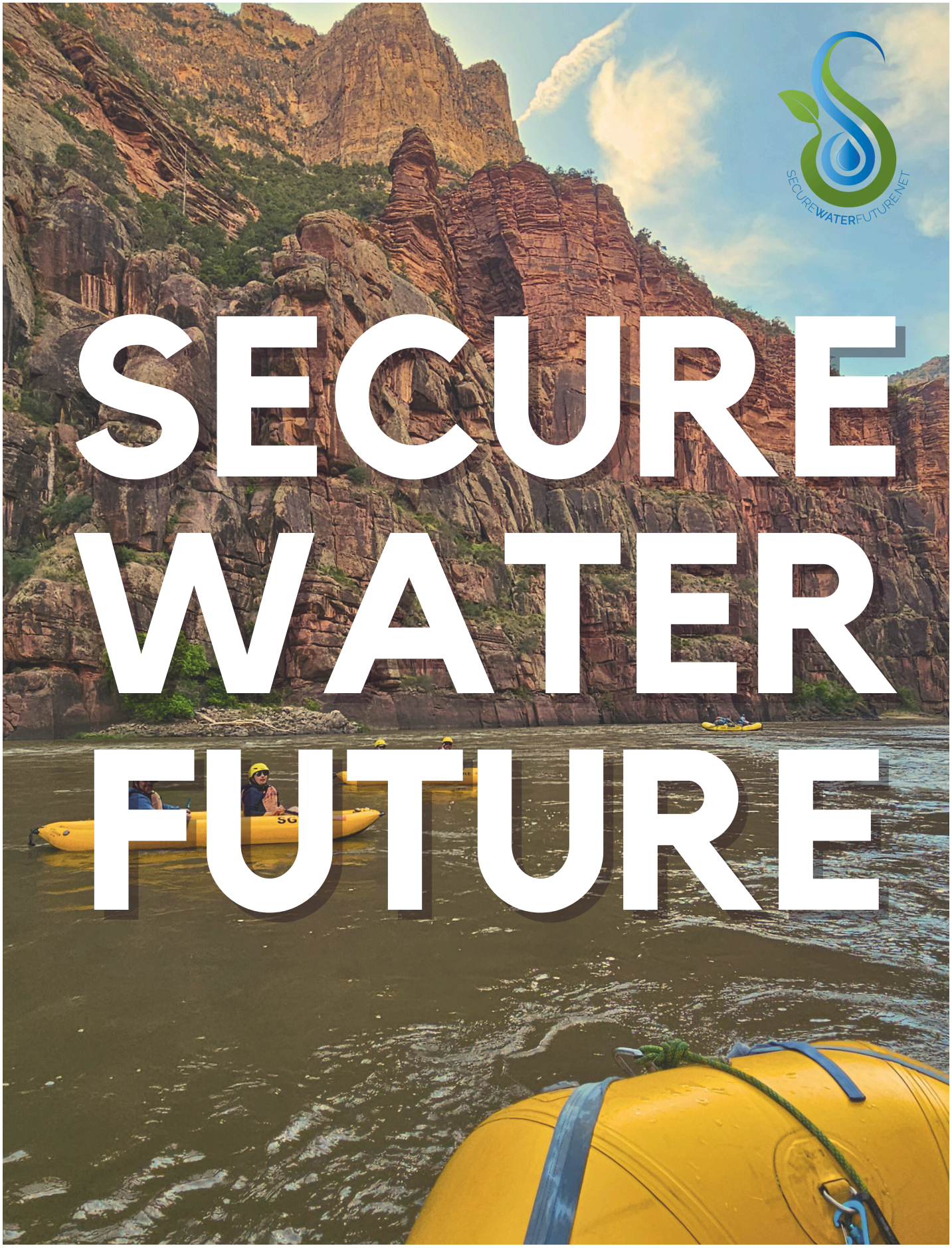


SECURE WATER FUTURE

YEAR FOUR & FIVE REPORT (2024-2026)



Super Soaker Water Academy students taking water samples on Lake Yosemite, 2025.



Upper Klamath Lake, 2026.



Participants of the Tulare State of the Basin Conference, 2025.

Securing a resilient water future for agriculture and ecosystems through innovation in measurement, management, and markets

USDA-NIFA Award No. 2021-69012-35916
USDA Award Date: September 1, 2021
Project Director: Dr. Joshua Viers, University of California, Merced

Partners: Utah State University; New Mexico State University; University of California, Davis; University of California, Berkeley; University of California Agriculture and Natural Resources; University of California, Los Angeles; Public Policy Institute of California; Environmental Defense Fund; USDA Southwest Climate Hub.

This document summarizes Secure Water Future (SWF) Year Four (2024-2025) and Year Five (2025-2026) SAS CAP project activities. This report was compiled with support from Erika Reynoso, Jack Severson, and Dr. Lauren Parker. We encourage you to follow our ongoing work at securewaterfuture.net.

This work is supported by Agriculture and Food Research Initiative Competitive Grant no. 2021-69012-35916 from the USDA National Institute of Food and Agriculture.



O'Shaughnessy Dam, 2025.



UC Water Academy at Yosemite National Park, 2025.

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Equipment at the UC Merced Experimental Smart Farm.



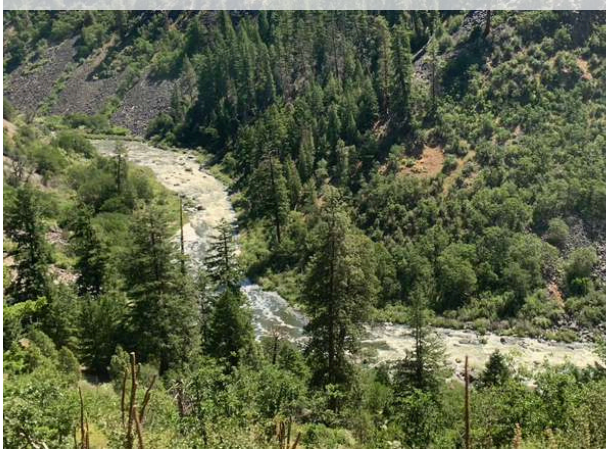
UC Water Academy students at UC Merced, 2025.



Students kayaking on Lake Yosemite during the Super Soaker Water Academy (SSWA), 2025.



Klamath River, UKU ELE, 2026.



Yelenka Nunez Bolano presenting a poster at the EDF / SWF State of the Science of Land Repurposing Workshop, 2026.

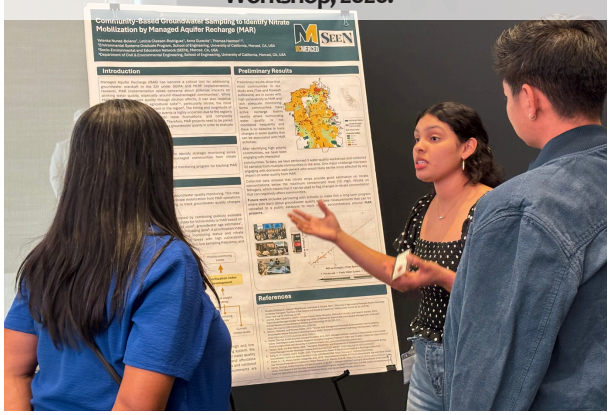


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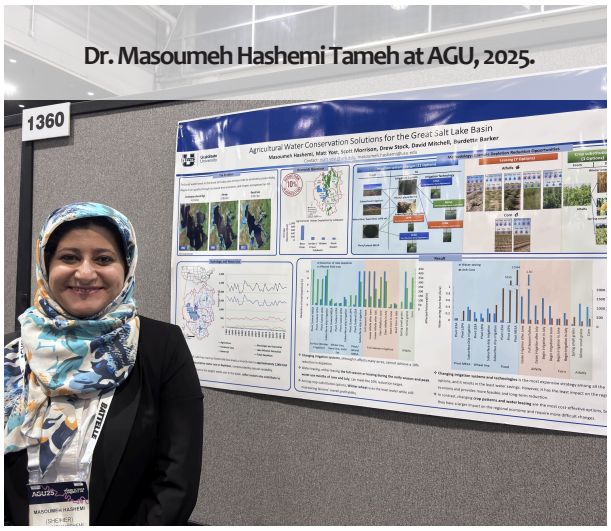
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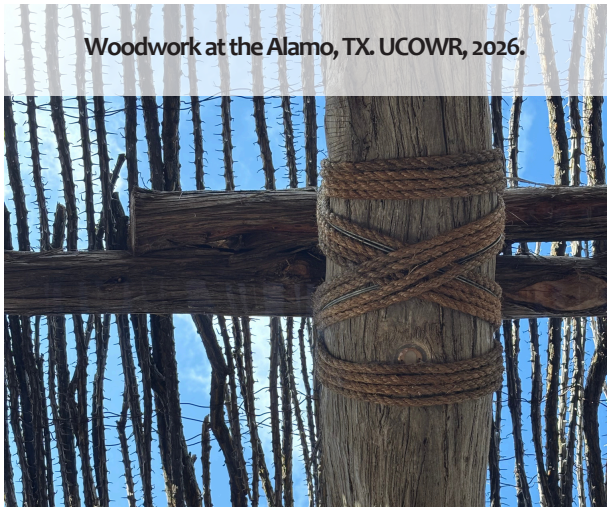
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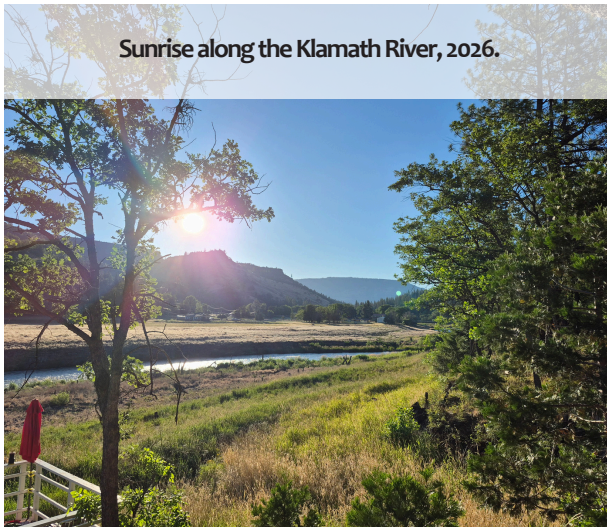
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Dr. John Abatzoglou presenting at the SNRI Speaker Series, 2026.

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PROJECT LEADERSHIP



JOSHUA VIERS, PH.D.

Project Director
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Dr. Joshua Viers is a Professor of Water Resources Management in the School of Engineering at UC Merced. He also serves as the Associate Vice Chancellor for Interdisciplinary Research and Strategic Initiatives in the Office of Research and Economic Development (ORED) where he supports the Vice Chancellor for Research, Innovation, and Economic Development. He has previously held positions as the Associate Dean for Research for the School of Engineering and campus Director of the Center for Information Technology Research in the Interest of Society (CITRIS). Josh has led UC Merced's efforts to build an Experimental Smart Farm, develop a joint industry-university consortium on ag-food-tech research, and convene several universities in developing water accounting methods to secure a climate-resilient water future. He teaches environmental engineering with a focus on water resources management, geospatial analytics, ecosystem restoration, and sustainability.



LAUREN PARKER, PH.D.

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Dr. Lauren Parker is the Managing Director of Secure Water Future and an Academic Coordinator at the Valley Institute for Sustainability, Technology, and Agriculture (VISTA) at UC Merced. Lauren brings both technical expertise in agricultural climatology and experience leading multidisciplinary decision-enabling projects to her role with SWF, including experience with stakeholder outreach, science communication, education, and team facilitation. Prior to joining UC Merced, Lauren was an applied climate scientist, research program manager, and program coordinator at the USDA California Climate Hub and a project scientist at UC Davis.



Participants of the SWF Experiential Learning Expedition hiking along the Yampa River, 2025.

WHAT IS SECURE WATER FUTURE?

Secure Water Future is a collaborative of investigators from across the semi-arid western US aiming to improve agricultural and environmental water resilience. To achieve resilience in western agriculture and ecosystems, we need better information and flexible institutions for our most precious resource—water.

Currently funded by the US Department of Agriculture, the team combines the expertise of researchers, extension specialists, and educators working across California, New Mexico, and Utah, with applicability to the western US and beyond.



Panel at the PPIC / SWF Research Priorities for California Water Policy convening, 2025.



Water-scarce regions in the western US need new management strategies to address extreme floods and drought, grow food for the country, and maintain healthy ecosystem function. The pressure of increased human population and footprint, increased frequency and severity of drought, and reliance on dwindling water sources for agriculture, environment, and communities has resulted in a disjointed system with limited flexibility. With community advisor participation and guidance at every step, this project creates improved strategies for water management, building resilience, adaptive capacity, understanding, and outcomes for data-driven decision-making among agricultural producers and water managers. The team includes experts in environmental and agricultural water use and information, modeling, institutional design, multidisciplinary research, education, and actionable outreach.



Finding Common Water, 2025.



SWF team members at the PPIC / SWF Research Priorities for California Water Policy convening, 2025.

Through three use cases (San Joaquin Valley, CA; Mesilla Valley, NM; Cache Valley, UT) with differing water laws but similar orchard and row crop agricultural systems, snow-fed water systems, and conjunctive use infrastructure, we synthesize opportunities to increase flexibility and water security in the semi-arid western US.

With comparatively low infrastructure costs and a short time to develop, iterate, and deliver, this project investigates and develops data-driven decision-making tools and institutional design recommendations based on improvements in water markets, management, and measurement practices to achieve water security. Innovative water markets offer flexibility in management, especially when supported by timely, transparent, and accurate water use and information and scaled climate data in trading locations. Leveraging advances in measurement technologies, from sensors to instrumentation and information, and assembling existing water and climate information data platforms facilitates participation in novel water management strategies and water markets.

By coupling hydro-economic and life-cycle assessments with water accounting and regional climate projections, the project's goal is to evaluate and enable water trading for resilient agricultural and ecological systems in the Southwestern US.

SWF TEAM STRUCTURE

Team Organization

There are more than 80 members of the Secure Water Future team. These project affiliates represent various career stages, from full professors and vice presidents of organizations to undergraduate students. Members of the Secure Water Future team focus on issues relevant to California, Utah, and New Mexico, with applicability to the semi-arid western US.

SWF Teams

There are seven distinct teams within Secure Water Future, each tackling different challenges and simultaneously working together: Data Integration, Markets, Management, Measurement, Extension, and Education.

Ad Hoc Groups

2025 SWF ELE cohort, 2026 UKU ELE cohort, and the 2025 UC Water Academy cohort.

Leveraged Projects*

AgAID (Viers, Medellin, Abatzoglou, Bernacchi, Parker);
CDFA Drought and Flood Impact Study (Medellin, Escriva-Bou, Abatzoglou, Viers);
California Energy Commission FlowPywr (Viers, Abatzoglou, Parker);
EPA EAR (Kiparsky, Dahlke, Green Nylen, Bruce, Bruno);
UCOP LACA (Harmon, Naughton, Viers);
EDA F3 (Viers, Bernacchi);
River Partners Grayson Restoration (Viers, Hestir);
NASA – Point Blue (Hestir, Viers);
Extension Sorghum Project (Hestir, Viers)

*These are projects that were cross-indexed with more than one co-investigator. Leveraged projects illustrate the network of intersecting work of collaborators.



Dr. Joshua Viers presenting at the EDF / SWF State of the Science of Land Repurposing Workshop, 2025.



Dr. John Williams discussing wildfire ecology along the Tuolumne River, 2025.



Super Soaker Water Academy (SSWA) participant kayaking on Lake Yosemite, 2025.

TARGET AUDIENCE

Growers and Communities in Specific Agroecological Systems

While our case studies primarily revolve around three locations – San Joaquin Valley, CA; Mesilla Valley, NM; and Cache Valley, UT – the implications of our work go beyond these specific regions. These sites represent water-stressed, snow-fed, conjunctive-use agroecological systems. By studying them, we aim to develop solutions that can be applied to similar regions in the U.S. and globally, broadening our audience to agricultural producers and ecosystem managers across the country and around the world.



UCWA students studying benthic freshwater sensitivities, 2025.

Agricultural Community Advisors

Growers, irrigation districts, and water managers constitute a major segment of our audience. Our findings aim to equip them with tools and strategies to optimize water use while ensuring the durability of their agricultural practices.

Ecosystem Managers

Those responsible for preserving and nurturing diverse ecosystems can benefit from our research, resilience strategies, and insights into durable water resource management.

Policy Makers

We have collaborated with governmental officials to ensure that our work is accessible to those who are creating and implementing policies.

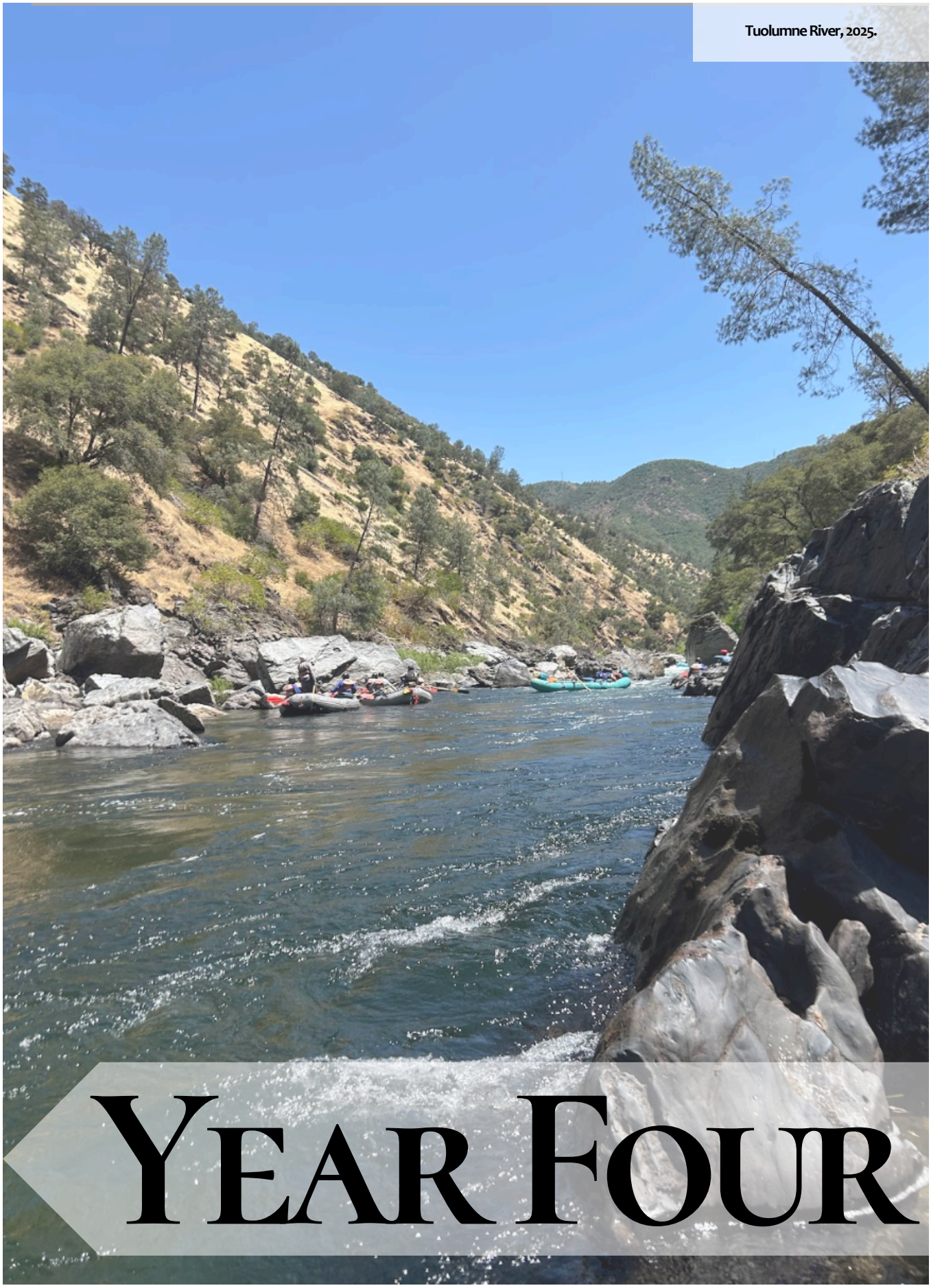
Students

As the next generation of thinkers, innovators, and leaders, students are pivotal to driving change. We have prioritized their inclusion, offering them hands-on learning opportunities, internships, and experiential educational programs.

Academics

We engaged with scholars and researchers in water resources, community engagement, and agricultural sciences. Our research findings are designed to add value to the ongoing discourse in these academic circles, offering data-driven solutions and insights.


SWF/EDF - ProYouth Career Day, 2026.



Tuolumne River, 2025.

Year Four

YEAR FOUR

Project Management

- Maintained project infrastructure to facilitate synergy across the four primary research teams, as well as the Education and Extension teams.
- Strengthened the internal reporting dashboard to track activity over the entire duration of the project.
- Utilized a variety of resources and events to increase cohesion throughout the team.

Research

- Held an in-person collaborative meeting to facilitate team cohesion.
- Contributed to the broader data repository for the project.
- Published multiple academic journal articles on the project's research thrusts.
- Convened water regulators and community advisors from California, New Mexico, and Utah to discuss water measurement and reporting needs for water markets.

Extension & Outreach

- Supported the development of a remote-sensed water balance model to improve water management for Utah canal companies.
- NMSU's Learning Games Lab and the SWF team published Cozy River Valley, a data-driven educational game that builds problem-solving skills for water resource management.
- SWF team at USU hosted a field trip to Cutler Reservoir to discuss regional water management challenges.
- Published the Land Repurposing Research Round-Up to share recent research, insights, and resources with land repurposing practitioners and stakeholders.

Education

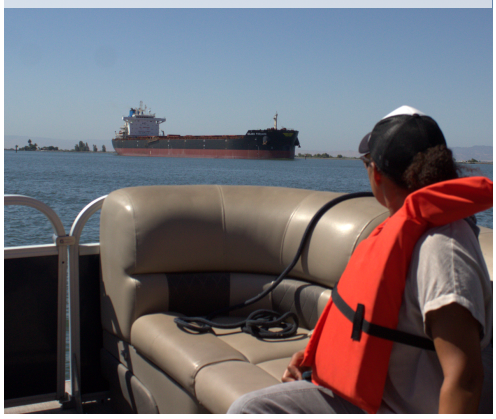
- Hosted the 4th iteration of the Secure Water Future Experiential Learning Expedition (SWF ELE) on the Yampa River for affiliated graduate students.
- Co-hosted the Super Soaker Water Academy (SSWA) summer camp, introducing local middle school students to STEM topics with a focus on water at UC Merced.
- SWF team led a cohort of 10 students for the UC Water Academy in California.
- CAIP program continued to engage with undergraduate students at USU in its third year. Students created and produced a YouTube channel, highlighting SWF research.

SELECTED ACCOMPLISHMENTS

SWF ELE participant, Moises Duran (USU), at CSU's Agricultural Experiment Station, 2025.



Touring the San Joaquin/Sacramento River Delta, UCWA, 2025.



The Secure Water Future team's goal is to understand, enable, and envision data-enabled water management strategies for decision-making in agricultural and ecological systems. The multidisciplinary team works with growers, irrigation districts, and ecosystem managers to adopt and adapt resilient strategies, train the next generation of multidisciplinary practitioners and researchers, and produce resources for data-driven decision-making.

RESEARCH

DATA INTEGRATION



PPIC / SWF Research Priorities for California Water Policy convening, 2025.

Our Data Integration research team aims to improve the use of actionable information on current water use, seasonal forecasts, and future projections to inform data-driven decisions made by community advisors.

In Year Four, the Data Integration research team consolidated its efforts on current water use, seasonal forecasts, and model projections.

By using information captured in the multi-state needs assessment in Year One, the Data Integration team continues to refine their water data decisions dashboard and engage in semi-structured narrative interviews with notable community advisors to pursue further development. Simultaneously, the group continues to analyze existing tools and support the other research teams in a consultatory and collaborative fashion.

MARKETS



Groundwater RoundTable workshop hosted by Dr. Ellen Bruno, 2025.

The Markets team continues to examine the institutional contexts and individual decisions that shape the potential for water markets to support agriculture, ecosystems, and communities. Over the past year, the Markets team engaged with stakeholders, synthesized the literature, developed and tested an interactive online tool, analyzed historical data, and conducted scenario analyses with case studies spanning regions across the American Southwest.

One of the team's major accomplishments is a report that offers recommendations for improving the information landscape to support fair and effective water markets that was based on a convening of water experts from NM, CA, and UT held in the prior year. In other work, empirically examining the outcomes of the Mojave Basin groundwater market in CA, the team found that the market, which has featured active trading for over 25 years, led to mild consolidation of water rights while simultaneously stabilizing aquifer levels and generating large economic gains for market participants. In a third example, immersive online collaborative modeling sessions of water banking in Utah suggested that water banking could lead to a win-win outcome where agricultural users retain their water rights, generate income, continue farming, and support environmental needs such as deliveries to Great Salt Lake.

The Markets team's research –which is being accomplished through multiple simultaneous projects that deploy varied methods and span several disciplines– informs the design, adoption, and effectiveness of water markets. The team is finding that water markets have the potential to support agriculture and ecosystems, and with effective market design, can effectively manage impacts on third parties. In Year Five, the Markets team's focus will shift more toward publishing and communicating research findings.

MANAGEMENT



EDF / SWF State of the Science of Land Repurposing Workshop, 2024.



CIWR / SWF: Land and Water Management Transitions Workshop field trip at Dos Rios State Park, 2025.

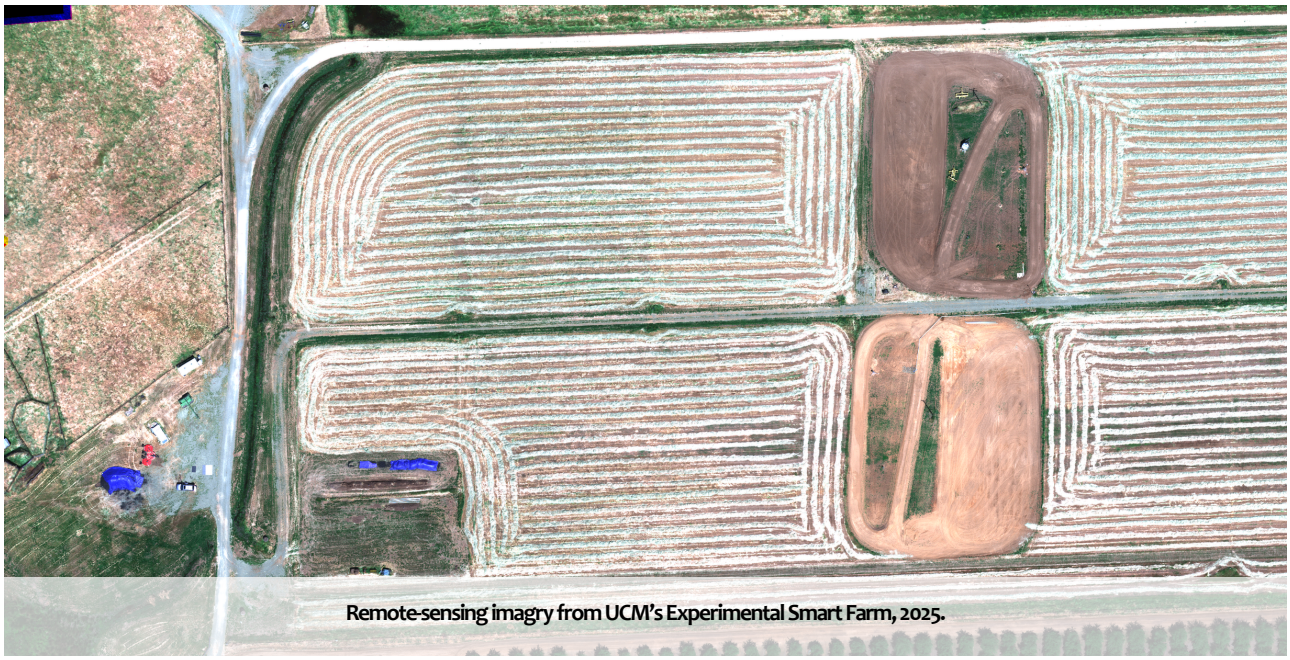
In Year Four, the Management research team continued to center their efforts on long-term water resources variability in the southwestern United States using three key basins, California's San Joaquin Valley, New Mexico's Mesilla Valley, and Utah's Great Salt Lake Basin. The focus was determining dominant controls on water resources variability to evaluate environmental, management, and policy approaches for sustainable management in future years.

Researchers used a water balance approach to assess long-term changes in water availability and water demand, identifying approaches for compromise and shared multi-benefit water use.

A complementary effort in Year Three evaluated novel water management strategies (e.g. aquifer recharge and water banking) to secure water for beneficial uses during prolonged drought conditions. By analyzing different water budget components in the aforementioned basins, the team gained a better understanding of management and water resources available to troubleshoot through drought conditions.

Additional factors that impact total water supply resources were also investigated. Analyzing the variability of meteorological patterns and examining historical trends in agricultural water demand in relation to hydroclimate, drought, population, and land use in these three regions support the identification of approaches for compromise and multi-benefit water use in the 21st century.

MEASUREMENT



Remote-sensing imagry from UCM's Experimental Smart Farm, 2025.

During Year Four, the Measurement Team made significant progress toward improving the accuracy of agricultural water budgets and translating measurement approaches into practical tools for water management across the Secure Water Future study regions. In Utah, the team advanced remote-sensing-based water balance analyses and strengthened collaboration with state water officials, including efforts to transfer and scale methodologies developed for assessing water use in northern Utah canal companies. This work included training and engagement with Utah water officials and contributed to a Measurement Infrastructure Gap Analysis for the Great Salt Lake Basin.

In New Mexico, the team completed major research on agricultural water use and irrigation management in the Mesilla Valley in collaboration with UC Merced. A peer-reviewed life cycle assessment of in-shell pecan production, the first of its kind, quantified the water, energy, and emissions implications of drip and flood irrigation. A complementary study demonstrated that hybrid drip–flood irrigation can maintain crop water productivity while increasing deep percolation needed for aquifer recharge. Together, these efforts strengthened the scientific basis for evaluating irrigation efficiency, groundwater recharge, and agricultural sustainability in arid regions and provided findings that can support growers, water managers, and future groundwater modeling.

The team also actively disseminated its work through peer-reviewed publications, conference presentations, workshops, and direct engagement with water managers. These activities included presenting agricultural water conservation and water-balance methods using GIS and remote sensing, sharing the pecan life cycle assessment, irrigation and evapotranspiration research with scientific and grower audiences, and engaging Utah agencies interested in incorporating the team's water-balance approach into their operations.



Participants of the SWF ELE program at the Shoshone Power Plant, 2025.



Participants of the SWF ELE program at Colorado State University's Agricultural Experiment Station in Orchard Mesa, CO, 2025.

SWF graduate student Kira Waldman at the International Symposium on River Science, 2025.



EDF / SWF State of the Science of Land Repurposing Workshop, 2024.



Secure Water Future had a strong presence at numerous conferences throughout Year Four of the project, including AGU, the PPIC / SWF Research Priorities for California Water Policy convening, and the 59th Annual Pecan Growers Conference. Additionally, the team hosted several workshops and panels. These events offered invaluable opportunities to highlight SWF deliverables and present work from the project's first four years.

CONFERENCES

CHARTING THE WAY FORWARD WORKSHOP



Dr. Joshua Viers moderating a panel discussion with San Joaquin Valley farmers, 2025.

On July 1, 2025, Dr. Joshua Viers kicked off a session at the UC Merced Symposium for Regenerative Agriculture about UC Merced and AES faculty engagement in regenerative agriculture research and education, followed by a panel of San Joaquin Valley farmers. Second-generation rancher and entrepreneur Rizaph Bellard shared her experience utilizing regenerative agriculture and raising grass-fed beef in Fresno. Rosie Burrough spoke about the links between regenerative agriculture, biodiversity, and human health. Another speaker, Joe L. Del Bosque, is a farmer in Firebaugh who shared his experience implementing reduced till, pollinator-friendly hedgerows, and water efficient irrigation systems. Almond farmer Amrik Singh Basra advocated for agricultural water allocation. A fourth generation farmer and chairman of the California Cotton Growers and Ginners Association, Gary Martin, described his regenerative practices growing conventional cotton with minimum tillage. Arshdeep Singh, a citrus grower from Fresno, is a strong advocate for small-scale family farming. While he praised California Department of Food and Agriculture's Healthy Soils Program in advancing regenerative agriculture, he pointed out that infrastructure around the program creates obstacles for farms that are worsened through compost application amounts and costs. John Warmerdam described how he began practicing regenerative agriculture and his experience using less chemicals despite there being no premium for his fruits. The Q&A session sparked conservation regarding marketing regenerative produce, using regenerative strategies, farmers borrowing challenges, and supporting local growers.



From left to right: John Warmerdam, Amrik Singh Basra, Rizpah Bellard, Joe Del Bosque, Rosie Burroughs, Arshdeep Singh and Gary Martin.

59TH ANNUAL PECAN GROWERS CONFERENCE

WHO WAS INVOLVED?

The 59th annual Western Pecan Growers Association (WPGA) Conference was held March 2-4, 2025. Dr. Richard Heerema served as coordinator for the educational program for this event. Turnout and interest for the conference were strong despite economic uncertainties facing the industry.



Jamin Miller (NMSU) presenting at the 59th annual Western Pecan Growers Association (WPGA) Conference, 2025.

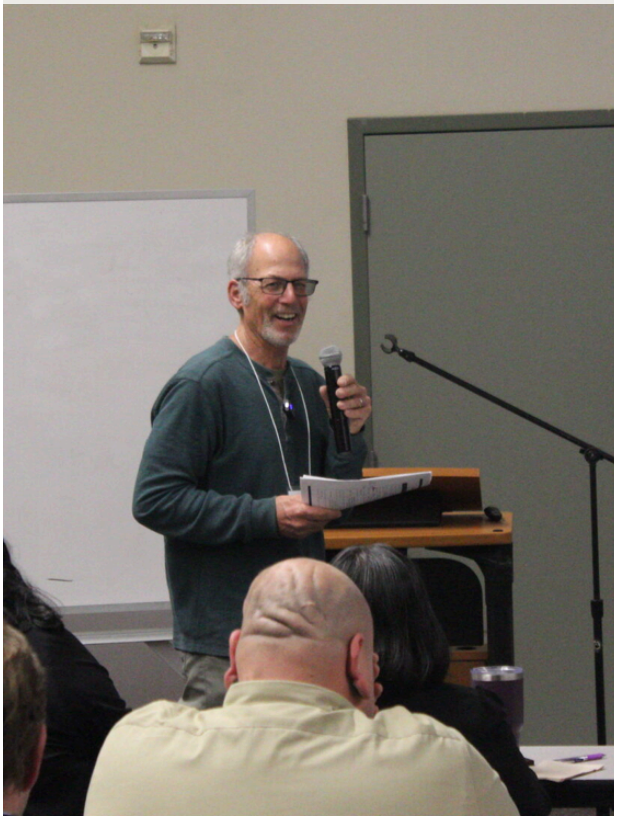
Several prominent SWF-related extension and outreach activities took place at this year's conference. On Monday morning, Dr. Salim Bawazir gave an oral presentation about SWF-funded research that showed strong correlations between evapotranspiration (ET) estimates made by the ensemble of the six models used by the freely available online OpenET platform and measured ET using the "gold-standard" eddy covariance method. The data for this work were previously published in the Journal of Remote Sensing (Tawalbeh et al., 2024) and created confidence in the validity of the OpenET data for pecan growers. Dr. Bawazir's presentation was immediately followed by a how-to presentation by SWF-funded Master's student, Jamin Miller (advisor Dr. Richard Heerema). Jamin went online to show the growers step-by-step how to navigate the website and find the estimated ET data for their own pecan orchards for different time ranges.

TULARE - STATE OF THE BASIN CONFERENCE

WHAT IS THE STATE OF THE TULARE BASIN CONFERENCE?

The SWF team co-hosted the 3rd annual State of the Tulare Basin Conference, bringing together stakeholders across the Tulare Basin of California to discuss challenges and solutions to water management in the region. The State of the Basin conference in November 2024 addressed the challenges and opportunities faced by the Tulare Basin. The purpose of the conference was to develop and implement integrated, inclusive, and innovative solutions to advance water resilience and advance ecosystems.

Larry Saslaw speaking at the State of the Tulare Basin Conference, 2024.





Tekoah Kadara, Executive Director of Allensworth Progressive Association, presenting at the State of the Basin Conference, 2024.

THE CONVERSATION & THEMES

The conference, under the theme, "The Past, Present, and Future: Building Upon Our Legacy – Looking Forward Seven Generations," highlighted the region's rich history. The theme emphasized a holistic, watershed-based approach to building resilience across social, economic, and environmental sectors. The event fostered collaboration among diverse leaders and experts, focusing on lessons learned from recurring floods and droughts to guide future water management strategies.

PPIC / SWF RESEARCH PRIORITIES FOR CALIFORNIA WATER POLICY CONVENING

PURPOSE OF THE PPIC / SWF CONVENING

The Public Policy Institute of California Water Policy Center, in partnership with UC Merced and Secure Water Future, hosted a gathering with the PPIC research network, experts, and policy partners to support California water policy and fill priority gaps. The group was tasked with evaluating the state of the research in California with the goal of recommending research priorities that could be helpful to decision makers. These discussions were driven by the increasing concern about federal agency support, data reliability, and the potential need for the state to backfill critical research support and services.

OUTCOMES FROM THE CONVENING

Participants examined research priorities for topics being addressed by the Secure Water Future project, including: building agricultural resilience, improving environmental management, updating water resource management strategies and improving the use of markets to manage water demand. The participants offered many recommendations that were distilled into three focus areas: Accounting for water, paying for water, and building resilient communities. At the end, participants examined institutional challenges in implementing these priorities.

Drs. Kimberly Gibson, Joshua Viers, and Lauren Parker at the PPIC / SWF Research Priorities for California Water Policy convening, 2025.



CIWR / SWF LAND AND WATER MANAGEMENT TRANSITIONS WORKSHOP



CIWR / SWF: Land and Water Management Transitions Workshop, 2024.



CIWR / SWF: Land and Water Management Transitions field trip at Dos Rios State Park, 2024.

WHAT WAS THE FOCUS OF THE WORKSHOP?

On October 16-17, 2024, the California Institute for Water Resources (CIWR) and Secure Water Future (SWF) hosted a workshop focused on research and policy needs for integrated land and water management transitions in the Central Valley. This event brought together researchers, practitioners, and community partners from universities, agencies, non-profits, and communities.

During the workshop, community and agency leaders spoke about the challenges faced in planning for land use transitions under the Sustainable Groundwater Management Act (SGMA). Participants had opportunities to learn about restoration and integrated land management practices, as well as experience them in person while attending a tour of Dos Rios State Park hosted by River Partners.

This workshop was designed to be complementary to the 2024 EDF / SWF State of the Science of Land Repurposing Workshop. Both workshops focused on land repurposing programs in California, addressing research needs and priorities as we near the implementation of the Sustainable Groundwater Management Act (SGMA).

EDF / SWF STATE OF THE SCIENCE OF LAND REPURPOSING WORKSHOP

THE STATE OF THE SCIENCE OF LAND REPURPOSING WORKSHOP

On October 28-29, 2024, EDF and SWF co-hosted the EDF / SWF State of the Science of Land Repurposing Workshop at UC Merced. The event brought together a diverse group of experts, including several SWF faculty, from fields such as ecology, economics, agriculture, hydrology, soil science, policy, social science, and engineering. Participants engaged in interdisciplinary discussions on the challenges and opportunities of land repurposing, including topics like stakeholder collaboration, land repurposing options, monitoring, and economic incentives.

Participants at the EDF / SWF State of the Science of Land Repurposing Workshop, 2024.





Dr. Lauren Parker engaging at the EDF / SWF State of the Science of Land Repurposing Workshop, 2024.

WHAT TRANSPIRED IN THE DIALOGUE?

The EDF team provided key insights on the progress made in land repurposing in California and how research is supporting these efforts. A key objective of the workshop was to foster a community that can work collaboratively and address research needs arising from the implementation of the Multibenefit Land Repurposing Program (MLRP) in California. The outcomes of the workshop included the development of a white paper that summarized critical research gaps and the creation of an interdisciplinary network to support land repurposing efforts, ensuring that the best available science can inform MLRP implementation efforts.

CSU Experimental Ag Station, 2025.



Super Soaker Water Academy participants getting experience with drones in the classroom, 2025.



Extension provides educational resources and assistance to individuals and communities in various fields. To develop and implement a multifaceted Extension program that looks at the changing knowledge, behavior, and attitudes toward securing a resilient water future for agriculture and ecosystems, the Extension team engages in field days and assists with regional conferences with thought partners.

EXTENSION

EXTENSION

Bear River, Utah., 2025.



Hadia Akbar speaking at the Cutler Dam tour, Utah, 2025.



In Year Four, the Extension team continued its mission to translate Secure Water Future's research into practical tools, educational resources, and stakeholder engagement opportunities that advance data-informed water management. Building on previous years, the team expanded its reach through workshops, public events, digital media, and decision-support tools designed to connect research with practitioners, educators, policymakers, and local communities.

Throughout the year, the Extension team convened diverse audiences through regional workshops and stakeholder events, including a field tour at Cutler Reservoir that brought together more than 45 farmers, ranchers, policymakers, practitioners, researchers, and students. The team developed a remote-sensed water balance model to support Utah canal companies; published Cozy River Valley, a data-driven educational game that enhances undergraduate learning in water resource management; and produced educational videos on topics such as rock glaciers and declining western snowpack.

SWF Extension team members continued to foster collaboration across the land repurposing community through the Land Repurposing Research Round-Up speaker series, supporting knowledge exchange through policy workshops, public lectures, podcasts, and additional programming that broadened the impact of Secure Water Future research.

UTAH STATE UNIVERSITY RESEARCH GETTING WATER TO THE GREAT SALT LAKE

Participants of the Cutler Dam Field trip, 2025.



KEY INSIGHTS

1. Farmers shared how water-saving practices can conserve water.

2. The immersive modeling session highlighted that simply releasing water to the lake comes with more issues than anticipated due to multiple competing users and seasonal diversions.

3. Water banking was explored as a solution to reduce losses during seasonal diversions.

4. While work is currently focused in the Cache Valley, future work will continue across Bear River Basin.

PURPOSE

Utah State University hosted a field event at the Cutler Dam on the Bear River, the largest tributary to the Great Salt Lake. The event brought together farmers, political officials, and researchers to discuss water management solutions. The event gave participants the opportunity to explore better ways of allocating water to the Great Salt Lake through immersive modeling. The Great Salt Lake reached a record low in 2022 due to water diversions, drought, and changing weather patterns, threatening Utah's ecology. Water levels continue to decline, making water conservation efforts increasingly important.

USU Immersive Modeling session, Cutler Dam, 2025.



IMMERSIVE MODELING SESSIONS

WHAT ARE IMMERSIVE MODELING SESSIONS?

Twenty-nine collaborators participated in four immersive modeling sessions where they personified agriculture, urban, and ecosystems users for a water bank. Each collaborator articulated a strategy for their user to consume and bank water. The users negotiated prices with the bank and then adapted their strategies based on the availability of water. At the end of the discussion, collaborators were asked what new insights they had and how to improve water banking and its representation in a model.





SWF Members leading the sessions: Dr. David Rosenberg and Hadia Akbar

Immersive Modeling session participants collaborating on water strategies, 2025.



KEY RESULTS

- Collaborators who personified agricultural users demonstrated diverse strategies to balance profits and resilience.
- Collaborators shifted to less water-intensive crops, such as wheat, during dry years.

NEW INSIGHTS

- The agricultural sector has intensive water needs which require long-term goals beyond economic optimization.
- Structures of Water-Banking
  - Arbitrage - bank negotiates prices
  - Water Markets - direct user to user trading
  - Steady Sell and Purchase Price - yearly sales
  - Reverse Option Market - bank sells to highest bidder

SWF GAME DEVELOPMENT

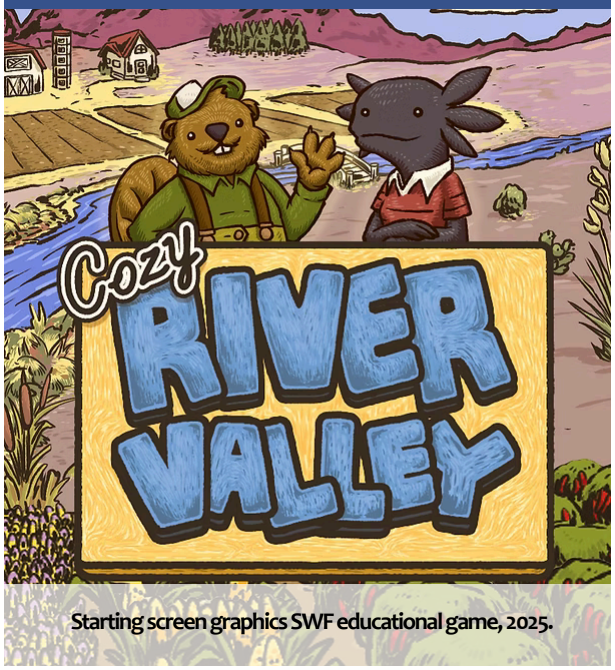
WHAT IS THE SWF GAME?

In Year Four, the New Mexico State University Learning Games Lab published Cozy River Valley, a strategy-based game that addresses topics such as:

- Balancing farm/aquifer performance
- Decision-making during dry years
- Crop water demand

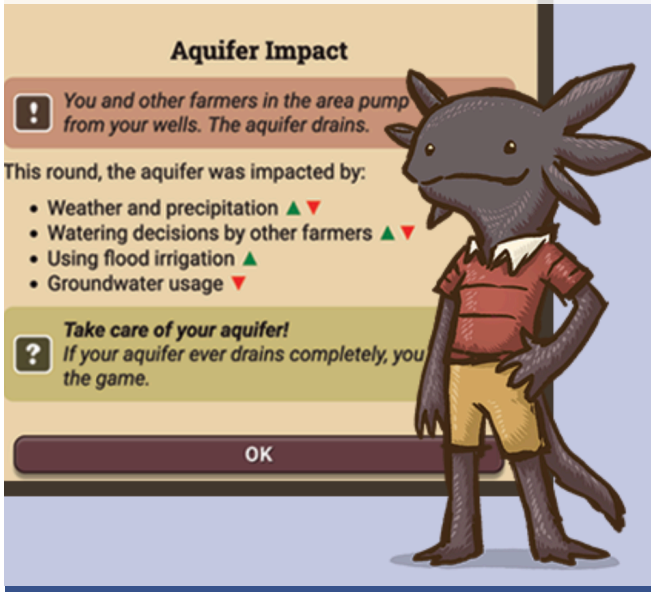
Educational aspects of the game that were incorporated into the game include:

- Conceptual understanding of water use in agriculture
- Managing agricultural production
- Impacts of using surface water versus groundwater



Starting screen graphics SWF educational game, 2025.

NMSU Learning Games Lab, Cozy River Valley.



THE TEAM BEHIND THE GAME

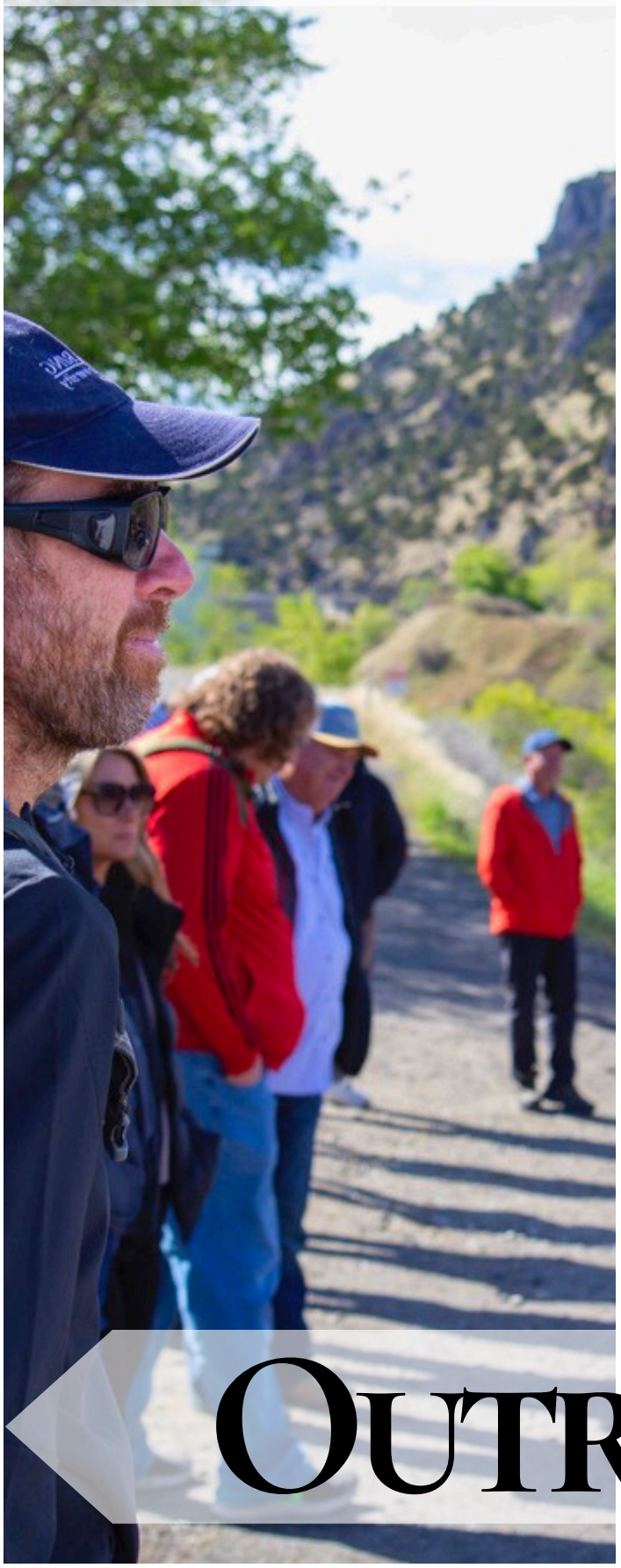
The Secure Water Future Extension team, based at New Mexico State University's Learning Games Lab, created Cozy River Valley with the aim to produce educational media for all ages. Amy Muise, Editor and Program Manager for the Learning Games Lab, and Dr. Barbara Chaimberlain, Director of the Learning Games Lab, have been overseeing the production and timeline of the water game's development.

The game is a key focus for the SWF Extension team, drawing upon research from SWF graduate students across the project's scope. The purpose of the interactive gameplay is to highlight surface water and groundwater use in relation to agriculture in the West.



SWF ELE, Yampa River canyon, 2025.

Participants of the Cutler Dam field trip, 2025.





International Symposium on River Science, 2025.

Outreach involves intentional efforts to deliver information, resources, and essential services to individuals who might not otherwise have access. This includes actively engaging with communities to raise awareness, share knowledge, and offer support. Outreach is vital for bridging access gaps and ensuring that all community members benefit from available resources and services. Through outreach, SWF aims to raise awareness, disseminate knowledge, and provide support to community members in their efforts to secure a resilient future.

OUTREACH

EDF / SWF: 2025 PROYOUTH OUTDOOR-CAREER DAY



ProYouth Outdoor-Career Day participants on the Kaweah River, 2025.

OUTDOOR CAREER DAY

Students from Sequoia High School participated in an immersive rafting experience on the Kaweah River, exploring river ecology through environmental DNA (eDNA) sampling, and engaged directly with university students and water professionals. These activities encouraged curiosity, built confidence in outdoor settings, and demonstrated how science, leadership, and community engagement intersect to address complex water challenges. The experience emphasized that effective water leadership grows from collaboration, stewardship, and a strong connection to place.

OBJECTIVES

The day centered on empowering the next generation of water leaders through mentorship, experiential learning, and meaningful connections to local rivers and communities. Secure Water Future and Environmental Defense Fund (EDF) partnered with Destiny Montes at ProYouth to organize a day introducing local high school students to water science, environmental stewardship, and the many career pathways available in the water sector. By combining hands-on field experiences with conversations from scientists, educators, and community leaders, students gained a deeper understanding of both the challenges facing California's water resources and the opportunities they have to make a difference.

FINDING COMMON WATER

WHAT IS FINDING COMMON WATER?

Finding Common Water (FCW) is a multi-day river trip organized by UC Merced and the Environmental Defense Fund (EDF) and supported by State Water Contractors (SWC). While the history of water management in California is known for conflict, FCW aims to flip the narrative and help participants find "common water." Participants were instructed to come to the trip as representatives of themselves and not their workplace. This approach is used to encourage dialogue and collaboration on many of California's pressing water issues.

Finding Common Water Team preparing for the rafting trip on the Tuolumne River, 2025.





Finding Common Water participants exercising creativity on the Tuolumne River, 2025.

PARTICIPANT REFLECTIONS

"The River doesn't care what you do, or who you are. You are just another person."

- Austin Stevenot, director of Tribal Engagement at River Partners and member of the Northern Sierra Mewuk Tribe said this realization helped him connect with others on this trip and planned to bring more Tribal people in the future so policymakers can see Tribal Stories firsthand.

"This collaborative mindset might not dominate yet, but it feels like the tide is turning."

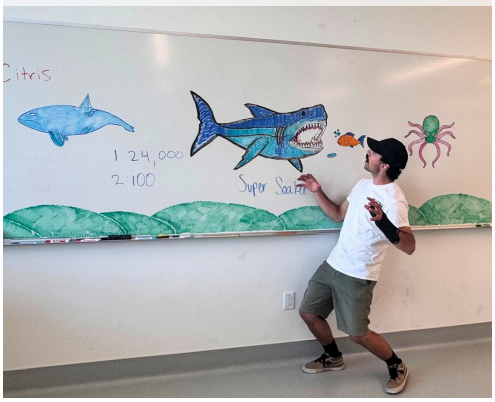
- Jessi Snyder, from Self-Help Enterprises, shared how the most valuable part of the trip was networking with people from government agencies, which helped her think about innovative projects she is working on.

UCWA participants hiking along the upper Tuolumne River, 2025.



EDUCATION

Even the mentors have fun at the Super Soaker Water Academy, 2025.



“You can’t learn about water without getting wet.”

The Secure Water Future educational catalogue coalesces around the basic premise that “You can’t learn about water without getting wet.” The Education team invites students from K-12 through college and graduate school to dive into our programming. Through experiential learning exercises, the Education team illustrates the impacts and the potential for technological and management solutions to improve future water security.

SUPER SOAKER WATER ACADEMY

WHAT IS THE SUPER SOAKER WATER ACADEMY?

The Super Soaker Water Academy (SSWA) is a week-long interactive program for middle school students. The program is part of the CalTeach Bobcat Summer Stem Academy and teaches students about water systems in California. Topics include how water is stored, managed, and used. Students connect what they learn to topics in agriculture, water quality, and advancing the adoption of new technologies.

The program is organized by Secure Water Future and CalTeach, offering a combination of classroom instruction and field-based activities.

HIGHLIGHTS OF THE SSWA

During the week of July 14-18 in 2025, 11 middle school students from California's Central Valley constructed soil moisture sensors to study evaporation, transpiration, and evapotranspiration. Students also took kayaks onto Lake Yosemite to gather water quality samples, later analyzing them under microscopes in CalTeach Labs. In addition, the academy featured activities like building soil profile models to examine groundwater contamination and learning to fly drones with support from CITRIS student staff.

SWF Super Soaker Water Academy participants and mentors kayaking on Lake Yosemite, 2025.



UC WATER ACADEMY

UC Water Academy at camp on the Tuolumne River, 2025.



WHAT IS THE UC WATER ACADEMY?

The UC Water Academy (UCWA) is a week-long experiential learning program that equips graduate students with a deeper understanding of California water resource management. The program addresses multiple topics and evolving challenges through immersive field experiences and hands-on training that prepares students to effectively communicate complex water issues to a wide range of audiences.

UC Water Academy touring O'Shaughnessy Dam, 2025.



HIGHLIGHTS FROM UCWA

Over the week of August 9-15, 2025 SWF team members facilitated the UCWA field experience. SWF hosted nine undergraduate/graduate students, peer leaders, and eight mentors on a week-long tour following the Tuolumne River. The group engaged with professionals, community advisors, and mentors through site visits, structured discussion time, and a three-day rafting trip that offers space for formal/informal collaboration.

UCWA students studying benthic freshwater sensitivities, 2025.



KEY TAKEAWAYS

The UCWA program provides students with a holistic view of water resources management and varying stakeholder priorities on agriculture and ecosystems. The program also provides networking opportunities with peers, researchers, and professionals interested in sustainable water management.

SECURE WATER FUTURE EXPERIENTIAL LEARNING EXPEDITION

WHAT IS SWF ELE?

Secure Water Future's Experiential Learning Expedition (SWF ELE) hosted eight graduate students from our partner institutions on a week-long immersive learning experience. Students traveled by van and raft, accompanied by faculty, water management mentors, and professionals to experience the semi-arid Western US and its water first-hand. Site visits enabled a deeper understanding of agricultural & natural resources, infrastructure. This experiential learning program immerses students into current concepts and knowledge related to water use, imparting them with an immersive education that prepares these future water leaders for their future careers. Our Experiential Learning Expedition is based on successful educational models, including the UC Water Academy and the Super Soaker Water Academy.



SWF ELE cohort, 2025.

TOPICS COVERED

In 2025, SWF ELE engagement covered:

- Hydroclimatic conditions
- Surface water, including headwaters and monitoring stations, reservoirs, and rivers
- Agricultural management
- Environmental water management
- Reconciling agriculture and ecosystems
  - Current and alternative land uses and multi-benefit land use
- Regulated vs. unregulated river systems

SWF ELE participants paddling the Yampa River, 2025.



OUTCOMES

Through the program, graduate students cultivated a greater understanding of Southwestern water challenges and solutions, developed connections to their research, and built a strong network with fellow researchers. Students published a collaborative, commentary-style paper that addressed the role of these experiential learning programs in fostering well-rounded and effective water leaders.

SECURE WATER FUTURE EXPERIENTIAL LEARNING EXPEDITION

Student cohort and mentors on the final day of rafting with the SWF ELE, 2025.



STUDENT RESPONSES

" I loved the opportunity to connect with such a brilliant, generous, insightful, hilarious, and kind group of students from different universities, similarly committed to addressing water in the West. Thank you for the opportunity to join this year's [SWF ELE] cohort and for bringing together such a stellar group of both students and mentors."

"The combination of place-based site visits with recreation and reflection created the perfect rhythm. It felt like a well-designed watershed: the headwaters were our knowledge-building moments, visits with farmers, tribal representatives, and district staff, and the rafting and community time were the downstream reaches, where all that energy and insight braided together and carried us forward."

WORDS FROM OUR MENTORS

"Having the opportunity to plan and facilitate programs like SWF ELE has shown me what thoughtful collaboration across disciplines can accomplish. It is genuinely inspiring to watch students learn from our site-visit hosts, mentors, and one another while developing a broader understanding of the interconnected challenges facing Western water systems. And, of course, who doesn't love learning alongside a Western river?"

- Jack Severson (UCM)

Participants of the SWF ELE program hiking at the Colorado National Monument, 2025.



SWF ELE participants hiking beside the Yampa River, 2025.



Sego Lily along the Yampa River, 2025.



Year Four Products

These appendices feature publications and presentations with the NIFA Acknowledgement and other major SWF products.

APPENDIX I: PRODUCTS WITH NIFA SUPPORT ACKNOWLEDGED

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APPENDIX II: PRODUCTS WITHOUT NIFA SUPPORT ACKNOWLEDGED

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APPENDIX III: OTHER PRODUCTS

Workshops and Outreach

California Water Policy Research Priorities Workshop: Building on SWF research across all program thrusts, Secure Water Future partnered with the Public Policy Institute of California Water Policy Center and UC Merced to convene researchers, policy partners, and experts to identify priority research needs for resiliency-focused California water policy. The workshop addressed topics including agricultural resilience, environmental management, water measurement, resource management and operations, and water markets. The effort informed a PPIC policy brief designed to benefit applied researchers, water practitioners, policymakers, and potential research funders.

Big Sky Workshop on the Economics of Agriculture and the Environment: Research on water markets and groundwater ownership in California's Mojave Desert led to a presentation on trends in ownership shares and water-trading behavior at the Big Sky Workshop in Bozeman, Montana. The work helps characterize how water markets may affect water-use patterns and local economic structure, providing information that can support implementation of California's Sustainable Groundwater Management Act and the design of water markets in other water-scarce regions.

EDF / SWF State of the Science of Land Repurposing Workshop: Ongoing research and implementation associated with the Multibenefit Land Repurposing Program informed a two-day workshop that brought together experts from multiple disciplines to strengthen the scientific foundation for land repurposing. Participants examined challenges and opportunities for implementing land repurposing strategies at scale, benefiting researchers and practitioners working in this area.

Ripple Effect Podcast: Information Needs for Water Markets. SWF research on the information needed for fair and effective water markets resulted in a podcast interview featuring Molly Bruce, Nell Green Nylen, and Sarah Null. The episode shared key findings about gaps between the data needed to operate water markets and the information currently available, helping a broad public audience understand those challenges and actions that different water-sector actors can take to address them.

State of the Tulare Basin Conference: SWF collaborated with the Tulare Basin Watershed Network to co-organize the third State of the Tulare Basin Conference, bringing together more than 90 growers, ranchers, environmental representatives, water managers, Tribal government representatives, state agency representatives, researchers, and community members for a day-long discussion of the basin's past, present, and future. The event also provided graduate students and postdoctoral researchers with opportunities to engage directly with regional stakeholders and contributed to subsequent efforts to establish a stakeholder-driven watershed working group and coordinated watershed planning.

APPENDIX III: OTHER PRODUCTS

Workshops and Outreach, Continued

Future of Water Presentation: Participation in the CITRIS "Future of Water" program resulted in an international presentation on the future of water in California and globally. The presentation highlighted California's major water challenges and approaches for building resilience, benefiting a cohort of innovation-focused participants representing startups, companies, nonprofit organizations, and academia.

Great Salt Lake Water Banking Field Workshop: Immersive modeling of water banking in Utah generated strategies for increasing water flows to the Great Salt Lake and led to a field workshop at Cutler Reservoir. More than 45 farmers, ranchers, water-policy managers, practitioners, experts, and students participated, creating an opportunity to connect modeling and research with local knowledge and water-management experience.

Research Instrumentation

Remote-Sensed Water Balance Model for Utah Canal Companies: Interest from the Utah Division of Water Resources in incorporating SWF-developed methods into its operations led to a workshop focused on a remote sensing-based water balance model for Utah canal companies. The activity supported state water management efforts by increasing understanding of how the model could be applied operationally, with benefits extending to the State of Utah and Utah's water management community.

APPENDIX III: OTHER PRODUCTS

Educational and Student Support Programming

UC Merced hosted senior water and natural resources scientist Dr. Bart Wickel on March 10-11, 2025. Dr. Wickel gave a lecture to undergraduates at UC Merced on applications of remote sensing and geospatial technology. Additionally, Dr. Wickel met with graduate students and early career individuals to discuss career pathways outside of academia.

Eight graduate students and six mentors participated in the week-long Secure Water Future Experiential Learning Expedition (SWF ELE) throughout Colorado and Utah, May 22-30, 2025. While on the trip, participants learned about the Upper Colorado River basin and some of the water related challenges that the region faces. With multiple site visits throughout the week, students and mentors gained insight from multiple perspectives in how water is used in the Colorado River basin, from hydroelectric generation to Indigenous water rights. This benefitted all parties involved by creating strong networks among students and mentors, engaging discussions, and bolstering the skills necessary to become the next generation of water leaders. Additionally, the graduate students produced a collaborative perspectives paper on the role of experiential learning in interdisciplinary team science, published in the Journal of the American Water Resources Association (see Year Five Products).

The Climate Adaptation Intern Program at USU provides undergraduate students with hands-on training to help communities respond to weather variability and impacts in Utah and across the western United States. During its first two years, the program trained 40 undergraduate interns and supported the development of 15 fact sheets translating knowledge for broader audiences. Those resources were downloaded more than 3,900 times by 195 educational, government, and business entities, extending the program's impact beyond participating students to organizations and communities working to address current environmental challenges.

Over the week of July 14-18, 2025, Secure Water Future and CalTeach co-hosted the Super Soaker Water Academy (SSWA) program at UC Merced. SSWA invited 11 local middle school students from the Central Valley for a five-day summer STEM academy. Students benefitted from learning about the water cycle, applications of ag-tech, and basic coding skills. The students participated in hands-on learning activities that emulated field research done by professionals in the sector. Students were taught about STEM pathways into higher education and technology. Many students had not had previous access to the technology and concepts used in SSWA activities.

SWF staff gave a lecture on the use of drones in agriculture to middle school students attending the Super Soaker Water Academy. This presentation provided specific examples of how drones are used in agriculture, as well as some of the SWF-related research happening at UC Merced.

APPENDIX III: OTHER PRODUCTS

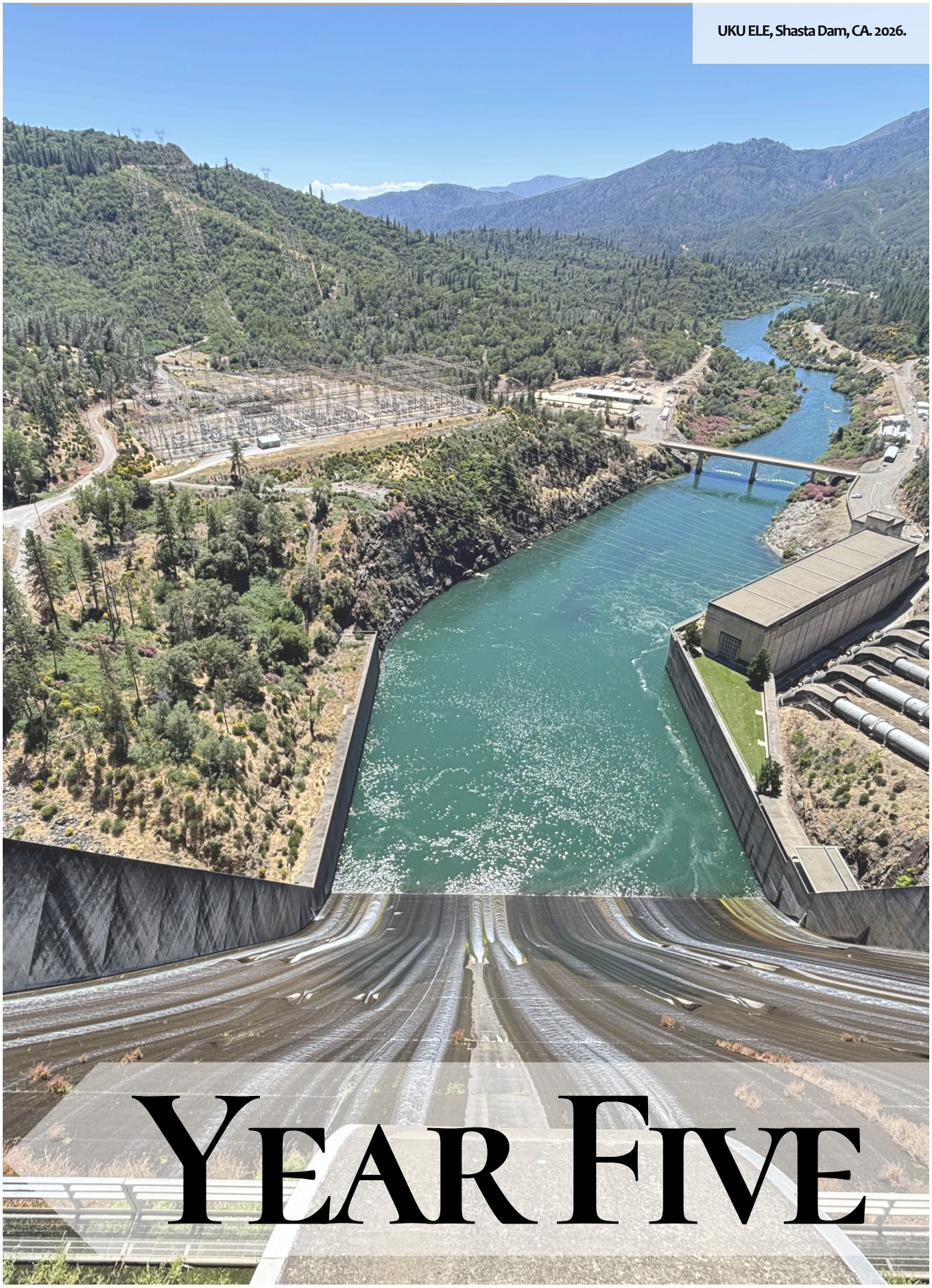
Educational and Student Support Programming Continued

On June 7, 2025, members from the Secure Water Future and the Environmental Defense Fund partnered with the ProYouth program at Sequoia High School in Visalia to co-host a 1-day on-water career day event for Young Leaders Club students. The event was intended to provide information to high school juniors and seniors about possible career paths and opportunities for higher education in their area. On this day, students explored their local watershed – the Kaweah River – by way of a one-day whitewater rafting trip, guest lectures, and informal collaborative time. This event benefitted the high school students, guest speakers from UCLA, UCM alumni, and staff from the Young Leaders program by expanding professional networks, educating students on possible career paths, and providing hands-on learning in local watersheds.

Over the week of August 9-15, 2025, SWF team members facilitated a UC Water Academy field experience. SWF hosted nine undergraduate and graduate students, peer leaders, and mentors on a week-long experiential learning expedition following the Tuolumne River. The group engaged with professionals and mentors through site visits, structured discussion time, and a three-day whitewater rafting trip that holds space for formal and informal collaboration. This benefited students by providing a holistic view of water resources management and varying stakeholder priorities, from ecosystems and recreation to agriculture and municipalities.



SWF ELE participants enjoying the Colorado National Monument, 2025.



UKU ELE, Shasta Dam, CA. 2026.

Year Five

YEAR FIVE

Project Management

- Maintained strong communication and coordination across project partners to support final-year deliverables and ensure successful project closeout.
- Continued to enhance team cohesion by strategically coordinating in-person meetings alongside conferences and other project events.
- Supported dissemination of project outcomes by coordinating presentations, conference participation, and publication efforts across the project team.

Research

- The Data Integration team advanced understanding of weather extremes, wildfire impacts, drought, and early-warning indicators for agricultural resilience.
- The Markets team explored new approaches to water trading, groundwater markets, and interstate water banking to improve water management across agricultural and environmental needs.
- The Management team's research identified key drivers of water variability and evaluated strategies such as aquifer recharge and water banking to improve long-term water management during drought.
- The Measurement team's research strengthened water-use assessment methods and identified alternative cropping strategies to sustain agriculture under water-limited conditions.

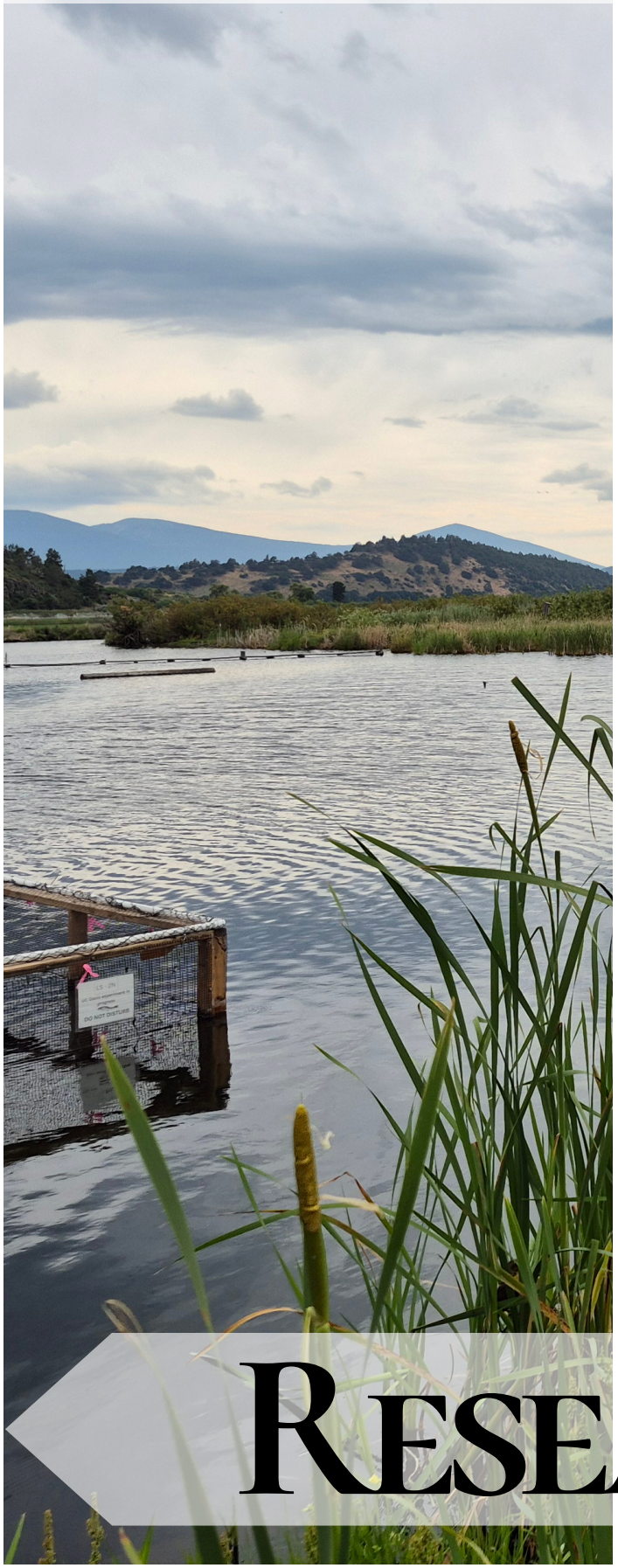
Extension & Outreach

- NMSU's Learning Games Lab led multiple immersive sessions showcasing Cozy River Valley, a data-driven educational game that builds problem-solving skills for water resource management.
- EDF and SWF co-hosted the Finding Common Water expedition, bringing together 19 water professionals for a three-day rafting experience on the Tuolumne River focused on relationship-building, dialogue, and collaborative programming.
- SWF and EDF partnered with ProYouth to host the second Outdoor Career day event for high school students on the Kings River.

Education

- Hosted the 2026 Upper Klamath Unbound Experiential Learning Expedition (UKU ELE), bringing together seven SWF graduate student researchers and other selected participants from the broader SWF network.
- Hosted the 5th iteration of the Super Soaker Water Academy summer camp, engaging 23 local middle school students with STEM topics through hands-on learning about water resources and ag-tech.

Lakeside Farms, OR. 2026.



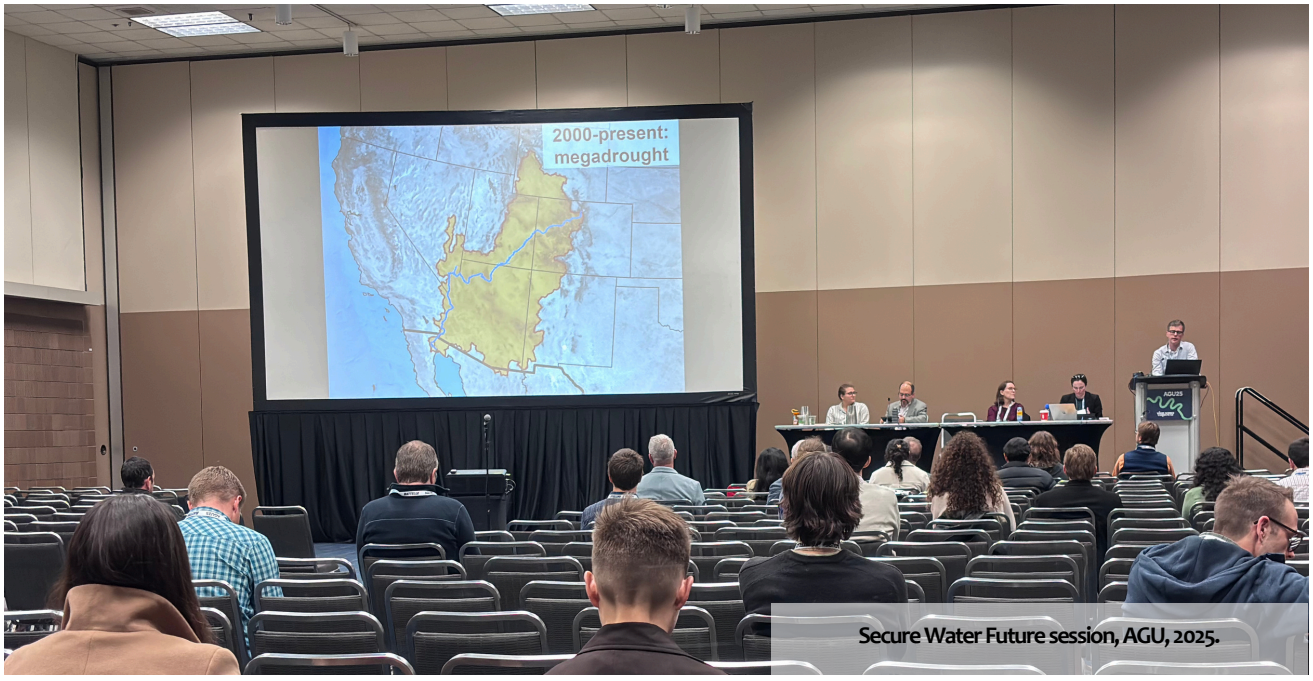
Bald Eagle sighting on the Klamath River, 2026.



The Secure Water Future research team advances integrated, data-driven approaches to understanding and managing water resources across agricultural, ecological, and community systems. Through interdisciplinary research, the team develops new knowledge, analytical frameworks, and decision-support tools to address emerging water challenges. Partnerships with growers, water managers, agencies, and policymakers help translate these advances into more resilient, equitable, and sustainable water management across the western United States.

RESEARCH

DATA INTEGRATION



Secure Water Future session, AGU, 2025.

Year Five contributions from the Data Integration team included several publications that broadly touch on weather-sensitive water issues that span the geography of the project. These include new insights into short-duration precipitation extremes that can be problematic for crops and erosion, as well as factors that contribute to widespread fire in headwaters, which is important given post-fire impacts to water quantity and quality in downstream agricultural areas. The team has also updated a set of weather projections and agricultural summary layers in https://climatetoolbox.org/ using the latest set of modeling results. Such information may be useful in water and agricultural decision-making over decadal time horizons. Lastly, the group has examined climate stressors such as the El Nino Southern Oscillation and sequential drought on croplands globally, potentially identifying early warning indicators that can be used to improve the resilience of agriculture to variable weather.

MARKETS



Dr. Mike Kiparsky at the 2026 Water in the West Research Conference, 2026.

In Year Five, the Markets team continued research examining the institutional contexts and individual decisions that shape the potential for water markets to support agriculture, ecosystems, and communities. One of the team's key accomplishments was the completion of a paper that systematically evaluates water trade modeling considerations, which was conditionally accepted in the journal Review of Environmental Economics and Policy. The team also published two extension articles geared for general audiences – a primer on water markets titled "An introduction to water markets" with UC ANR Publications and a summary of groundwater market development in California in the UC publication ARE Update. Additionally, the Markets team advanced research with new immersive modeling of interstate water banking to get more water to Great Salt Lake.

The SWF Markets team also focused on translating research to practitioners and policymakers through webinars, factsheets, podcasts, and workshops to broaden the reach of our research. The team hosted several events to bridge research and practice, including a half-day convening with practitioners and other experts from seven Western states and Canada to inform a forthcoming report on spatial considerations for local groundwater markets; a roundtable on groundwater market impacts to small farmers in California; a field trip to Cutler Reservoir in Utah to engage agricultural and policy leaders on water banking for the Great Salt Lake; and several sessions at 2026 UCOWR Annual Water Resources Conference.

The Markets team also participated in a research priorities event with the PPIC Water Policy Center, shared report insights on information needs and data gaps for water markets via podcast, and presented findings at various extension events to diverse audiences ranging from state regulators to local dairy farmers. Together, these achievements are working to ensure that the research supports resilient water policy and market design.

MANAGEMENT

During Year Five, the Management team advanced research on managed aquifer recharge (MAR), groundwater sustainability, groundwater–surface water interactions, and regional water scarcity. The team completed a global synthesis of MAR research and implementation, identifying major advances as well as persistent technical, hydrogeologic, institutional, and socioeconomic barriers to successful recharge projects. The synthesis emphasizes that MAR effectiveness depends not only on hydrogeology and water availability, but also on governance, monitoring, financing, and community engagement.



Dr. Yara Pasner at the Western Pecan Growers Association Annual Conference, 2026.

The team also advanced groundwater-modeling tools and methods. The Ichnos particle-tracking framework provides a flexible, parallelized tool for evaluating groundwater flow paths, recharge pathways, well capture, stream–aquifer interactions, and contaminant transport across a range of groundwater-modeling platforms. And the team implemented the physically based Stream-Aquifer Flow Exchange (SAFE) formulation within IWFM, including the ability to quantify asymmetric exchange between opposing stream banks. This work improves representation of groundwater–surface water connectivity and has implications for recharge accounting, conjunctive-use planning, and groundwater-management boundaries.

A major Year Five accomplishment was showing that vertical hydraulic gradients help constrain regional groundwater models. Three Sacramento Valley models simulated similar groundwater levels but differed in vertical flow, anisotropy, and water budgets. Including observed gradients improved estimates of vertical connectivity and revealed stronger downward gradients across much of the valley, with implications for recharge and contaminant movement.

Management team researchers also organized and contributed to the session "From Data to Decisions: Connecting Water Measurement with Adaptive Management" at the 2026 UCOWR/NIWR Annual Water Resources Conference in San Antonio, Texas. The session brought together SWF research on regional water budgets, agricultural adaptation and irrigation management, groundwater recharge, and strategies for sustaining agricultural production under increasing water constraints.

MEASUREMENT



Dr. Alfonso Torres-Rua presenting at the UCOWR conference, 2026.



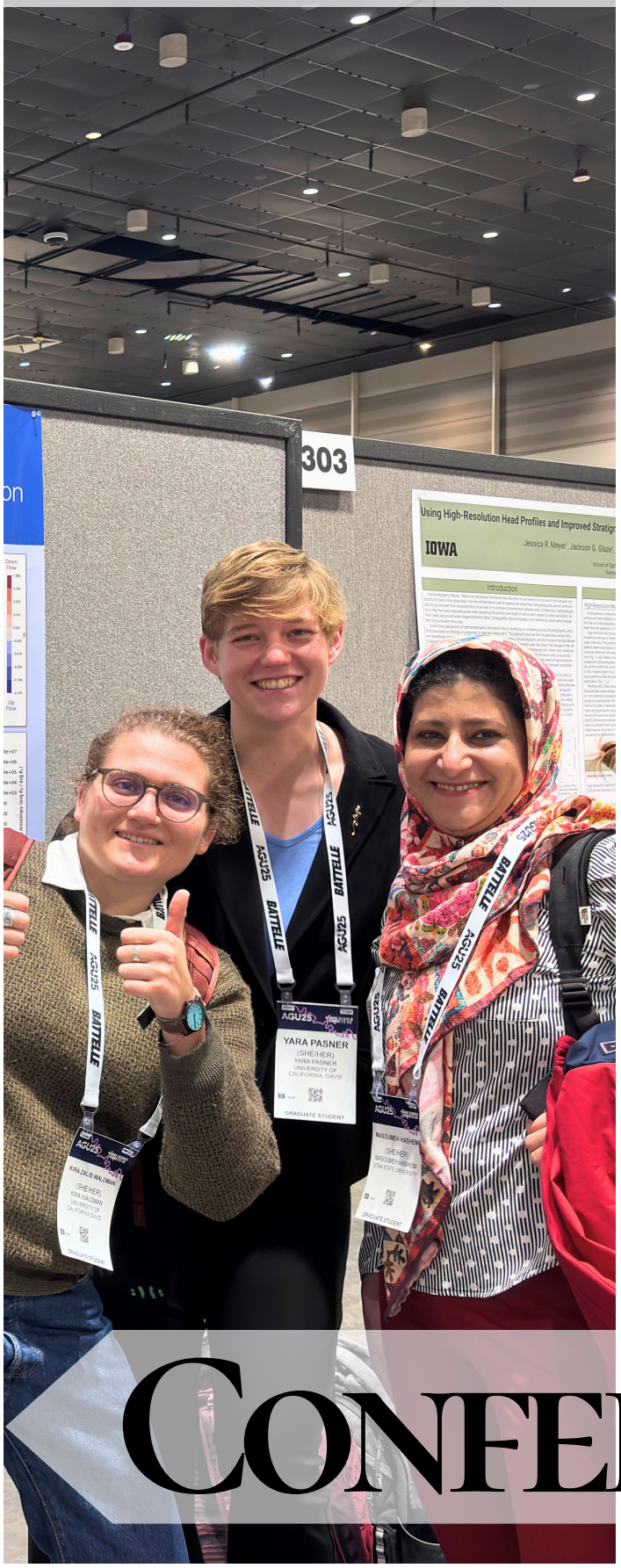
UKU ELE participants overlooking agricultural fields in the Upper Klamath Basin, 2026.

In Year Five, the Measurement team advanced research across California, Utah, and New Mexico to strengthen understanding of water availability, storage, delivery, and agricultural use under increasingly variable conditions. Key accomplishments included validating innovative approaches for localized groundwater recharge and storage, assessing vulnerabilities within water delivery systems, and identifying opportunities to reduce the water use and environmental impacts of agricultural production.

A major highlight was the successful validation of microscale managed aquifer recharge (uMAR), using geophysical techniques to identify subsurface storage opportunities and field experiments to demonstrate that stored water can be readily recovered. The Measurement team also completed a comprehensive assessment of factors affecting water canal companies across major Utah river basins, providing new insights for future planning and adaptation. A tri-state life cycle assessment of alfalfa production further identified important differences in environmental impacts across the region and demonstrated the potential for optimized deficit irrigation to reduce both water use and emissions in California.

The team extended the reach of its work through engagement with water-management agencies, presentations at major scientific conferences, peer-reviewed research, and graduate student training. Two SWF-supported PhD dissertations were successfully completed, marking an important milestone in the team's scientific and workforce-development contributions. Collectively, these accomplishments demonstrate how innovative measurement, field validation, and applied research can strengthen water security, agricultural sustainability, and resilience across the western United States.

Kira Waldman, Dr. Yara Pasner, & Dr. Masoumeh Hashemi at the American Geophysical Union conference, 2025.



Ann Hayden gives a keynote presentation at the EDF / SWF State of the Science of Land Repurposing Workshop, 2026.



Secure Water Future had a strong presence at numerous conferences throughout Year Four of the project, including AGU, UCOWR, and the 60th Annual Pecan Growers Conference. Additionally, the team hosted several workshops and panels. These events offered valuable opportunities to highlight project deliverables and present work from the initiative's first four years in a comprehensive and engaging manner.

CONFERENCES

INTERNATIONAL SYMPOSIUM ON RIVER SCIENCE

PURPOSE OF THE INTERNATIONAL SYMPOSIUM ON RIVER SCIENCE

The International Symposium on River Science brings together educators, researchers, practitioners, and policymakers to share innovations and strategies for understanding, managing, and restoring river systems. The symposium aims to advance science and collaboration in support of a more resilient and secure future for freshwater ecosystems. Key themes of the 2025 symposium included:

- River ecology and biodiversity
- Hydrology
- Restoration and Management
- Policy and Community Engagement
- Education and Experiential Learning



SWF ELE and UCWA alumni presenting at the International Symposium on River Science poster session, 2025.



Jack Severson presenting at the International Symposium on River Science, 2025.

SECURE WATER FUTURE INVOLVEMENT

At the International Symposium on River Science, multiple SWF team members and SWF affiliates attened the gathering and presented on a variety of topics. Jack Severson (above) presented "Place Based Paddling: Experiential Learning for a Secure Water Future," co-authored by Kira Waldman, Lauren Parker, and Joshua Viers. The talk featured the Secure Water Future Experiential Learning Expedition (SWF ELE), an immersive program that brings together graduate students and professionals to explore climate adaptation through place-based learning. The program demonstrates how experiential education can foster collaboration, leadership, and informed water resource decision-making.

60TH ANNUAL PECAN GROWERS CONFERENCE

SWF INVOLVEMENT AT THE 60TH ANNUAL "PECANFERENCE"

The 60th annual Western Pecan Growers Association (WPGA) Conference was held March 1-3, 2026. Dr. Richard Heerema coordinated the conference's educational program, bringing together researchers, Extension specialists, and industry leaders to share the latest advances in pecan production and water management.



Dr. Yara Pasner at the 60th annual Western Pecan Growers Association (WPGA) Conference, 2026.

SUPPORTING PECAN GROWERS THROUGH RESEARCH

The conference featured a presentation by Dr. Joshua Viers, who provided a broader perspective on agricultural water management in the western United States, emphasizing the connection between regional water resources, long-term sustainability, and on-farm decision-making. Dr. Yara Pasner presented SWF-supported research examining groundwater resources and irrigation management in Southwestern pecan orchards, demonstrating how improved water-use efficiency can support both agricultural productivity and long-term groundwater sustainability. Together, these presentations demonstrated the impact of SWF-supported research while strengthening collaboration among researchers, Extension personnel, and pecan growers throughout the region.

EDF / SWF STATE OF THE SCIENCE OF LAND REPURPOSING WORKSHOP

PURPOSE OF THE STATE OF THE SCIENCE WORKSHOP

Held on April 20-21, 2026, the State of the Science of Land Repurposing Workshop brought together researchers, students, practitioners, policymakers, and community partners to advance the science and practice of strategic land repurposing. Through interdisciplinary discussions spanning ecology, economics, agriculture, hydrology, soil science, engineering, and the social sciences, participants explored the challenges and opportunities of land repurposing, including stakeholder collaboration, groundwater sustainability, climate resilience, monitoring, and multi-benefit land management.

Dr. Joshua Viers speaking on Day 2 of the EDF / SWF State of the Science of Land Repurposing Workshop, 2026.





Darlene Franco of the Wukchumni Tribe presenting at the EDF / SWF State of the Science of Land Repurposing Workshop, 2026.

WHAT TRANSPIRED IN THE DIALOGUE?

Building on the EDF / SWF workshop in 2024, participants reconvened to advance conversations around the scientific, technical, and social dimensions of land repurposing under California's Sustainable Groundwater Management Act (SGMA). The workshop highlighted emerging research and on-the-ground implementation while creating space for researchers, practitioners, and policymakers to exchange perspectives and identify opportunities for collaboration. Discussions addressed grower participation and economic incentives, ecological restoration, groundwater sustainability, and pathways for translating research into practical land repurposing strategies.

UNIVERSITIES COUNCIL ON WATER RESOURCES (UCOWR)

SWF Team on a river boat tour at the UCOWR conference in San Antonio, TX, 2026.



ABOUT THE UCOWR CONFERENCE

The Universities Council on Water Resources (UCOWR) Annual Water Resources Conference is a leading interdisciplinary forum that brings together researchers, educators, students, water managers, and policymakers to address today's most pressing water challenges. The 2026 conference focused on advancing innovative research, fostering new collaborations, and developing practical solutions to improve water resources management across the United States and beyond.

SECURE WATER FUTURE AT UCOWR

Secure Water Future researchers and students contributed to the 2026 UCOWR Conference through multiple sessions and presentations highlighting experiential learning, groundwater sustainability, agricultural water management, and decision-support tools. These contributions showcased SWF's interdisciplinary approach to advancing water resilience while strengthening partnerships among researchers, practitioners, and water managers.



Yellow-crowned night heron, San Antonio, 2026.

Paddle High-Five on the Kings River, 2026.



Northern Pacific rattlesnake on the Kings River, 2026.



Extension connects research, education, and practice by developing resources and experiences that support a resilient water future for agriculture and ecosystems. Through field days, conferences, partnerships, and educational programming, the team translates SWF research into accessible tools and interactive learning opportunities that build understanding of water management challenges, tradeoffs, and collaborative decision-making.

EXTENSION

COZY RIVER VALLEY DEVELOPMENT



Starting screen graphics for the SWF educational game, Cozy River Valley, 2025.

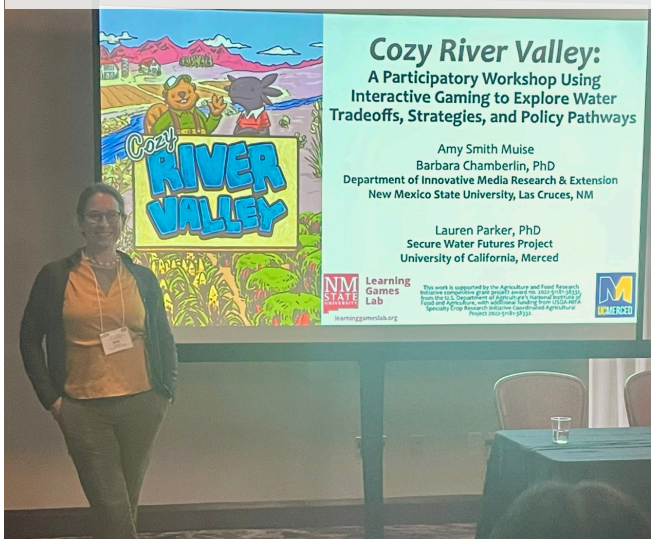
UCOWR PARTICIPATORY WORKSHOP

Game developer Amy Smith Muise hosted a participatory workshop at UCOWR, inviting approximately 25 water resources researchers and practitioners to play the game in small groups, interrogate their decisions, and compare their strategies. After two structured play rounds, participants engaged in conversation to explore how game mechanics reflect or diverge from real-world constraints and how measurement systems, market instruments, and government structures could shift player behavior. Through workshops like this and other feedback-focused sessions, the Game Team gathers information to help the team improve the game and its educational outcomes.

LEARNING THROUGH PLAY

Developed by the New Mexico State University Learning Games Lab, Cozy River Valley brings the complexities of agricultural water management to life through interactive, strategy-based learning. Players make decisions about crop water demand, agricultural production, and water use while balancing the health of their farm with the long-term condition of the aquifer. As conditions change—including during dry years—players must weigh the benefits and tradeoffs of relying on surface water versus groundwater. Through these choices, the game builds a practical understanding of agricultural water use, resource constraints, and the challenges of sustaining both farms and water supplies over time.

Amy Smith Muise of NMSU's Learning Games Lab sharing Cozy River Valley at the UCOWR conference, 2026.



ROUNDTABLE ON GROUNDWATER MARKET IMPACTS

WHY A ROUNDTABLE?

The Sustainable Groundwater Management Act (SGMA) opened the door for groundwater markets to emerge in California. Many groundwater sustainability agencies expressed interest in market development initially and a handful have made actionable progress towards implementation. While groundwater markets have potential to reduce the costs of groundwater conservation, they also carry the possibility of unintended consequences. Additionally, not everyone may be able to participate on equal footing.



Groundwater RoundTable workshop hosted by Dr. Ellen Bruno, 2025.

Secure Water Future's Dr. Ellen Bruno (UCB), a co-convener of the roundtable with Dr. Ruth Dahlquist-Willard, and Ngodoo Atume (UC ANR colleagues), 2025.



ABOUT THE CONVENING

On November 11, 2025, this workshop brought together a group of 30 researchers, extension agents, policymakers, and water practitioners to discuss the role of groundwater markets and their impacts on small farmers under SGMA. In this roundtable, equity concerns, the exit of small farmers, labor and employment effects, consolidation of permits, and market power were discussed.

The goal of this roundtable was for both practitioners and researchers to communicate their current state of knowledge. It served to strengthen partnerships between the research community and groundwater stakeholders on issues relevant for small farms as groundwater markets develop under SGMA. Post-event feedback was overwhelmingly positive; one anonymous survey respondent said, "This was an extremely useful day and a real opportunity for a two-way sharing of ideas between academic knowledge and on-the-ground knowledge."



Pine forest in the Upper Klamath River Basin, UKU ELE, 2026.



SWF 'Cinnamon Roll', UKU ELE, 2026.



Students exploring a side creek along the Kings River, 2026.

Outreach involves intentional efforts to deliver information, resources, and essential services to individuals who might not otherwise have access. This includes actively engaging with communities to raise awareness, share knowledge, and offer support. Outreach is vital for bridging access gaps and ensuring that all community members benefit from available resources and services. Through outreach, SWF aims to raise awareness, disseminate knowledge, and provide support to community members in their efforts to secure a resilient future.

Outreach

FINDING COMMON WATER

THE PROMISE OF THE BIG MIDDLE

Water management issues are often approached through scientific or regulatory frameworks, which can overlook the fundamentally social, perceptual, and relational nature of our shared challenges. Organized and facilitated by SWF staff and supported by EDF and State Water Contractors, Finding Common Water takes professionals outside of their offices and boardrooms and into shared landscapes, building the relational infrastructure that is central to durable collaboration. Through facilitated dialogue over a multi-day wilderness experience, individuals from state and federal agencies, tribal communities, water districts, agriculture, and nonprofits build trust, empathy, and understanding while engaging as people first rather than representatives of institutions. The space created for open conversation and mutual learning allows participants to grapple with some of California's most wicked water resources issues, explore common values, and find promise in "the big middle."





WHAT DO PARTICIPANTS HAVE TO SAY?

Participants emphasized the value of stepping outside their day-to-day roles to build relationships, exchange perspectives, and engage in thoughtful conversations with water professionals from across sectors. Survey responses highlighted the program's intentional facilitation, balance of structured and informal time, and immersive river setting as important to creating space for connection, reflection, and collaborative thinking.

"I enjoyed the opportunity to engage with folks from different stakeholder groups; these types of opportunities are invaluable when genuinely aspiring to identify collaborative resource management practices."

"I loved how much time we had to explore ideas and not rush our thinking. I wish I could do this every year."

EDF / SWF: 2026 PROYOUTH OUTDOOR-CAREER DAY



ProYouth: Outdoor-Career Day participants on the Kings River, 2026.

OUTDOOR CAREER DAY RECAP

Secure Water Future, the Environmental Defense Fund (EDF), and ProYouth partnered to provide 27 local high school students and community advisors with an immersive day of mentorship, field science, and outdoor learning on the Kings River. Through hands-on learning experiences, such as carbon sampling support from Dr. Nathan Rabideaux at UC Merced, students explored headwater management, scientific research, and future opportunities. By connecting with scientists, educators, and community leaders, students gained a deeper understanding of California's water challenges while discovering how collaboration, stewardship, and science can lead to meaningful careers and inspire the next generation of water leaders.

STUDENT REFLECTIONS

"Being out here makes you forget all your worries."

"Something I learned is how to relax and conquer your fears."



Having fun in the whitewater on the Kings River, 2026.

John Vradenburg with UKU ELE graduate students at Upper Klamath Lake, 2026.





Water quality activity for SSWA, 2026.

“You can’t learn about water without getting wet.”

Secure Water Future’s educational programming brings water science to life through immersive, hands-on learning. From K–12 classrooms to graduate-level field experiences, students engage directly with the environmental, agricultural, and societal dimensions of water management. These experiences build practical knowledge, encourage interdisciplinary thinking, and prepare the next generation to navigate an increasingly complex water future.

EDUCATION

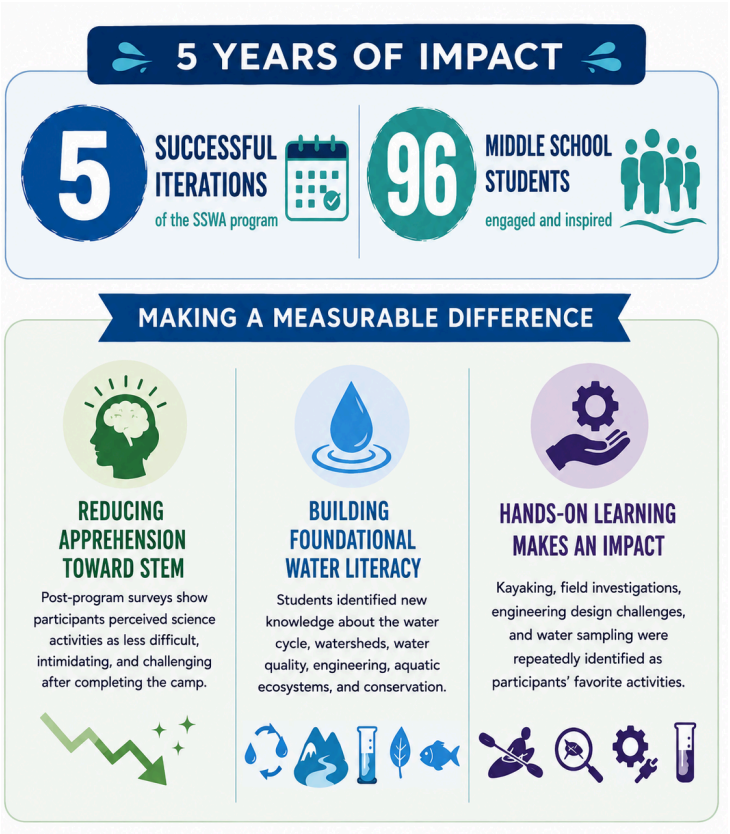
SUPER SOAKER WATER ACADEMY

SWF Super Soaker Water Academy (SSWA) participants kayaking on Lake Yosemite, 2026.

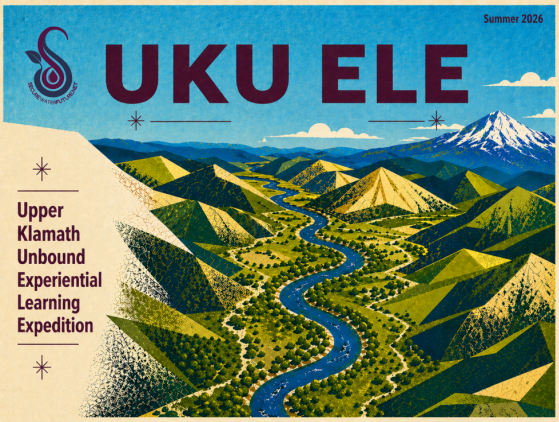


SSWA PURPOSE & IMPACT

Now in its fifth year, the Super Soaker Water Academy continued to provide Central Valley middle school students with an immersive introduction to water science and STEM. In partnership with CalTeach, CITRIS, and the Bobcat Summer STEM Academy, SWF welcomed 23 students for a week of hands-on learning exploring connections among water, agriculture, ecosystems, and technology. Activities included soil moisture monitoring, water quality sampling and analysis, groundwater modeling, kayaking on Lake Yosemite, and drone demonstrations, building students' scientific skills and awareness of future STEM pathways.



UPPER KLAMATH UNBOUND EXPERIENTIAL LEARNING EXPEDITION



TOPICS COVERED

- Water systems and management
- Agriculture and working landscapes
- River ecology and restoration
- Tribal stewardship and perspectives
- Water quality and ecosystem health
- Science communication and leadership

WHAT IS UKU ELE?

The 2026 evolution of the SWF ELE brought SWF-affiliated graduate students and mentors on an immersive eight-day journey across the Upper Klamath River Basin, exploring a region recently transformed by the largest dam removal in U.S. history. The Upper Klamath Unbound Experiential Learning Expedition (UKU ELE) combined place-based learning, field experiences, and facilitated discussions to strengthen collaboration, science communication, and professional networking skills. Along the way, participants engaged directly with scientists, Tribal leaders, agricultural producers, water managers, and conservation organizations, gaining firsthand insight into the diverse perspectives shaping the basin. These experiences challenged students to consider the interconnected ecological, agricultural, cultural, and water management dimensions of a river system undergoing significant change.



UKU ELE graduate student cohort and mentors, Klamath River, 2026.

UPPER KLAMATH UNBOUND EXPERIENTIAL LEARNING EXPEDITION

VISION AND FORMULA

UKU ELE follows the SWF ELE model, built on four core principles: immersive place-based learning, intentional cohort development, circular mentorship, and thoughtful program design. Rather than treating learning as a series of isolated lectures or site visits, the program intentionally weaves together field experiences, stakeholder engagement, reflection, and collaboration into a cohesive learning journey. Shared experiences in the field create opportunities for meaningful dialogue, relationship-building, and reciprocal learning among students, mentors, and practitioners. Through this approach, participants develop not only a deeper understanding of western water systems, but also the communication skills, professional networks, and collaborative mindset needed to work effectively across disciplines, sectors, and communities.

UKU ELE graduate students, Claire Boudard and Shobha Khanna, floating with mentor Dr. Amanda Stahl in the Klamath River, 2026.



UKU ELE at Upper Klamath Lake, 2026.



PARTICIPANT PERSPECTIVES

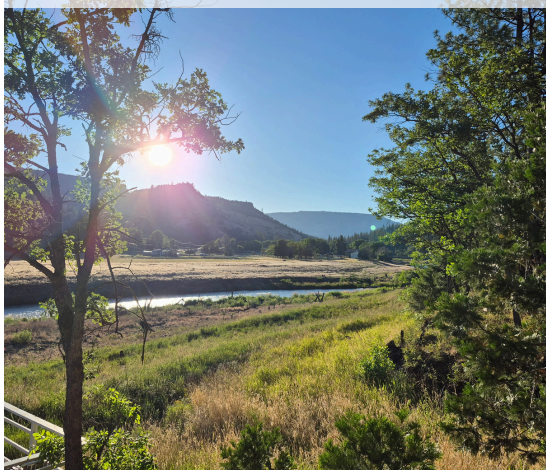
"The program broadened my perspective on water resources by showing how rivers, wetlands, groundwater, agriculture, fish, and communities are interconnected. Learning about Klamath Basin restoration, dam removal, and tribal perspectives taught me the importance of collaboration and relationship-building in addressing complex environmental problems. I particularly benefited from seeing how long-term solutions require cooperation among different groups rather than treating competing interests separately."

"For me, the UKU ELE experience broadened my perspective, strengthened my ability to think holistically, and reinforced the importance of interdisciplinary approaches to solving complex water challenges. These are lessons that are difficult to gain through traditional classroom instruction alone and will continue to influence my future career in water science and management."

Kayaking on Lake Yosemite, SSWA, 2026.



UKU ELE, Klamath River, 2026



These appendices feature publications and presentations with the NIFA Acknowledgement and other major SWF products.

Year Five Products

APPENDIX I: PRODUCTS WITH NIFA SUPPORT ACKNOWLEDGED

Abatzoglou, J. T., & Kalashnikov, D. A. (2026). Observed and projected contribution of cutoff lows to global precipitation. Environmental Research: Climate, 5(3), 035034. https://doi.org/10.1088/2752-5295/ae83da

Akbar, H. (2026, March 25). Immersive modeling to generate holistic strategies to get more water to Great Salt Lake [Conference presentation]. Spring Runoff Conference, Logan, UT, United States. https://digitalcommons.usu.edu/runoff/2026/all2026/30/

Akbar, H., & Rosenberg, D. (2026, June 9). Immersive modeling for water banking: Engaging stakeholders to generate strategies to shepherd water to the Great Salt Lake [Conference presentation]. 2026 UCOWR/NIWR Annual Water Resources Conference, San Antonio, TX, United States. https://ucowr.org/wp-content/uploads/2026/06/2026-Book-of-Abstracts_v2.pdf

Cliburn, C., Schumacher, B. L., Waldman, K. Z., Rothberg, D., Gomez-Cervantes, A., Hashemi, M., Duran-Gomez, M. R., Murdoch, L., Severson, J., Parker, L. E., & Viers, J. H. (2026). Cultivating collaborative water leaders: The power of experiential learning. JAWRA Journal of the American Water Resources Association, 62(3), e70123. https://doi.org/10.1111/1752-1688.70123

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Escriva-Bou, A., Medellín-Azuara, J., Viers, J. H., & Abatzoglou, J. T. (2026, June 9). The benefits of water trading and expanded water supplies in the transition to sustainable water use for California's agriculture [Conference presentation]. 2026 UCOWR/NIWR Annual Water Resources Conference, San Antonio, TX, United States. https://ucowr.org/wp-content/uploads/2026/06/2026-Book-of-Abstracts_v2.pdf

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APPENDIX I: PRODUCTS WITH NIFA SUPPORT ACKNOWLEDGED

Grimm, M., Green Nylen, N., & Kiparsky, M. (2026). Regulating data center water use in California. Center for Law, Energy & the Environment, University of California, Berkeley School of Law. https://clee.berkeley.edu/publications/regulating-data-center-water-use-in-california/

Gurazada, M., Abatzoglou, J. T., & Singh, D. (2025, December 15). ENSO's influence on co-occurring hot-dry and hot-wet extremes across global croplands [Conference presentation]. AGU Annual Meeting 2025.
Gurazada, M., Abatzoglou, J. T., & Singh, D. (2026). ENSO's influence on co-occurring hot-dry and hot-wet extremes across global croplands. Environmental Research Letters, 21(5), 054018. https://doi.org/10.1088/1748-9326/ae4a3d

Harmon, T. C., Nuñez Bolaño, Y., Flores-Landeros, H., Morande, J. A., & Medellín-Azuara, J. (2025, December 16). Stakeholder-informed land repurposing for groundwater sustainability: Evaluating agricultural, economic, and environmental trade-offs in overdrafted subbasins of California's San Joaquin Valley [Conference presentation]. AGU25 Annual Meeting. https://agu.confex.com/agu/agu25/meetingapp.cgi/Paper/1869064

Heerema, R., & Fernald, A. G. (2026, March 2). Soil water dynamics and irrigation performance in pecan orchards using soil moisture monitoring [Conference presentation]. Western Pecan Growers Association.
Heerema, R., Bawazir, A. S., Fernald, A. G., Miller, J., Perera, A., & Preciado, J. (2025, September 4). Investigación para mejorar el balance hídrico en huertas de nogal en regiones áridas [Conference presentation].

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APPENDIX I: PRODUCTS WITH NIFA SUPPORT ACKNOWLEDGED

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Marshall, A. M., Abatzoglou, J. T., Koshkin, A., & Rhoades, A. (2026). High-resolution mountain topography can inform global snow vulnerability estimates. Environmental Research Letters, 21(1), 014017. https://doi.org/10.1088/1748-9326/ae2d73

Mashaly, A. F., Hanson, A. M., Perez, K. A., & Fernald, A. G. (2026). Dynamic water budget modeling to fill knowledge gaps and improve water management in arid and semi-arid regions. Hydrological Processes, 40(3), e70443. https://doi.org/10.1002/hyp.70443

Medellín-Azuara, J., Escriva-Bou, A., Papadimitropoulos, S., Tapia, M., & Viers, J. H. (2026, June 8). Strategic water futures in Tulare County: Market solutions and recharge under SGMA and climate uncertainty [Conference presentation]. 2026 UCOWR/NIWR Annual Water Resources Conference, San Antonio, TX, United States. https://ucowr.org/wp-content/uploads/2026/06/2026-Book-of-Abstracts_v2.pdf

Morande, J. A., Flores-Landeros, H., Nuñez Bolaño, Y., & Harmon, T. C. (2025, December 18). Demonstration of a micro-scale managed aquifer recharge (µMAR) project in California's Central Valley: Design, construction, and monitoring [Conference presentation]. AGU25 Annual Meeting. https://agu.confex.com/agu/agu25/meetingapp.cgi/Paper/1899888

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APPENDIX I: PRODUCTS WITH NIFA SUPPORT ACKNOWLEDGED

Osorio-Diaz, K., Torres-Rua, A. F., Yost, M., & Hipps, L. (2026). Agricultural water balance and variability in Utah irrigation canal companies with OpenET products and spatial data. Irrigation Science. Advance online publication. https://doi.org/10.1007/s00271-026-01172-8

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Parker, L. E., & Viers, J. H. (2026, June 9). Finding common water through immersive experience [Conference presentation]. 2026 UCOWR/NIWR Annual Water Resources Conference, San Antonio, TX, United States. https://ucowr.org/wp-content/uploads/2026/06/2026-Book-of-Abstracts_v2.pdf

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Preciado, J., Heerema, R., & Fernald, A. G. (2026, August). Water savings, groundwater recharge, and pecan yields: A practical look at what two new studies from New Mexico mean for pecan growers in arid regions. Pecan South. https://www.pecansouthmagazine.com/magazine/article/water-savings-groundwater-recharge-and-pecan-yields-a-practical-look-at-what-two-new-studies-from-new-mexico-mean-for-pecan-growers-in-arid-regions/

Rodríguez-Flores, J. M., Cole, S. A., Medellín-Azuara, J., Escriva-Bou, A., Abatzoglou, J. T., Viers, J. H., Santos, N. R., & Sumner, D. A. (2026). Timely drought impact assessment for agriculture using a water–food systems approach. Environmental Research: Water, 2(2), 025006. https://doi.org/10.1088/3033-4942/ae5685

Sarwar, A., Medellín-Azuara, J., Abatzoglou, J. T., & Viers, J. H. (2026). Identifying agricultural consumptive-use patterns to support adaptive water management in California's Santa Clara Valley via remote sensing and machine learning. PLOS Water, 5(7), e0000416. https://doi.org/10.1371/journal.pwat.0000416

APPENDIX II: PRODUCTS WITHOUT NIFA SUPPORT ACKNOWLEDGED

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Schumacher, B. L., Yost, M. A., Ulrich-Schad, J. D., Barker, B., & Null, S. E. (2025, November 11). Agricultural water manager perspectives on water markets in Utah [Conference presentation]. CANVAS 2025 Annual Meeting.

Schumacher, B. L., Yost, M. A., Ulrich-Schad, J. D., Barker, B., & Null, S. E. (2026). Agricultural water manager perspectives on water markets in Utah. JAWRA Journal of the American Water Resources Association, 62(1), e70085. https://doi.org/10.1111/1752-1688.70085

Severson, J. (2026, June 10). Cultivating collaborative water leaders: Lessons from the Climate Adaptation Science Academy [Conference presentation]. 2026 UCOWR/NIWR Annual Water Resources Conference, San Antonio, TX, United States. https://ucowr.org/wp-content/uploads/2026/06/2026-Book-of-Abstracts_v2.pdf

Severson, J., Cliburn, C. Y., Schumacher, B. L., Waldman, K. Z., Rothberg, D., Gomez-Cervantes, A., Hashemi, M., Duran-Gomez, M. R., Murdoch, L., Parker, L. E., & Viers, J. H. (2025, December 15). Cultivating collaborative water leaders: Lessons from the Climate Adaptation Science Academy [Conference presentation]. AGU Annual Meeting 2025. https://agu.confex.com/agu/agu25/meetingapp.cgi/Paper/1955511

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Sinshaw, B. G., Dahlke, H. E., Viers, J. H., & Safeeq, M. (2026). Global advances in managed aquifer recharge: A systematic synthesis. Environmental Reviews, 34, 1–18. https://doi.org/10.1139/er-2025-0195

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Yost, M. A., Ulrich-Schad, J. D., Barker, B., & Null, S. E. (2025, December 16). Advancing Utah's secure water future: Irrigation organizations and water market uptake [Conference presentation]. AGU Annual Meeting 2025.

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APPENDIX III: OTHER PRODUCTS

Workshops and Outreach

Utah Agricultural Water Balance Seminar - September 18, 2025. Katherine Osorio-Diaz and Alfonso Torres-Rua presented a remote-sensing approach for assessing agricultural water use to the Utah Division of Water Resources, highlighting both the method's practical value and the challenges of estimating current and future demand.

River Field Studies Network Workshop - October 9, 2025. The workshop connected educators advancing experiential watershed learning. Kira Waldman shared lessons from Tuolumne River education, and Jack Severson presented "Place-Based Paddling: Experiential Learning for a Secure Water Future," drawing on the CASA ELE program.

Small Farmers and Groundwater Markets Roundtable - November 4, 2025. Thirty researchers, lawyers, agency managers, and growers met in Davis to examine barriers small farmers face in emerging SGMA groundwater markets. Discussion focused on equitable allocations, employment effects, market transparency, and governance choices that can protect small-farm participation.

Watershed Moments at the 2025 AGU Annual Meeting - December 15, 2025. Organized by Kira Waldman and Lauren Parker, this session brought water leaders, educators, and practitioners into conversation with Secure Water Future research, strengthening connections between applied learning, water education, and professional practice.

California Climate Vote: Water Issue Brief - January 22, 2026. Michael Kiparsky, Nell Green Nylen, Molly Bruce, Marie Grimm, Dave Owen, and Felicia Marcus outlined priority water challenges for California's next governor, including groundwater sustainability, Colorado River uncertainty, drinking-water access, and data-center water use.

OpenFarm Presentation - March 12, 2026. Shobha L. Khanna presented preliminary research using OpenET and other open-source data to estimate how implementation of the Sustainable Groundwater Management Act affects evapotranspiration and agricultural gross revenue.

Climate Issues in the 2026 Governor's Race: Water- March 16, 2026. Nell Green Nylen translated the California Climate Vote water brief into an accessible Legal Planet article, emphasizing the need for sustained groundwater implementation, interstate Colorado River cooperation, and stronger information and safeguards around data-center water use.

Institutions, Innovation, and Multi-benefit Projects - March 17, 2026. At the Stanford Water Research Symposium, Michael Kiparsky examined how institutional design and innovation can help multi-benefit water projects move from promising concepts to durable, implementable outcomes.

APPENDIX III: OTHER PRODUCTS

Workshops and Outreach, Continued

Data Centers' Water Use - June 4, 2026. Data Centers' Water Use. Nell Green Nylen briefed the Southern California Association of Governments Energy and Environment Committee on data-center water demand, information gaps, and policy considerations for regional and local decision-makers.

Building Community Capacity: Strategic Policies and Investments for Equity - July 30, 2026. During a California Public Utilities Commission staff panel, Nell Green Nylen discussed data-center water impacts and policy approaches that can strengthen local capacity to evaluate proposals and protect community interests.

Data Centers' Water Impacts - August 6, 2026. At the California Association of Sanitation Agencies annual conference in Napa, Nell Green Nylen explained how data centers can affect local water systems and identified practical information needs for clean-water agencies evaluating new development.

Pecan Orchard Water-Management Videos - August 20, 2026. Jorge Preciado, with Richard Heerema, Alexander Fernald, and Salim Bawazir, released two concise videos on water-balance insights for hybrid irrigation and the relationship between water-management strategies and pecan yield. The videos make project findings more accessible to growers and researchers.

Southwest Groundwater and Sustainable Agricultural Systems Annual Symposium. At Fresno State, approximately 45 water managers, regulators, farmers, and researchers discussed sustainable groundwater management and agriculture. Ellen Bruno presented Secure Water Future research on groundwater markets under SGMA.

Regulating Data Center Water Use in California Webinar. Marie Grimm and Michael Kiparsky presented findings and recommendations from a new report on data-center water use in California and discussed policy options for improving transparency, siting decisions, and oversight.

Spatial Considerations for Local Groundwater Markets Convening. Nell Green Nylen and Marie Grimm convened participants from California, New Mexico, Utah, and beyond for a half-day virtual exchange on how local groundwater-market design can address effects on third parties and the environment.

Utah Agricultural Land Trust Presentation. Sarah Null shared Secure Water Future research with Utah irrigators and agricultural producers, connecting the project's findings with the priorities and experience of the state's agricultural community.

APPENDIX III: OTHER PRODUCTS

Workshops and Outreach, Continued

State of the Science of Land Repurposing Workshop. Hosted by Environmental Defense Fund and Secure Water Future, this two-day workshop brought researchers, practitioners, and community perspectives together to assess emerging evidence, implementation experience, and approaches for evaluating the costs and benefits of land-repurposing strategies.

Land Repurposing Research Round-Up. Anna Schiller, Gopal Penny, Amy Quandt, Sarah Sarfaty Epstein, and Environmental Defense Fund partners organized a quarterly speaker series where researchers, students, and practitioners exchanged emerging findings, tools, and applied perspectives on land repurposing.

Research Instrumentation

Economic Impacts of Agricultural Land Repurposing Objectives and Planning Scale - August 5, 2026. Yelenka Nunez-Bolano, Humberto Flores-Landeros, Josue Medellin-Azuara, and Thomas Harmon released analysis scripts, spatial data, and economic-model results for four land-repurposing scenarios in the Tule and Kaweah subbasins. The package supports comparison of economic effects across county, subbasin, and groundwater-agency planning scales.

Warm Snow Drought Data and Reproducibility Package - August 13, 2026. Saswata Nandi and Mohammad Safeeq released quality-controlled Sierra Nevada snow-course and snow-pillow records, climate extracts, and figure scripts supporting their analysis of the 2026 snowpack collapse despite near-normal winter precipitation.

Agricultural Water Balance and Variability in Utah Irrigation Canal Companies - August 21, 2026. Katherine Osorio-Diaz, Alfonso Torres-Rua, Matt Yost, and Lawrence Hipps deposited monthly water-balance inputs and outputs for three Utah canal companies, integrating OpenET, gridMET, and spatial data to support transparent agricultural water accounting and reproducible analysis.

The ClimCompare tool, developed by Shobha L. Khanna, provides an interactive way to compare DaymetV4 and PRISM data across the western United States. The Google Earth Engine interface visualizes differences in temperature and precipitation from 1980–2024 and allows users to generate location-specific time series.

APPENDIX III: OTHER PRODUCTS

Educational and Student Support Programming

Climate Adaptation Intern Program at Utah State University. Organized by Scott Hotaling and Kendall Becker, the program paired undergraduate training with public-facing resources on climate adaptation. Year Five products addressed residential water conservation, wildfire and water security, and public perceptions of environmental change.

Water, Weather, and Agricultural Educational Materials. With support from John Abatzoglou, this initiative provided community-college faculty with classroom-ready resources on water, weather, and agriculture, extending Secure Water Future research into postsecondary instruction and curriculum development.

Student Career and Professional Development Visit, February 17–18, 2026. River and riparian ecologist John Stella met with Secure Water Future students at UC Merced to discuss career pathways, professional growth, and how scientists can translate research into real-world decisions and meaningful impact.

Colorado River at a Crossroads Graduate Seminar, June 28, 2026. Kira J. Z. Waldman, Daniel Rothberg, and Lindsay Murdoch extended the CASA ELE Yampa River experience into a ten-week, student-led UC Davis seminar. Eighteen students learned from water managers, policymakers, Tribal representatives, journalists, and researchers while examining the basin as an interconnected physical and governance system.

EDF / SWF 2026 ProYouth Outdoor-Career Day. Lucy Caine, Claudia Mendoza Chavez, Jack Severson, and Destiny Montes led 13 at-risk high school students through water testing, conversations with environmental professionals, and hands-on career development on the Kings River.

Upper Klamath Unbound Experiential Learning Expedition (UKU ELE). Led by Jack Severson and Dr. Lauren Parker, this eight-day graduate student expedition immersed participants in the Klamath Basin and connected them with scientists, Tribal leaders, agricultural producers, water managers, and conservation organizations while building collaboration, communication, and leadership skills.

Super Soaker Water Academy. Secure Water Future and CalTeach provided 23 Central Valley middle school students with a week of hands-on STEM learning at UC Merced. Activities covered regional water challenges, field research, higher education, and careers, including a demonstration of agricultural drone applications.

UC Water Academy hiking near Early Intake on the Tuolumne River, 2025.



Riverboat tour in San Antonio, TX, UCOWR, 2026.



The Secure Water Future team includes collaborators from the University of California Merced, University of California Davis, University of California Los Angeles, University of California Berkeley, New Mexico State University, Utah State University, PPIC, EDF, UC ANR, and USDA.

The Team

LEADERSHIP



JOSHUA VIERS

Dr. Joshua Viers is a Professor of Water Resources Management in the School of Engineering at UC Merced. He also serves as the Associate Vice Chancellor for Interdisciplinary Research and Strategic Initiatives in the Office of Research and Economic Development (ORED) where he supports the Vice Chancellor for Research, Innovation, and Economic Development. Josh has led UC Merced's efforts to build an Experimental Smart Farm, develop a joint industry-university consortium on ag-food-tech research, and convene several universities in developing water accounting methods to secure a resilient water future.

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LAUREN PARKER

Dr. Lauren Parker is the Managing Director of Secure Water Future, and the project manager for SWF-adjacent projects at UC Merced, including those with the California Energy Commission and AgAID. Lauren's background is in applied climatology, primarily focusing on issues surrounding perennial agriculture and agricultural water resources in a changing climate. She has experience with stakeholder outreach, science communication, education, and team facilitation. Prior to joining UC Merced, Lauren was an applied climate scientist, research program manager, and a program coordinator at the USDA California Climate Hub and a project scientist at UC Davis.

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JOHN ABATZOGLOU

Dr. John Abatzoglou is a Professor in Management of Complex Systems at UC Merced. John received his bachelor's degree in Atmospheric Science from UC Davis and doctorate in Earth Systems Science from UC Irvine. John's academic interests are primarily focused around climate science and impacts in the American West. John's Climatology Lab works on a diverse set of research questions spanning climate science and meteorology as well as their impacts on systems including water resources, wildfire, and agriculture.

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ANDREW AYRES

Dr. Andrew Ayres is a Research Fellow at the Public Policy Institute of California and an Assistant Professor of Economics at the University of Nevada Reno. Andrew's main areas of research include environmental and natural resource economics, institutional economics, applied econometrics, and water economics and policy. Andrew's current work examines legal and economic institutions for the management of groundwater resources, with a focus on water marketing and managing impacts from fallowed lands.

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LEADERSHIP



ELLEN BRUNO

Dr. Ellen Bruno is an Assistant Cooperative Extension Specialist at UC Berkeley in the Department of Agricultural & Resource Economics. Ellen's research and extension program addresses economic questions at the intersection of agriculture and the environment. Much of Ellen's current work considers the potential and effectiveness of water-related policies, which includes understanding how farmers respond to changes in water prices. Ellen received her Ph.D. in Agricultural and Resource Economics from UC Davis and her B.S. degree in Management Science from UC San Diego.

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HELEN DAHLKE

Dr. Helen Dahlke is a Professor in Integrated Hydrologic Sciences at the University of California, Davis. Helen obtained a Ph.D. in Environmental Engineering from Cornell University. Helen's current research interests include surface water - groundwater interaction, water resources management, vadose zone transport processes, and applications of DNA nanotechnology in hydrology. One of Helen's main research efforts focuses on testing the feasibility of using agricultural fields as recharge sites for groundwater banking.

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ALVAR ESCRIVA-BOU

Dr. Alvar Escriva-Bou is an assistant professor with the Civil and Environmental Engineering Department at the University of California, Davis. His research uses systems approaches to explore integrated water, energy, food and environmental resources management. Specifically, he focuses on the integration of the human dimension in these socio-environmental systems, linking engineering and economic models to assess drought impacts, improve urban and agricultural resilience, or analyze policy outcomes and tradeoffs.

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SAM FERNALD

Dr. Sam Fernald is the Director of the New Mexico Water Resources Research Institute (NM WRRI). He leads NM WRRI in its mission to develop and disseminate knowledge that will assist the state, region, and nation in solving water resources problems. NM WRRI supports university faculty research, provides training opportunities for students, and transfers research findings to the academic community, water managers, and the general public. Sam is the past president of the National Institutes for Water Resources (NIWR) which advocates for the 54 water institutes in the nation.

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LEADERSHIP



SAFEEQ KHAN

Dr. Safeeq Khan is a Cooperative Extension specialist in water and watershed sciences at the University of California Division of Agriculture and Natural Resources (UC ANR) and an Adjunct Professor in the Department of Civil & Environmental Engineering at UC Merced. Safeeq's research broadly focuses on understanding interactions between ecosystems, regolith, and terrestrial components of the Earth's critical zone. Safeeq's research relies heavily on field experiments and data-driven numerical models as research tools to inform land and water management.

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JOSUÉ MEDELLÍN-AZUARA

Dr. Josué Medellín-Azuara is an Associate Professor in Civil and Environmental Engineering at UC Merced. Josué is also an Associate Director for the UC Davis Center for Watershed Sciences and the UC Agricultural Issues Center, and an Adjunct Research Fellow at the Public Policy Institute of California. Josué is the principal investigator for the economic impact assessments of recent California droughts on agriculture and communities.

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DAVID MEYER

Dr. David Meyer has helped design and implement evaluations for organizations of all sizes, including the United Nations, the National Science Foundation, the US Department of Agriculture, as well as state and local government agencies. David spent 10 years in the private sector providing strategic planning, team assessments, and performance measurement for companies ranging from Fortune 100 companies to start-up ventures. David's Ph.D. is in organizational psychology and human resources development and he has research interests in technology transfer, mixed-motive business teams, and interdisciplinary research groups.

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MIKE MYATT

Mike Myatt oversees EDF's California Water program as senior director, climate-resilient water systems. The California Water program focuses on advancing incentive-based approaches that ensure adequate water for ecosystems, improve agriculture's resilience to climate change and address the needs of disadvantaged communities. Mike leads EDF's initiatives to advance groundwater sustainability policies and practices across the Central Valley. Mike collaborates with nonprofit partners, state and federal agencies, community-based organizations, landowners, and local community advisors to ensure that diverse perspectives are included in all phases of his work.

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LEADERSHIP



SARAH NULL

Dr. Sarah Null is a professor of watershed sciences at Utah State University. Sarah's research includes environmental water management, improving aquatic habitat objectives in water resources systems models, evaluating tradeoffs between human and environmental water uses with uncertainty, and identifying climate adaptations for water systems. Sarah's work focuses on California and the American West. She holds a Ph.D. and master's degree in geography from UC Davis and a bachelor's degree in economics from UCLA.

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ALFONSO TORRES-RUA

Dr. Alfonso Torres-Rua is a Utah State University researcher focused on remote sensing applications for water measurement, conservation, and education in agriculture, urban, and environmental landscapes. Alfonso's lab team aims to develop knowledge, methodologies, and tools to address water scarcity and climate change questions in arid regions.

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ROBYN GRIMM

Dr. Robyn Grimm was a Director (Climate Resilient Water Systems) at Environmental Defense Fund. Prior to EDF, Robyn worked at the consulting firm CH2M-Hill, where she was a water resources policy analyst and advised the State Department of Water Resources on flood planning. Robyn follows and regularly engages in conversations around the implementation of California's Open and Transparent Water Data Act, and provides input to California's Department of Water Resources. Robyn is now CEO at the California Water Data Consortium.

ADVISORY BOARD



ERIC AVERETT

Eric Averett is CEO of Atlas Water and has been an adjunct professor at Taft College and Bakersfield College for 20 years. Before joining Atlas Water, he was general manager of the Rosedale–Rio Bravo Water Storage District for over 14 years. He has been involved in evaluating and resolving water supply and quality challenges facing Kern County since 1991. He sits on the board of directors of the Kern County Water Agency. Eric graduated from California State University, Bakersfield with a degree in environmental resource management.



NATHAN DAUGS

Nathan Daugs is the manager of the Cache Water District in Utah. He is a graduate of Utah State University with a degree in Animal Science. He previously worked as a planner and technician for the Utah Department of Agriculture and Food and Utah Association of Conservation Districts, where he worked with landowners implementing water and environmental enhancement projects. Nathan is committed to ensuring sustainable economies and ecosystems through proper water management.



EREK FUCHS

Dr. Erek Fuchs specializes in quantitative hydrology with interests that include connectivity physics and groundwater resilience in conjunctive use of irrigated agricultural systems. He was born in New Mexico and raised on a small ranch near Capitan. He completed his academic degrees in Range and Watershed Science (BS), Range Hydrology (MS), and Water Science and Management (Ph.D.) with an emphasis in Quantitative Hydrology and Agricultural Water Resources at New Mexico State University.



MARK MATSUMOTO

Dr. Mark Matsumoto joined the University of California, Merced on September 1, 2015 where he was previously the Dean of the School of Engineering. He was previously Associate Dean for Research and Graduate Education and Professor of Chemical and Environmental Engineering at UC Riverside. Dr. Matsumoto's career research focus is environmental engineering treatment processes, particularly those associated with hazardous waste sites, groundwater remediation, and water reuse applications.



RIC ORTEGA

Ric Ortega has served as General Manager and Director of Governmental and Legislative Affairs of the Grassland Water and Resource Conservation District since August of 2011. Born and raised in the small town of Dos Palos, Ric grew an affinity to the outdoors from an early age. Ric holds a Bachelor of Science in Animal Science, Ecology and Systematic Biology from Cal Poly, San Luis Obispo and a Master of Science in Wetland Ecology from UC Davis.

ADVISORY BOARD



BLANE SANCHEZ

Blane Sanchez, from Isleta Pueblo, served as the first New Mexico tribal member on the NM Interstate Stream Commission over the last 16½ years, ending in July 2023. A background in farming and ranching influenced by his grandfather led him to obtain an undergraduate degree from New Mexico State University in agriculture (range science). His 30-plus years of professional work and experience include the areas of natural resources management, water quality standards, environmental protection, facilitation, tribal and state water policy, water utilities administration, and exposure to water research.



JOAN SNYDER

Joan Snyder is a retired investment banker whose decades-long career on Wall Street involved asset management, securities research, and, as an Executive Director of Merrill Lynch International, client responsibilities for Asia. She is a sixth-generation member of a CA farming family and managed her own New York farm for thirty-five years. With a primary residence in Vermont, she maintains a consulting practice in finance for agtech and regenerative ag projects.



ASHLEY SWEARENGIN

Ashley Swearengin is president and CEO of the Central Valley Community Foundation, a charitable foundation serving the six counties of Central California and providing over $100 million in funding to more than 650 community benefit organizations over the last decade. Prior to joining CVCF, she served as Mayor of the City of Fresno from 2009 through 2016. As mayor, she implemented substantial changes to improve the delivery of city services, revitalize the downtown and urban core, promote business and job growth, address chronic homelessness, and stabilize the city's financial position.



ANN WILLIS

Dr. Ann Willis is the California Regional Director for American Rivers where she leads the conservation program to conserve and protect rivers through science-guided projects, policies, and collaborations. Her journey to river conservation began on the Middle Fork Salmon River, where she was introduced to whitewater rafting after graduating from college. Her experience of belonging on that trip has guided each of her choices as she's followed her passion for rivers and the communities that depend on them.

PROJECT TEAM

The Secure Water Future project team encompasses faculty, postdocs, graduate students, undergraduate students, and staff from universities and non-profit partners. This list includes affiliated team members from September 1, 2024, through August 31, 2026.

Faculty & Research Collaborators

John Abatzoglou, Ph.D. (UCM)
Chelsea Arnold, Ph.D. (UCM)
Andrew Ayres, Ph.D. (PPIC)
Khaled Bali, Ph.D. (UC ANR)
Salim Bawazir, Ph.D. (NMSU)
Leigh Bernacchi, Ph.D. (UCM)*
Molly Bruce, J.D. (UCB)*
Ellen Bruno, Ph.D. (UCB)
Henry Cathey (NMSU)
Barbara Chamberlin, Ph.D. (NMSU)
Helen Dahlke, Ph.D. (UCD)
Dave DuBois, Ph.D. (NMSU)
Alvar Escriva-Bou, Ph.D. (UCD)
Sam Fernald, Ph.D. (NMSU)
Teamrat Ghezzehei, Ph.D. (UCM)
Nell Green Nylen, Ph.D. (UCB)
Ellen Hanak, Ph.D. (PPIC)
Tom Harmon, Ph.D. (UCM)
Richard Heerema, Ph.D. (NMSU)
Scott Hotaling, Ph.D. (USU)
Safeeq Khan, Ph.D. (UCM)
Mike Kiparsky, Ph.D. (UCB)
Giorgos Kourakos, Ph.D. (UCD)
Ahmed Mashaly, Ph.D. (NMSU)
Josué Medellín-Azuara, Ph.D. (UCM)
Amy Muise (NMSU)
Mike Myatt (EDF)
Colleen Naughton, Ph.D. (UCM)
Sarah Null, Ph.D. (USU)
Lauren Parker, Ph.D. (UCM)
Mariana Rivera-Torres (EDF)
David Rosenberg, Ph.D. (USU)
Bob Sabie (NMSU)
Caiti Steele, Ph.D. (USDA Southwest Climate Hub)
Gregory Torell, Ph.D. (NMSU)
Alfonso Torres-Rua, Ph.D. (USU)
Josh Viers, Ph.D. (UCM)
Matt Yost, Ph.D. (USU)

*Departed the SWF Team during Year Four or Year Five

Graduate Students

Hadia Akbar (USU)
Andrew Calderwood (UCD)*
Gustavo Dourado Facincani (UCM)*
Humberto Flores Landeros (UCM)*
Greg Goodrum (USU)*
Lucy Hackett (UCB)*
Masoumeh Hashemi (USU)
Tasnim Kamal Shamma (NMSU)
Shobha Khanna (UCM)
Liying Li (UCM)*
Raji Lukkoor (UCM)
Jamin Miller (NMSU)*
Moises Duran (USU)
Katherine Osorio-Diaz (USU)
Yara Pasner (UCD)*
Anushka Perera (NMSU)
Saddy Pineda (USU)
Jorge Preciado (NMSU)*
Ken Prewitt (UCM)*
Naivy Rodal Morales (UCM)*
Liam Sabiston (NMSU)*
Gabriela Sancho Juárez (USU)
Garrison Schlauch (UCB)
Britta Schumacher (USU)*
Berhanu Sinshaw (UCM)
Zada Tawalbeh (NMSU)
Kira Waldman (UCD)*
Arthur Wardle (UCB)*
Aaron Watt (UCB)*

*Degree completed during Year Four or Year Five

Undergraduate Students

Alexie Calderon (UCM)*
Lily Chavez (NMSU)
Adam Crawford (UCM)*
Wendy Haw (UCM)*
Erika Reynoso (UCM)*

*Degree completed

Staff

Isaiah Apodaca (NMSU)
Abby Bushman (USU)
Jack Severson (UCM)

External Evaluator

David Meyer, Ph.D. (BSU)*

*Departed the SWF Team during Year Five



SWF ELE Participants at the Shoshone Hydroelectric Plant, 2025.



Swirls on the Klamath River, 2026.