# Linking Indicators of Drought Hazard to Multi-Sectoral Impacts

## Stakeholder Engagement Summary

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One of the *Linking Indicators of Drought Hazard to Multi-Sectoral Impacts* project’s goals was to **co-develop decision support tools alongside stakeholders.** To make the results of the research relevant and useful for decision makers, we employed a science-to-action approach (Vano et al. 2017) throughout the research process. Specifically, we worked closely with NIDIS staff and convened stakeholder advisory groups to gather advice and feedback and to ensure that the project outputs are easily digestible and transferable to other geographic regions.

Of the project’s six activities, Activity 6 focused on these engagement efforts:

* Activity 1. Review drought impacts and responses during California’s 2012–16 drought.
* Activity 2. Develop sector-specific drought hazard indicators considering the water grid.
* Activity 3. Link sector-specific drought hazard indicators and impacts.
* Activity 4. Assess thresholds and triggers to inform decision making.
* Activity 5. Develop a suite of drought hazard indicator maps and other visualization tools.
* **Activity 6. Engagement and Workshops with Scientific and Stakeholder Partners.**

### Summary of Engagement Activities

In summary, over the course of the project we:

1. Established **5 sectoral stakeholder advisory groups**, including a scientific advisory group and four sectoral groups: the environment, agriculture, urban communities, and small communities.
2. Convened **twelve stakeholder advisory workshops** made up of roughly **60 participants** across multiple sectors.
3. Convened multiple targeted engagement meetings with organizations like CUWA, the Water Board, DWR, the Cal Water Data Consortium, and the California Water Commission.
4. Published 6 blogs:

* [California’s Latest Drought in 4 Charts](https://www.ppic.org/blog/californias-latest-drought-in-4-charts/) (May 2021)
* [Anticipating and Addressing the Impacts of the Drought](https://www.ppic.org/blog/anticipating-and-addressing-the-impacts-of-the-drought/) (May 2021)
* [How better data can help California avoid a drinking water crisis](https://www.bing.com/search?q=how+better+data+can+help+california+avoid+a+drinking+water+crisis&cvid=1aed9e6e42ab4b9ead78872fa96d6b48&aqs=edge..69i57j69i64.6238j0j4&FORM=ANAB01&PC=U531) (June 2021)
* [The Current Drought: Time to Hope for the Best, Prepare for the Worst](https://www.ppic.org/blog/the-current-drought-time-to-hope-for-the-best-prepare-for-the-worst/) (Nov 2021)
* [Managing Water Stored for the Environment During Drought](https://californiawaterblog.com/2021/11/07/managing-water-stored-for-the-environment-during-drought/) (Nov 2021)
* [Are California’s Cities Conserving Enough Water?](https://www.ppic.org/blog/are-californias-cities-conserving-enough-water/) (Dec 2021)

1. Published 2 policy briefs:

* [Drought in California](https://www.ppic.org/publication/droughts-in-california/) factsheet update (April 2021)
* [Drought and California’s Agriculture](https://www.ppic.org/publication/policy-brief-drought-and-californias-agriculture/) (April 2022)

1. Held 2 public events:

* [Is California Ready for Drought](https://www.ppic.org/event/is-california-ready-for-drought/) (May 2021)
* [Farming in a State of Extremes](https://www.ppic.org/event/farming-in-a-state-of-extremes/?utm_source=ppic&utm_medium=email&utm_campaign=event) (April 2022)

1. Presented at several professional conferences:

* California Collaborative Data Summit (August 2021)
* AGU Fall Meeting (December 2021)
* Annual Salmonid Restoration Conference (April 2022)
* E&J Gallo Water Summit (May 2022)
* AGU Fall Meeting (December 2022)
* EGU Annual Meeting (April 2023)
* Drought in the Anthropocene Workshop (July 2023)

1. Submitted 1 (of 4) papers
   1. Rebuilding Resilience: Drought and Declining Freshwater Species in California in [January/February 2023 Water Resources IMPACT magazine](https://www.awra.org/AWRA/Members/Publications/IMPACT.aspx).
   2. *3 Methodology papers TBD*

### Stakeholder Advisory Groups and Workshops

Our efforts to engage with sectoral and scientific stakeholders throughout our project were primarily grounded in establishing five stakeholder advisory groups. These groups include a scientific advisory group and four sectoral groups: the environment, agriculture, urban communities, and small communities (note: we have renamed rural communities, small communities following the guidance of our stakeholder group members).

The science group is led by Mike Dettinger and is made up of11 members that include representatives from DWR, SWRCB, USBR, USGS, NIDIS, alongside additional climate and environmental scientists. The environment group is led by Ted Grantham and Jeff Mount, and includes 12 representatives from DWR, SWRCB, CalTrout, NOAA, Fish & Wildlife, TNC, EDF, and academia. The agriculture group is led by Josué Medellín-Azura, consists of 12 members, and includes growers alongside representatives from CDFA, USBR, NRCS, EDF, and various county water authorities. Kurt Schwabe leads the urban communities group, which includes 11 members from various urban water districts, DWR, SWRCB, and CUWA. Finally, our small communities group consists of 13 members, including individuals from DWR, SWRCB, Indian Health Services, environmental justice organizations, and county governments, and is led by Alvar Escriva-Bou.

After establishing each group in quarter one of the project, we convened virtual kickoff meetings in quarter two between December 2020 and January 2021. During these kickoff meetings, we introduced members to one another, the core research team, and reviewed the project goals and objectives. We also presented our preliminary methodological framework and gathered feedback about how to make our results most effective for stakeholder use. The following is a list of when each kickoff workshop was convened:

1. Science SAG meeting #1: December 7th 2020
2. Environment SAG meeting #1: December 8th 2020
3. Small communities SAG meeting #1: January 19th 2021
4. Agriculture SAG meeting #1: January 25th 2021
5. Urban communities SAG meeting #1: January 29th 2021

The second group of project workshops began in May 2021 with the Environmental stakeholder advisory group workshop. During this meeting, Ted Grantham presented initial results for our environment specific drought hazard indicators, including the details of a two part methodology for aggregating hydro-climatic data into a regional, environment specific, drought index. In August 2021, the science advisory group met to provide feedback on the composite hydro-climatic indicators we have developed as part of the project’s Activity 2. Towards the end of 2021, we convened three more stakeholder workshops with the agriculture, urban, and small communities advisory groups. Our environmental stakeholder advisory group met additionally in February 2022 to provide feedback on the environmental drought indicators our team, led by Ted Grantham, has been developing. During these meetings we discussed the respective sectoral impacts of drought and presented our methodological approach for integrating the water grid into indicators of drought. The following is a list of when each of the aforementioned workshops took place:

1. Environment SAG meeting #2 – May 2021
2. Science SAG meeting #2 – August 30th 2021
3. Agriculture SAG meeting #2 – November 29th 2021
4. Urban SAG meeting #2 – December 9th 2021
5. Small communities SAG meeting #2 – December 14th 2021
6. Environment SAG meeting #3 – February 23rd 2022

*The final stakeholder advisory group workshop in May 2023 will convene members across all five groups to present project results for feedback and crowdsource input for the project’s extension.*

On May 8th, 2023 we convened the final project workshop to provide an overview of the progress made during the project and to receive feedback for improvements to be made during the extension period. Alvar Escriva-Bou presented methodologies behind the development of multisectoral drought indicators which combine a variety of factors not integrated into standard drought monitoring systems. He also outlined ongoing work examining drought vulnerability and exposure levels throughout the state. Ted Grantham presented about environmental drought indicators. The team received feedback on how indicators can best be refined to support drought assessment approaches.

In addition to our stakeholder group workshops, the core research team also followed up with interested stakeholders to more thoroughly discuss questions and ideas that came up during those meetings. These stakeholders include state officials from the California Department of Water Resources, the State Water Resources Control Board (April 2022), the California Water Data Consortium (May 2022), the California Urban Water Agencies (CUWA) (January 2022), and the California Water Commission (March 2023).

### External publications and events

In addition to our ongoing engagement with the project’s stakeholder groups, we have disseminated initial project results to the public through the circulation of publications like blogs and policy briefs, and public events. First, a component of our updated factsheet “[Drought in California](https://www.ppic.org/publication/droughts-in-california/)” included a review of the previous drought’s impacts across regions and sectors, and reached over four thousand readers. In addition to our factsheet on drought, the first blog in our series on current drought conditions in California, “[California’s Latest Drought in 4 Charts](https://www.ppic.org/blog/californias-latest-drought-in-4-charts/),” provided a comparison across multiple indicators of drought between the 2012-16 drought and recent years. This blog reached over seven thousand members of the public in the month following its release. Figures from the factsheet and the blog have also been featured by the [Washington Post](https://www.washingtonpost.com/local/2021/05/21/california-drought-emergency-fires/) and by NIDIS in their [June California-Nevada Drought Status Update](https://www.drought.gov/drought-status-updates/drought-status-update-california-nevada-4), further broadening their reach. The second blog in this series focused on current drought impacts, “[Anticipating and Addressing the Impacts of the Drought](https://www.ppic.org/blog/anticipating-and-addressing-the-impacts-of-the-drought/),” delved deeper into how urban communities, small communities, agriculture, and ecosystems can respond to drought conditions, and provided sector specific recommendations.

Dove-tailing off of this blog series, our May 2021 “[Is California Ready for Drought](https://www.ppic.org/event/is-california-ready-for-drought/)” event offered a dynamic discussion about reducing the drought’s impacts on California’s most vulnerable sectors, and reached about 1,800 viewers. Additionally, we shared initial components of our team’s work on groundwater level projections and the risk of residential wells going “dry” in our commentary with Rich Pauloo in CalMatters, “[How better data can help California avoid a drinking water crisis](https://calmatters.org/commentary/my-turn/2021/06/how-better-data-can-help-california-avoid-a-drinking-water-crisis/),” which provides a forecast of where residential wells may be impacted by the drought if conditions persist.

In November 2021, we published another update the current drought conditions in California, “[The Current Drought: Time to Hope for the Best, Prepare for the Worst](https://www.ppic.org/blog/the-current-drought-time-to-hope-for-the-best-prepare-for-the-worst/).” This publication included an analysis of conditions and a forecast of potential scenarios moving forward, alongside policy recommendations for various sectors across the state. In the same month, work from this project also contributed to components of a California Water Blog commentary, [Managing Water Stored for the Environment During Drought](https://californiawaterblog.com/2021/11/07/managing-water-stored-for-the-environment-during-drought/). Later in December 2021, we published a review of urban water conservation efforts, “[Are California’s Cities Conserving Enough Water?](https://www.ppic.org/blog/are-californias-cities-conserving-enough-water/)”, which compared present day water saving efforts to those made in the previous drought.

Lastly, in April 2022, we published a new policy brief, [Drought and California’s Agriculture](https://www.ppic.org/publication/policy-brief-drought-and-californias-agriculture/) , which assesses the economic impacts the 2021 drought conditions had on California farmers. Upon release, we also organized a virtual event on April 21st 2022, [Farming in a State of Extremes](https://www.ppic.org/event/farming-in-a-state-of-extremes/?utm_source=ppic&utm_medium=email&utm_campaign=event), with panelists from representatives from the Governor’s Office, local irrigation districts, and a local farmer.

### Conferences and academic publications

For more academic dissemination of the results, core project team members have also presented our results at various conferences in the last year including the California Collaborative Data Summit in August 2021, the American Geoscience Union (AGU) Fall Meetings in December 2021 and 2022, the Salmonide Restoration Federation’s Annual Meeting in April 2022, and the E&J Gallo Water Summit in May 2022.

Additionally, project partners Ted Grantham and Jeff Mount submitted a paper on Rebuilding Resilience: Drought and Declining Freshwater Species in California in [January/February 2023 Water Resources IMPACT magazine](https://www.awra.org/AWRA/Members/Publications/IMPACT.aspx).

### Stakeholder Advisory Group Participants

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| --- | --- | --- |
| **Name** | **Advisory Group** | **Organization** |
| Michael Anderson | Science | DWR |
| Amanda Sheffield | Science | NOAA-NIDIS |
| Dennis Lettenmaier | Science | UCLA |
| Justin Huntington | Science | Desert Research Institute |
| Noah Molotch | Science | University of Colorado Boulder |
| Alan Haynes | Science | NOAA/NWS California Nevada River Forecast Center |
| Liz Kiteck | Science | USBR |
| Claudia Faunt | Science | USGS |
| Erik Ekdahl | Science | SCWRB |
| HB Zeff | Science | US Bureau of Reclamation |
| Molly White | Science | DWR |
| Julie Zimmerman | Environment | The Nature Conservancy |
| Ann Hayden | Environment | Environmental Defense Fund |
| Sandra Johnson | Environment | Cal Trout |
| Rachel Johson | Environment | NOAA |
| Ted Sommer | Environment | DWR |
| Peter Moyle | Environment | UC Davis |
| David Herbst | Environment | UC Santa Barbara |
| Avril Horne | Environment | University of Melbourne |
| Sarah Null | Environment | Utah State |
| Les Grober | Environment | SWRCB |
| Ali Forsyth | Environment | Sites Reservoir Project |
| Kristal Fad | Environment | Department of Fish and Wildlife |
| Cindy Paulson | Urban | CUWA |
| Brad Coffey | Urban | MWD |
| Jeff Stephenson | Urban | San Diego County Water Authority |
| Richard Atwater | Urban | Foothills Municipal Water District |
| Ken Jenkins | Urban | California Water Service |
| David Mitchell | Urban | M. Cubed Consulting |
| Rosemary Menard | Urban | City of Santa Cruz |
| Joshua Haggmark | Urban | City of Santa Barbara |
| Katie Evans | Urban | Coachella Valley Water District |
| James Nachbaur | Urban | SWRCB |
| Julia Eckstrom | Urban | DWR |
| Jessi Snyder | Small communities | Self-Help Enterprises |
| Mary Pitto | Small communities | Rural County Representatives of California |
| Sidd Nag | Small communities | Rural County Representatives of California |
| Erick Orellana | Small communities | The Community Water Center |
| Julia Ekstrom | Small communities | DWR |
| Stephanie Anagnoson | Small communities | Madera County |
| Ross W. Miller | Small communities | Tulare County |
| Natalie Stork | Small communities | SWRCB |
| Andrew Altevogt | Small communities | SWRCB |
| Courtney Howard | Small communities | County of San Luis Obispo |
| Adan Ortega | Small communities | California Association of Mutual Water Companies |
| Sarge Green | Small communities | California Water Institute at Fresno State |
| Jonathan Rash | Small communities | Indian Health Services |
| Amrith Gunasekara | Agriculture | CDFA |
| Karen Ross | Agriculture | CDFA |
| Kristin White | Agriculture | USBR |
| Wendy Rash | Agriculture | USDA |
| David Guy | Agriculture | Northern CA Water Agency Association |
| Tom McCarthy | Agriculture | Kern County Water Authority |
| Dan Sumner | Agriculture | UC Davis |
| Kim Brown | Agriculture | Wonderful Company |
| Robynn Grimm | Agriculture | Environmental Defense Fund |
| Jon Reiter | Agriculture | Cavalrei |
| Dave Puglia | Agriculture | Western Growers Association |