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City of Peoria
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Black Environmental
Jesse@blackenvironmental.com

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Brown and Caldwell
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2018
The Kachina News
Article and advertisement deadlines

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High-resolution PDF files with fonts embedded, Adobe Illustrator 9.0 .eps files, .tif files, .jpg files, or Microsoft Word files. Include any high-resolution (300-dpi) photos or artwork used with Microsoft files separately as either .tif or .jpg.

E-mail all articles or advertisements to: manager@azwater.org

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**Dave Redman**

1820 W. Drake Drive, Suite 105 • Tempe, AZ 85283

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Now it is time to get back to work again. We have another busy and very exciting year coming up.

First and foremost, I want to make sure you all know that the AZ Water Association will be celebrating its 90th Anniversary this year. There are not a lot of organizations that can make that claim. I recommend that you read the AZ Water History article that appears in this issue of The Kachina News. The article is re-printed with several others that are part of a special insert in the January 2018 issue of The Arizona Capitol Times. The Times goes out to all of Arizona’s State legislators, State agency directors, advocacy and law firms, business leaders, and more. This insert is an opportunity to emphasize the importance of water and wastewater services to our economy and well-being, increase the visibility of AZ Water, and to further AZ Water’s Mission to “Advocate for Arizona’s water through bold leadership, connecting professionals, providing education, and inspiring environmental stewardship”.

In order to complete the Mission, we have taken major steps to raise AZ Water to a new level. Back in 2014 we updated our Strategic Plan, which was followed in 2016 with a comprehensive Business Plan. To expand our outreach, we hired an Executive Director, David Iwanski. His efforts have increased the visibility of AZ Water. We also moved our conference to the Phoenix Convention Center (PCC) in order to accommodate how fast AZ Water was growing and to serve more members. The PCC provides the space for an enhanced conference experience, including expanded vendor participation. With this move came more costs, especially for the first year. However, the Board is also improving its in-house administrative capabilities and reducing reliance on contractors for some of these functions, as a means of reducing costs and optimizing revenue use. In order to stabilize revenue streams, the Board of Directors recently approved an increase in annual dues from $50 to $65, to take effect in 2018. The membership dues is still an excellent investment for Arizona water and wastewater professionals, and the increase will go a long way to sustaining the organization.

In addition to entering our 90th year, we have an exciting schedule of events that are already on the AZ Water website. By the time you receive this edition of The Kachina News, several events will have already occurred. On January 27, 2018, AZ Water will bring an eastern tradition to the west with a “Beefsteak Dinner Fund Raiser” event. This is an opportunity to network and socialize with other AZ Water members, members of the business community, and individuals interested in water, and to help benefit the AZ Water Association. The event is being held at the Arizona Heritage Center at Papago Park in Tempe, Arizona. On February 1, 2018, the Southern Arizona Technical Luncheon will present an AZ PURE Water Brew Update, a Special Joint Luncheon with the American Society of Civil Engineers (ASCE). Other Southern Arizona Technical Luncheons are scheduled for March 1 and April 5.

The Water Treatment Committee is also very busy putting together a Seminar Series on February 13-15 covering groundwater and surface water treatment, including surface water treatment facility and groundwater treatment virtual tours. Check out the AZ Water website for details.

There are many other happenings, including, of course, the Annual Conference & Exhibition to be held at the Phoenix Convention Center, May 2-4, 2018. Again, please check the website for details and other upcoming events.

Finally, to emphasize one of our key commitments, “Attracting professionals to the water industry,” all AZ Water members should be ambassadors to our schools, from universities on down, at least through middle schools, to market careers in the water industry. I shamelessly refer you to the article that I prepared for The Arizona Capitol Times, titled “Workforce Challenges in the Water Industry” that is also included in this issue of The Kachina News. Participate in career/job fairs, science fairs, and public outreach events. Like every endeavor, we need new blood, not just to replace those of us who are looking at retirement, but to inject new energy and inspire innovation, so critical to providing superior water services throughout Arizona, the nation, and the world.
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It sure has been an eventful year. We partnered with AWWA to conduct a number of road shows across the State to solicit membership and to preach the benefits of belonging to the AZ Water Association, AWWA and WEF. Additional trips are planned for 2018. Individual memberships and retention numbers are up slightly; although, the expectation was that we wanted to see a much more robust membership growth rate – this effort will continue to be addressed in the coming year. The 2017 Conference and Exhibition at the Phoenix Convention Center was a success, and a predominant comment was that it had the “feel of a national event”. The Scholarship Fundraising Golf Tournament set a record for monies raised. That kind of success only motivates the Planning Committee to raise the bar and make the kinds of improvements and responses to comments to build an even strongly annual conference presence.

The Board has also been extremely supportive of allowing me to chase some non-traditional kinds of opportunities. Examples of this include the following. We partnered with the City of Phoenix, the Arizona Water Infrastructure Finance Authority and Stifel and Associates to give a presentation on water and wastewater infrastructure and related financing at the Annual Meeting of the Arizona League of Cities and Towns. We had over 150 elected officials in attendance and the League was elated at our performance. Outreach to education institutions, specifically U of A, ASU, NAU, Estrella Mountain Community College and GateWay Community College, in an effort to identify and groom the next generation of water professionals, has been well received and with the help and support from the Young Professionals I am committed to address as many students and recent graduates as possible.

This January, the Association will publish a multi-page insert to celebrate our 90th Anniversary, in The Arizona Capitol Times, the premier publication used by the Governor’s Office, State Agencies, the Legislature, lobbying firms, law firms, public relations companies and key business leadership throughout the state. Readership is expected to reach 8000, and we are presented with a never before attempted opportunity to tell our story of who we are, what we do, how we do it and why we do it to influential people outside our industry (some of those articles have been republished in this edition of The Kachina News and continued in the spring issue).

Water legislation is expected to be a key topic for action in the coming session. Being able to educate elected officials has been

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Pipeline Assessment
Potable water CCTV inspection, leak detection, internal visual and sounding, acoustic sewer assessment

Pipeline Rehabilitation
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Valve Assessment & Maintenance
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2017 – WHAT A YEAR!

Hurricane Maria

I’m sure we are all quite aware of the extreme weather events and natural disasters that occurred in the second half of 2017. There were wildfires in the Pacific Northwest, Canada and California (twice); there was a 7.1 – magnitude earthquake in Mexico, and a series of hurricanes that hit Texas, Florida, and many Caribbean islands including Puerto Rico. Obviously (at least to all of us water professionals), each of these events stretched the water infrastructure and the water professionals that operate and maintain these systems in ways most of us can only imagine. This was definitely the case when Maria (a Category 5 hurricane) hit the island of Puerto Rico in September.

In November my friend and classmate on the AWWA Board of Directors – Elpidio Gonzalez, AWWA Director for the Puerto Rico Section – provided his colleagues with an update on the situation in Puerto Rico. Elpidio is a civil engineer and he has worked in the Water/Wastewater industry in Puerto Rico for more than 25 years. I think he summed things up pretty well with the following quote:

“The level of destruction was massive … Fifty years of infrastructure were destroyed within hours by this “Monster” and it will take years for the island to fully recover.”

Many of our fellow water professionals (and AWWA members) are doing everything they can to help the people of Puerto Rico by providing technical/engineering support to help rebuild damaged water systems, helping to construct and operate drinking water treatment systems and through fund raising. I have often said that we work in the greatest industry in the world – the water industry. And, it is the people we work with – the dedicated water professional – that make this the greatest industry in the world. We should take great pride in what the individuals associated with AWWA have done to help mitigate the destruction Maria caused in Puerto Rico. Again, I think Elpidio summed things up pretty well with his closing remarks:

“God bless you all for the time and effort that you are placing. Thanks to you all we are going to come out of this much stronger! #PRStrong!”

WRF – WE&RF Merger

In October the Boards of Directors for the Water Environment & Reuse Foundation (WE&RF) and the Water Research Foundation (WRF) announced that the organizations were going to merge into one research foundation. In a press release announcing the merger, organization leaders were quoted as saying “Bringing...”

continued on page 64
The Utility Management Conference
AWWA | WEF
February 20-23, 2018
San Antonio, TX
Hyatt Regency Riverwalk

REGISTER NOW

This conference is jointly sponsored by the American Water Works Association (AWWA) and the Water Environment Federation (WEF) and held in cooperation with the Water Environment Association of Texas.
WEFTEC was a success! The keynote speaker was Fredi Lajvardi, a Carl T. Hayden teacher. Yes! That is correct. The National WEFTEC keynote was from Arizona. Mr. Lajvardi talked about mentorship and his experience with the robotics program at Carl T. Hayden. In 2004 The Carl T. Hayden high school robotics team competed in the college underwater robotics competition. The local high school team competed against the prestigious MIT and other major universities. The underdogs from an Arizona High School edged out the competing Universities and took 1st place. Mr. Lajvardi had an amazing story to tell of mentorship, perseverance, and the impact of encouragement and positive thinking.

Another positive outcome from WEFTEC was the operation challenge team from Arizona. It has been many years since Arizona has participated in the operations challenge. As a relatively new team, this group of operators from Surprise represented us well. They competed in six events and showed remarkable teamwork throughout the competition. They took first place for their creativity in their team picture and finished with an overall time well ahead of many of the other first year teams. I look forward to seeing our local competition expand and the continued success of the operations challenge.

If you were not one of the 24,000 attendees that experienced the top notch presentations, training opportunities, or vendor exhibits in Chicago at WEFTEC 2017, I would encourage you to start thinking about WEFTEC 2018. The call for abstracts is now open for WEFTEC 2018 which will be in New Orleans, Louisiana on September 29 - October 3, 2018. Don’t miss the opportunity to be part of the world’s most influential water quality event!

Did you know that as a WEF member, you have access to all episodes of the “Words on Water” podcasts? These innovative and informative podcasts are a great way to stay involved and up-to-date with the community and what is going on with water. The latest podcast is with Jenny Hartfelder. Jenny is the recently inducted President of WEF. She talks about mentorship, a diverse workforce, women in engineering, and her priorities for WEF. Check out Jenny’s podcast as well as other past episodes at www.wef.org/wordsonwater.

The WEF/AWWA Utility Management Conference is the leading management conference for the water and wastewater industry. This year’s Utility Management Conference will be held in San Antonio, Texas on February 20-23, 2018. The conference highlights include intelligent water systems, innovation & strategic planning, leadership & workforce development, benchmarking & performance optimization, customer service, infrastructure & asset management, and much more! Be sure to register by January 26, 2018 to take advantage of the super saver rate.

I am going to leave you this month with a couple of fun water facts to impress your friends outside of the water / wastewater industry:

Throughout AZ Water Association’s 90-year history, one thing comes to mind: the more things change, the more they stay the same. From name changes and organizational changes, to growing pains during boom years, AZ Water has endured. For AZ Water, the changes have been healthy for our organization and the Arizona water industry; and in the end, almost everything we have done over our 90-year history is consistent with our current mission: Advocate for Arizona’s water through bold leadership, connecting professionals, providing education, and inspiring environmental stewardship.

To understand the history of AZ Water, it is important to understand our organizational structure. Although AZ Water is an independent organization, it also serves as the Arizona section of the American Water Works Association (AWWA) and the Arizona member association of the Water Environment Federation (WEF - formerly known as the Water Pollution Control Federation). The AWWA and WEF are two national/international organizations representing the water industry. The roots of AZ Water began in the early years of Arizona statehood when an organization called the Arizona Public Health Association was established to address the needs of water supply and waste disposal by public and private organizations with the new state. They were officially organized in 1925 as the Arizona Public Health Association and Arizona Sewage & Water Works Association and held their first annual meeting in 1927.

To separate the public health aspects, the Arizona Sewage & Water Works Association was split from the Public Health Association in 1928, the same year the National Organization Water Pollution Control Federation, WPCF, was formed. Arizona Sewage & Water Works Association became a member association of the WPCF (now known as the Water Environment Federation - WEF), and the Arizona section of the American Water Works Association (AWWA). In 1938, the National Association of Sanitarians met in Phoenix, the same year the Arizona Sewage & Water Works Association published its first newsletter.

The Association’s first newsletter provided a status of domestic sewage disposal in Arizona and included an article addressing the dangers of cesspool disposal of sewage to well water supplies.

Throughout the 1940’s and 50’s, the organization stayed the course, with the marquee event being the annual conference. The annual conference rotated locations every year, from various Phoenix hotels, to Apache Junction, Tempe, Chandler, Tucson, and Nogales.

In the early 1960’s, two meaningful events occurred. The first was an important name change to the Arizona Water & Pollution Control Association, a name that would remain in place until 2009. In 1960, we also saw the introduction of our logo, the Hemis Kachina, a symbol of plentiful harvest. Today, that actual Kachina introduced by Association President Dick Polenske, is still displayed at Board meetings and at the annual conference as a symbol of our commitment to and recognition of the importance of water. Even then, the conference programs included water topics that are important to us in today’s high-tech world.

- 1955 - Roll of Corporation Commission on Water Utilities
- 1955 - Groundwater Situation in Arizona
- 1959 - Financing and the Availability of Money for Public Works Projects
- 1959 - How Long Should a Water Pipeline Last?
- 1962 - Present and Proposed Use of Colorado River Water in Arizona
- 1966 - Legal Aspects of Waste Water Reuse
- 1967 - Live Television Inspection of Sewers

In recognition of the important role that water and wastewater operators play in the water industry, in 1978, an Operator’s Forum was introduced to the annual conference as operator membership in the organization grew. Conference presentation topics in the 1970’s included:

- 1971 - Discussion of CAP Activities and Water Augmentation Possibilities
- 1974 - Use of Wastewater Effluent in Nuclear Power Generation
- 1977 - Water Supply Planning and Its Relationship to Growth
- 1978 - Energy Recovery at Pima County’s Ina Road WWTP
- 1979 - Arsenic Removal for Individual Households

The 1980’s and early 90’s were a time that saw some growing pains with the organization, just as growth throughout the State was on the rise. As a volunteer organization, meeting the needs of the membership and industry continued to be a challenge. In 1998, the Association hired a manager, a move that was the beginning of the advancement of AZ Water into a first class organization that we are today, including the following key milestones and accomplishments:

- A name change from the Arizona Water & Pollution Control Association to the AZ Water Association in 2009.
- A consistent review and update to our strategic plan as well as our constitution and bylaws.
- A first class annual conference, now held at the Phoenix Convention Center, to accommodate the more than 2,100 attendees and 239 exhibitor booths.
- Active committee engagement that engages all aspects of the water industry.
- A membership make-up that totals over 2,100 members and has expanded to include the contracting industry, legal profession, and environmental scientists, just to name a few.

Through it all, one thing has remained, our vision of a vibrant Arizona through safe, reliable water continues to hold true.
IS WASTEWATER REUSE IN YOUR PLANT'S FUTURE?

Today's water treatment standards are rapidly changing, requiring plants to implement adaptive water management strategies. Aqua-Aerobic Systems' experience in Biological Processes and Filtration provide you with the most advanced technologies for reuse applications and meeting the most stringent effluent demands. Whether utilizing filtration following a secondary biological process or implementing a "green" approach to your plant's water reuse initiatives, we have the ideal solutions to meet your water reuse goals.

Aqua-Aerobic® Cloth Media Filtration
Featuring OptiFiber® Pile Cloth Media

AquaDisk® Cloth Media Filter
- Vertically mounted disks reduce required footprint
- High solids and hydraulic loading rates
- Low backwash rates

AquaDiamond® Cloth Media Filter
- Up to eight vertically oriented diamond laterals
- Fits neatly into existing traveling bridge filter profile
- Provides two to three times flow capacity of a traveling bridge filter with an equivalent footprint

Aqua MegaDisk™ Cloth Media Filter
- Large 10' diameter disks
- Up to 24 disks in a single filter treating 24 MGD
- Fewer filters required results in lower capital and O&M costs
- Ideal for deep bed sand filter retrofits

Aqua-Aerobic® MBR Membrane Bioreactor
- Enhanced biological nutrient removal in a compact footprint and direct filtration via submerged membranes

AquaMB Process® Multi-BARRIER Membrane System
- High level nutrient removal utilizing multiple barriers, featuring cloth media filters followed by membranes
- Low energy consumption

Aqua UltraFiltration™ System
Featuring Aqua MultiBore™ Membranes
- Membrane filters do not break
- No air scouring required
- Modular T-rack assembly has small footprint

John Spielman | Ryan Spielman
41355 N. Desert Winds Dr. | Cave Creek, AZ 85331
p 480.488.3009 | f 480.488.2525
john@iessouthwest.com | www.iessouthwest.com

Represented By:
committee news

The AZ Water YP Committee wrapped up another successful year doing educational outreach, networking, professional development, community service and working to form AZ Water Student Chapters at ASU, NAU & UA. Currently NAU & ASU both have thriving student groups of AZ Water members, and UA is preparing to catch up. The YP Committee has plenty of social events to offer a relaxed environment for Young Professionals to get to know each other and create a strong bond amongst committee members. One example of this is our networking lunches and our happy hours. The YPs hosted a Picnic in October for all of AZ Water, and over 70 people were in attendance. Other events include hiking, kickball, and our annual Holiday Party. The November YP meeting was held at 23rd Ave WWTP in Phoenix, and a tour was given by City of Phoenix staff before the meeting.

In October the new Student Chapter of AZ Water at NAU was visited by Dave Iwanski – AZ Water’s Executive Director and got to learn about the value of water and the importance of being involved in AZ Water early on.
This fall we also had our annual kickball event. This event has turned into a competitive bout between the AZ Water YPs and ASCE young professionals group, the YMFs. We look forward to the rematch next year and this event is always a good time!

AZ Water YPs vs. ACSE YMFs in a friendly game of Kickball at Daley Park in Tempe

In December, the YPs toured the Tres Rios Wetlands; thank you to the City of Phoenix for making this possible! The YPs ended the year with an annual Holiday Party at the Duce.

AZ Water YPs tour the Tres Rios Wetlands

AZ Water YPs at the annual YP Holiday Party

Upcoming events for the YP Committee include: an association sponsored award for the Future Cities youth contest, judging for the Stockholm Junior Water prize, booth participation at the Science Center for E-Day, and the WEF/AWWA YP Summit in San Antonio, Texas.

We’d like to Congratulate Navid Najari with Brown & Caldwell on becoming the 2018 Vice-Chair. Nashita Naureen will be the 2018 Chair. If you’re interested in getting involved with the YP Committee contact Nashita at yp@azwater.org for more information.

Water For People Committee

Thank you to all of the supporters who helped our AZ Committee raise over $39,000 in the last fiscal year to bring an end to the global water crisis! Through your engagement and support we placed #10 for the top Committee fundraisers. Your dedication and commitment to Water For People continues to amaze us. We truly could not accomplish our goals without your support. Thank you from the entire Water For People Arizona Committee!

Winter Campaign

Did you know that Water For People is currently in the midst of our Winter Campaign: One of Everyone.

Reaching Everyone Forever truly takes all of us, and through your support of Water For People, you are part of this mission.

This winter Water For People is sharing the stories of Everyone. Norah and Miguel and their young daughters in Bolivia. Annie in Malawi. Maritza and her bright students in Peru. These people are the driving forces behind progress in their communities, and are among the countless people whose lives are changed Forever because of water.

They are each One of Everyone, and so are you, www.waterforpeople.org/OneofEveryone.

Upcoming Events

Give meaning to your miles by participating in the 7th Annual Run for World Water, 5K at Kiwanis Park. Save the date for March 10, 2018 and see the flyer on page 60 for additional information.

Residuals & Biosolids Committee

It’s been a very busy time for the Residuals & Biosolids Committee! One exciting event we have been working on is the Beefsteak Dinner which will be held on Saturday, January 27th at the Arizona Historical Society in Tempe. This event has been designed to be a fun event for everyone to attend, and raise some money for AZ Water as well. It will feature "all you can eat" steak. We will have entertainment and a 50/50 drawing. The Museum will be open at the beginning of the event for everyone to enjoy. Tickets and Sponsorship opportunities are available at AZwater.org

The WEF Residuals and Biosolids Conference is fast approaching! This event will be held in from May 15th through May 18th at the Phoenix Convention Center. Industry leaders in the Residuals and Biosolids will be presenting and discussing the latest trends and research with technical sessions. Traditionally this event has drawn participants from around the globe. Registration for this event is expected to open in mid-January at www.wef.org

We are also pleased to announce that we have a new Vice-Chair of the committee! Amy Gamache has accepted the position, and she will become the Chair of the Biosolids Committee in September of 2018 serving a two year term.

The Biosolids committee is always looking for new members. If you are interested in joining the committee, please contact me at dave.quinby@surpriseaz.gov or Amy Gamache at argamache@weeci.com and we will be glad to let you know when and where our next meeting will be.
THE IMPORTANCE OF INVESTING IN INFRASTRUCTURE MAINTENANCE

By Mike Worlton, AZ Water Board Member

Water is integrally connected to life in Arizona. Some of the earliest settlers in Arizona, the Hohokam, constructed 500 miles of canal to sustain a large agricultural society. In 1911 Roosevelt Dam was dedicated for the means of storing water to sustain the Salt River Valley. Over the years, water infrastructure has continued to sustain life in Arizona. Today’s water infrastructure in Arizona is the product of great investment and planning and sacrifice on the part of generations past, but the investment and planning must go on.

Well maintained water infrastructure is critical to the health and welfare of all Arizonans. It also plays a critical role in growth of Arizona’s communities, businesses, industry, and tourism. By design, most water infrastructure is buried or obscured from public view. Consequently, maintenance may be deferred until there is a noticeable issue or violation of water quality standards. Rupture of large water mains occasionally brings these issues to the surface. This may lead to the shutdown of a busy intersection, damaged roadways, expensive emergency repairs, loss of valuable water, and dangerous conditions. This example highlights the cost of ignoring critical water assets and the importance of maintaining and planning for replacement of water infrastructure.

Why Invest Today?

Forward thinking water professionals proactively maintain existing water infrastructure to avoid the costly consequences of neglect. They also understand the economics of deferred maintenance. A simple analogy that illustrates this concept is found in car maintenance. You may decide to forgo oil changes for a year to save money in the short term, but ultimately this decision can have more costly consequences. The consequence may include costly engine damage and great inconvenience. Imagine finding yourself stranded on the side of the road in a remote area, with blown engine, and cursing your short sighted plan to save a few dollars last year.

Another important aspect of water infrastructure investment is budgeting for future replacement and renewal of water infrastructure. This is analogous to planning for retirement. Retirement planning requires patience and discipline. Planning and disciplined saving today provides peace of mind and security for the future. Retiring water infrastructure also takes planning and disciplined savings. Studying the life span of water assets and planning for water infrastructure retirement or renewal cost can ease financial burdens by spreading them over many years.

Congress illustrated an understanding of the need for water infrastructure investment when, as part of the Clean Water Act, they mandated that US EPA assess these needs nationwide every four years. The most recently released Drinking Water Infrastructure Needs Survey and Assessment concluded that Arizona will need to spend over $7.4 billion in drinking water infrastructure over the next 20 years. A similar needs assessment for wastewater systems estimates about $4.4 billion in needed wastewater system spending over the next 20 years. Deferring this investment will lead to greater costs in the future. So, what can we do to protect our water assets and secure a stable water future? Here are some keys:

- Champion stable and adequate funding of the Arizona Department of Water Resources. ADWR has played a key role in Arizona’s success with water management in the face of significant population growth. ADWR also represents Arizona’s interests in Colorado River water entitlement and supply management negotiations. Adequate funding is essential for ADWR to carry out its statutory responsibilities, and to retain and hire highly skilled, knowledgeable professionals to serve as leaders on statewide water issues.

- Secure and protect investment in water production and delivery infrastructure. Adequate funding is needed to maintain, renew, and replace the strong backbone of supply, treatment, collection and delivery infrastructure built over the last century to provide reliable and safe water supplies.

- Support water-related education for our next generation. It is imperative that we educate the public and our elected leaders on the value and importance of water, along with the next generation of water planners and water providers.

Investment in water infrastructure will build on Arizona’s proud water history and continue to sustain growth and life for future generations.

By Mike Worlton, AZ Water Board Member
OFF-GRID WATER PURIFICATION IN THE NAVAJO NATION

By Robert G. Arnold, PhD, PE; University of Arizona
Christopher B. Yazzie, MS student; Environmental Engineering, University of Arizona
Vasiliki Karanikola, PhD; University of Arizona
Daniel R. Quintanar; Project Manager, Tucson Water

The challenge
The Navajo Nation has the lowest percentage population with access to potable water in the United States. The Navajo Nation covers an area about the size of West Virginia with parts in New Mexico, Utah and Arizona. Fifty-six percent of that land area lies in Arizona (Figure 1). The average population density in the Navajo Nation in 2010 was 7.2 per square mile. Vast areas of the Reservation suffer from—or perhaps enjoy—lower population density. Thirty-five percent of the population is not linked to a central power source, and 8,000 homes lack direct access to water. It is reasonable to expect that a significant fraction of those homes will never be linked to central infrastructure for power and water due to cost.

The majority of Navajo lands receive less than 10 inches of rainfall per year. There is little surface water suitable for development in the Navajo Nation. Accessible ground waters have been estimated at greater than half a trillion acre-feet. At the current rate of regional groundwater withdrawals in the Nation (~105 AFY) it would take five million years to exhaust the groundwater resource.

This is misleading since much of that groundwater is brackish with total dissolved solids (TDS) concentrations commonly in the range 1000-3000 mg/L. EPAs secondary (advisory) standard for TDS in potable water is 500 mg/L. In some areas, ground water is contaminated with uranium, arsenic, chromium or nitrates (Figure 1, Table 1). Beginning in the 1940s, widespread mining and milling of uranium ore on the Navajo Reservation left behind a large number of abandoned uranium mines and heavy metal contamination in soil and water. Importantly, all major contaminants in Navajo ground waters can be separated from potable waters using membrane processes.

Table 1: Detection frequency, median concentration, and MCL exceedance frequency for As and U in UWSs in the Navajo Nation—summary of data from 1993 to 2016, from Hoover et al. (2017)

<table>
<thead>
<tr>
<th>UWSs</th>
<th>No.</th>
<th>Detection frequency (%)</th>
<th>Median (µg/L)</th>
<th>UWSs exceeding MCL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navajo Nation</td>
<td>463</td>
<td>55.1</td>
<td>2.0</td>
<td>15.1</td>
</tr>
<tr>
<td>Chinle</td>
<td>89</td>
<td>34.8</td>
<td>0.7</td>
<td>8.0</td>
</tr>
<tr>
<td>Eastern</td>
<td>87</td>
<td>43.7</td>
<td>0.3</td>
<td>8.5</td>
</tr>
<tr>
<td>Fort Defiance</td>
<td>97</td>
<td>70.1</td>
<td>3.6</td>
<td>26.0</td>
</tr>
<tr>
<td>Shiprock</td>
<td>79</td>
<td>57.0</td>
<td>3.0</td>
<td>14.5</td>
</tr>
<tr>
<td>Western</td>
<td>111</td>
<td>65.8</td>
<td>4.0</td>
<td>19.0</td>
</tr>
<tr>
<td>Uranium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navajo Nation</td>
<td>463</td>
<td>75.0</td>
<td>3.8</td>
<td>12.5</td>
</tr>
<tr>
<td>Chinle</td>
<td>90</td>
<td>67.8</td>
<td>4.0</td>
<td>10.8</td>
</tr>
<tr>
<td>Eastern</td>
<td>86</td>
<td>48.8</td>
<td>0.4</td>
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</tr>
<tr>
<td>Fort Defiance</td>
<td>97</td>
<td>70.1</td>
<td>2.0</td>
<td>8.8</td>
</tr>
<tr>
<td>Shiprock</td>
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<td>6.6</td>
<td>17.6</td>
</tr>
<tr>
<td>Western</td>
<td>111</td>
<td>95.5</td>
<td>5.3</td>
<td>18.5</td>
</tr>
</tbody>
</table>

Throughout the Navajo Nation, residents use less water, pay a higher unit price for water and energy and use a greater percentage of their income for power and water than virtually any other group in the United States. Third World infrastructure persists across a significant fraction of Navajo lands. The unit cost of water among Navajos who drive long distances to gain access to pure water has been placed as high as $43,000 per acre foot, or $13 per 100 gallons, including the time lost to travel. For perspective, in 2017, the City of Tucson purchased water from the Central Arizona Project for about $160 per acre-foot and sold water at rates as low as $0.23 per 100 gallons (low-water-use block rate).

Searching for a solution
For more than a decade, the US Bureau of Reclamation (USBR) has looked for methods to extend pure water service to highly disperse populations on Navajo lands. Recently, USBR funded research at the University of Arizona that led to demonstrations of solar driven membrane processes capable of treating ground water to potable standards. Sweeping gas membrane distillation (SGMD), a technology in which water crosses a membrane barrier as a vapor was among the first technologies considered for small-scale water purification. However, SGMD proved difficult to justify based on cost. At $0.10/kWh, the energy cost to evaporate one acre-foot of water is about $76,000, or about $23 per 100 gallons of purified water. Unless the latent heat of evaporation can be recovered during the condensation step, membrane distillation (MD) will remain poorly suited for purifying brackish water.

Nanofiltration (NF) is more economically attractive for treatment of brackish waters with relatively modest osmotic pressures, particularly for ground waters that don’t require extensive pretreatment prior to NF. Solar-driven nanofiltration treatment...
technology (SNF) (Figure 2) is economically feasible for small scale, dispersed purification systems, and its operation can be automated. Such systems typically consist of:

- A photovoltaic array with battery bank
- High pressure pump
- NF membrane or array of membranes
- Assorted tanks for storage of the brackish feed
- Finished waters and electrical control equipment

Without additional attention to system component optimization—that is, even without compatible sizing of system components to minimize total present value cost—it is possible to produce 500-1000 gallons of finished water of potable quality during a 5-hour period of maximum daily sunlight for about $2 per 100 gallons or $6,500 per acre-foot, the cost of water that results in the recovery of capital and operations cost over a 10-year system design life.

For that unit, solar panels are mounted on the roof of a decommissioned school bus (Figure 4). The high pressure pump and membrane array are inside the bus.

Figure 4. Installation of solar panels atop the mobile SNF system on the roof of a decommissioned school bus that will be used to provide tech demonstrations at remote areas of Navajo Nation. At lower left, Bob Seaman, lead design tech, University of Arizona. Upper left, Chris Yazzie, Masters student in Environmental Engineering. At right, Peter Zhou, electrical engineer and co-owner of AATech.

Vision statement

To date, work by the University of Arizona, USBR and Apex Applied Technologies (AATech, a local for-profit company) has shown that ground waters from the large, mildly brackish aquifer system that underlies Navajo lands can be treated to potable standards at a unit cost that satisfies willingness-to-pay criteria, even in sparsely settled parts of the Nation. SNF is useful for the application.

If a water supply program is to spread throughout remote areas of Navajo Nation, however, several additional steps must be taken. Most important, primary responsibility for design, construction, operation and regulation of the program and facilities must be transferred to the Navajos. To assist in that transition, the existing project team can create a detailed design and operations manual that summarizes the principles, design and operational methods. Commercialization must play a role in spreading the SNF technology among low-population-density areas. Water supply in those areas should be approached in a manner that emphasizes the involvement of a chronically underemployed regional workforce. Local residents can train in the art and science of water treatment and treatment system operation to take those jobs. Industry regulation should also be regional in character, recognizing Native American sovereignty on reservation lands.

Over the long haul, it is possible to envision a water industry that first constructs additional demonstration projects in a few remote areas, then uses revenue from water sales at first-generation facilities to extend similar services across a much broader region—eventually providing dispersed water treatment to much of the

continued on page 20
population that is now underserved. Such a program will remain a
distant objective without an initial capital investment for program
and workforce development through a highly directed construction
and training program. Work to date has shown that there are no
overwhelming obstacles to such a pathway to water security in the
Navajo Nation or other, similar areas that cannot be economically
served from central power and water treatment facilities.

Project Team
The project team for system design and construction consisted
of personnel from both the University of Arizona and AATech. The
constructed systems are now the property of the STAR School, a
K-8 charter school located immediately southwest of the Navajo
Nation. The relationship between the University and AATech/STAR
School has endured for several years, resulting in the three SNF
water treatment systems delivered to this point. Others that have
played invaluable roles on that pathway include the US Bureau of
Reclamation (Phoenix office), which managed and financed early
exploratory work in off-grid water purification, and the TRIF (State
funded) grant program at the University of Arizona.

Acknowledgments
The authors wish to acknowledge the efforts and support
provided by personnel from the U.S. Bureau of Reclamation,
Phoenix office—particularly Mitchell Haws and Kevin Black. We
are grateful for grants from the U.S. Department of Agriculture and
the TRIF water program at the University of Arizona. We must also
acknowledge the vision, support and encouragement provided
by Mark Sorensen, founder of the STAR School. The co-owners of
AATech, Dr. Jing Luo and Peter Zhou, guided and helped finance
much of the work described. A number of students, former students
and staff at the University of Arizona are responsible for the planning
and construction program. These include Robert Seaman, our
lead technologist for this work; Rodolfo Peon, a PhD candidate in
Arid Lands Studies at the University of Arizona; Oleksiy Chernoloz,
an MS graduate of the environmental engineering program;
and Hua Jiang, an MS graduate in chemical engineering at the
University of Arizona. No one has done more to promote off-grid
water purification in areas that cannot be connected to central
infrastructure than Dr. Wendell Ela, our former colleague at the
University of Arizona, who now teaches at Murdoch University in
Perth, Australia.

References
Arsenic and Uranium Concentrations in Unregulated Water
Sources on the Navajo Nation, USA
Is your wastewater utility facing a trending issue in the industry? Give the next generation of water professionals a chance to address it for you.

**PROBLEM STATEMENT NEEDED**

For AZ Water’s 1st Student Design Competition

Problem statements can be submitted from utilities for any current or upcoming projects – ideally at wastewater treatment facilities. Teams of university-level students will compete for a chance to represent AZ Water Association in the national student competition at WEFTEC. The utility providing the selected problem statement will be expected to also facilitate a tour for the students, answer questions, and provide a judge for the regional competition.

Email [youngprofessionals@azwater.org](mailto:youngprofessionals@azwater.org) for more info or to submit a problem statement.
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Conference & Exhibition
May 2ND-4TH, 2018 | Phoenix, Ariz.

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• Barbeque
• Career Fair
• Committee Meetings
• Competitions
• Exhibition Hall with Over 250 Vendors
• Golf Tournament
• Operator Training and Workshops
• Presentations – Over 180

Exhibitor Registration opens January

Attendee Registration opens February

www.azwater.org
2018 AZ Water Association
Annual Conference & Exhibition Awards

It is that time of the year again to nominate your fellow Arizona water and wastewater operators, professionals, projects, and systems for recognition at the 2018 AZ Water Association Annual Conference & Exhibition. Nominations will begin in January 2018 and end in March 2018.

Award descriptions and criteria for the AZ Water Awards Program can be found ONLY online at www.azwater.org/group/awards

2018 Awards Listing

AZ Water Awards

Environmental Stewardship
Kachina Award for Outstanding Service
Nathan Burbank Environmental Educator
Quentin Mees Research Award
Kenneth J Miller WFP Award
Select Society of Sanitary Sludge Shoveler
Gimmicks & Gadgets
Operator of the Year (Large & Small Systems)
Treatment and System of the Year (Large & Small Systems)
Operations Supervisor of the Year (Large & Small Systems)
Electrician of the Year (Large & Small Systems)
Maintenance Mechanic of the Year (Large & Small Systems)
Technology Professional of the Year
Laboratory Analyst of the Year
PROJECTS OF THE YEAR
• Water Reuse
• Water Treatment
• Water System
• Wastewater System
• Wastewater Treatment
• Engineer of the Year
• Young Professional of the Year

Operations Leader of the Year
Construction Professional of the Year (open to Owners, Designers, Operators and Contractors)
Safety Professional of the Year*
Safety Awards
Scholarship Awards
Outstanding Sustainability Program/Project Award*

National Awards

AWWA Awards
Warren G. Fuller Award
Exemplary Source Water Protection Award
John Lechner Award
Diversity Award

WEF Awards
Arthur Sydney Bedell Award
George W. Burke, Jr. Award
William D. Hatfield Award
Laboratory Analyst Excellence Award
* New Award

Questions can be directed to the Awards Program Committee Chair, Sarah Rogowski at awards@azwater.org.

Don’t miss being recognized!
Submit your nominations!
Communicating the Value of Water Conservation for Two Arizona Communities

Candice Rupprecht, Water Conservation Manager, City of Tucson
Haley Paul, Water Resources Coordinator, Town of Gilbert

Arizona municipalities are no strangers to conservation. After several decades of explosive growth in the Sun Corridor, in 1980 water management became a core issue of a sustainable future and conservation was envisioned as one of the solutions to keeping our demand for water in check and our water supplies reliable. Driven by the need to reduce per capita water use and establish best management practices as mandated by the Groundwater Management Act, conservation campaigns and programming started soon after the establishment of Arizona’s Active Management Areas.

As evidenced by declining per person demands, Arizona has embraced an ethic of responsible water use and a culture of conservation, steadily transforming water-thirsty lawns to native, xeriscape landscapes that use less water and provide valuable native habitat for our local ecosystems. The transition of our outdoor environment is not the only visible shift in the trajectory of per capita water use in many communities. Regulation, innovation, and invention mean plumbing products on the market today are more water-efficient than their predecessors. Thanks to plumbing codes, incentive and rebate programs, and the eventual need to replace aging fixtures, retrofits and new builds are using far less water than before. Additionally, in the last two decades many cities and towns throughout Arizona have adopted rate structures designed to reduce water use for extremely high users by charging more for each unit of water. Communities have also instituted long-standing education programs and conservation campaigns.

Target audiences for education programs that emphasize the efficient use of water and proper care for desert landscapes include K-12 students and teachers, homeowners and landscape professionals. Water Use It Wisely is a statewide messaging platform that provides water conservation tips and resources. In Tucson, decades after Pete the Beak was introduced to help Beat the Peak and address a summer peaking problem, Pete is still a recognized figure in the community, associated with water conservation. Water conservation is not just the rebates provided by a utility or targeted messaging to change behaviors; it is all of the measures collectively that work to engage consumers in making smart choices about their water use.

At the same time that per capita water use has decreased nationally, water costs, like most other things, have increased in the last several decades. Customers can be quick to question why water rates are increasing when they have done what their providers asked and reduced their use. There have certainly been examples of utilities that mandated conservation due to a water shortage, experienced a rapid decline in water demand and therefore revenue, and then had to increase rates to ensure sufficient revenue to operate the system. While this has happened in places throughout the country, that is not necessarily Arizona’s dilemma. In Arizona, water rates tend to rise because of an increase in the wholesale price of water (lately related to preventing shortage on the Colorado River), higher employee-related costs over time, and increases in the cost of energy and chemicals to transport and produce potable drinking water and treat and recycle wastewater. Logically, water bills would be more expensive today if per capita use had never dropped and the utility had to produce more water and reclaim more wastewater to meet historic demands for an increasing population. More water means more infrastructure, more employees, more chemicals to treat the water, more energy to move the water and plainly, more water.

Yet, this is a complicated equation to explain to customers – and one that has remained largely unanswered. How has conservation impacted today’s water rates? Rate payers ask, “Why are rates going up, even though I’m using less? Why do you ask me to conserve, and then raise my rates?” These questions are worth answering because it provides an entry point to engaging with customers in a conversation not just about the role of water conservation, but more importantly, the value of our water systems and their ability to provide reliable water service to our communities, now and in the future.

The City of Tucson and the Town of Gilbert recently participated in an avoided cost analysis conducted by the Alliance for Water Efficiency to help water providers around the country begin to explain how utility costs have been avoided through water conservation. To answer this question, both utilities had to identify a historic reference date, determine the population being served at that time and what the annual water demand was to meet that population’s needs. Then, the historical per-person demand was multiplied by today’s population to determine hypothetically, how much water would have been needed in each community if conservation had not occurred.

In Gilbert, the population grew by 229% from 1997 to 2015, while system per capita water use decreased 29%, from 244 gpcd to 173 gpcd. In 1997, Gilbert produced 18.3 million gallons per day (mgd). Hypothetically, if per capita water use had stayed at those 1997 levels, Gilbert would have needed to produce 60.3 mgd in 2015. Thanks to conservation, in 2015, Gilbert produced 43 mgd. The average single-family customer would have used 186,000 gallons of water in 2015 instead of the actual average annual usage of 144,000 gallons.

From 1989 to 2015, Tucson Water’s service area population increased by 70%, while per capita water use decreased by 31% from 188 gpcd to 130 gpcd. In 1989 Tucson produced 96.4 mgd and hypothetically would have needed to produce 134.4 mgd in 2015. Thanks to conservation, in 2015, Tucson only produced 93.3 mgd. The hypothetical usage for the average single-family customer would be 97,200 gallons in 2015 instead of 74,000 gallons of actual average usage.

Higher demands require the delivery of more potable water, but also require the treatment of more wastewater, so this question of avoided costs affects not just water providers, but also wastewater providers. Without conservation, the Pima County Regional Wastewater Reclamation Department in Tucson, would...
have needed to treat 80 mgd in 2015. Instead, it treated 56.2 mgd. Likewise, Gilbert’s wastewater division would have needed to treat 21.5 mgd if conservation had not occurred. Instead, in 2015, it treated 14 mgd. Clearly, if water patterns had not changed, both communities would have required additional investments to meet higher water demands and treat additional wastewater flows. The next questions are, what additional investments were avoided, and how much would they have cost? With those answers, the individual customer rate impact can be calculated.

Interestingly, Tucson and Gilbert have similar avoided costs, when comparing avoided water resources and wastewater treatment capital improvement costs. Per-person water demand reductions helped Gilbert avoid costs of $340 million in water and wastewater treatment expenses. More potable water treatment capacity would have required expansion to treat an additional 17 mgd, plus the assumed peaking demand of 96 mgd (up from the 73 mgd actual peak in 2015) to meet hypothetical demands. The wastewater system would also need an additional 7 mgd of treatment capacity. Tucson’s avoided capital costs are slightly higher, totaling $351 million; avoided infrastructure costs include a large transmission main and a recycled water treatment plant designed for 7 mgd—both have been deferred and may be avoided entirely. Lower demands have also avoided the buildout of an additional 12 mgd of wastewater treatment capacity. Both communities also have avoided operations and maintenance costs—in Tucson these costs are about $30 million and in Gilbert about $4.6 million. In addition, system development fees (sometimes referred to as meter connection fees or tap fees) for new businesses and new homes in Gilbert are 45% lower today thanks to conservation—a savings of $7,733 that the builder is not passing on to customers. The town did not have to build as much additional system capacity to meet the demands of new development. Existing infrastructure capacity was able to meet demand as more water-efficient development came online, thus making it more affordable for new development to tie into Gilbert water and wastewater systems.

The final step is to determine the individual customer impact of each utility’s costs avoided thanks to conservation. The 2015 average annual water and wastewater bill for a single-family customer of each utility is calculated and this value is compared to the additional costs incurred by each single-family customer. In the analysis, these additional costs, referred to as the avoided costs, are summed and then divided by the number of customers to calculate each single-family customers’ share of these additional costs. This exercise illustrates what would happen to annual water bills at a single-family residence in the absence of conservation. The resources and infrastructure needed to provide that extra water would today cost a Gilbert customer $61 more per year, and a Tucson Water customer would pay $112 more per year.

Bottom line: conservation helps keeps customers’ bills lower over time. Conservation forestalls spending on infrastructure expansion and supply acquisition needed to meet historic, higher-demand trajectories. This avoided cost analysis shows that customers in both Tucson and Gilbert have lower water bills because per capita per day water use declined. Today, water bills are 5.8% lower in Gilbert and 11.7% lower in Tucson than if conservation had never occurred and water demand had never dropped.

When everyone conserves, everyone saves. Reductions in per person water demand benefit ratepayers and utilities by stretching existing water supplies and allowing existing infrastructure to meet the needs of customers, even with growing populations. We all know water is precious here in the desert. As shortage looms and drought lingers, this analysis gives yet another reason for utilities to invest in their conservation efforts.
the pipeline - operator certification challenge

Ted Bailey
Baileytb@att.net

WATER TREATMENT GRADES 1 AND 2
1. Which of the following is NOT a chemical used as a primary coagulant in drinking water:
A. Aluminum Sulfate.
B. Ferric Chloride.
C. Sodium Sulfate.
D. Ferrous Sulfate.

2. How much water can a reservoir hold if it is 60 feet in diameter and 17 feet deep?
A. 21,140 gal
B. 62,172 gal
C. 359,354 gal
D. 465,000 gal

3. What is the requirement for turbidity in individual filter effluents for surface water treatment facilities?
A. Less than 0.3 NTU’s in 95% of readings from process instruments.
B. Less than 0.03 NTU’s from samples analyzed in certified laboratories.
C. Less than 1.0 NTU’s from conventional filtration processes.
D. Less than 5.0 NTU’s from direct filtration processes.

4. What is the chlorine demand in a facility treating drinking water if the dosage of chlorine is 64.5 lbs/day added to a flow of 2.66 MGD and the residual is 1.15 mg/L?
A. 1.76 mg/L
B. 2.91 mg/L
C. 4.15 mg/L
D. 6.04 mg/L

5. How much alum has been used from a day tank 3 feet in diameter if the starting level was 4.25 feet and the ending level was 1.875 feet?
A. 55 gallons
B. 160 gallons
C. 188 gallons
D. 200 gallons

WATER TREATMENT GRADES 3 AND 4
1. What is a requirement of the Surface Water Treatment Rule?
A. Filter runs of 48 hours or more.
B. Turbidity removal of 99%.
C. Disinfection residuals of 1.0 mg/L.
D. Filtration of surface water.

2. What is the name of the disinfectant produced by combining chlorine and ammonia?
A. Ammonium Chloride
B. Chloramine
C. Ethylmethylene Trichloride
D. Trihalomethane

3. How many gallons per hour of 48% Aluminum Sulfate (at 1.33 Specific Gravity) are used to treat 10.3 million gallons per day at a dosage of 7.2 milligrams per liter (parts per million)?
A. 1.0 gph
B. 2.5 gph
C. 4.8 gph
D. 6.95 gph

4. What is the detention time in hours through a basin that is 21 feet wide, 32 feet in depth when the flow is 6.23 million gallons per day?
A. 0.4 hours
B. 0.85 hours
C. 1.2 hours
D. 8.34 hours

5. When practicing chemical precipitation softening to remove calcium, how high should the pH of the water be raised?
A. 3 pH units above the raw water
B. 7.0
C. 8.3
D. 10.5

WATER DISTRIBUTION GRADES 1 & 2
1. A water well supplies a reservoir 35 feet in diameter and 32 feet in depth. If the well pumps at a rate of 750 gpm, how quickly can the reservoir be filled?
A. 60 minutes
B. 122 minutes
C. 245 minutes
D. 307 minutes

2. A pressure gauge on a hydrant reads 88 psi. How many feet of head are on the hydrant?
A. 38 feet
B. 88 feet
C. 125 feet
D. 203 feet

WATER DISTRIBUTION GRADES 3 & 4
1. Which organisms can grow in an environment with little or no oxygen?
A. Aerobic
B. Anaerobic
C. Coliforms
D. Pathogens

2. How many pounds of 70% Calcium Hypochlorite are required to disinfect a main if the main is 1300 feet long and 18 inches in diameter, and the dosage is 30 mg/L?
A. 1.5 lbs
B. 3.0 lbs
C. 4.3 lbs
D. 6.2 lbs

3. A water well producing 550 gpm is used to fill a reservoir that measures 48 feet in diameter and is 24 feet high. How long will it take to fill this reservoir?
A. 6.5 hours
B. 8.34 hours
C. 9.84 hours
D. 12.3 hours

4. In water distribution pipelines head loss and friction loss are the same.
A. True
B. False

5. Which Arizona Blustake color is to be used by a water utility planning to dig an area 50 feet long, 4 feet wide and 6 feet deep that may contain a 24” potable water main, a 16” sewer, and an 8” reclaimed water line?
A. Blue
B. White
C. Red
D. Both A and C

WASTEWATER COLLECTION GRADES 1 & 2
1. Root growth is a principal cause of wastewater collection pipe damage that allows infiltration and exfiltration of wastewater.
A. True
B. False
2. One of the hazardous gases produced in wastewater collection systems is:
   A. Oxygen.
   B. Chlorine.
   C. Helium.
   D. Hydrogen sulfide.

3. A tracer dye indicates flow through 600 feet of sewer takes 4 minutes. What is the velocity in feet per second (fps)?
   A. 1.9 fps
   B. 2.5 fps
   C. 3.6 fps
   D. 8.1 fps

4. A sewer line is 24 inches in diameter and flows completely full at 2500 gpm. What is the velocity in feet per second through this sewer line?
   A. 0.39 ft/sec
   B. 1.77 ft/sec
   C. 2.79 ft/sec
   D. 4.15 ft/sec

5. One hundred gallons per day of Sodium Hypochlorite solution containing one pound chlorine per gallon of solution is added to a flow of 2.4 mgd. What is this dosage in mg/L?
   A. 2.0 mg/L
   B. 3.0 mg/L
   C. 4.0 mg/L
   D. 5.0 mg/L

WASTEWATER COLLECTION GRADES 3 & 4

1. Accumulated air in wastewater force mains is blown off by:
   A. Air release valves.
   B. Altitude control valves.
   C. Blowers.
   D. Check valves.

2. Electrical panel doors are closed when testing because:
   A. Hot copper sparks could injure electricians when the circuit is energized.
   B. Less current will be drawn when the door is closed.
   C. Meters work better when the door is closed.
   D. The door could get in the way if not closed.

3. An 18-inch sewer force main is running full at a velocity of 2.3 feet/second. What is the flow in gallons per minute?
   A. 1070 gpm
   B. 1250 gpm
   C. 1825 gpm
   D. 2323 gpm

4. Chemical grouting is widely used in wastewater collection systems for sealing:
   A. Broken pipe.
   B. Manhole cracks.
   C. Pipe joints that are leaking.
   D. Closed circuit camera connections.

5. A lift station wet well is 48 inches in diameter and 26 feet deep. If two pumps lower the wastewater 14 feet in 10 minutes while the wastewater is flowing into the wet well at 25 gpm, how much do the two pumps pump in gpm?
   A. 17.5 gpm
   B. 25 gpm
   C. 42.5 gpm
   D. 58 gpm

WASTEWATER TREATMENT GRADES 3 & 4

1. The aeration tank suspended solids analysis is important to help control the activated sludge process.
   A. True
   B. False

2. Calculate the volatile matter removed (lbs/day/cu ft) in a 28,000 cubic foot digester receiving 2,400 gallons per day of raw sludge. The solids content is 5%, the volatile content is 68%, and the volatile solids are reduced 50% by digestion.
   A. 0.011 lbs/day/cu ft
   B. 0.012 lbs/day/cu ft
   C. 0.023 lbs/day/cu ft
   D. 0.049 lbs/day/cu ft

3. How many pounds per day of BOD are removed by a basin with an influent flow of 7.5 MGD and BOD of 234 mg/L and an effluent BOD of 32 mg/L?
   A. 6.4 ppd
   B. 202 ppd
   C. 8340 ppd
   D. 12635 ppd

4. What is the detention time in a basin 48 feet in diameter with 18 feet of water and a flow of 3.3 MGD flowing through it?
   A. 33.3 minutes
   B. 90 minutes
   C. 1.77 hours
   D. 23.0 hours

5. If chlorine is about 2.5 times denser than air, about how much does a full ton container of chlorine weigh?
   A. 2,000 lbs
   B. 3,500 lbs
   C. 4,000 lbs
   D. 5,000 lbs
COMMUNITY WATER COMPANY OF GREEN VALLEY (CWC) is a non-profit public service corporation serving customers in Green Valley and Sahuarita for over 40 years. In July 2015, CWC filed a rate case with the Arizona Corporation Commission (ACC). As part of that filing, they argued that ongoing declines in per-customer water demand would likely continue, and requested that this trend be reflected in their new rates.

ACC staff initially rejected this part of CWGV’s rate request, stating that recent declines in demand could be due to random variations or temporary factors, such as climatic fluctuations. The ACC had previously rejected similar requests by other water utilities. CWC retained Montgomery & Associates (M&A) in December 2015 to perform a more thorough analysis of their declining demand. This included a time series analysis of CWC’s historic demand and updating a dynamic simulation model of residential demand that M&A had previously built for them. In addition, a cross-sectional analysis compared CWGV with nine other municipal water providers across Arizona for whom M&A had built demand models. Finally, econometric analysis was used to test the theory that CWGV’s recent demand reductions might be caused by climatic fluctuations.

The results of these analyses were that CWGV’s declining demand was long-term, forecast to continue, and not caused by random factors or climate fluctuations. We also demonstrated that the falling demand experienced by CWGV is far from unusual; in fact, it has become the norm. Water use in the US has been declining for decades, across all water use sectors – municipal, agricultural, industrial, and energy. Total groundwater and surface water withdrawals peaked in 1980 and have been declining ever since, nationally and for all regions of the country (see Figure 1). Water use for all activities peaked at nearly 1,600 gallons per capita per day (gpcd) in 1980; by 2010, rates were under 1,000 gpcd. The surprising, but inescapable conclusion is that water demand is no longer tightly tied to population, economic output, or quality of life.

The downward trend in municipal demand spans the West, and has been particularly robust in Arizona. Research by M&A on municipal water use in Maricopa and Pima Counties revealed significant declines in residential water use between 2000 and 2015 in 10 of 11 providers studied (see Figure 2). In most cases, declines in per-household demand have more than offset increases in demand from growth, meaning that total deliveries of water have been dropping, even as service area populations have grown. Declines in total deliveries across Arizona’s major metro areas have averaged 2.0% - 2.5% per year. In one striking example, Tucson Water delivered the same amount of potable water in 2016 as in 1985, despite more than a 70% increase in customers.

Five main factors are driving these declines in municipal water demand:

1. Indoor demand is being reduced by the gradual replacement of older fixtures and appliances, as they reach the end of their useful life or due to remodeling, with new, more efficient ones;
2. Outdoor demand reflects changing tastes and preferences and shifting socio-demographics, which has resulted in wholesale removal of irrigated turf and installation of more drought-tolerant landscaping;
3. New homes have more water-efficient fixtures and appliances than the existing housing stock, and are far less likely to have irrigated turf or swimming pools;
4. Federal voluntary standards like WaterSense and Energy Star have driven manufacturers to produce more efficient appliances and fixtures. California, Texas, and Colorado have made these standards mandatory, affecting what is sold in big box stores across the West; and
5. Local conservation efforts, including education, rebates, and ordinances have created markets for, and hastened the acceptance of, highly water-efficient devices and landscapes.

These factors driving down municipal water demand are forecast to continue. Irrigated turf, swimming pools, and evaporative coolers are becoming increasingly rare, while new toilets, shower heads, clothes washers and dishwashers are becoming ever more water-efficient. Experts who recently
predicted that indoor water use in homes equipped with the latest conserving fixtures and appliances would approach 40 gallons per capita per day (gpcd) now believe 30 gpcd is in reach.

All this increased water use efficiency sounds like good news for a semi-arid state like Arizona. And overall, it is. But there can be unintended consequences, particularly if reductions in demand are not anticipated or planned for. These include:

Fiscal Consequences
- revenues drop more than expenses
- conservation-oriented rate designs exacerbate the problem
- budgeting uncertainties

Operational Issues
- longer “water age” impacts residual disinfectant levels and disinfection by-products
- less reclaimed water available than anticipated
- uncertainties as to available unused system capacity for wastewater plants

Planning Challenges
- optimal timing of capital improvements
- acquisition of new supplies
- design of water conservation programs
- rate setting

Public Perception Issues
- water conservation blamed for rate hikes
- people feel they’re being punished for conserving

The public perception issues – that customers are being punished with higher rates for conserving – are addressed in a companion article in this issue. Here, we discuss the fiscal consequences of long-term declines in demand, and the resulting challenge for rate makers.

Water utilities generally have very large fixed costs and much smaller variable costs, mostly consisting of energy and chemicals. For CWC, fixed costs are roughly 85% of total costs, and as much as 92% at the margin. Thus, if demand were to fall by 5% over a period of a couple years, costs would fall only about 1%. Revenues, however, would fall much more. CWC’s revenues are split equally between fixed fees and commodity charges, which means a 5% drop in demand would reduce revenues by 2.5%. Many municipal providers in Arizona receive significantly more than half their revenues from commodity charges. Revenues can drop even more due to increasing block rates, as customers using less water fall into lower block rates.

The result is a continual need to raise water (and sewer) rates to offset declines in revenue. This conclusion, coupled with the analysis of the causes of long-term declines in demand, challenges the traditional view of rate increases driving down demand (Figure 3). Instead, the other factors enumerated above are principally responsible for decreases in demand, which causes net revenues to fall, resulting in the need to raise rates (Figure 4).

These ongoing reductions in net revenue can be particularly acute for providers regulated by the ACC. If one filed a rate case in 2017, then the test year was probably 2016, and new rates would likely take effect in 2018. The two-year difference can mean that newly enacted rates may not produce the approved rate of return. Fortunately, the ACC has recognized these issues associated with long-term declines in demand.

Upon submittal by CWC of its rebuttal testimony in March 2015 on why declines in demand were highly likely to continue, ACC staff changed their position and recommended that the new rates account for the impacts of long-term declines in demand. The administrative law judge assigned to the rate case adopted staff’s recommendation, and rates reflecting the forecast reductions in demand were approved unanimously by the ACC commissioners, with new rates taking effect in September 2016.

Operational and planning challenges associated with declining demand still exist. However, the ACC’s recognition of these declines in rate setting is a significant and positive step in helping utilities deal with the fiscal implications.

1USGS, 2014, “Estimated Water Use in the United States in 2010”.
2Montgomery & Associates, 2015, Maricopa County Residential Water Demand Study, Project Deliverables ##7 & 12, August 2015.
AZ WATER
MEMBER SERVICES UPDATE
Welcome to our 4th Quarter Members!

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What’s New

- **Member Services will be launching a “Tell Your Story” portal in 1Q2018.** It’s your opportunity to share how AZ Water has helped shape your career. **See [www.azwater.org/group/memberservices](http://www.azwater.org/group/memberservices) for info.**

- Membership campaign coming – March 2018

- **Join our next committee meeting on: January 26, 2017 (at Hazen and Sawyer)**

Want to maximize your AZ Water membership? Email us at: memberservices@azwater.org

Tell a friend about the benefits of AZ Water membership!
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ARCKER WESTERN, SETTING THE HIGHEST STANDARDS FOR ETHICS, QUALITY AND SAFETY.
The water industry is facing a serious workforce challenge. Why is this a problem? Water is critical for life and economic prosperity. In the United States we expect that good quality water will be delivered to our homes and businesses and wastewater will be removed without disruption or even our taking notice. It takes many types of skilled individuals to make this happen. The people who operate and maintain these systems are among the most important.

Operators run the facilities that produce drinking water; maintain and repair the pipes, reservoirs, and pumping facilities that deliver the water to our homes and businesses; maintain and repair the sewer mains and pumping stations that convey wastewater away from our homes and businesses; and run the facilities that treat wastewater to ensure the effluent meets public health and environmental requirements. Water service operators are the first responders to water main breaks, sewer overflows, and other water service events. They work 24/7, 365 days per year, protecting public health and the environment. They labor behind the scenes. They are “the silent service.”

In its 2010 Water Sector Workforce Sustainability Initiative Report, the Water Research Foundation estimated that 30 to 50 percent of the workforce was expected to retire between 2010 and 2020. The 2017 State of the Water Industry (SOTWI) Report issued by the American Water Works Association (AWWA) ranks “Aging workforce/anticipated retirements” as the #12 concern out of more than 30 categories. According to the Bureau of Labor Statistics, the job outlook for water and wastewater treatment and system operators from 2016 to 2026 indicates a 3% decline. While some reductions will be due to automation and other efficiencies, increasing complexity in these systems will require a more sophisticated and better-trained workforce.

These are sobering statistics in an industry with such a critical mission.

Why is this happening? The simple answer is Baby Boomers are retiring. And, they are doing so at a faster rate than they are being replaced. In addition, there has been a decrease in students entering technical fields, due to fear of or disinterest in the sciences, engineering and math.

Why does this matter? Improperly operated and maintained water and wastewater facilities can result in degraded water quality, reduced water pressure, inadequately treated wastewater discharged into our waterways, and reduced lifetime of the infrastructure. This can create public health and environmental impacts, and result in regulatory agency enforcement and fines, lawsuits, and substantial degradation in public relations and trust.

So what can we do? First, the water industry must inform the public that jobs in the water industry are well paying, important, and meaningful work. According to the Bureau of Labor Statistics Occupational Outlook Handbook, the 2016 median pay for water and wastewater operators was $45,760 per year or $22.00 per hour. This is well above minimum wage. Business leaders can help by communicating how critical reliable water and wastewater services are to their success and that well trained staff are necessary to achieve this level of service.

Recently, there has been a renewed effort to emphasize Science, Technology, Engineering, and Math (STEM) education. This must continue and expand, and be adequately funded for both vocational and scholastic courses of study. School boards and legislators are the keys to this effort.

We need to better inform our educational institutions about careers in the water industry down to the middle school and high school level. The message can be delivered by water professionals attending career fairs, science night events, and festivals. The educational institutions should reach out to their local water providers and to professional organizations like the AZ Water Association (www.azwater.org) to get more information and help plan these activities.

Finally, military veterans demonstrate values and abilities that can translate nicely to the water industry. These include ability to learn quickly; leadership skills; teamwork; efficient performance under pressure; respect for procedures; understanding of technology; integrity; and triumph over adversity. I have met a number of operators who learned about water operations in the military.

There are a number of programs underway. The AWWA has developed the Water Equation Campaign and associated One AWWA Operator Scholarship Program, which provides training opportunities to and scholarships for aspiring operators. The AWWA Veterans Workforce Initiative, helps inform and recruit veterans into the water industry. The AWWA and Water Environment Federation established the Work for Water Website (www.workforwater.org), where students and job seekers can find information about jobs in the water industry. The AWWA and Water Environment Federation established the Work for Water Website (www.workforwater.org), where students and job seekers can find information about jobs in the water industry and water industry agencies can connect with potential candidates. It addresses high school/votech education; College; Military Second Career; and Advanced Science. There are educational and certificate programs, like the Water Resources Technologies program at Gateway Community College.

Support the effort to eliminate and prevent operator shortages in the water industry.

“Mike Stevens (right) and Keith James, both with the City of Peoria Public Works – Utilities Department, performing maintenance on a well control valve.”
Executive director report

and will continue to be a priority. I had the good fortune to be asked to write an op-ed piece this past September in the Water Edition of the Times, and I heard back from several legislators that they agreed with the AZ Water Association’s approach that dealing successfully with water issues depends on leadership, opportunity, collaboration and knowledge – the “LOCK principal”. I want to personally thank Bob Hollander, Marie Pearthree, Lisa Jackson and Jeanne Jensen for their help in finalizing the article that maximized the messages we want to convey and build upon.

Our membership needs to know that the entire Board has been so supportive and encouraging of my efforts, and that their direction and guidance gives me the motivation to help AZ Water achieve even bigger and better results in the future. Growing our membership, expanding our influence, educating the public and elected officials and messaging about water and related infrastructure are the critical themes I want to carry forward in the coming years. Thank you all for the opportunity to be your Executive Director.

AZ Water

Educating the Public and Elected Officials
Who We Are, What We Do, How We Do It, and Why We Do It

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CONTINUING ARIZONA’S SMART AND INNOVATIVE WATER MANAGEMENT LEGACY

By AZ Water Association Water Resources Committee Members

Legislation within the 1980 Groundwater Management Act (GMA) underlies water management for most of Arizona. The state’s history of dealing with difficult decisions and finding a path forward to protect Arizona’s water is something all Arizonans should be proud of. However, there is still work to be done. The 2012 Colorado River Basin Water Supply and Demand Study by the Bureau of Reclamation projected that the Colorado River Basin will have a 3.2 million acre feet supply deficit by the year 2060, and a large portion of the deficit is Arizona’s. As one might expect, correcting this deficit cannot be done overnight, and will require a diversity of resources, hard work, and most of all a collective will to find solutions. Arizona has a strong history of creating positive solutions to water issues; and this history must be relieved for us to continue to be successful. It is important to have a collective “One Arizona” voice while realizing that needs are diverse. Unique local circumstances must be considered with resident experts and leaders to help develop solutions. State support and leadership is required to turn ideas into results. Consider how this formula has worked in the past:

Metropolitan Areas: Since the GMA, metropolitan cities have progressively switched their dominant water usage from groundwater to more sustainable surface water. However, with longer term growth and drought planning in mind, there was a need for additional avenues to boost water resource portfolios. Utilizing groundwater recharge as an indirect use of reclaimed water and surface water took many years of consideration by local hydrologists, regulators, and policy makers. Localized issues of groundwater quality, impacts to existing users, and the effectiveness of various methods had to be considered. Ultimately, the State stepped forward to authorize and fund demonstration projects so that the solution could be tested and approved. The following two decades have produced over 4 million acre feet of water stored underground for the future. A framework of rules and funding sources, combined with local considerations and expertise, allowed this fledging program to boom and help secure a resource for future use.

Rural Areas: Out of Arizona’s 22 water planning areas, 20 are mostly rural. These rural areas lie outside the core provisions of the GMA and statutorily have the lowest level of water management unless designated as Irrigation Non-Expansion Areas (INAs). INAs are established by the GMA as areas within which no new land can be irrigated with groundwater. Outside INAs, water use in rural Arizona is mostly agricultural with heavy reliance on groundwater. The resulting aquifer declines from groundwater mining pose a threat to both municipal water users and agricultural businesses. Currently, the Arizona Department of Water Resources, with the involvement of local populations, is prioritizing work in three of the state’s rural planning areas – the Northwest Basins, West Basins, and Cochise areas – which are experiencing rapid groundwater declines. Overall, the resolution of rural water issues presents fertile ground for collaboration between state agencies and a diverse group of local stakeholders.

Colorado River Supply: The Colorado River is Arizona’s largest renewable water supply, of which approximately half the appropriation goes to CAP water users and the other half to on-river users; each have unique characteristics and challenges in managing that water. Although there is a priority system to ownership of this water, we all must face the need to further manage the system in a collaborative way. Less water flows into Lake Mead than flows out of it, resulting in a structural deficit of 1.2 million acre-feet. In each recent year, regardless of drought conditions, the water level in Lake Mead has dropped. Whether one has the highest priority or the lowest, this issue affects the entire State, its economy, and long-term planning. A strong “One Arizona” voice that considers the effects on all individual needs is what is called for moving forward to meet this challenge for this and the next generation.

At AZ Water, we strengthen the development of Arizona water professionals and local experts through training and network development. We support the State agencies through technical expertise and guidance of their policies, and we affirm the Legislature’s oversight and regulation of water matters and funding of water projects. We don’t want the recipe for water solutions to be starved of the ingredients needed to be successful, which is why we do what we do. We support the legislature infusing its resources into the future of water resources planning, and continuing Arizona’s legacy of smart and innovative water management.