Fall 2025 – Volume 11; Issue 3

NEVADA WATER NEWS

NWRRI NEVADA WATER RESOURCES RESEARCH INSTITUTE

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PROJECT SPOTLIGHT

"Comparative Analysis of Historical Streamflow Trends for the Upper Carson and Walker River Basins"

This project is funded through the National Institutes for Water Resources (NIWR) 104(b) grant.

Jobs Peak in Carson Valley, Nevada.

Snowmelt from the Sierra Nevada generates streamflow in the Carson and Walker River Basins that farmers depend on to support agriculture in west-central Nevada. However, warmer annual temperatures mean earlier snowmelt, which can affect irrigation practices. If spring streamflow occurs too early, farmers are unable to make the most of valuable water resources during the growing season. Changing patterns in streamflow may also increase their reliance on groundwater resources to offset decreased streamflow during the growing season. "When less surface water is available during the growing season, farmers typically pump more groundwater to meet the agricultural demand," explains Dan Saftner (DRI), the PI of the project that also includes Dr. Rishi Parashar (DRI) and undergraduate student Sara Zeitoun (UNR).

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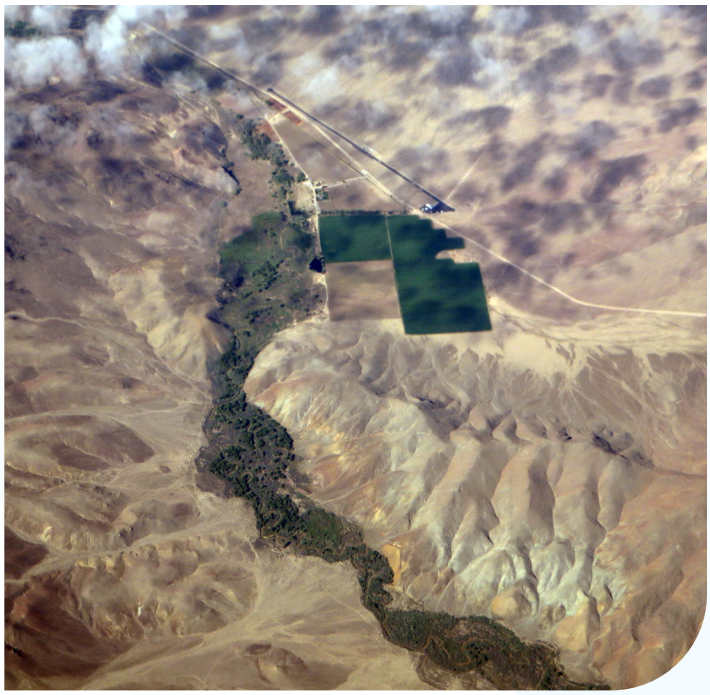
If you have questions about submitting a NWRRI proposal, email Suzanne Hudson at Suzanne.Hudson@dri.edu. Visit the NWRRI website at www.dri.edu/nwrri for current RFP information.



Changing streamflow patterns affect the availability of water that can be used for irrigation (left: Carson River, photo by Dicklyon, CC BY-SA 4.0, via Wikimedia Commons; right: Walker River, photo by Ken Lund from Reno, Nevada, USA, CC BY-SA 2.0, via Wikimedia Commons).

Understanding historical streamflow trends will help water managers plan for changes in streamflow patterns and adjust water allocation and storage strategies accordingly.

The aim of this study is to better understand historical streamflow trends so that water managers can plan for changes in streamflow patterns and adjust water allocation and storage strategies accordingly. "Our initial analysis of historical gage records shows clear differences between before and after 1975, when the influence of warming became more pronounced," Saftner says. "Minimum flows tended to increase before 1975, but generally declined in the post-warming period. The timing of 50% and 80% of annual streamflow has also shifted, so water is moving through the system earlier in the year. These shifts indicate that both the timing and magnitude of available surface water are changing, with important implications for irrigation scheduling." By understanding past shifts in streamflow timing, water managers can plan water release schedules to meet peak summer demands and ensure reliable water supplies year-round.

The researchers will also evaluate whether the timing and magnitude of streamflow changes with temperature are consistent in the headwaters of two key river basins along the eastern slope of the Sierra Nevada: the Carson and Walker River Basins. "Reliance on groundwater in the Carson Valley has steadily increased since the 1950s, resulting in a lowering of the water table throughout much of the valley," Saftner explains. "The questions we are asking in this study are if the relationship between streamflow changes and warming temperatures is consistent between the neighboring Carson and Walker River Basins, what the drivers are of any differences, and if there are any expected long-term effects on groundwater resources in the region." To answer these questions, the researchers will identify the hydrologic and watershed characteristics that may explain differences in streamflow trends between the two basins.

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The Walker River (photo by JJia/BLM Nevada, Public domain, via Wikimedia Commons).

This study focuses on the headwaters of the Carson and Walker Rivers because human impacts on hydrology in those areas are minimal. These headwaters have minimal storage and diversion infrastructure to buffer the effects of temperature variability, allowing researchers to isolate different environmental variables and the related impacts on streamflow. "Watershed characteristics such as elevation, slope, and aspect can strongly influence how precipitation translates into streamflow," Saftner says. "Higher-elevation catchments may retain snowpack until later into the spring, whereas lower-elevation catchments show stronger shifts toward earlier runoff from snowmelt. The Carson and Walker watersheds have different characteristics that may help explain differences in the timing of flow."

The initial results for the upper Carson River indicate significant increasing trends in median daily streamflow in early spring (April) and decreasing streamflow in late spring and early summer (May and June). "Our findings suggest that earlier snowmelt-driven runoff is now a consistent trend in both basins, although the magnitude of change differs between watersheds and stream gages," Saftner says. Because minimum flows are declining and streamflow is occurring earlier in the spring, there is less surface water available during the traditional irrigation season. This information can help water managers anticipate reduced late-summer streamflow and plan for alternative storage, diversion timing, or supplemental groundwater use.

The initial results also show some interesting trends. "Although overall flows are decreasing, extreme events such as rain-on-snow storms appear to be contributing to more frequent spikes in maximum daily flows," Saftner adds. "Such variability complicates planning because

"Our initial analysis of historical gage records shows clear differences between before and after 1975, when the influence of warming became more pronounced […]. These shifts indicate that both the timing and magnitude of available surface water are changing, with important implications for irrigation scheduling."

–DAN SAFTNER

The Carson River from Nevada State Route 822 in Dayton, Nevada (photo by Famartin, CC BY-SA 4.0, via Wikimedia Commons.)

managers must prepare both for earlier shortages and for more frequent peak events. This dual challenge highlights the importance of flexible management strategies." By incorporating these changes into community and regional water planning efforts, water managers can continue to meet the needs of agriculture, public water systems, and other water users.

The goals of the NWRRI program are to expand our understanding of water and water-related phenomena, and support and sustain Nevada's water resources. This project will provide insight into how warming temperatures affect water availability in snow-dominated systems. The results will help water managers in Nevada and across the western United States have a better understanding of surface water and groundwater dynamics, as well as a scientific basis for water allocation and storage strategies. This is particularly important in Nevada because state water authorities are implementing management strategies that account for surface water and groundwater as a single resource. The results of the research will be shared with farmers, water purveyors, and water managers of the Carson and Walker Basins to help them plan for changing water availability.

A key component of the NWRRI program is to train the next generation of scientists. Undergraduate student Sara Zeitoun is participating in this project, which gives her experience in data compilation and statistical analysis, as well as generating plots and maps from the data collected. "Through this work, Sara is learning how to analyze and interpret meteorology and hydrology records, which are skills that are highly relevant as she considers a career in environmental policy," Saftner says. "The project also allows her the opportunity to work with real-world water management questions, bridging her academic training and experience in applied science."

NWRRI Program Announcements

We are excited to announce two newly funded NWRRI 104(b) projects. The project "Influence of Aridification on Future Phosphorus Storage and Mobility in the Las Vegas Wash" will focus on how phosphorus pollution leads to harmful algal blooms, which can produce toxins that make the water unsafe for communities and wildlife. Wetlands and floodplains along the Las Vegas Wash can trap phosphorus before it reaches Lake Mead, but continued drought leads to sediment erosion during storms that can deposit that phosphorous into the lake. This project will test samples of wash sediments and determine the phosphorus content to understand how sediment erosion may affect the water quality of Lake Mead. The research team includes Drs. Zach Perzan (PI) and Alison Sloat (co-PI) of UNLV and will include a graduate student, two undergraduate students, and collaborators from the Southern Nevada Water Authority and US Bureau of Reclamation.

The project "How Do Forest Treatments Affect Water Quantity in the Truckee Watershed?" will focus on the effects of forest treatments on drinking water supplies. Much of Nevada's drinking water comes from snow in mountain forests. Water managers often use various forest treatments, such as logging and prescribed fires, to reduce fire risks and protect water infrastructure. However, it is difficult to predict how these treatment activities will influence downstream water supplies. Previous research has shown that changes in tree cover can affect snow persistence and soil water retention that could result in either more or less runoff into streams at various times of year. This project will use field measurements and remote-sensing observations to investigate the effects of various forest treatments on snow and water retention. The team will compare snow and soil measurements from thinned forests to nearby forests with more trees. The results of this project will provide actionable information on how forest thinning affects downstream water resources that water managers can use to determine the appropriate locations and types of forest treatments to reduce fire risks and improve water reliability. The research team includes Drs. Gabrielle Boisrame and Christine Albano of DRI and will include a PhD student to help with project management and an undergraduate research assistant to help with data collection and analysis.

The NWRRI program will also continue to support the NWRRI Undergraduate Internship Immersion Program by funding undergraduate students to participate in a variety of water research projects. Last summer's projects included "Are Beaches a Source of Litter to Lake Tahoe?" and "Using Landforms to Infer the Presence of Water Ice on Mars."

Publications

The following publications resulted from the NWRRI project "Strain-specific Monitoring of SARS-CoV-2 in Rural Wastewater Systems":

- Zhuang, X., V. Vo., M.A. Moshi, K. Dhede, N. Ghani, S. Akbar, C.-L. Chang, A. Young, E. Buttery, W. Bendik, H. Zhang, S. Afzal, D.P. Moser, D. Cordes, C. Lockett, D. Gerrity, H.-W. Kan, E.C. Oh, 2025. Early Detection of Novel SARS-CoV-2 Variants from Urban and Rural Wastewater through Genome Sequencing and Machine Learning. *Nature Communications*, 16: 6272. https://doi.org/10.1038/s41467-025-61280-5
- Harrington, A., V. Vo, M. Moshi, C.-L. Chang, H. Baker, N. Ghani, J.Y. Itorralba, K. Papp, D. Gerrity, D. Moser, E. Oh, 2024. Environmental Surveillance of Flood Control Infrastructure Impacted by Unsheltered Individuals Leads to the Detection of SARS-CoV-2 and Novel Mutations in the Spike Gene. *Environmental Science & Technology Letters*, 11(5):410-7. https://doi.org/10.1021/acs.estlett.3c00938

NWRRI UNDERGRAD INTERNSHIP INTERVIEW:

Xylia Souza

Xylia Souza participated in the NWRRI Undergraduate Internship Immersion Program in the summer of 2025. She worked on the project "Are Beaches a Source of Litter to Lake Tahoe?" and was mentored by Dr. Monica Arienzo of DRI, as well as Rachel Eves and Sabbathiel Greene who were summer interns in 2024. The focus of the project was to measure and categorize the litter on Lake Tahoe's beaches in collaboration with ECO-CLEAN Solutions to identify sources of litter in the lake. We asked Xylia about her experience during the internship, current research, and plans for the future. Here's what she had to say:

Photo by Morgan Souza

1) How did you find out about the internship?

I am currently studying environmental science at UNR with a focus on conservation and restoration. I learned about this internship because Meghan Collins from DRI came into my natural resources and environmental sciences class at TMCC and talked about summer internship opportunities at DRI.

2) What project did you work on and how did you participate?

I worked on the project "Are Beaches a Source of Litter on Lake Tahoe?" The other interns and I collected and analyzed litter from beaches at Lake Tahoe. We used the BEBOT from ECO-CLEAN Solutions, which is one of the project partners, to collect both native and nonnative materials from the beaches. The BEBOT would then deposit the materials on a tarp for us to sort. After we sorted out the nonnative materials (such as nut and seed shells, food pieces, and typical trash items and plastic), we labeled them as "litter" and put them in buckets to take back to DRI and returned the native materials back to the beach.

> *"I was very surprised to learn how much trash is under the sand on Lake Tahoe's beaches and how many different types of trash you can find."*
>
> **–XYLIA SOUZA**

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Back at DRI, we sorted all the trash into main and subcategories, such as plastic bottle caps, straws and straw wrappers, other metal, and more. Once the categories were sorted, the trash was weighed and counted, and pictures were taken of each pile. This information was compiled on a data sheet and then digitalized. Once we had all of the data from the beaches, we created graphs and charts comparing the data from different beaches and trash categories.

I also helped create research questions for the project, such as "How do trash cans affect the amount of litter on Lake Tahoe's beaches?" and "Does grain size make litter degrade faster?" To answer these questions, our team then went back into the field and collected more data by creating points on ArcGIS field maps, documenting the latitude and longitude of the trash cans on the beaches, and collecting sand from the beaches.

We then analyzed the sand at DRI using a microscope and computer tools to find the grain size and compared the results to our previous data. I also used ArcGIS Pro to create maps of where the trash cans were located and their distance from the beach. At the end of the summer, we presented our findings to both DRI and The League to Save Lake Tahoe. Overall, I participated in every part of the project from data collection to presenting our findings.

3) What did you learn on this project and how does the project contribute to our understanding of water resources in Nevada?

I learned so much from working on this project, I gained experience in fieldwork, data collection, and data analysis. This research helps us better understand how much trash is found on Tahoe's beaches so that we can better understand the kinds of litter entering the lake. Once we understand the type of litter that is entering the lake, we can find solutions to better clean and protect the beaches and the lake.

4) What else did you learn from your experience on the project?

I learned a lot about the BEBOT and more about what the League to Save Lake Tahoe does. I was very surprised to learn how much trash is under the sand on Lake Tahoe's beaches and how many different types of trash you can find. We found a lot of nut shells and it really surprised me how many people don't know that they shouldn't throw fruit peels and nut shells on the beach.

5) Did participating in this internship give you any ideas for your future studies?

I definitely have new ideas for future studies. I talked to a lot of professionals and learned more about getting a master's or PhD, as well as other opportunities and internships that I could apply for in the future.

6) What are your goals for the next steps in your studies and career?

I plan to get my bachelor's at UNR in environmental science and I want to work on conservation or restoration in the future. I also would love to apply for more internships while getting my degree and have more wonderful experiences like this internship.

NWRRI UNDERGRAD INTERNSHIP INTERVIEW:

Samantha Scheideman

Samantha Scheideman participated in the NWRRI Undergraduate Internship Immersion Program in the summer of 2025. She worked on the project "Are Beaches a Source of Litter to Lake Tahoe?" and was mentored by Dr. Monica Arienzo of DRI, as well as Rachel Eves and Sabbathiel Greene who were summer interns in 2024. The focus of the project was to measure and categorize the litter on Lake Tahoe's beaches in collaboration with ECO-CLEAN Solutions to identify sources of litter in the lake. We asked Samantha about her experience during the internship, current research, and plans for the future. Here's what she had to say:

Photo by Samantha Scheideman

1) How did you find out about the internship?

I am currently studying natural resources and environmental science.

2) What project did you work on and how did you participate?

I worked on the project "Are Beaches a Source of Litter on Lake Tahoe?" This project entailed cleaning the beaches with a litter robot, the BEBOT, and taking the litter back to DRI to sort, weigh, and count the various pieces and types of litter we found on the beach.

3) What did you learn on this project and how does the project contribute to our understanding of water resources in Nevada?

I learned that there is a lot of litter left on our beaches. Beaches are the starting point for litter to then move into our waterways, and ultimately affect water quality.

4) What else did you learn from your experience on the project?

I learned how to upload data and use it to present information in different ways to different audiences. I also learned how to use

> *"[This internship] gave me a better understanding and outlook of what real science looks like compared to what is taught in a classroom."*
>
> **–SAMANTHA SCHEIDEMAN**

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ArcGIS to map our locations and present our data in a variety of visual formats.

5) Did participating in this internship give you any ideas for your future studies?

This internship helped me clarify what exactly I wanted to do in science. It gave me a better understanding and outlook of what real science looks like compared to what is taught in a classroom.

6) What are your goals for the next steps in your studies and career?

I plan to get my bachelor's at UNR in environmental science and I want to work on conservation or restoration in the future. I also would love to apply for more internships while getting my degree and have more wonderful experiences like this internship.

EVENTS

Please keep an eye on the event websites for changes in conference schedules.

Practical Application and Interpretation of Pumping Tests Short Course
December 8, 2025
New Orleans, LA
www.ngwa.org/detail/event/2025/12/08/default-calendar/25dec8sc

Groundwater Week 2025
December 9–11, 2025
New Orleans, LA
groundwaterweek.com/

AGU25
December 15–19, 2025
New Orleans, LA
www.agu.org/annual-meeting

OSM26
February 2–27, 2026
Glasgow, Scotland
www.agu.org/ocean-sciences-meeting

2026 NWRA Annual Conference Week
February 2–5, 2026
Las Vegas, NV
www.nvwra.org/2026-ac-week

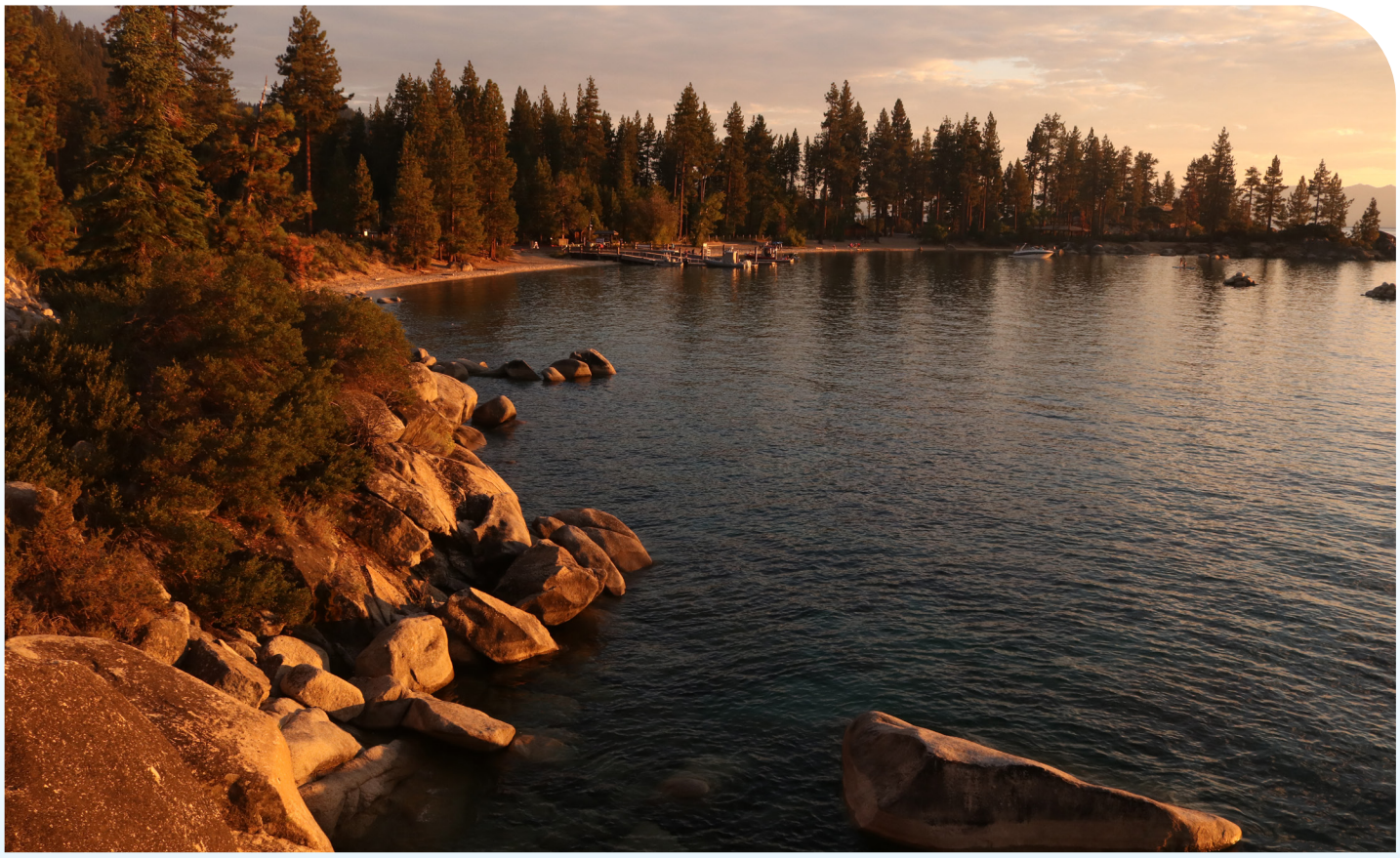
PFAS in the Age of Uncertainty Conference
March 9–10, 2026
San Antonio, TX
www.ngwa.org/detail/event/2026/03/09/default-calendar/26Sept5010

2026 Pacific Northwest Ground Water Exposition
March 20–21, 2026
Vancouver, WA
pnwgwa.org/

World Environmental & Water Resources Congress
April 26–29, 2026
Mobile, AL
www.ewricongress.org/

AWRA 2026 Geospatial Water Technology Conference
May 18–20, 2026
Niagara Falls, NY
www.awra.org/Members/Events_and_Education/Events/2026-Landing-Pages/01_GWTC/GWTC2026.aspx

UCOWR 2026
June 8–10, 2026
San Antonio, TX
ucowr.org/conference/



Lake Tahoe (photo by DRI Science).

Success and dedication to quality research have established DHS at DRI as the Nevada Water Resources Research Institute (NWRRI) under the Water Resources Research Act of 1984 (as amended). The continuing goals of NWRRI 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. The work conducted through the NWRRI program is funded through the National Institutes for Water Resources (NIWR), which is supported by the U.S. Geological Survey under Grant/Cooperative Agreement No. G21AP10578. DRI administratively houses and logistically supports the operations of NWRRI.

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