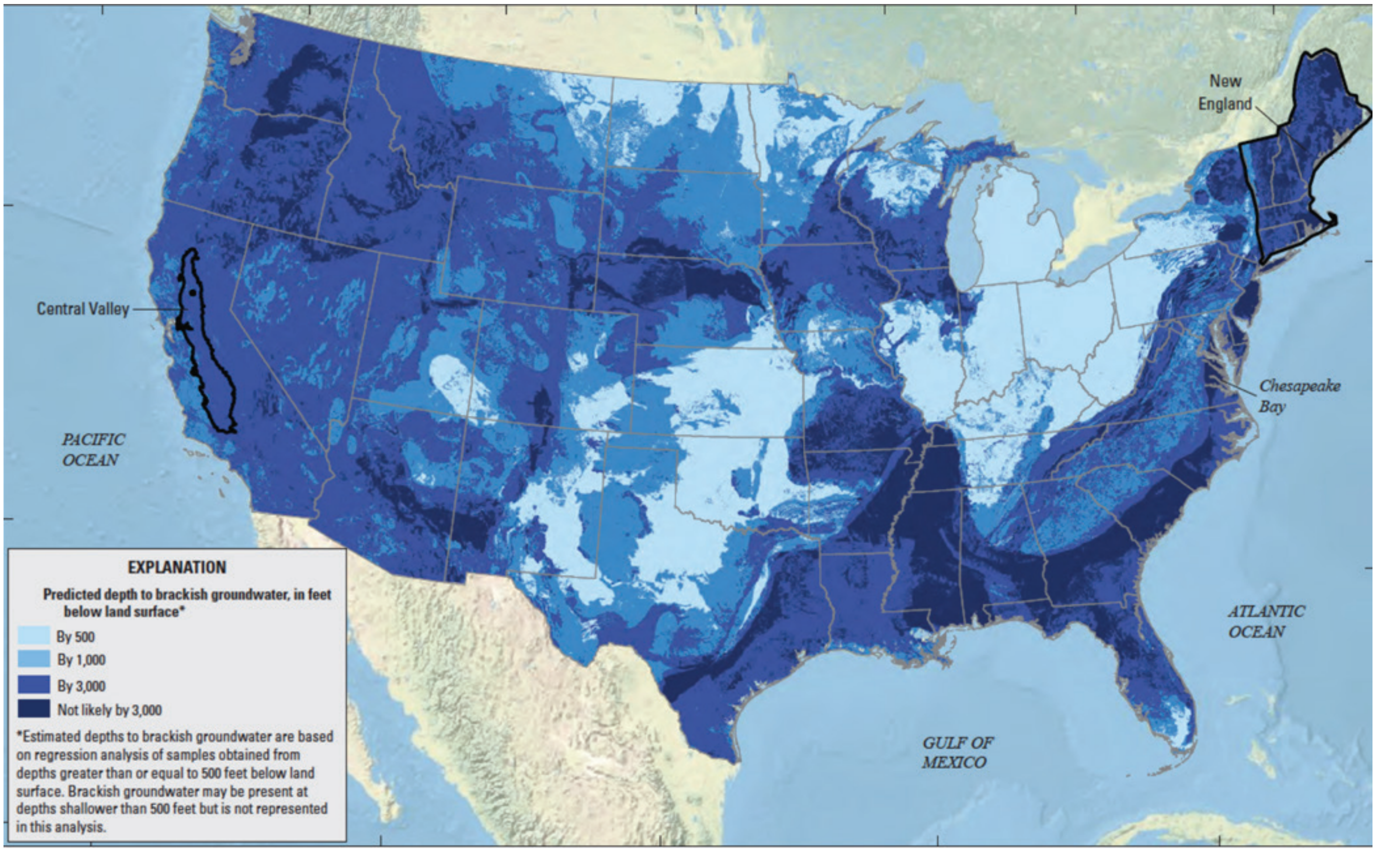


Figure 3. Predicted depth to brackish groundwater in the United States. Source: USGS

too salty and not appealing to most people. If you drink brackish water, your kidneys may overproduce urine to expel excess salt from your body, leading to dehydration. Your body has a built-in protection mechanism so that drinking brackish water often stimulates regurgitation. However, if you are ever stranded in the desert or marooned on a desert island, it might be good to remember that you can sip brackish water to stave off dying of thirst.

Just How Much Water Is There, and Where Is It in the Water Cycle?

The U.S. Geological Survey estimates that there are more than 332,519,000 cubic miles of water on the planet. That is an estimated 326 million trillion gallons distributed among various components of the environment (Figure 5). Approximately 97%, or 321,003,271 cubic miles of water, is in the ocean. Two percent is frozen in glaciers and ice caps. Roughly one percent is freshwater. And only a tiny fraction exists as water vapor in our atmosphere. Figure 6 depicts the most recent iteration of the water cycle, incorporating human influences that affect where water is stored, how it moves, and how clean it is.

Pools are places where water is temporarily stored, like the ocean. Fluxes are the ways that water moves between pools, such as evaporation, precipitation, discharge, recharge, or human use. The rate and volume of water moving between these pools and fluxes can range over many orders of magnitude. As it moves among the various pools, water may change phase from liquid to solid to gas. When examining the hydrologic cycle, it is necessary to also consider residence time—that is, the amount of time that any phase of water remains in a given pool.

Residence time in any compartment of the hydrologic water cycle is estimated as the volume of water in a pool divided by the average flux of water into and out of that pool. Average residence time for a water molecule in the atmosphere is on the order of 10 days; in the vadose zone, it is about 1 year; roughly tens to hundreds of years for lakes; several thousands of years in the ocean; and hundreds of thousands of years in the ice caps. For deep saline waters beneath freshwater zones, residence time is measured on the geological scale, on the order of tens of millions of years. Some aquifers contain waters that were recharged during wetter, cooler periods of Earth

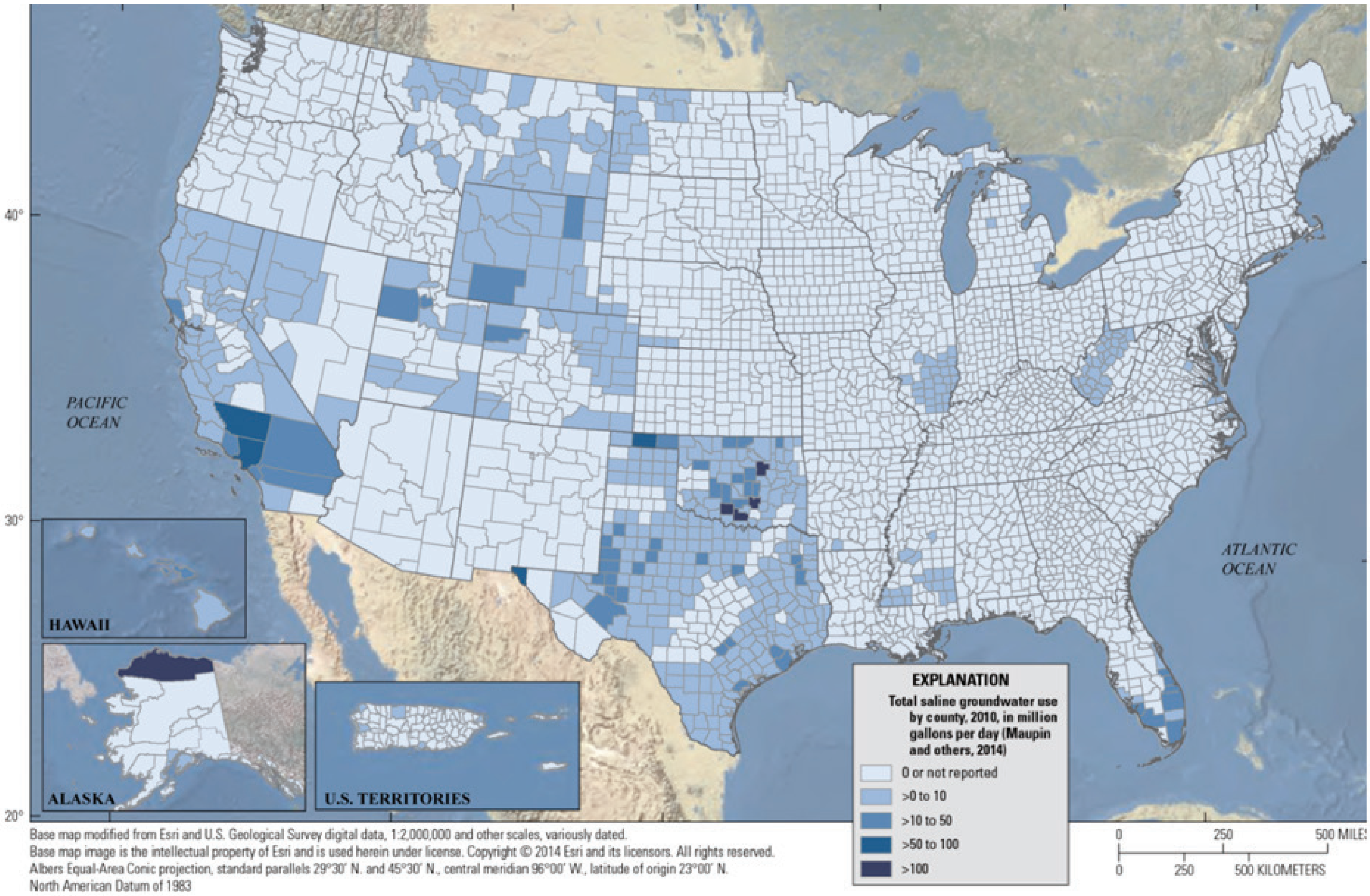


Figure 4. Saline groundwater use, by county, in the United States and selected U.S. territories in 2010. Source: USGS

history defined by the glacial-interglacial cycles over the past tens of thousands to hundreds of thousands of years.

The Geologic Water Cycle

Popular media reports have extolled "oceans worth of water deep beneath the United States" that "may represent the planet's largest water reservoir." But careful reading shows that it is not liquid water. At great depths and high temperatures, a water molecule splits to form a hydroxyl radical (OH) bound into the crystal structure of different assemblages of minerals that are more stable under those conditions than closer to Earth's surface. Minerals like olivine, garnet, and pyroxenes that are "dry" when they crystallize in Earth's crust exist at greater depths in versions that carry small amounts of hydroxyl radicals and are therefore "wet." The processes of plate tectonics have, for billions of years, transported water and water-bearing minerals to great depths within subduction zones. This water behaves like a catalyst, lowering the melting point of subducted slabs, and completing the cycle. Most subduction zone volcanoes have an average of 4% water by weight. Some volcanoes, like the Shiveluch volcano in the Kamchatka Peninsula, may be superhydrous, with water contents as high as 10% to 14%.

The Human Factor—Food for Thought

On the surface of the Earth and at shallow depths, humans can alter the cycle by redirecting rivers, building dams, or draining water from wetlands. Humans extract water from natural water bodies, man-made reservoirs, and groundwater aquifers for 1) residential use, 2) commercial and industrial use such as power generation, mining, and aquaculture, as well as 3) agricultural irrigation and livestock. These activities can impact water quality by introducing a range of toxic chemicals, sediment, and sewage. Runoff in agricultural and urban areas includes fertilizers, pesticides, and other chemicals that may be toxic even in very low concentrations.

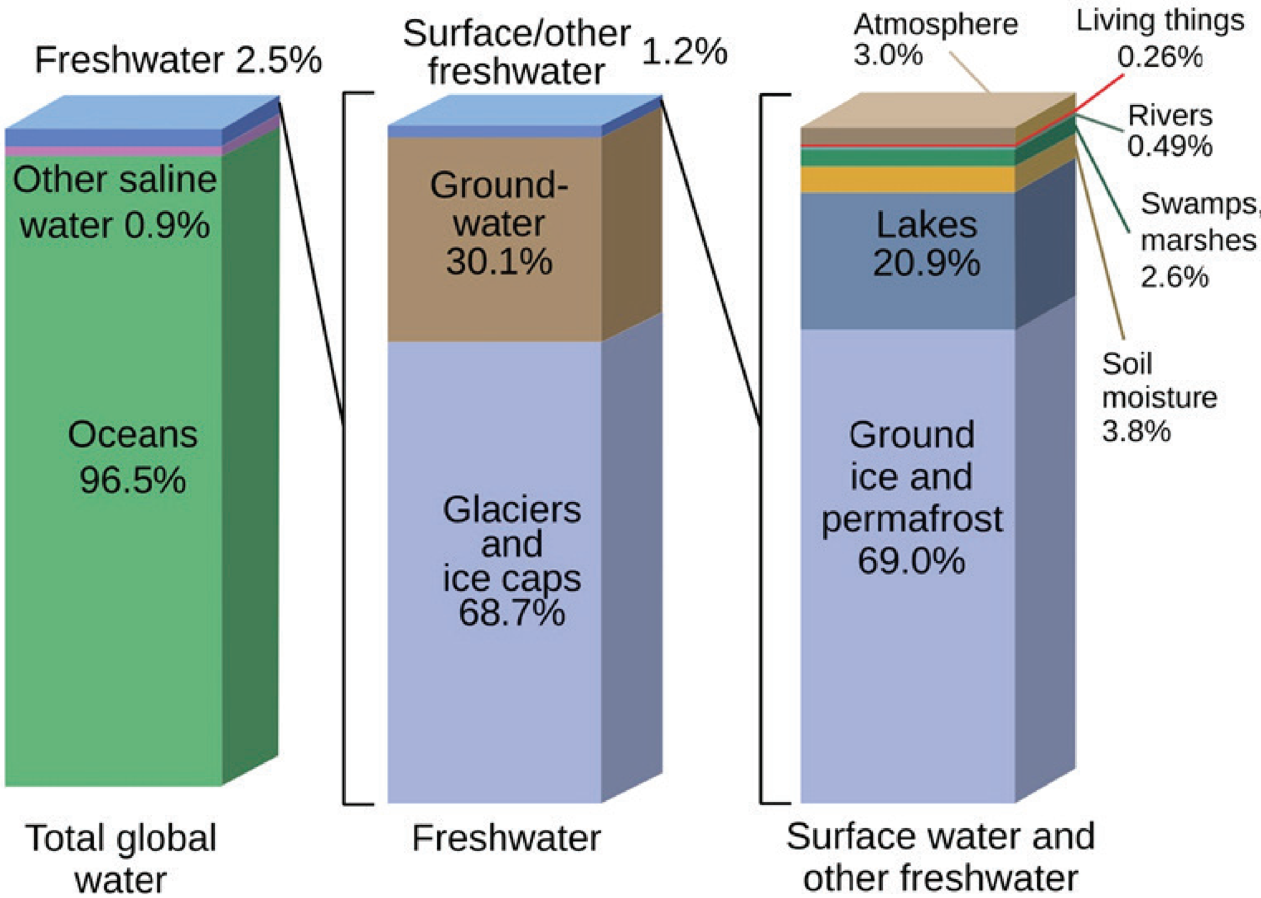


Figure 5. Distribution of water in the water cycle of Earth. Source: USGS

Power plants and factories can not only add chemical contaminants but also heat that may degrade the environment. Over-pumping of aquifers along with over-allocation of surface waters has led to declining groundwater levels and degradation of aquifers.

Nor Any Drop to Drink

Three critical parameters must be acknowledged. First, once water resources are contaminated, it may be extremely challenging to remove the contamination. Technology may not be available to accomplish the remediation, or it may be cost-prohibitive.

Second, the current human population of roughly 8 billion people continues to grow at an exponential rate, increasing the demand for more potable water. The demands of humans and the needs of all other living organisms must be accommodated by less than 1% of the water on Earth.

Third, water must be valued. Even in these inflationary

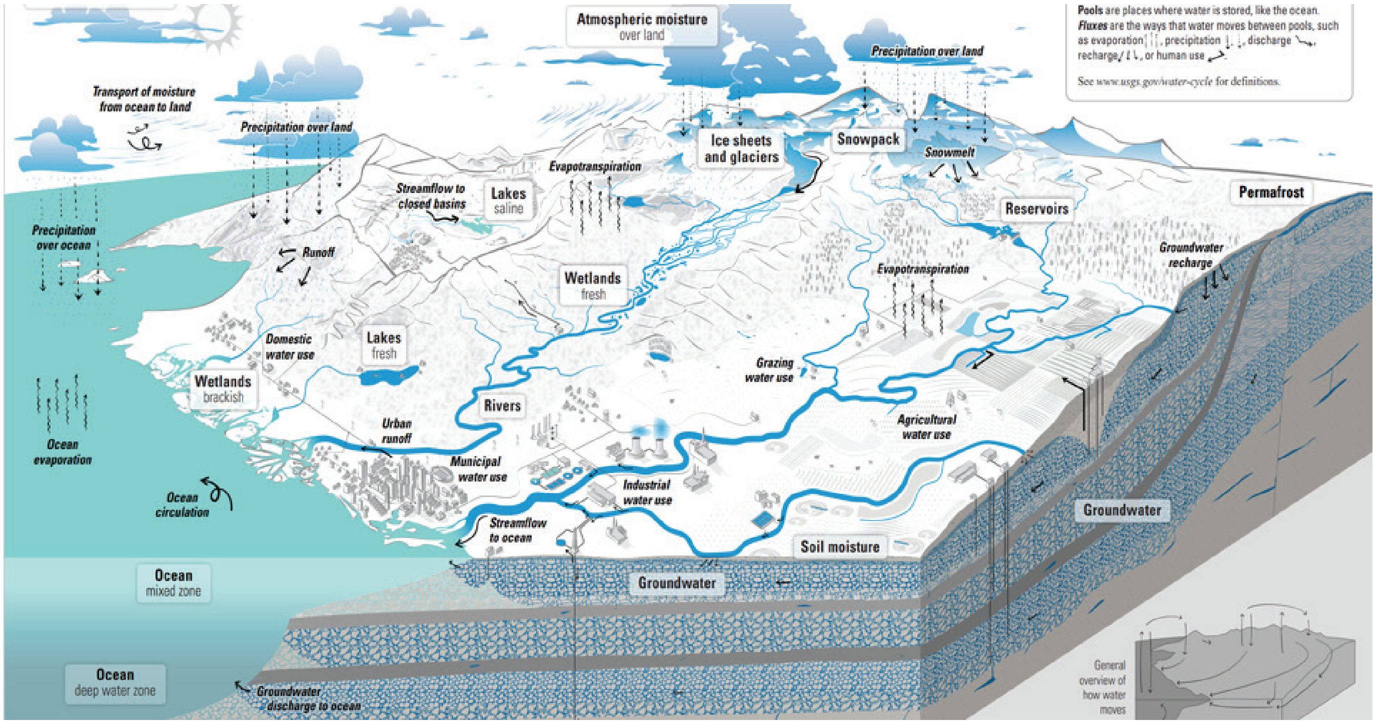


Figure 6. Water cycle showing how human water use affects where water is stored, how it moves, and how clean it is. Source: USGS

> *If you are ever stranded in the desert or marooned on a desert island, it might be good to remember that you can sip brackish water to stave off dying of thirst.*

times, when gasoline costs an average of $4 to $5 per gallon, drinking water costs $1 to $2 for one gallon. Purchased in quantity, the average price of water in the United States is about $1.50 for 1,000 gallons. We could live without gasoline, but we cannot live without safe drinking water. ■

E. J. Hanford (ejhanford@att.net) is a retired professional geologist, registered since 1979 and formally retired since 2012. She has more than 45 years of experience as a geologist and environmental scientist consulting for the public and private sectors, as well as university teaching and research. Her work has been honored for more than four decades at professional conferences and published in peer-reviewed national and international journals. She compiles weekly Geoscience, Environmental Science, and Coastal Zone Management Bulletin Boards. Many thanks to William J. Elliott, consulting engineering geologist, for his “red pen” and helpful critique.

LET'S MEET *in Colorado*

NOVEMBER 10-12, 2025 | WESTMINSTER, CO

AWRA 2025 ANNUAL CONFERENCE

Why Attend?

This conference is one of the most diverse and inclusive conferences in water resources management. AWRA provides you with innovative, practical, and applied water resources management solutions, management techniques, and current research.

Important Details Coming Soon!

Registration Options
Hotel Room Block Details
Call for Topical Session Proposals
Call for Abstracts

Location:

Westin Westminster Hotel
10600 Westminster Blvd
Westminster, CO 80020

FEATURE

Fighting Water Loss with Advanced AI

Stuart Mitchell

AI-enhanced leak detection systems will be crucial to address nationwide water loss. Source: PipeSense

THE UNITED STATES IS FACING A MAJOR DILEMMA. The population size is increasing, and with it, water demand nationwide. Simultaneously, the connecting infrastructure supplying water resources to homes, communities, and businesses is aging rapidly. Throughout my career supporting the pipeline integrity management sector, I have observed massive changes stemming from the use of technology, and thankfully, the latest developments hold hope for overcoming some of our biggest challenges.

Much of the 2-million-plus miles of water pipeline spanning across America is nearing the end of its lifespan. The average U.S. water network pipe is reportedly in its mid to late 40s, having been built and installed in the 1970s and '80s. What's worrying is that, in a report published in early 2024 from Utah State University (USU), utility operators reported that the average failure age of a water pipeline is 53 years old. The same report found that, of the 400,000 miles surveyed in the United States and Canada, 20% of pipelines had exceeded their operating life cycle. This concern is felt throughout the industry, with aging infrastructure routinely highlighted as a significant concern by industry experts and leaders—as surveyed by the American Water Works Association (AWWA). Far from being a fear tactic to drive investment into water infrastructure, the day-to-day reality reflects the concern. Some of the most headline-grabbing stats include:

- Across the United States and Canada, there are 260,000-plus water main breaks annually, costing approximately $2.6 billion per year in maintenance and repairs.
- A water main breaks approximately every two minutes.
- An estimated 6 billion gallons of treated water are lost every day.
- Annually, the United States loses 2.1 trillion gallons of water because of aging and broken-down infrastructure.
- Between 20% and 50% of water is lost in North America's water systems.
- The American Society of Civil Engineers (ASCE) reported that water loss costs U.S. municipalities and water utilities $7.6 billion annually.

We all know that water is an incredibly precious resource. This reality will be heightened over the coming decades. As the global population reaches 10 billion by 2050, we cannot afford to continue the current water loss trends.

In the United States, communities are already experiencing the effects of water loss. AP reported that several cities are being hit hard by water loss, including Prichard, Alabama, which lost more than 50% of its drinking water; Jackson, Mississippi, which lost an estimated 65% of its water supply during a 2022 system collapse; Highland Park, Detroit, which has experienced approximately 70% water loss from pipes that are 120 years old; and several Georgia systems that are losing upwards of 80% of treated drinking water.

Typically, poorer communities experiencing industrial decline are disproportionately affected by water loss and face the associated health risks of water contamination from pipeline corrosion. Unfortunately, as these communities and utilities experience water loss on such a mass scale, the systems become less cost–efficient and less likely to receive investment or upgrading—meaning they continue to deteriorate.

By adopting AI and ML systems into standard industry practices, we can improve leak detection and location accuracy, save operators time and money, and support individuals, the environment, and communities to help end pipeline leaks and their consequences.

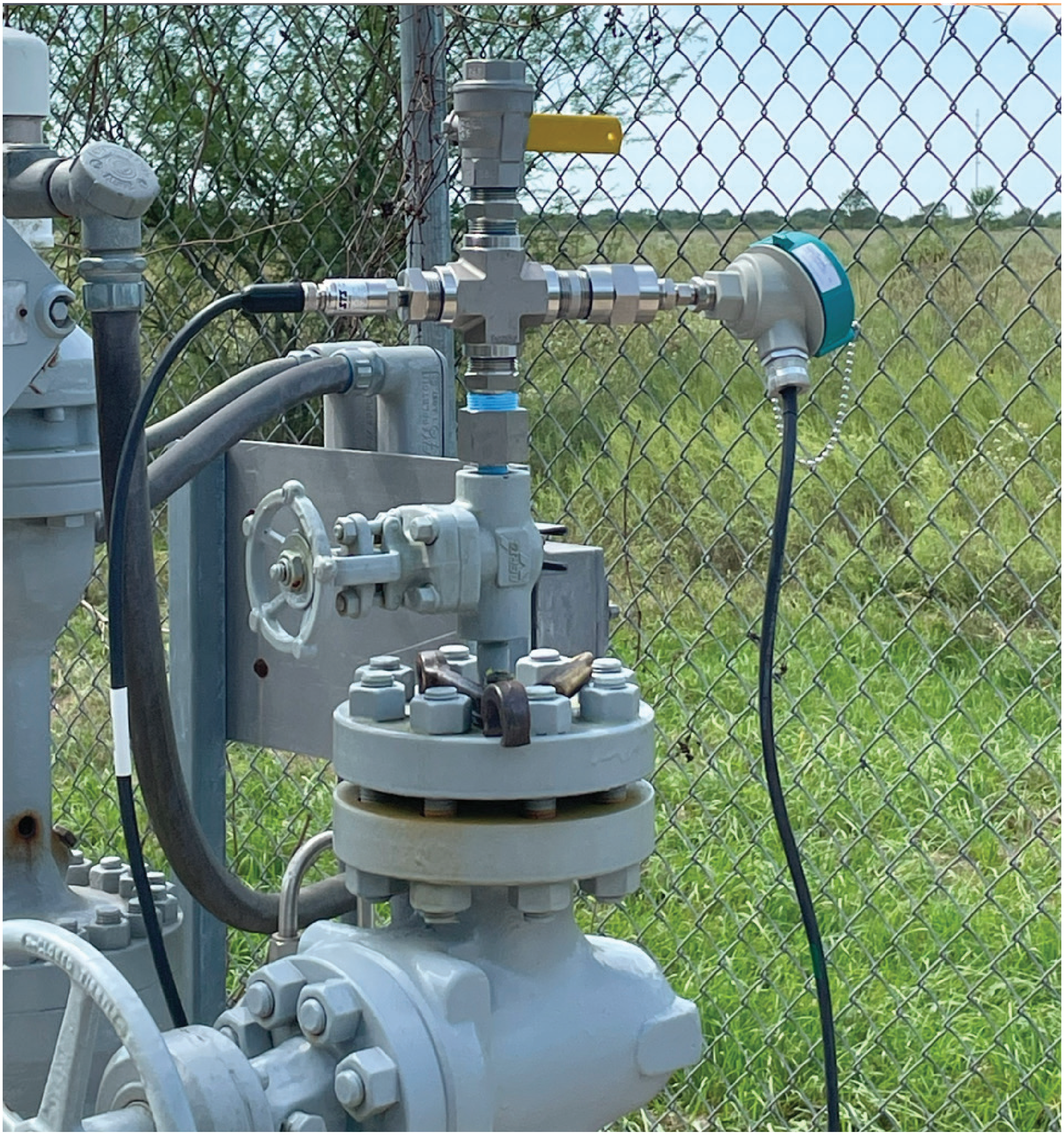
Fighting Water Leaks

Where resources are limited, innovative approaches are a necessity. To reduce water loss, pipeline leaks need addressing. A new view on infrastructure and asset management can help slow down the consequences of aging water networks and act against associated pipeline leaks.

Traditional methods of pipeline leak detection are not equipped to deal with system complexities, the current rate of water loss, or the potential water supply catastrophe facing U.S. municipalities. With a track record of false positives and labor-intensive methods, traditional leak detection approaches have become outdated, inadequate, and costly. Additionally, proactive measures were previously difficult to achieve because of time constraints and the need to schedule repairs—typically, a reactive process. To control water scarcity, transitioning to new technologies and methodologies is essential. Artificial intelligence (AI) has a significant role in mitigating water loss and safeguarding the future of pipeline integrity.

Built by expert data scientists, AI-enhanced monitoring solutions are developed to assess, analyze, and quantify the condition of an asset. By gathering data on a pipeline's history, structural integrity, performance, water demand, and health, it's possible to create an algorithm that can predict the future of an asset as well as potential areas of concern. As with many AI-backed solutions, the data captured is gathered faster than is possible with a team of individuals.

Accounting for geographic location, weather



PipeSense's pipeline leak detection system, PipeGuard. Source: PipeSense

conditions, nearby water demand, population size, and other major external factors, AI monitoring models can be designed to fit varying factors surrounding specific miles of pipeline. This data creates a concise picture of an asset's health and the risk of water loss. Each algorithm—designed according to the unique needs of diverse locations—can predict maintenance requirements, prompting the utility company to address the problem before it escalates.

By integrating advanced AI-backed pipeline monitoring solutions into an overarching maintenance strategy, operators and pipeline leak detection specialists can work together to capture predictive data and fight against water leakage. Considering the role of an asset in a local water network and the costs associated with maintenance, operators can use evidence from the accurate and up-to-date data captured by AI to make better-informed and proactive decisions to address potential weaknesses, water allocation, and water conservation.

With water networks running underneath us, leaks are typically difficult to pinpoint and access in a time-sensitive fashion. Previously, by the time utility companies were aware of the leak, they would have already experienced mass water loss. Assessing an asset's performance, history, and health, predictive AI monitoring models can identify leaks before they occur, saving time, money, and water loss. Some reports have indicated that advanced analytic models and predictive maintenance can lead to annual cost savings of between 10% and 20%.

Additionally, in densely populated water networks, knowing the health and history of an asset can help operators better understand which pipelines and systems require urgent maintenance, allowing them to prioritize resources to mitigate the risk of leaks. Rather than wasting precious time and resources on pipelines that don't demand urgent attention, through predictive AI analysis, the largest leaks can be prioritized and effectively dealt with.

Adding AI to the Tool Kit

In my nearly 30-year career, I've worked alongside countless operators and utility companies in dealing with the fallout from pipeline leaks. Now as president & CTO of PipeSense, a United States-based pipeline leak detection specialist, I've seen first-hand the impact of the nation's aging infrastructure—and the vital need for innovative solutions to combat it.

Regardless of what a pipeline carries—whether oil, gas, or water—the consequences of a leak are nearly always severe. Listening to industry expert predictions and the evidence that is piling up, it's clear that the next five to 10 years are critical. Action, without further delay, is necessary. As an industry of experts, we must continue exploring new opportunities to deliver pipeline integrity to the market via fully integrated pipeline monitoring and leak detection services. Advanced AI and machine learning (ML) systems can provide invaluable support in combatting leaks and maximizing the lifespan of an asset.

Combining high-speed pressure sensing and AI-based image processing, these evolving technologies are key to minimizing water loss and offering peace of mind to utility companies.

For example, by real time processing of ultra high-speed sampled data, AI-enhanced systems can screen the pipeline pressure profile for abnormal events. Then, these events can be compared to databases featuring tens of thousands of images representing a wide range of pipeline leak events and abnormal pressure events from various configurations and contents. Through use of controlled "training" pressure releases from along the pipeline, AI can be deployed to detect changes in leak signal magnitude and accurately determine leak location to less than 50 feet in its system testing.

By adopting AI and ML systems into standard industry practices, we can improve leak detection and location accuracy, save operators time and money, and support individuals, the environment, and communities to help end pipeline leaks and their consequences

Into the Future

Tackling water loss isn't a superfluous goal—it must be our ultimate goal. In line with the United Nations' Sustainable Development goals, which include the need for clean water and sanitation for all, more needs to be done to tackle an ongoing issue that has been impacting communities and municipalities for too long. Already, we are seeing adverse effects of water loss in several states. It's time to be proactive, and AI can help overcome barriers via a cost-effective and efficient approach. ■

Stuart Mitchell (smitchell@pipesense.com) is president & CTO of PipeSense. Stuart has three decades of experience working in the pipeline integrity management sector, including more than 20 years working to develop and commercialize innovative technologies, most recently at PipeSense. Crucial to the development and commercialization of PipeSense's leak detection technologies, Stuart utilizes his vast experience to drive technology strategy and secure results for clients.

AMERICAN
WATER RESOURCES
ASSOCIATION

We work together. We learn together. We solve problems together.

AWRA invites you to discover *Community, Conversation, & Connection* and give back to the water resources profession as a volunteer on our technical committees.

https://www.awra.org/volunteer

LET'S MEET *in Alaska!*

APRIL 28 - 30, 2025 | ANCHORAGE, AK

AWRA 2025 SPRING CONFERENCE:

Development Risks & Challenges in Changing Climate Conditions

Why Attend?

Impacts to the cultural and socioeconomic health of the planet and all life as we know it are related to water and **changing climate conditions**. Climate change is increasingly causing severe weather events, changes in weather patterns and altering hydrologic cycles. These increasing uncertainties are posing significant **risks** to current and future **development**. **Come** to our conference, make **connections**, and contribute to these important **conversations**!

Important Details:

Registration is Open! Get the early-bird rate through February 24!
International Registration Waiver Application: Due February 24.
Hotel Room Block: Open through April 10, 2025
Call for Topical Sessions & Abstracts: Closed

Location

Marriott Anchorage Downtown
820 W 7th Ave, Anchorage, AK 99501

#AWRA2025 | www.awra.org | events@awra.org

A special thank you to the AWRA Alaska State Section for hosting!

AMERICAN WATER RESOURCES ASSOCIATION