

CLIMATE:**Dusty federal rules complicate water management in parched West**

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California wine country was parched early in the winter of 2012.

So Sonoma County Water Agency chief engineer Jay Jasperse was relieved when a major storm blew in that December, dumping buckets of rain that filled Lake Mendocino, the agency's reservoir on the upper Russian River.

Then Jasperse watched in misery as the Army Corps of Engineers drained that water to make room in the reservoir in case another big rain fell on the flood-prone region.

The corps was following its rules for the reservoir -- an operations manual that Mother Nature ignored.

"It basically quit raining through 2013 and early 2014," Jasperse said. "We had the driest year in over 400 years based on tree ring studies, and so we're all looking back and a lot of folks in the community are saying, 'Why didn't we hang onto the water that was released by the corps in December 2012?'"

With climate change expected to shift precipitation and snowmelt patterns, federal rules that have long governed water management in the West are making it difficult to balance supply and flood protection.

Already, warmer temperatures are causing winter precipitation to fall as rain rather than snow in the mountains that provide much of California's drinking water. And the mountain snowpack is melting earlier in the season, rather than during the spring and summer months when users rely on it for water supply.

But winter and early spring are when the region tends to see intense storms fed by "atmospheric rivers" that dump massive amounts of water in a very short period of time -- a big flood risk.

The average atmospheric river moves an amount of vapor 10 times what the Mississippi River dumps as water into the Gulf of Mexico, according to Marty Ralph, director of the [Center for Western Weather and Water Extremes](#) at Scripps Institution of Oceanography. These storms provide between a third and a half of the region's average annual rainfall and snowpack, he said.

Although research on atmospheric rivers is in its early stages, the West Coast has long been lashed by storms they spawn and built reservoirs to accommodate their deluges.

For reservoirs where the Army Corps handles flood control, the agency wrote manuals with "rule curves" delineating how much water can be stored in the reservoir during different times of the year.

During fall and winter, water levels are kept low to leave room for runoff in big storms.

When spring comes, the reservoir is allowed to refill and water levels are kept higher during the summer when the risk of storms is low. Then, when fall comes, the reservoir is drawn back down to create flood space.

But with warming temperatures pushing the snowmelt season earlier, the season when runoff needs to be captured for water supply begins to overlap with the time when major storms still pose a flood risk.

"The big dilemma is, if you drain the reservoir in the fall a fair bit in order to make room for a possible flood in the winter, but then you don't get enough rain when you're officially able to refill in the spring, there's no water to refill with," Ralph said.

'Slide rules and pencils, not computers'

Water management is complicated in the West because there's more than one agency overseeing many dams.

The Army Corps often manages flood protection, so it prefers to keep as little water in the reservoir as possible, while the Bureau of Reclamation or local agencies like the Sonoma County Water Agency manage for water supply and tend to angle for as much water as possible.

Hydropower, environmental and recreation interests are also part of the equation.

Some say divided management responsibilities help ensure that any decision is given full attention. But others argue that because managers must follow the Army Corps' manuals first, flood control is given the upper hand.

"The corps' manual is No. 1 on the hierarchy," said Ron Stork with Friends of the River in Sacramento. "You can do anything you want with the dam as long as it doesn't interfere with the corps' manual."

Moreover, many of the manuals are decades old, and activity and development in the watershed have often changed dramatically since the rules were first written.

For example, the rule curve at Lake Mendocino hasn't been updated since 1959. Over the years, Sonoma County agriculture has shifted from orchards to vineyards, cities have grown, and inflows from a neighboring hydroelectric tunnel have been cut. The National Environmental Policy Act has also inserted endangered species concerns into the mix.

"A lot of these rule curves literally were done when the corps was using slide rules and pencils, not computers, and that's just outrageous," said Melissa Samet, senior water resources counsel for the National Wildlife Federation.

A number of groups, ranging from environmental organizations to the state of California, have been pressing the corps to regularly update its manuals.

But the corps contends that engineers have long accounted for climate variability in their planning.

"To say that climate change wasn't contemplated is almost wrong -- anytime you do water resource engineering, you build some sort of adaptive capacity into it, because the process of identifying how much flow of water you're going to have at a given location is uncertain," said Stu Townsley, flood risk program manager for the Army Corps' South Pacific Division. "It's a remarkably robust process."

Still, Townsley acknowledged that if current climate predictions prove correct, rule curves will likely have to be updated -- a pricey proposition that could potentially require new congressional authorization.

"Frankly, we're just not really funded," Townsley said. "This would come out of the corps' operations and maintenance budget, and that budget's been in essence flatlined for the past 30 years. We're literally confronted with, should we pay to keep a dam tender in there to make a gate change, or can we support these kinds of studies?"

Is flexible water management possible?

What many stakeholders would like to see is for modern weather forecasting to be incorporated into reservoir management.

"The fundamental runoff patterns, we know, are changing -- have changed -- as has the weather science," Rep. Jared Huffman (D-Calif.), who represents Sonoma County, said in an interview. "From both ends of that, you've got an overwhelming case for updating these manuals."

Huffman, who previously worked as an attorney for the Natural Resources Defense Council as well as the director of the Marin Municipal Water District, introduced legislation ([H.R. 3988](#)) earlier this month to require the corps and the National Oceanic and Atmospheric Administration to review whether weather and runoff forecasting can improve reservoir operations in some cases.

Those on the water supply side hope modern weather forecasting and better monitoring throughout the watershed could open the door to a fundamental rethinking of how reservoirs are managed.

"With the rule curve, there's not that much room in terms of increasing the water supply function," said Chris Delaney, senior engineer at the Sonoma County Water Agency.

But with the ability to see coming storms even just a few days out, water managers could store extra water in the reservoir during winter months and then release it to make room for runoff if a major storm were predicted, he said.

"You would basically remove the line and operate the whole pool in benefit of water supply," Delaney said. "Or, if you had a large event, you might actually drain the reservoir extra in order to increase that flood control option."

That type of flexibility is being contemplated now as the corps works with stakeholders to update its manual for Folsom Dam near Sacramento during a major construction project.

Whether the science and forecasting ability are to the point where water managers feel confident making updates related to climate change varies by location, said David Raff, the Bureau of Reclamation's new scientific adviser, who has long worked on water and climate issues.

"It is very regionally dependent," he said. "And yet we start to see trends and agreement amongst models that is enough information to start to adapt to climate change."

Ralph, the atmospheric rivers researcher, said meteorologists can currently offer forecasts about three days out that are accurate enough for reservoir operators to start paying attention. But how much extra water that could allow to be held back also depends on how quickly the rules allow water to be released without causing environmental and flood risk concerns downstream.

"I think the advances we're making in atmospheric rivers and prediction offer the potential for a breakthrough advance for how to do this in the future," Ralph said. "But nobody in their right mind would sign on to do this without a serious demonstration."

But then there's another problem: There's only so much wiggle room for the agencies without congressional involvement, federal managers say. The corps in particular has a reputation for being risk-averse, not wanting to chance the possibility of not being able to perform the tasks it's responsible for, even if there are big benefits on the other side.

If Congress approved a dam to be built for flood control 40 years ago, that's still its purpose today unless lawmakers formally change it.

Reclamation is also facing the possibility of having to go back to Congress for authorizations if the conversations it is having now with communities about the future climate and water-demand challenges in Western river basins yield proposals for new reservoirs or changes in the flood control rules.

Raff said any such proposal would need to be "darn near consensus for it to be viable."

But, he said, "I don't think that there are very many subjects or opportunities with regard to that that are wins just about everywhere."

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