Something new is

The AZ PURE Water advanced water purification facility will travel more than 12,800 km (8000 mi) before retiring in October 2018.
Pima County

brewing in Arizona

Using a mobile, potable reuse demonstration facility and the promise of good beer for public outreach

Jeff Prevatt, Barbara Escobar, and Channah Rock

As many states begin to explore potable reuse for balancing their water portfolios, Arizona is boldly blazing a path forward. A collaborative team of water professionals designed and constructed a mobile, potable reuse demonstration facility that traversed the state in a comprehensive outreach campaign targeted at educating citizens about water quality and water management. To aid in the delivery of their message, the team created an effective marketing strategy centering around a friendly competition that pitted commercial brewers throughout the state against each other to produce delicious craft beers for entry in the AZ PURE Water Brew Challenge, an event held at the 2017 WateReuse Symposium.

"Delivering clean and safe drinking water from what was once sewage is bold and provocative and we were fully aware of the stakes, public perception, and public safety concerns", said Channah Rock, team outreach coordinator. "Our project set out not only to change public opinions, but it also required an overturn of a long-held state rule prohibiting potable reuse. We recognized that if executed incorrectly, even just once, it could set back public confidence, and possibly regulations, for decades."

The challenge

The AZ PURE Water Brew Challenge was created when the team won a statewide Water Innovation Challenge competition. The challenge invited collaborative teams to develop innovative and scalable, market-based solutions to advance the sustainability of Arizona's water future. Whether it be a town, city, county, tribal area, or an entire region, it forced teams to collaborate and develop creative solutions toward solving the water needs and problems of today and tomorrow. With the $250,000 cash prize in hand, the reuse team eagerly got to work recruiting sponsors and designing the layout for a mobile treatment facility that would serve as a community outreach tool.

As if the daunting task of changing public perception and state rules weren't enough, the team decided to make things even more challenging and targeted the state's annual AZ Water Conference for their initial launch. Choosing this event left only 4 months for design and fabrication of the advanced water purification facility.

The interior of the AZ PURE Water advanced purification facility was designed to be clean and sterile to reinforce a sense of quality. It provides an excellent background to highlight the treatment technologies being used in the project. Pima County

Team leader and perpetual optimist Jeff Prevatt was asked if there was ever a moment in which he felt they would not be able to meet the deadline and pull off such an ambitious project: "I try to always emphasize that there are NO bad ideas. There are great ideas that may sometimes go terribly wrong, but there really are no bad ideas … We could pull this off."

Beginning with a used shipping container, the team painstakingly transformed it into an amazingly informative, functional, and stunning demonstration facility.

The results of the AZ PURE Water Brew Challenge were overwhelmingly successful in achieving the Arizona's first potable reuse permit and obtaining a regulatory rule change to allow potable reuse within the state.

But the fun didn't stop there; along the 12,400-km (7700-mi) journey the reuse team encountered numerous people equally passionate about water, curious about potable reuse, and anxious to lend a hand including the legendary Roger Penske, Daytona 500 winner Austin Dillon, and even Bill Nye the Science Guy.

Managing water and innovation

Arizona is no stranger to strategic water planning and has a long history of water management that dates back decades. Projects include the Central Arizona Project canal bringing water from the Colorado River to Phoenix and Tucson, some of the most extensive reclaimed water distribution systems in the nation as well as the largest nuclear power facility in the U.S. that, coincidentally, utilizes reclaimed water for cooling and steam generation.

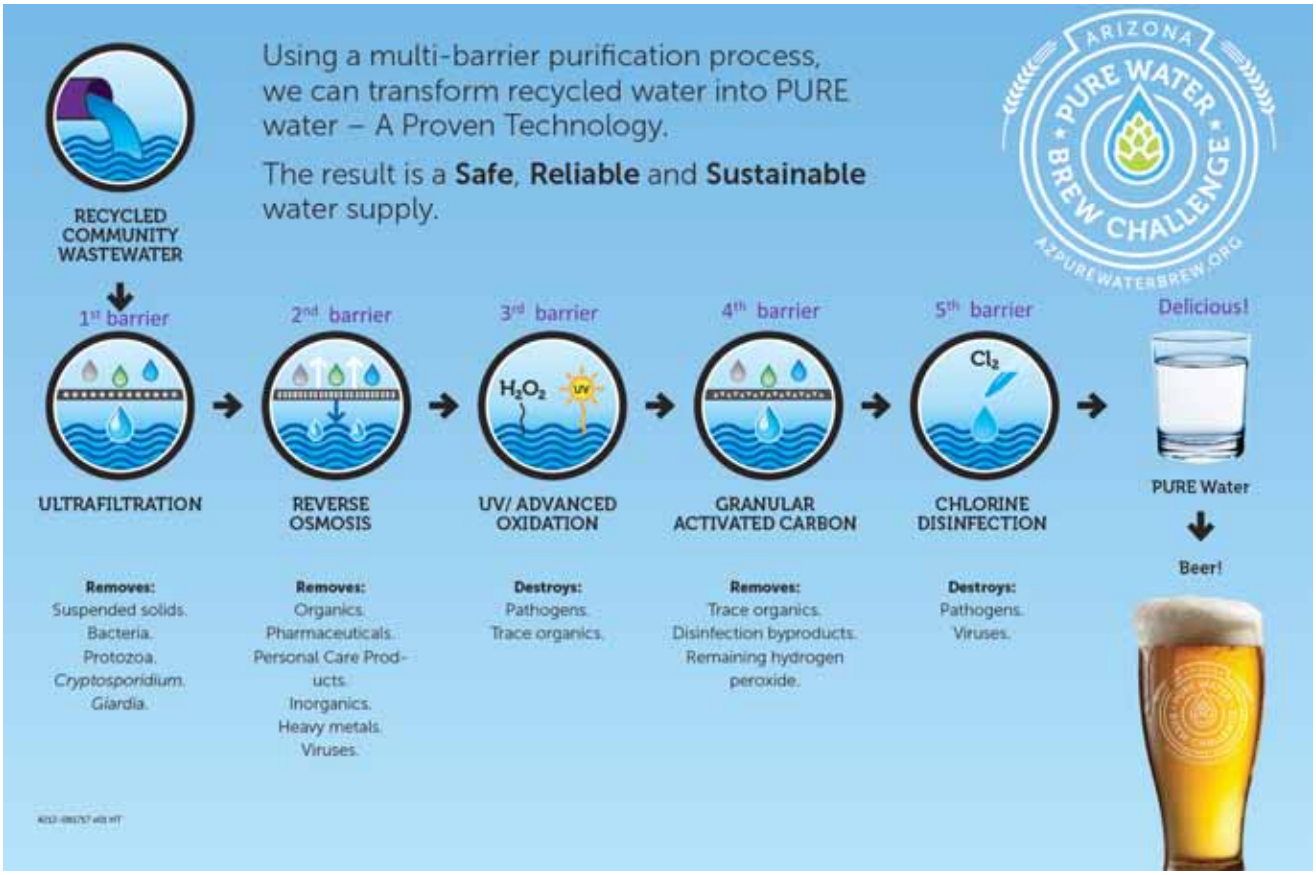
Building on these traditions, Pima County has created a Water Campus dedicated to cutting edge research and innovation that includes the University of Arizona's Water, Energy, and Sustainable Technology (WEST) Center. The Water Campus includes a 1860-m^2 (20,000-ft^2) certified compliance laboratory, 1115 m^2 (12,000 ft^2) of research labs, and 465 m^2 (5000 ft^2) of high bay space used for conducting pilot testing by industry manufacturers and utilities. The WEST Center's unique high bay space proved invaluable for fabricating the AZ PURE Water advanced water purification facility, which was constructed entirely within this space.

Beginning construction

The team purchased a used 12-m (40-ft) shipping container and had it extensively modified to provide for a 6.1-m (20-ft) opening along one side for maximum viewing at public outreach events.

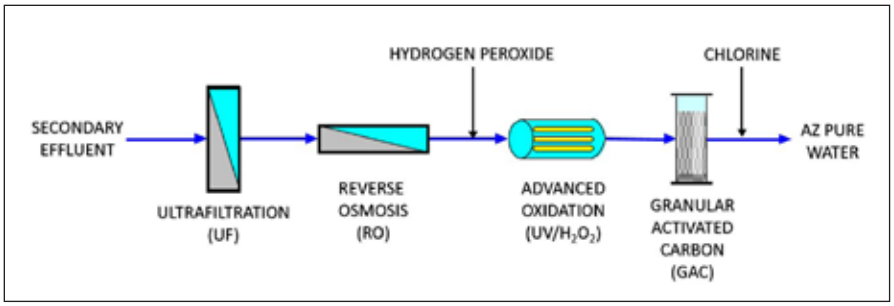
"Public perception was a key focus in the design and fabrication, so every design detail was targeted to maximize public confidence in the treatment technologies and tour experiences," Prevatt said.

Figure 1. One of the many pictographs created to explain the multi-barrier purification process



To achieve this, the entire interior of the trailer was built to resemble a clean, laboratory-like environment with each piece of technology made highly visible along with pictographs explaining each step of the multi-barrier process. (See Figure 1, above.) The goal was to have each guest walk away with an overwhelming sense of confidence in not only the process technologies but also knowledge that their local utilities were taking thoughtful steps to ensure future water utility needs were being addressed. The mobile demonstration facility achieved this perfectly by providing guests an opportunity to understand the purification technologies as well as opportunity to see and touch the process components and taste the final product for themselves. The final product is as aesthetically pleasing to behold as it is functional, which proved to be extremely effective for achieving public acceptance.

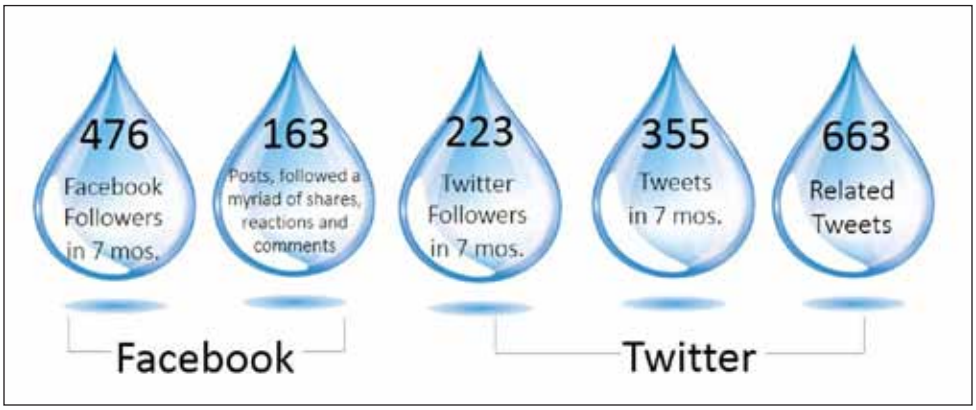
Figure 2. Process flow used in the advanced water purification facility



The treatment process

The engineering consulting firms of CH2M, now Jacobs (Englewood, Colo.), and Carollo Engineers (Phoenix) undertook the first hurdle of designing the treatment process. The water purification process adheres to the multi-barrier treatment approach with each process component building upon the last to achieve increasingly higher quality water. This process was chosen because it has repeatedly produced the highest purity water with ample redundancy for assurance in meeting the public health requirements for 12-log reduction for virus and protozoa. The integrated system includes critical control points incorporated throughout the process to reduce risks to public health through controlled redundancy. This process is like a 38-ML/d (10-mgd) facility currently under construction in El Paso, Texas. The PURE Water team was scheduled to visit El Paso in route to the WateReuse Symposium in September 2018 in Austin. The process components include ultrafiltration, reverse osmosis, advanced oxidation ultraviolet disinfection, activated carbon filtration, and chlorine disinfection. (See Figure 2, above.)

These tried and true treatment technologies individually are used to produce millions of gallons of purified water worldwide each day and the final configuration assembled for this project performed flawlessly, producing extremely high-purity water. The overall layout along the side wall proved highly beneficial for public



The AZ PURE Water team used social media to reach out to younger customers. Water Now Alliance

tours, aesthetics, and ease of operation with the opposite side doors opening to provide an excellent opportunity for maximum viewing and facilitating equipment installation. The targeted production rate was limited to 11 L/min (3 gal/min) equating to one case of 16 oz. bottled water each minute.

Validation testing

Analytical validation of the water purification process was a critical component for allaying public health concerns and demonstrating the safety of the finished product. This validation is essential to both helping establish the permitting requirements established by the Arizona Department of Environmental Quality (ADEQ) as well as protecting the reputations of the team members and their respective organizations. Due to the vast number of analytes requiring analysis and the need for rapid results, water quality testing was distributed among the laboratories of Pima County, Tucson Water, University of Arizona, City of Phoenix, other partnering municipalities, and the contract laboratories Eurofins and Test America.

The advanced water purification facility repeatedly underwent extensive testing and validation that potable reuse water is a safe and viable product for augmenting water supplies. To verify the reproducibility of the PURE Water process, initial performance validation was conducted at the Agua Nueva Water Reclamation Facility in Tucson, the Rio de Flag Water Reclamation Facility in Flagstaff, and City of Phoenix's 23rd Avenue facility. Water quality was continuously monitored throughout production.

Team Outreach Coordinator Channah Rock was featured in a segment of the show, "Bill Nye Saves the World." She explained the AZ PURE Water Brew Challenge to Bill and the viewers. Bunim/Murray Productions

Extensive laboratory analysis documented water quality for both conventional pollutants and microconstituents. While current drinking water standards require analyses for 77 conventional pollutants, water generated through the PURE Water advanced purification process underwent analyses for more than 288, including MS2 phage testing to document virus and pathogen removal. More than 3000 analyses were completed in total.

The team even developed a comprehensive challenge testing protocol for documenting pathogen reduction designed for achieving the 12-log virus removal, 10-log protozoa removal, and 10-log bacteria removal performance. The team was able to demonstrate greater than 18-log reduction for MS2 challenge testing. Compliance and Regulatory Affairs Manager Barbara Escobar proudly boasts, "Not only is AZ PURE Water safe and the highest quality water you will ever taste, we've got the data to prove it! We drink it, and so should you."

Community outreach and public perception

To change public perceptions and build support for potable reuse, WaterNow Alliance and the PURE Water team worked together to develop messaging strategies to convey the benefits and safety of potable reuse. Using past research, WaterNow developed a list of terms and phrases to use and avoid when talking with the public and the media. Messages such

as, “All water is recycled” and, “Judge water by its quality, not its history” were important to remind the public that water recycling is not new and that it is the quality of the water that matters. On the other hand, such terms as “recycled wastewater” and “effluent” were avoided because they are unfamiliar to most people and tend to evoke perception bias.

At each outreach event, attendees visited the AZ Pure Water Brew Challenge information booth and toured the mobile treatment facility. The goal was to encourage each guest to learn about the challenge and water reuse in each community, drink purified water, taste craft beer, ask questions, and take a survey – but most of all, have fun! Thousands of people were surveyed to gauge their perceptions on recycled water prior to, and after, completing the tour.

Figure 3. Broadcast map demonstrating regions that aired coverage of the AZ PURE Water Brew Challenge

Overall, the survey results demonstrated the value of innovative tools where people can touch and see technologies as well as taste the water/beer. These experiences change public perception related to complex topics of water reuse and recycling. The information gained from the consumers will continue to be extremely valuable for future efforts targeted at informed messaging, outreach, and communications on potable reuse topics nationwide.

Taking the show on the road

The national effect of this project has been astounding. The enthusiastic response and acceptance is reflected in the multiple collaborative requests from fellow states seeking to host the mobile demonstration facility in their own communities.

“It has gotten everyone talking about water,” exclaimed Rock. Not only did the project reach multiple cities throughout Arizona, but it also extended in nearby states. The team held Outreach events in Denver and meetings with the Colorado Department of Public Health and the Environment and Denver Water to develop potable reuse standards for the state. Likewise, the team was scheduled to travel to Idaho for outreach events coordinated through the City of Boise and the Idaho Department of Environmental Quality, as well as attend at the WateReuse Symposium in Austin in September. Similar requests have come from Florida and Oregon. (The team is working closely with Clean Water Services on the design and construction of their own mobile demonstration facility.)

The map (Figure 3, above) shows geographical areas broadcasting segments highlighting the AZ PURE Water Brew Challenge.

For many arid states to continue to grow and prosper, water supplies must be maintained and alternate sources of water explored. This includes potable reuse. Without the innovative vision and collaboration displayed throughout this project, Arizona’s efforts to beneficially reuse our water resources would have not been possible.

Not only were communities treated to highly purified water backed by sound research and science, they were able to enjoy truly amazing craft beers and engage in meaningful discussion on the importance of water.

“We are proud to have received the first potable reuse permit in the state of Arizona and was integral in ADEQ lifting decades of prohibition and change of state law,” said Escobar. “This was a remarkable project and I am glad to have played a role in securing water options for future generations.”

Jeff Prevatt *is a deputy director for Pima County Regional Wastewater Reclamation and served as team leader for the AZ PURE Water project.* ***Barbara Escobar*** *is the compliance and regulatory affairs manager for Pima County Regional Wastewater Reclamation and oversaw the analytical validation testing for the AZ PURE Water project.* ***Channah Rock*** *is a professor at the University of Arizona and served as the outreach and messaging coordinator for the AZ PURE Water project.*

The Pure Water Brew Team consists of members from Pima County Regional Wastewater Reclamation Department, Tucson Water, Town of Marana, University of Arizona, Carollo Engineers, Jacobs, Clean Water Services, WateReuse, and HDR Engineering.