Over the past several decades, southern Nevada has experienced a dramatic increase in population like much of the Southwest. This has subsequently increased water demands in the region from sources that are also experiencing climate stress. Therefore, finding ways to extend and safely reuse water resources is vital for continuing to meet the region’s needs. A significant part of ensuring the quality of treated water intended for reuse is understanding the effectiveness of treatment processes, especially for particularly recalcitrant contaminants such as per- and poly-fluoroalkyl substances (PFAS).

Per- and poly-fluoroalkyl substances are synthetic chemicals used in a variety of applications, such as textile coatings, paper products, food packaging, nonstick cookware, and the aqueous film-forming foams (AFFF) used in firefighting (Brendel et al., 2018). “Per- and poly-fluoroalkyl substances refer to a class of more than 4,000 synthetic chemicals that have been manufactured and released into the environment for over 50 years,” explains Dr. Xuelian Bai, the principal investigator (PI) of this project that also includes co-PI Dr. Yeongkwon Son and researcher Rania Eddik (Lim, 2019). “In 2016, a lifetime health advisory of 0.07 µg/L was issued by...
(Project Spotlight continued)

the EPA for long-term exposure to both perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS) through drinking water.”

In recent years, the ubiquitous use of PFAS and their resistance to water treatment processes have increased concerns about their presence in reclaimed water and their effects on human health. “There are severe environmental risks and human health concerns associated with PFAS because of their long-term persistence, low biodegradability, and high bioaccumulation in wildlife and humans,” Bai says. “The Agency for Toxic Substances and Disease Registry (ATSDR) states that human exposure to certain PFAS may affect the growth, learning, and behavior of infants and children; lower chances of conception; interfere with natural hormones; increase cholesterol levels; affect the immune system; and increase the risk of cancer” (ATSDR, 2018).

Previous studies have only focused on a few legacy PFAS, such as PFOA and PFOS. The goal of this project is to measure a broad spectrum of PFAS compounds and their precursors, as well as determine their mass balance during wastewater treatment processes. The different compounds also behave differently in the engineered environment, which can also affect the persistence, degradation, and bioaccumulation of PFAS compounds. “This study will provide critical data on the identification and detection of PFAS characteristics, including chain length, functional moiety, ionic state, precursors, and alternatives,” Bai says. “This information is significant for studying the diverse PFAS classes and understanding the fate of different types of PFAS during wastewater treatment.”

This project will also be the first to assess the occurrence, distribution, and fate of PFAS during all phases (i.e., liquid, solid, and gas) of wastewater treatment. These compounds may be released into the air during treatment, which is a currently unstudied pathway for human exposure. The researchers will use on-site air samplers to measure gas-phase PFAS at a wastewater treatment facility in Las Vegas, Nevada, and then determine the mass flows of PFAS at each treatment stage. “This information is critical to understanding PFAS treatment and fate during wastewater treatment processes, especially the presence of airborne PFAS in wastewater treatment plants,” Bai adds.

The data collected and analytical methods developed during this project will provide valuable insights that will help forward the advancement of water treatment processes. The researchers will then disseminate the measured data and analytical methods developed to stakeholders, as well as provide recommendations for managing the risks of PFAS. “The expected deliverables from this research will benefit water utilities, wastewater management agencies, and regulatory agencies addressing issues related to PFAS exposure from municipal wastewater,” Bai says. “This study will
provide a deeper understanding of the presence and fate of PFAS in wastewater treatment plants, which will lead to further advances in treatment processes and ensure the quality of treated water intended for reuse.”

Recent population growth in the Southwest also means it is even more important to understand the potential effects of human exposure to PFAS and find ways to improve treatment processes for reclaimed water. “Water scarcity and water reuse are a severe problem in Nevada and understanding the occurrence of PFAS during wastewater treatment will ensure water quality before it is reused for other purposes,” Bai explains. “This research is particularly important given that wastewater reuse is a beneficial practice in many regions with water scarcity issues and PFAS are one of the most toxic wastewater contaminants currently known.”

In addition to working to preserve and conserve water resources in Nevada, the results of this study will provide critical baseline data on PFAS mass balance that could be valuable globally for improving wastewater treatment plants. “The removal efficiency of PFAS after each treatment stage and distribution of PFAS in the water, solid, and gaseous phases of wastewater treatment plants will be disseminated to stakeholders worldwide,” Bai adds. “They can then use the data for advanced treatment, risk prediction, management, and regulation.”

**References**


“**This study will provide a deeper understanding of the presence and fate of PFAS in wastewater treatment plants, which will lead to further advances in treatment processes and ensure the quality of treated water intended for reuse.”** – Xuelian Bai
Envisioning a Regional Drought Learning Network (DLN)

The Southwest and Southern Plains have increasingly experienced climate stress related with drought. In particular, the 2018 drought experienced by these regions highlighted the urgent need for more proactive drought planning. The Drought Learning Network (DLN) was launched as a way for resource managers to share vital climate information, as well as best practices and lessons learned from that drought. The DLN will serve as a framework for federal, state, and local stakeholders to prepare for, respond to, and recover from drought. An introductory workshop was held in February 2020 to discuss stakeholders’ needs and lay the groundwork for the DLN framework.

As part of the NWRRI’s goal to support information transfer related with water resources research, the NWRRI provided funding for David Simeral, an associate research scientist in climatology with the Western Regional Climate Center (WRCC) at Desert Research Institute and U.S. Drought Monitor Author, to participate in the February 2020 conference. David and his colleagues Emile Elias, Director of the USDA Southwest Climate Hub, and Caiti Steele, Coordinator and Deputy Director of the USDA Southwest Climate Hub, provided Nevada Water News with some information about the DLN.

1) What are some of the drought-related challenges that communities in the Southwest and Southern Plains face? Do some communities face more challenges than others?

In the Southwest and Southern Plains, drought presents challenges to a variety sectors, including negative economic impacts on farmers and ranchers, the outdoor recreation industry, and tourism. Farmers practicing rain-fed agriculture are hardest hit by drought and these are all too frequently the tribal producers in the Four Corners region. With little water infrastructure on tribal lands, the rangeland forage fails when the rains fail and water sources for livestock dry up. We witnessed this in 2018, when 200 horses died on the Navajo Nation. Generally, farmers who depend on surface water and have no access to groundwater will feel the effects more than farmers with irrigation wells. However, this is not always the case because we are hearing of wells running dry in eastern New Mexico and eastern Arizona.

More recently, the COVID-19 pandemic has forced tribal governments in some areas to restrict outside access to tribal lands, which has presented challenges because some tribes in the region are currently experiencing intensifying drought conditions due to the weak monsoon this summer. The combination of drought and restricted access has created issues with tribal farmers and ranchers being able to receive supplemental hay deliveries.

Drought in the Southwest also has a direct impact on snow and water-based outdoor recreation activities, such as skiing, river rafting, fishing, and boating. For example, during drought years, the number of days ski area is operational may be significantly reduced because of poor snowpack conditions (snow drought), which can lead to workforce reductions and a shortened season for nearby communities (i.e., reduced hotel occupancy and higher unemployment).

2) What is the objective of the DLN?

The DLN is intended to be a peer-to-peer learning network to retain lessons learned in drought management and allow communities to learn from each other. Every time a drought comes along, most people respond reactively. Once a drought has passed, we often return to business-as-usual behaviors, momentarily forgetting the pain and hardship that the drought brought. At the same time, effective drought responses might never reach a wider audience. The DLN is an effort to promote proactive planning for drought, because we know it is a matter of when a drought is coming rather than if it is coming.

The DLN will provide a forum for managers to share and learn about what was successful (or not) in planning for, responding to, and recovering from drought. Specifically, the initial objectives of the DLN are to establish a collective approach and time line for the development of a regional framework, document stakeholder experiences during drought, and leverage service-provider resources.

(Continued on following page)
3) How can increasing community connection increase drought resiliency in drought-affected regions? How will the DLN work to achieve that?

Increasing community connections is essential if we are to encourage the sharing of best practices. When an individual or a group of people finds successful solutions for drought planning and response, this must be shared with others who can benefit from the information. As a network, the DLN will support managers in sharing what was successful (or not successful) in planning for, responding to, and recovering from past droughts to inform current/future response. During the COVID-19 crisis, we are primarily sharing information through webinars, which we are pleased to report are being well received.

4) In what ways do you think that developing the DLN will forward drought-management research in the Southwest and Southern Plains?

The focus of the DLN is knowledge exchange, which will break down the siloes that prevent effective knowledge sharing across state lines and between different agencies and groups. Because we are building strong connections with agricultural producers and others in the Southwest and beyond, we can better identify the specific drought-related challenges faced by individuals (i.e., small and new farmers), natural resource managers, and tribal entities. For example, some of the initial activities of the DLN focused on providing monthly webinars that conveyed information on current and upcoming weather and climate conditions in New Mexico, with an emphasis on tribal lands.

5) Based on the discussions in the February workshop, what are some of the ways that communities can work together and/or learn from each other to better manage drought? Did these discussions highlight any specific knowledge gaps that might be avenues for future research?

Setting up the DLN is still in the preliminary stages. The focal areas identified as high priorities during the February DLN workshop in Las Cruces, New Mexico, include sharing projections for management decisions, building a database of case studies and best practices, developing weather and climate resources for New Mexico Tribes, supporting new and small farmers, and enhancing drought response in Utah. As the Southwest DLN working groups pursue these focal areas, they are likely to highlight specific knowledge gaps that might provide avenues for future research.

6) Did any communities at the meeting share any improvements they have made to their drought resiliency?

It is too early to say, but some of the feedback we’ve had from webinars indicates that the people tuning in really appreciate the information that DLN partners have been sharing. We recently hosted a call for producers in eastern New Mexico and the southern High Plains. We invited two ranchers to talk about their experiences preparing for drought and the feedback we’ve had from attendees has been tremendous. The attendees really appreciated hearing from their peers because they have a deep understanding of and sympathy for the situations they face.


Upcoming Events

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<th>Event</th>
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<tr>
<td>AGU20 Fall Meeting</td>
<td>December 1-17, 2020</td>
<td>Virtual event</td>
<td><a href="http://www.agu.org/Fall-Meeting">www.agu.org/Fall-Meeting</a></td>
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<tr>
<td>Groundwater Week</td>
<td>December 8-11, 2020</td>
<td>Virtual event</td>
<td><a href="http://groundwaterweek.com">groundwaterweek.com</a></td>
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<tr>
<td>Hydrogeology of Shallow Groundwater Contaminant Plumes in Las Vegas, NDEP guidance, and NDEP Cleanup Prioritization</td>
<td>January 12, 2021</td>
<td>Las Vegas, NV</td>
<td><a href="http://www.aegsnv.org/meetings">www.aegsnv.org/meetings</a></td>
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</tbody>
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Please keep an eye on the event websites for changes in conference schedules.
Events List Continued

NGWA's Hydrogeology of States Webinar Series: Florida
February 4, 2021
Online
www.ngwa.org/detail/event/2021/02/04/default-calendar/21feb04web

Groundwater Remediation Sites in Las Vegas Complicated by Significant Depth to Water Fluctuations
February 9, 2021
Las Vegas, NV
www.aegsnv.org/meetings

Groundwater Injection in Orange County, CA, for Aquifer Recharge and to Create a Hydraulic Barrier to Saltwater Intrusion
March 9, 2021
Las Vegas, NV
www.aegsnv.org/meetings

Nevada National Security Test Site Tour
March 31, 2021
Las Vegas, NV
www.nvwr.org/2021-march-nnss-tour

Coping With Megadrought in the Colorado River Basin
April 13, 2021
Las Vegas, NV
www.aegsnv.org/meetings

Truckee River Tour
May 6 & 7, 2021
Reno, NV
www.nvwr.org/2021-truckee-river-tour

Coastal Landslides and Highway Management: Big Sur, California
May 11, 2021
Las Vegas, NV
www.aegsnv.org/meetings

Chapman Conference: Distributed Volcanism and Distributed Volcanic Hazards
May 11-15, 2021
Flagstaff, AZ
www.agu.org/Chapmans-Distributed-Volcanism

117th Annual Meeting of the Cordilleran Section
May 12-14, 2021
Reno, NV
www.geosociety.org/GSA/Events/Section_Meetings/GSA/Sections/cd/2021mtg/home.aspx

2012 June Well & Water Week
June 14-17, 2021
Reno, NV
www.nvwr.org/2012-june-well-water-week

Field Methods: Groundwater Sampling and Analysis Short Course
June 21-23, 2021
Westerville, OH
www.ngwa.org/detail/event/2021/06/21/default-calendar/21jun226

Aquifer Test and Interpretation and Analysis
June 24-25, 2021
Westerville, OH
www.ngwa.org/detail/event/2021/06/24/default-calendar/21jun192

2021 Connecting Land and Water for Healthy Communities Conference
July 19-21, 2021
Denver, CO
www.awra.org/Members/Events_and_Education/Events/2021_Summer_Conference.aspx

Nevada Gold Mines Tour of Twin Creeks Mine
September 14-15, 2021
Winnemucca, NV
www.nvwr.org/2021-nevada-gold-mines-tour

2021 Tour of Marlette Lake Water System
September 22, 2021
Washoe Valley, NV
www.nvwr.org/2020-marlette-lake-tour

GSA Annual Meeting
October 10-13, 2021
Portland, OR
community.geosociety.org/gsa2021/home

2022 NWRA Annual Conference Week
January 31- February 3, 2022
Las Vegas, NV
www.nvwr.org/2022-annual-conference-week
Success and the dedication to quality research have established the Division of Hydrologic Sciences (DHS) as the Nevada Water Resources Research Institute (NWRRI) under the Water Resources Research Act of 1984 (as amended). As the NWRRI, the continuing goals of DHS are to develop the water sciences knowledge and expertise that support Nevada’s water needs, encourage our nation to manage water more responsibly, and train students to become productive professionals.

Desert Research Institute, the nonprofit research campus of the Nevada System of Higher Education, strives to be the world leader in environmental sciences through the application of knowledge and technologies to improve people’s lives throughout Nevada and the world.

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