

**BAY AREA WATER SUPPLY AND CONSERVATION AGENCY  
BOARD OF DIRECTORS MEETING**

**September 11, 2015**

Correspondence and media coverage of interest between August 25, 2015 and September 10, 2015

**Correspondence**

From: Nicole Sandkulla, BAWSCA CEO/General Manager  
To: Charles Ice, San Mateo County Environmental Health  
Date: September 8, 2015  
Re: BAWSCA Comments on San Mateo County Revised Groundwater Assessment Plan for San Mateo Plain

**Media Coverage**

**Drought:**

Date: September 10, 2015  
Source: Pasadena Now  
Article: In Pasadena, State's Water Czar Gives the Big Picture on California's Drought

Date: September 8, 2015  
Source: San Jose Mercury News  
Article: With El Nino threatening to turn California's drought into drenching winter, worries mount

Date: September 2, 2015  
Source: WaterWorld  
Article: Investment in CA water irrigation improvements paying off amid drought

Date: September 2, 2015  
Source: SJ Mercury News  
Article: Menlo Park: Lawn Be Gone program good for another \$80,000 in rebates

Date: August 30, 2015  
Source: Sacramento Bee  
Article: When the wells run dry: California families cope in drought

Date: August 25, 2015  
Source: Water Deeply  
Article: In Future Droughts, Big Storms Decide California's Fate

**Water Supply:**

Date: September 9, 2015  
Source: NBC Bay Area  
Article: San Francisco's New Source of Water Comes From Unlikely Place: the Ground

## **Water Supply, cont'd:**

Date: September 9, 2015  
Source: AgAlert  
Article: Progress reported on planning for Sites Reservoir

Date: September 9, 2015  
Source: Daily Journal  
Article: Final pipe laid in \$4.8 billion seismic upgrade: San Francisco Public Utilities Commission replaces San Bruno line, is nearing end of Water System Improvement Program

Date: September 9, 2015  
Source: Orange County Register  
Article: Drip, drip, drip goes the desalination plant permit process

Date: September 8, 2015  
Source: San Jose Mercury News  
Article: Pipeline replacement, drought top NCCWD issues

Date: September 7, 2015  
Source: The Californian  
Article: Groundwater management urgently needed

Date: September 7, 2015  
Source: USA Today  
Article: 8 states running out of water

Date: September 4, 2015  
Source: LA Times  
Article: Purified wastewater triggers release of arsenic within aquifer, study finds

Date: September 2, 2015  
Source: Associated Press  
Article: State orders California firm to stop tapping Sierra springs

Date: August 30, 2015  
Source: Sacramento Bee  
Article: Time for another water bond? Draft language floating

Date: August 28, 2015  
Source: SF Chronicle  
Article: A future of dams



September 8, 2015

Mr. Charles Ice  
San Mateo County Environmental Health  
2000 Alameda de las Pulgas, Suite 100  
San Mateo, CA 94403

Dear Mr. Ice:

**Subject: Revised Groundwater Assessment Plan for San Mateo Plain**

The Bay Area Water Supply and Conservation Agency (BAWSCA) is pleased to have had the opportunity to provide early comments to San Mateo County (SMC) on the *Revised Groundwater Assessment Plan for San Mateo Plain* (Plan). BAWSCA represents the interests of 24 cities and water districts, an investor-owned utility, and a university, that purchase water wholesale from the San Francisco Regional Water System. These agencies, in turn, provide water to 1.7 million people, businesses and community organizations in Alameda, Santa Clara and San Mateo counties. As the San Mateo Plain Subbasin (Basin) is overlain primarily by BAWSCA member agencies that utilize the Basin supplies to varying degrees, BAWSCA has a direct interest in ensuring the reliability of the Basin.

As part of its long term planning efforts, BAWSCA recently completed its Long-Term Reliable Water Supply Strategy (Strategy) Phase II Final Report (February 2015). The goal of BAWSCA's Strategy is to ensure that a reliable, high-quality supply of water is available where and when people within the BAWSCA member agency service area need it. As part of this effort, BAWSCA has an interest in local groundwater and has invested in the development of the Strategy Groundwater Model. BAWSCA is happy to share the Strategy Groundwater Model with SMC, and hopes that this regional tool can be helpful to SMC. BAWSCA looks forward to working cooperatively with SMC, and other Basin stakeholders, as SMC proceeds with the Plan.

In addition, BAWSCA is proposing to form a Groundwater Reliability Partnership (Partnership) for the Basin with the following proposed goals:

- Increase understanding of the hydrology and geology of the Basin;
- Increase communication and promote information sharing between groundwater users and other stakeholders; and
- Continue current sustainable use of the Basin to maintain groundwater quality and quantity.

In support of this Partnership, BAWSCA will host a series of public meetings to discuss and refine these goals, to provide a forum for groundwater users and other stakeholders to share information, and then work toward an agreed upon set of goals. BAWSCA hopes that SMC staff will attend and contribute to these meetings.

Mr. Charles Ice  
September 8, 2015  
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BAWSCA would like to thank SMC for the opportunity to review early drafts of the Plan and provide input. BAWSCA looks forward to continued future collaboration with SMC and opportunities to provide input on the Plan as it is developed.

Sincerely,

A handwritten signature in cursive script that reads "Nicole Sandkulla". The signature is written in black ink and is positioned above the printed name and title.

Nicole Sandkulla  
CEO/General Manager

cc: Board of Directors  
Water Management Representatives  
Allison Schutte, Hanson Bridgett

## **In Pasadena, State's Water Czar Gives the Big Picture on California's Drought**

*Felicia Marcus, chair of the State Water Resources Control Board, delivered a message of hope and pragmatism to a Pasadena service club Wednesday*

Pasadena Now | September 10, 2015 | Eddie Rivera

California's current drought situation is bad. Really bad. How bad? It is the third worst in the state's history, topped only by droughts in 1977 and 1924. It is the worst ever in terms of its impact.

More than 400,00 agricultural acres have gone fallow. More than 17,000 agricultural jobs have been lost. 2013 was the driest year ever, and 2014 was the hottest. Ever.

All of California's reservoirs are low, and the Sierra snowpack from which most of our water derives, is also at a low point.

But Felicia Marcus, chair of the State Water Resources Control Board, is nothing if not pragmatic. And somewhat optimistic. As she told the weekly meeting of Pasadena's Rotary Club at the University Club, it's important to "look at the big picture."

"I'm going to tell you what to say to your friends who say, 'If only those idiots at so and so would just do that one thing,'" she told the group.

"My view," she said, "is that no one is an idiot, and that we have to do all of those things."

First, some background. She was appointed by Governor Jerry Brown to the State Water Resources Control Board in 2012, and designated as Chair in April of 2013. Under her leadership, the Board implements both federal and state laws regarding drinking water and water quality, and it implements the state's water rights laws. According to their website, the Board sets statewide water quality, drinking water, and water rights policy, hears appeals of local regional board water quality decisions, decides water rights disputes, and provides financial assistance to communities to upgrade water infrastructure.

Before her appointment to the Water Board, Marcus served in positions in government, the non-profit world, and the private sector. In government, Felicia served as the Regional Administrator of the U.S. EPA Region IX in the Clinton Administration where she was known for her work in bringing unlikely allies together for environmental progress and for making the agency more responsive to the communities it serves, particularly Indian Tribes, communities of color, local government, and agricultural and business interests. While at U.S. EPA, Felicia worked extensively on the range of environmental issues under EPA's jurisdiction, most heavily in air quality, Bay-Delta water, tribal, and US-Mexico border issues.

Okay, back to the drought. California has actually been aggressively responding to the situation on numerous fronts, said Marcus. The state has implemented drought task forces, issued drought orders, has instituted more recycling, and developed new regulations on urban water use.

“We need to pray for the best,” she said, “but plan for the worst.” She compared California’s drought to Australia’s in 2014, which saw thousands of farmers go under, and tens of thousands of jobs be eliminated as the government refused to assist farmers and businesses, saying that drought was a natural disaster, much to the fury of both farmers and citizens.

In Sao Paulo, Brazil, on the other hand, rain is plentiful and common, yet the reservoirs are empty. People see green everywhere, but don’t realize that not enough water is being saved. The result, according to [circleofblue.org](http://circleofblue.org), a water and resource think tank, is a “landscape that belies the severity of the water crisis and a skewed perception that complicates voluntary conservation efforts—Sao Paulo’s primary tool for ensuring adequate water supplies in the short-term.”

Which brings us to the widely predicted El Nino this fall and winter.

“We think it should be strong,” said Marcus, “but the question is where? We think we are going to see a lot of precipitation in Southern California, but not as much in Northern California,” for example. This means less snowfall in the Sierras, and of course, the state needs both rain and snow to replenish the snowpack.

Anticipating that, the state has actually had a 25% reduction in water use, thanks to various specific regulations, as well as emergency conservation regulations.

“We are getting results,” said Marcus. But meanwhile, sea levels are currently rising due to climate change, and groundwater is being contaminated, she said.

“About 500,00-2 million people in the Central Valley are drinking some kind of contaminated water,” she said.

“This is why we need to protect our groundwater, and we did pass historic groundwater protection legislation last year as well. That took us 100 years,” added Marcus. “And state water agencies are working together better than ever, as well, which is also helping the state steer through the crisis.

And, she contends, things could be worse, a lot worse.

“We need to deal with reality, not rhetoric,” she says, and she thinks California is doing just that, through a combination of legislation, local leadership and numerous water action plans.

The state is about as prepared as it can be, thanks to some foresight and planning, but given the vagaries of rainfall and weather, drought management is a tricky business.

Essentially, you can wait for rain, or you can make plans to be without it.

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## **With El Niño threatening to turn California's drought into drenching winter, worries mount**

SJ Mercury News | September 8, 2015 | Bruce Newman

Among all the apocalyptic disasters that Californians routinely prepare for -- earthquake, drought, wildfire, carnageddon -- the most welcome is rain, even though giant El Niño events like the one currently massing in the Pacific can bring their own set of calamities: flooding, mudslides, carnageddon with hydroplaning.

After four years of drought, creeks and rivers flowing through the Bay Area are more trickle than torrent. But weather scientists are recording water temperatures in the Pacific nearing the highest they've ever seen, suggesting El Niño will open an atmospheric fire hose in the jet stream this winter. That's caused a rising tide of anxiety that has left even the highest-and-driest Californians on edge.

Across the Bay Area, roofers and tree-trimmers are so busy preparing for the onslaught that many have stopped accepting new jobs. And public works crews are shoring up creek beds, clearing storm drains and stocking up on sandbags in preparation.

The pre-El Niño buzz is already building along the banks of the San Francisquito Creek in below-sea-level East Palo Alto, and on rooftops from Alamo to Morgan Hill.

As the final nails were being driven into a new roof on Charles Hwuang's Alamo home this week, he said he would sleep better this winter. "Hearing about El Niño made me more nervous," Hwuang said, "made me do something about it sooner rather than later. I'll sleep better tonight."

The last "very strong" El Niño winter of 1997-98 left 17 Californians dead and property damage of \$550 million in its wake. It also brought San Francisquito Creek, quite literally, to the Palo Alto doorstep of Kevin Fisher. His was one of 1,700 Peninsula properties damaged when the creek overtopped its banks after a month of steady rains. "It was like being in an aquarium," Fisher said, recalling the water's ominous rise outside a picture window facing his backyard.

If the rains come in quick succession, city storm drains in low-lying places like Pinole and Hercules in the East Bay can be counted on to back up and turn the streets into rivers.

"A few days of heavy rain, you'll have flooding throughout the Bay Area," said Bill Allenbaugh, of El Sobrante, owner of Bill's Defensive Driving School. "That's when it's more likely there are going to be rear-end accidents with multiple vehicles involved. People just don't pay attention. They drive at a certain speed, then it starts raining and they drive at the same speed. You can't do that!"

Workers with the Santa Clara Valley Water District do repair work on a levee along Lower Penitencia Creek in Milpitas, Calif., Thursday, Aug. 27, 2015. The

Workers with the Santa Clara Valley Water District do repair work on a levee along Lower Penitencia Creek in Milpitas, Calif., Thursday, Aug. 27, 2015. The work is being done in

anticipation of potential flood waters triggered by expected heavy winter rains, spurred by the "El Nino" effect. (Patrick Tehan/Bay Area News Group) ( Patrick Tehan )

The roar of chain saws is likely to get louder this winter as PG&E crews respond to power outages caused by the drought-weakened timber. "I think we've had 5,000 major trees die," said Gary Kremen, chairman of the board of the Santa Clara Valley Water District, which for months has been urging its customers to conserve water, and now must prepare to provide them with sandbags for flood control -- in a very real sense the sky is falling.

Everyone wants this to be the deluge that douses the drought, but too much rain coming down too fast could sink low-lying communities like Alviso, East Palo Alto and Fisher's neighborhood, which is a mile and a half southeast of San Francisquito Creek.

"Lives are at stake when it floods in East Palo Alto," Kremen said. "In the 1998 flood, people almost died there. And it's going to come. We will get some floods."

"What people don't realize is that San Francisquito Creek drains 40 square miles of the Santa Cruz Mountains," says Fisher, an engineer, who had a narrow middle-of-the-night escape the last time, carrying his two small children, dog and elderly mother-in-law to a neighbor's SUV after his family vehicles were flooded.

That night, the city of Palo Alto "got caught totally flat-footed," Fisher said. "They didn't have a clue." Since then, an auto-dialer system to alert residents that the creek could flood has been installed, and a monitoring system allows anyone to watch the creek rise on their computer. "But it's been nearly 20 years," Fisher said, "and truthfully, in terms of the flood risk, there's been zero change. I think another flood would just about do us in."

To prevent anybody being done in by the next El Niño, San Mateo and Santa Clara counties created the Joint Powers Authority (JPA), which has taken a special interest in the Pope-Chaucer Street Bridge, a chokepoint on San Francisquito Creek that sits at the juncture of Palo Alto, Menlo Park and East Palo Alto. Crews were out last week shoring up the creek's banks, and if the water gets dangerously high this winter, they will be back with sandbags and inflatable flood walls -- berms filled, perversely, with water.

In the heart of tech-savvy Silicon Valley, the preposterously low-tech burlap bag filled with sand remains the most sophisticated weapon to fight flooding. "Short of actually building a big engineered solution," JPA Executive Director Len Materman said, "sandbags are the tried-and-true solution."

The East Bay Municipal Utility District, which has no responsibility for flood control, maintains a stockpile of sandbags to prevent its water treatment plant from being flooded by an El Niño monsoon. "There's a lot of talk about what needs to be done this fall to be ready for it," Abby Figueroa, the district's spokeswoman, said. "It's on everyone's mind."

On an average day, the west Oakland water treatment plant gets about 60 million gallons of wastewater. During the sort of unhalting storms El Niño can bring, groundwater leaks into cracks



in the sewer pipes and the volume of wastewater can triple, overwhelming the system and sensitive noses near the Bay Bridge. Figueroa said if the plant's capacity remains maxed out for too long, it releases "partially treated sewage" into the bay.

Four years of dry winters have lulled many homeowners into a false sense of security about the fitness of their roofs to withstand an El Niño pounding, said Jeff Tamayo, co-owner of Town & Country Roofing in Brentwood. His company would hire 25 additional workers if Tamayo could find them, which is why his crews are booked two months out.

"What happens historically is people wait for it to start raining before they call for a roof repair," he said. "And by then it's too late. We'll be a month to six weeks out before we can get to them. With a heavy downpour and strong winds, things that should never, ever leak all of sudden leak very bad."

Of course, there is no guarantee the coming storms will deliver the marauding moisture marinade that will recharge aquifers, refill reservoirs and leave a sable of snow in the Sierra to melt our troubles away. "All the forecasts we've seen so far are about El Niño conditions. They're not rainfall forecasts," meteorologist Jan Null, of Golden Gate Weather Services, said. "We don't know what we're going to get."

The faster one storm is followed by another, the less water the ground can absorb, causing the kind of runoff that led to 33 landslides along Portola Valley's Alpine Road during the '97-98 El Niño storms. Because Kevin Fisher lives in what the Federal Emergency Management Agency has designated a floodplain, he is part of the tiny fraction of Californians who have flood insurance. About 8.3 million homeowner policies were in effect in 2011, according to the Association of California Insurance Companies, a private trade association, and yet as of this year only 232,651 of those included flood coverage. That's 3.6 percent, compared to the 10 percent who carry earthquake insurance.

"Flood is not covered in a homeowners insurance policy," said Nicole Mahrt Ganley, the group's spokeswoman. "People talk about getting physically prepared for disaster, but they don't always talk about being financially prepared. Even if you're not required to have it, that doesn't mean that it's not a good idea." And flood insurance requires a 30-day waiting period to take effect.

Along the bone-dry banks of the San Francisquito, you can almost hear the lyrics of the old Johnny Cash song, If the good Lord's willing and the creeks don't rise. Fisher doesn't know the words, but he's heard the tune before. "Of course I'm worried," he said. "We all are."

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## **Investment in CA water irrigation improvements paying off amid drought**

WaterWorld | September 2, 2015

DAVIS, CA, Sept. 2, 2015 -- Thanks to irrigation improvements across the state of California -- which agricultural producers have implemented with help from the Natural Resources Conservation Service (NRCS) -- many farmers remain successful despite severe water cutbacks amid ongoing drought.

A good example is Tehama County rancher Sam Williams, who participated in a Farm Bill project in the Anderson Cottonwood Irrigation District (ACID) in 2010. Williams is using 37-percent less irrigation water, due to improved irrigation water efficiency, and his fields have stayed lush and green despite 25-percent water curtailments in 2014 and again this year. Likewise, he said that he has hardly been affected by the drought.

"It's saving a lot of water; the new system is much more efficient," said Williams. "It used to take me four days to irrigate everything. Now ... I can do it in 24 hours. I had an old concrete pipeline, and I had leaks out the top, and probably the bottom and sides too. There's no telling how much water was lost. I didn't dream we'd improve it this much."

Working with NRCS, Williams was able to install nearly 6,000 linear feet of PVC pipeline to replace old leaky concrete pipes that supplied irrigation water to 130 acres of pasture and a small orchard. Several water structures were also installed to control flow, and NRCS redesigned his system so it works on the natural grade, increasing water pressure.

NRCS Civil Engineer Technician Moises Lozano agrees that Williams is saving a significant amount of water with the improved system. "He would use about 640 acre feet of water per season before the improvements," said Lozano. "Based on the irrigation design and last year's irrigation history, we calculate that he only applied 402 acre feet of water last season. That's a 37-percent water savings -- about 78 million gallons of water per year that he was able to save. That's about the same as 118 Olympic-sized swimming pools."

Water efficiency resulting from Williams' improvements and similar work done by 53 other program participants in Shasta County have helped all of ACID's customers to weather the drought. It has also saved the District a lot in pumping costs.

ACID General Manager Stan Wangberg said that improvements implemented by customers, as well as improvements carried out by the District itself, are what made it possible to deliver the water needed by customers despite 25-percent mandatory water cutbacks in 2014 and again in 2015 resulting from the severe drought.

Between 2010 and 2013, 54 landowners in the ACID service area participated in the local project. Together they installed more than 28,000 feet of pipe and 61 water control structures to

improve water efficiency. That was in addition to 12,000 linear feet of pipe and new laterals that the District installed as part of its own system improvement plan.

The ACID project was funded through the former Agricultural Water Enhancement Program, a 2008 Farm Bill program that was replaced in the 2014 Farm Bill by the Regional Conservation Partnership Program (RCPP). RCPP will continue to fund similar conservation projects and priorities in tandem with select partners.

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## **Menlo Park: Lawn Be Gone program good for another \$80,000 in rebates**

SJ Mercury News | September 2, 2015 | Kevin Kelly

MENLO PARK -- A program that gives rebates to residents who rip up their lawns to save water got another boost.

The City Council recently allocated up to \$80,000 to continue the Lawn Be Gone program, which Menlo Park launched three years ago in partnership with the Bay Area Water Supply and Conservation Agency. Because the city manager can only sign off on expenditures that cost less than \$50,000, the council had to act.

Because so many residents and businesses put their names on a waiting list to participate, the program in 2014 began paying up to \$80,000 in rebates, up from \$15,000 each of the first two years. Funding for the program is distributed evenly between commercial and residential customers in the Menlo Park Municipal Water District, with each sector getting up to \$40,000. A state grant covers about 19 percent of the program.

Each square foot of lawn swapped out for drought-tolerant plants and materials is eligible for \$2. The city estimates that the total cost to replace each square foot of lawn is \$3.

In the 2014-15 fiscal year, the city approved 14 Lawn Be Gone applications -- 10 residential projects and four commercial projects -- which together saved an estimated 1.25 million gallons of water. According to the city, every square foot of lawn removed saves an average of 26 gallons a year.

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## **When the wells run dry: California families cope in drought**

Sacramento Bee | August 30, 2015 | Scott Smith

Tulare, CA - Looking for water to flush his toilet, Tino Lozano pointed a garden hose at some buckets in the bare dirt of his yard. It's his daily ritual now in a community built by refugees from Oklahoma's Dust Bowl. But only a trickle came out; then a drip, then nothing more.

"There it goes," said Lozano, a 40-year-old disabled vet, masking his desperation with a smile. "That's how we do it in Okieville now."

Millions of Californians are being inconvenienced in this fourth year of drought, urged to flush toilets less often, take shorter showers and let lawns turn brown. But it's dramatically worse in places like Okieville, where wells have gone dry for many of the 100 modest homes that share cracked streets without sidewalks or streetlights in California's Central Valley.

Farming in Tulare County brought in \$8.1 billion in 2014, more than any other county in the nation, according to its agricultural commissioner. Yet 1,252 of its household wells today are dry, more than all other California counties combined.

Lozano, a 40-year-old disabled vet and family man, has worked with his neighbors to rig lines from house to house, sharing water from a well deep enough to hit the emptying aquifer below. County trucks, funded with state drought relief money, fill 2,500-gallon tanks in many yards. Residents also get containers of drinking water, stacking them in bedrooms and living rooms.

These "Third-World-type conditions" are hidden from plain sight, says Andrew Lockman, of Tulare County's Office of Emergency Services. "It's not an earthquake or flood where you can drive down the street and see the devastation."

Okieville is quiet, dry and hot. Close your eyes and you're likely to hear a rooster crow or a dog bark. Agriculture is the main employer, and for miles around, dense fields of deep green cornstalks grow as feed for dairy cows. Alfalfa, almond, oranges and grapes abound. Residents express pride in their town, and support the need for irrigation.

"They need water for the cows," said Okieville resident and tire salesman Gilbert Arredondo. "Without dairies we wouldn't have jobs. They produce cheese."

For 150 years, surface canals and underground aquifers turned semi-arid regions of California green, and even in drought, the state produces most of America's fruit, vegetables and nuts.

But the meager Sierra Nevada snowpack doesn't replenish the rivers like it used to, and farmers are drilling ever-deeper wells to compensate for the plunge in surface water. One farm bought its own \$1 million drilling rig just to ensure its supply.

So far, 15 shallower wells used by 23 homes in Okieville are depleted.

Maria Marquez, a 50-year-old widow, panicked when her shower abruptly ended in June 2014. They couldn't afford to move, and who would buy a house without running water? Drilling her own new well would cost more than years of earnings from the food truck where she works.

Unlike Lozano, who rents his home, Marquez was eligible as a homeowner to get a tank installed for washing and flushing, to be filled each Monday by a county truck, as well as bottled water for drinking and cooking through California's \$3.7 billion drought relief program, which includes \$38 million for drinking water and tanks.

"It's our home," said her daughter Judy Munoz, 26. "She doesn't want to leave it behind."

Her neighbor Christine Dunlap, 72, is among the few left with Dust Bowl roots. As with other "Okieville" communities in California, the hundreds of thousands of Midwesterners who migrated west in the 1930s were mostly replaced by migrants from Mexico after the camps evolved into permanent communities.

"We've got used to it," said Dunlap, whose 170 foot-deep well ran dry in February. She's still got family, she said, so "we consider ourselves lucky."

California became the last state in the West to regulate groundwater when Gov. Jerry Brown signed legislation ending a Gold Rush-era policy that generally let property owners take as much as they wanted. A \$7.5 billion water bond measure also approved in 2014 includes \$2.7 billion to boost water storage.

But sustainable alternatives remain years away, and the groundwater supplying nearly 60 percent of the state's needs in dry years is being used up like never before.

Seeking a solution for problems in Okieville, 5 miles outside of Tulare, Maria Marquez welcomed Maria Herrera, an organizer for the nonprofit Self-Help Enterprises, who brought a team of engineers and a lawyer to address about 50 people gathered in her dirt yard. "We have a lot of important items to talk about tonight," began Herrera.

As the night wore on, consensus seemed to grow around forming their own water district, and applying for state and federal grants to pay for two 500-foot deep wells costing about \$2 million. Monthly water bills would be about \$50, and everyone would get reliable water — at least until the surrounding farms dig deeper.

It would take at least two years to design and build it before water flows, engineer Owen Kubit explained.

"I don't think we can last this summer without no water," Arredondo said.

Others nod in frustration.



"We can pray for rain," Kubit said.

Marquez does pray, kneeling alongside one of her granddaughters after the girl's nightly bath.

"God, give us water so we don't have to move," the 4-year-old says, pressing her palms together.

"God, please fill up our tank, so we don't run out of water."

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## **In Future Droughts, Big Storms Decide California's Fate**

Water Deeply | August 25th, 2015 | by Matt Weiser

Climate change is expected to make California more dependent on extreme "atmospheric river" storm events, scientists say

California will become increasingly dependent on the whims of a few big storms to meet water demand, according to research into the effects of climate change.

Already, California is well known for extreme weather events, from the severe drought now gripping the state to the deadly floods and mudslides that can wipe out whole neighborhoods. These are largely triggered by storms called "atmospheric rivers."

Sometimes compared to a horizontal hurricane, an atmospheric river funnels high-velocity winds that pull huge quantities of tropical moisture across the Pacific Ocean. That moisture is concentrated in a narrow band, like a fire hose, that often targets a relatively small area of California, bringing torrential rain, deep snow – and sometimes dangerous flooding. Such storms are also called "pineapple express" events.

The effects of climate change caused by human greenhouse gas emissions are expected to make such storms more severe in the future, said Michael Dettinger, a climate scientist at the U.S. Geological Survey and Scripps Institution of Oceanography. At the same time, routine storm events – that winter pattern of cold Pacific low-pressure systems every two weeks or so – are expected to become less common.

What that means, he said, is that atmospheric rivers will determine whether California has enough water to survive the climate of the future.

Dettinger's work is based on analyzing computer models of the state's future climate, based on different scenarios of greenhouse gas emissions. He spoke on Monday at the California Climate Change Symposium, which continues today in Sacramento.

"Fundamentally what's going on is most of the normal storms, the small storms, decline in all the models," Dettinger said. "The way we'll get wetter is by having the largest storms get wetter. That's not exactly how you want to see it develop."

The reason this happens is that as the atmosphere warms, it becomes capable of holding more water vapor. As a result, atmospheric river storms – already the cause of California's worst natural disasters – are expected to become even more extreme in the future. Dettinger referred to these as the "hell raiser" atmospheric river events.

Therefore, when California does get those big snow- and rain-producing storms, it is more likely that they will also bring damaging floods, mudslides and wave erosion.

The phenomenon is independent of the El Niño condition, the cyclical warming of the equatorial Pacific Ocean every three to five years, which is not directly connected to climate change. Atmospheric rivers can form no matter what El Niño condition is in effect.

“The biggest atmospheric rivers seem to increase dramatically,” Dettinger said. “There aren’t many. But in current projections, they do tend to increase a lot. The way that our precipitation will change in the future is pretty much dictated by what happens to those large storms.”

He pointed out that, even now, droughts are mostly caused when California misses out on big storms. That has certainly been the tale of the current drought.

Although the state has benefited from several large storms over the past four years, they have often come early in the winter season – a time when precipitation is generally not heavy – and then the storms stopped arriving completely.

One cause of this in the current drought is a persistent ridge of strong high pressure looming off the coast that has blocked Pacific storms from reaching the state. Instead, many have been diverted to the north, bypassing California.

Dubbed the “Ridiculously Resilient Ridge” by Stanford graduate student Daniel Swain, the phenomenon is largely unexplained.

“What we find is that having really persistent ridging like this is unprecedented in our historic record,” said Noah Diffenbaugh, an associate professor of Earth System Science at Stanford University. Swain is one of his students. “It’s a really rare occurrence in the current climate – anywhere from century scale to two millennia. It’s clearly bad luck to get this kind of persistent ridging.”

There are indications, however, that such troublesome ridges may become more likely in the future as climate change intensifies.

“There’s some evidence that global warming has made that bad luck more likely,” said Diffenbaugh, who also spoke at the symposium. “It’s less rare than it would have been without any global warming.”

Photo courtesy by Scripps Institution of Oceanography

## **San Francisco's New Source of Water Comes From Unlikely Place: the Ground**

*Groundwater to supply homes and businesses across the city for the first time in nearly nine decades*

NBC Bay Area | September 9, 2015 | Joe Rosato, Jr.

Since the early 1930s, San Francisco's drinking water has flowed from the Hetch Hetchy Valley of northwestern Yosemite, funneling through a myriad of pipes along 167 miles, before landing in city reservoirs and out its taps. Its pristine nature has long been a source of bragging rights for San Francisco's Public Utilities Commission, which even bottles and sells Hetch Hetchy water. But, starting in 2017, a small percentage of the city's drinking water will come from its own backyard as San Francisco taps into its groundwater to help quench its thirst.

"San Francisco hasn't used groundwater for drinking since the 1930s," said Jeff Gilman, the SFPUC's groundwater project manager.

In an effort to diversify its water supply, the city is digging a series of six wells between Golden Gate Park and San Bruno to tap into the underground aquifer. A small amount of the water will be blended with the Hetch Hetchy drinking water, destined for customer delivery.

The groundwater will make-up a minuscule percentage of San Francisco's water use — contributing about 4 million gallons a day to the 65 million gallons the city uses daily. Although the project was set in motion before California's drought fully kicked in, officials said the groundwater project would provide the city an alternative source of water in the event of future droughts and disasters.

"So that gives us some added insurance in the event of some major catastrophe where pipelines are disrupted," Gilman said. "We can count on a local source of drinking water."

Sunset Reservoir is the size of four Costcos and can hold 267 Olympic-sized swimming pools of water. Its twin tanks cover eight city blocks.

The groundwater isn't as sparklingly clean as the snowmelt water flowing out of Yosemite. The SFPUC said tests on the groundwater revealed nitrate levels higher than state standards. But officials said treating it with chlorine and blending a small percentage with Hetch Hetchy water will dilute it to safe levels. And officials said recent taste tests show the water's flavor won't be noticeably altered.

"Our customers won't even discern a difference in the taste or the quality of the water," said Katie Miller, manager of the SFPUC's distribution system.

The city recently temporarily drained one of the twin tanks at Sunset Reservoir in the city's Sunset District for cleaning and to install a large pipe that will feed the newly-tapped groundwater into the massive tanks when the system goes operational in 2017.

“We can bring in very high quality groundwater from 300 feet below San Francisco,” Miller said, “and blend it with the water here at Sunset Reservoir.”

Beneath the glow of massive spotlights, crews hosed and scraped at layers of silt from the floor of one of the reservoir's tanks. Normally, San Francisco fire crews would help keep the tanks clean by flushing water lines at above ground hydrants — but because of the drought the city has curtailed such cleanings. The pair of tanks has the capacity to hold 177 million gallons of water in underground vaults stretching eight city blocks.

Dramatic Photos of California's Drought Dramatic Photos of California's Drought

“It’s kind of a little bit eerie because it’s so vast,” Gilman said, stepping through the darkened, cavernous room where the echoes of the cleaning created an atmospheric din.

San Francisco relied on groundwater until the Hetch Hetchy system opened in 1934 — following the controversial damming of the Hetch Hetchy Valley. Since then, the city has only used groundwater to irrigate Golden Gate Park and the San Francisco Zoo. But very soon that same water will make the short journey to homes and businesses across the city — for the first time in nearly nine decades.

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## **Progress reported on planning for Sites Reservoir**

AgAlert | September 9, 2015 | Kate Campbell

Efforts to build Sites Reservoir are moving ahead and officials sounded optimistic last week as they discussed preliminary steps to construct the 1.8 million acre-foot off-stream storage facility west of Maxwell.

However, they noted there are still many issues to be addressed about how the project will be financed and built.

Sites Reservoir has been studied since the 1960s and the project was one of a handful of high-benefit water projects listed as a priority in the CALFED Bay-Delta Program's record of decision in 2000.

The deep economic recession, followed by a deeper drought, followed by a comprehensive package of water-related legislation, followed by California voters decisively passing a \$7.12 billion bond measure that includes \$2.7 billion set aside for the public benefit of water storage projects, prompts the question: What's going on with plans to build Sites Reservoir?

The answer, local water officials said, is a lot, with activity increasing in the coming months.

"We've been vetting this project for five years and advocating for Sites with interest in potentially becoming lead agency for the project," said Thad Bettner, Glenn-Colusa Irrigation District general manager.

In August 2010, Glenn-Colusa Irrigation District, Reclamation District 108, Tehama-Colusa Canal Authority, Maxwell Irrigation District, Glenn and Colusa counties and Yolo County Flood and Water Conservation District entered into a joint powers agreement to help facilitate the project.

Then in July 2015, Colusa County Water District, Westside Water District, Orland-Artois Water District and Proberta Water District became members of the JPA.

In the past year, the JPA has been working with state and federal water agencies, signing a memorandum of understanding to partner with the U.S. Bureau of Reclamation to continue working on the feasibility studies for the project.

Bettner said the JPA is working to create a similar arrangement with the state Department of Water Resources for state environmental reviews.

"That will help as we talk to the water commission and the environmental community about the public benefits of Sites," Bettner said.

All that advance work takes money, he said, to help with groundwork, like feasibility and environmental studies.

Ultimately, he said, estimates for building the dam, a hydroelectric plant, pipelines to move water from the Sacramento River 15 miles west to the proposed reservoir and pumps to lift the water into storage will cost up to \$4 billion.

"We're working to develop the financial resources locally and complete the studies that have to get done," Bettner said. "We think it will cost about \$5 million to get all that work done. Right now, we're analyzing what needs funding and how do we do it."

At a public workshop in Davis last month, water commission officials indicated it will be several years before regulations and programs are finalized, and storage project proposals approved.

Under voter-approved Proposition 1, water projects that meet stringent "public benefit" criteria—such as bolstering ecosystems, bettering water quality, controlling floods and improving recreation—may begin applying for available bond funding as early as Jan. 1, 2017.

The water commission will meet Sept. 16-17 in Sacramento to review draft regulations for investing in water storage projects and the upcoming rulemaking process. The commission will discuss public comments on the groundwater basin boundary emergency regulation.

Meanwhile, Jim Watson, a civil engineer with more than 30 years of project management experience in California, has just been appointed general manager of the Sites Joint Power Authority.

He said one of his first jobs is working with the water commission to understand project funding requirements.

"Sites will provide a lot of flexibility and benefits to the state's water supply system wide," said Watson, explaining the annual reservoir yield after filling would be up to 500,000 acre-feet.

"Because it can be reliably filled when there are surplus flows on the Sacramento River, the project can help deliver reliable supplies—preserving cold pool behind Shasta, easing demand pressure on Lake Oroville storage and helping groundwater aquifers," he said.

The Sacramento River has 11 gauged tributary creeks between Shasta Dam and Big Chico Creek near Chico that contribute to one of the most reliable water supplies in California, he said.

Even infrequent storms during drought conditions affect these creeks, causing temporary increases in Sacramento River flows that could be captured by the Sites Reservoir intakes and transported into storage.

"We're setting out to find ways to minimize impacts to species and habitat," Watson said. "And we're working on a project that uses renewable resources. A pumped storage facility reuses water to enhance supplies and can provide power supplies when needed."



Watson said developing a financing plan for the project is a top priority because it will make a difference in costs per acre-foot to deliver water to the system.

"We're looking at opportunities to reduce costs per acre-foot," he said. "With conventional financing models used in the past 100 years, we know it comes out to about \$600 an acre-foot. We're looking at improving that number with alternative approaches."

Taking a broader view of the proposed Sites Reservoir project, California Farm Bureau Federation Water Committee Chairman John Garner said it's clear the state needs more water storage, whether it's a wet or dry year.

"Having additional water resources takes pressure off the state's entire water-supply system and adds much needed flexibility," Garner said.

"Sites Reservoir is a project that promises efficient use of water, capturing surplus flows below Shasta Dam and putting it to use before moving it to the delta and out to the Pacific Ocean," said Garner. "When you've got high flows on the Sacramento River—200,000 cubic-feet per second going down the river—there's plenty of water for everybody. If we can capture a million acre-feet of that water over time to be used later, it can benefit everything."

He pointed to Folsom Reservoir on the American River, which in the current drought is being drawn down to near dead pool, and asked "how much would an extra million acre-feet help out the system in this situation today?"

The other aspect of a completed Sites Reservoir is the water released for migrating salmon can be recaptured and benefit other water needs later in the year, not to mention providing a certain amount of flood-control benefits, he said.

"The main question in our area is how to finance building the project," said Garner, who farms in Colusa County. "It's a big commitment, especially for agriculture in the north state to shoulder. That's why a solid financing plan is so important."

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## **Final pipe laid in \$4.8 billion seismic upgrade: San Francisco Public Utilities Commission replaces San Bruno line, is nearing end of Water System Improvement Program**

Daily Journal | September 9, 2015 | Samantha Weigel

Joseph Liu, Steven Ritchie and Dan Wade overlook the San Francisco Public Utilities Commission's recently replaced San Andreas Pipeline No. 3 in San Bruno. The waterline serves nearly 1 million customers along the Peninsula.

A multi-billion dollar project aimed at ensuring more than 2.6 million Bay Area residents will have access to water after an earthquake is wrapping up with the San Francisco Public Utilities Commission finishing one of its last pipeline upgrades this week.

Now, just one project remains on the Peninsula as part of the SFPUC's \$4.8 billion Water System Improvement Program, which took nearly a decade to plan and is comprised of numerous projects throughout the Hetch Hetchy Reservoir delivery system.

As a region prone to seismic activity and drought, the SFPUC recognized the importance of updating the system in which much of the infrastructure dates back to the 1920s, said Dan Wade, director of the Water System Improvement Program.

“A United States Geological survey a few years back predicted that we've got more than a 60 percent chance that within the next 30 years, there's going to be a major earthquake on one of the three major faults within the Bay Area — the Calaveras, the Hayward or the San Andreas. And our system crosses all three of those major faults,” Wade said. “So we truly are in a race against time to get these upgrades in place so that we're ready for that major earthquake.”

The importance of tending to aging infrastructure was underscored this July when a 54-inch pipeline ruptured and leaked nearly 15 million gallons in San Bruno. This week, the SFPUC will wrap up a project that would have supplemented the broken line and prevented the loss of valuable treated drinking water.

Wednesday marks the completion of the San Andreas Pipeline No. 3 — a 1,100-foot segment of a 66-inch line that runs through San Bruno and can now withstand a 7.9-magnitude earthquake. Had this project been finalized just a few months earlier, it could have been used instead of allowing the ruptured San Andreas Pipeline No. 2 to continue running — which was necessary for more than 12 hours to make sure customers in San Bruno and North Coast County Water District topped off their supplies and had enough pressure for fire service.

Had the new line been in service just a few months earlier, “life would have been a lot easier,” said Steven Ritchie, SFPUC's assistant general manager of water. “They needed to have time to fill up their storage and get their alternative water supplies.”

The rupture-caused influx of water flowed into an existing creek and also prompted the closure of Junipero Serra Park in San Bruno. A temporary fix took nearly two weeks before the surrounding communities were again serviced by the pipe and, with the No. 3 line in action, permanent repairs to the ruptured pipe will begin soon.

The pipeline replacement was part of the ratepayer-funded improvement program, which is comprised of numerous projects including the first tunnel to ever be drilled underneath the San Francisco Bay floor.

The 5-mile long San Francisco Bay Tunnel diverted another aging set of pipes that was estimated to have leaked between 52.5 million gallons and 65.7 million gallons of water over the course of the last four or five years.

Between the drought highlighting the need to maintain proper storage systems and predicted seismic activity, finalizing system upgrades are as critical as ever, Ritchie and Wade said.

“The whole Water System Improvement Program was intended to make sure that we have reliability into the future,” Ritchie said. “One of the things our analysis showed, was if we have a major earthquake in the system, the Peninsula could have been out of water for six months. So all of these projects that we’ve been doing that were just getting close to the end of now, were to make sure that this water would be reliably available for people on a routine basis and in an earthquake.”

The SFPUC wholesales water to nearly all San Mateo County suppliers and the new pipe can more reliably transmit drinking water coming from the recently revamped Harry Tracy Water Treatment Plant in San Bruno.

The \$278 million upgrade culminated in April with the treatment plant renovations now able to provide 140 million gallons of water a day for up to 60 days within 24 hours of a major earthquake.

Repairs to the San Andreas pipeline allow the SFPUC and its customers to realize the benefits of the treatment plant upgrade, Wade said.

With nearly 83 projects across seven counties, the entire program is slated to replace more than 280 miles of pipeline. It’s exciting to see the costly effort nearing completion and the San Bruno improvements mark the last major line repaired as part of the program.

While many don’t think much about water until it becomes a problem, the SFPUC is striving to make sure the utility can sustain its customers well into the future, Wade and Ritchie said.

“It’s fantastic. A program like this takes quite a few years to plan and design. To see them come to reality and construction, we’re 90 percent complete, by the time we’re done, it’ll be about a 15-year period from beginning to end,” Wade said. “At that point, we can celebrate the fact that we completed the Water System Improvement Program. But the work never stops and we still have portions of the system that we need to continue to repair and replace to keep those service goals.”

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## **Drip, drip, drip goes the desalination plant permit process**

Orange County Register | September 9, 2015 | Opinion

Poseidon Water reapplied last week for a coastal development permit with the California Coastal Commission, putting the proposed desalination plant in Huntington Beach one permit away from reality.

The company withdrew its application in 2013 when the commission demanded a potentially more fish-friendly subsurface intake system be considered over the proposed open ocean intake system. Two expert panels and nearly 20 months later, the panels found that, while a subsurface system was technically feasible, it was also economically infeasible.

The new application is relatively unchanged, with some minor revisions following new state water board amendments in May.

But the dozen environmental groups who have been fighting the desalination plant for years are unswayed. They're demanding a third expert study, to investigate the economic feasibility of a subsurface intake system at other locations.

Although in reality, it seems they'd simply prefer it not be built at all.

"We don't need the water now or any time in the future," Ray Hiemstra, the associate director of programs for the Orange County Coastkeeper, said when noting that mandatory state cutbacks have conserved more water than Poseidon could produce.

But rather than subscribe to environmental Luddism, these pages saw that first-ever mandatory cutback as a harbinger of things to come, requiring an all-of-the-above water strategy.

In drought-prone California, no forward-thinker would rule out the near-future 50 million gallons per day of potable water – roughly 8 percent of the county's water needs and enough for 300,000 O.C. residents.

The Coastal Commission has 90 days to respond to Poseidon's request. We hope they are forward thinkers, too.

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## **Pipeline replacement, drought top NCCWD issues**

SJ Mercury News | September 8, 2015 | Yasmine Mahmoud

The North Coast County Water District discussed issues such as its 20-year plan, pipeline repair and water conservation incentive systems for its customers at its Aug. 19 meeting.

The status of repair and replacement of the water pipeline system throughout the area was a focus at the meeting, as part of the NCCWD's 20-year master plan.

"Our system is getting old," said Joshua Cosgrove, Vice President of the NCCWD. "It's still aging but I think we have the ability to hold on with aggressive pipeline replacement," he said.

There will be \$250,000 dedicated to the pipeline replacement program, said Thomas Piccolotti, NCCWD Board President.

An update of the San Francisco Public Utilities Commission's San Andreas No. 2 Pipeline, which broke July 27, and runs through Junipero Serra County Park in San Bruno, was provided by the district. Repairs to the pipeline were completed earlier this month.

"Our current status is that SFPUC has finished their repair and NCCWD is 100 percent back on line," said Scott Dalton, Superintendent of the NCCWD.

During the period of repairs, the NCCWD had no access to SFPUC water, and had to use interties from Westborough and Daly City in order to access water said NWCCD General Manager, Cari Lemke.

"It was an incredible feat," said Lemke of NCCWD's intertie use. "It shows the flexibility of our systems."

The board also discussed the SFPUC's recent 28 percent increase of water cost to the district.

"A 28 percent increase on our cost, the district's cost to purchase water. As a result of the rate increase imposed by the SFPUC, the town wholesale rates for water may go up 10 to 12 percent," said Cosgrove.

Neighboring counties are charging for recycled water, such as Redwood City.

Water sold by the NCCWD to Pacifica residents is approximately half a cent per gallon, versus a much larger cost for bottled water, according to Cosgrove.

"I think that's a good representation of how cheap water is," said Cosgrove.

Water usage by customers of the NCCWD has decreased drastically according to Cosgrove.

"We are under 30 percent of water usage," Cosgrove said.

The district distributed 16,000 branded blue buckets, said Lemke. These buckets can be used to conserve water while bathing and performing household chores.

Lawn Be Gone! is a Bay Area Water Supply and Conservation Agency program, which provides its customers with a rebate for every square foot of lawn replaced with drought tolerant plants. The district has \$40,000 dedicated to the project and there are already 18 applications for the program, which will begin Oct. 18, said Lemke during the meeting.

An application for the Lawn Be Gone! program as well as a list of pre-approved, drought tolerant plants can be found on the district's website.

# # #



## **Groundwater management urgently needed**

The Californian | September 7, 2015 | Opinion

At Whole Foods stores, fancy-produce shoppers are being offered a new, drought-conscious option: “dry-farmed” tomatoes.

Dry farming simply means growing vegetables without the benefit of introduced irrigation, the way that most edible plants were produced over thousands of years during all early agrarian eras of human history.

And just this week, The New York Times Food section reported that winemakers in California’s Napa Valley and Paso Robles have been led by the four-year drought in our state into rethinking the way they irrigate their vineyards, and some of them have become committed to going with the non-flow and dry-farming their grapes as well.

In France, the south of which has historically dry regions, many wine-growing appellations actually forbid irrigation in the production of grapes. It leads to less uniformity in each vintage, but those differences have long been prized. There are healthful side benefits as well. Less introduced water means less moisture to sustain weeds and bugs, leading to lower or no use of dangerous chemical herbicides and pesticides.

This is all to say that the drought may lead to teachable moments for California farmers who up until now often have reacted to the drastic lack of Sierra snowmelt and local rainfall in one, entirely non-sustainable way: drilling deeper wells, depleting the groundwater not only on their own properties but for everyone who lives and works around them.

In an interview aired Sunday on “Meet the Press,” Gov. Jerry Brown acknowledged that his administration hasn’t been tough enough about overseeing rampant new well-drilling, which, NASA satellites show, is rapidly lowering the ground level in the state’s Central Valley at the same time it is taking out water at a far faster level than it can be replenished even in a rainy winter season.

Formerly loose rules that made California’s agriculture water the least-regulated in the West have been tightened since Brown declared a drought emergency in January, “but of course I don’t rule by decree,” Brown said. “I work through the Legislature. California now has groundwater management for the first time in its entire history, so we are much more aggressive. But ... we’re not aggressive enough. And we will be stepping it up year by year.”

As in other Western states, local agencies are being created with the ability to police what farmers can take out of aquifers, whose underground boundaries go far beyond their own surface real estate. But the three-bill package passed by the Legislature has a very slow schedule, with oversight plans not set to be finalized until 2022 toward a goal of sustainability by 2040. Patient roll-outs are fine in theory, but new JPL data released this month shows that the ground level in the San Joaquin Valley is sinking faster than ever before, up to two inches a month in some

places, putting homes and businesses at risk for damage. The report also shows that groundwater in the valley is up to 100 feet lower than previous record lows.

Colorado has been divided into water districts since 1878, overseen by local commissioners with the power to apportion flow from rivers and wells during dry times. California can't afford to go slow and rely on arguments about historic water rights. Sustaining our agrarian future calls for action now.

# # #

## **8 states running out of water**

USA Today | September 7, 2015

Although drought conditions have improved in many regions of the United States, higher than average summer temperatures and patchy rainfall over the summer has contributed to one of the worst wildfire seasons on record. There are currently at least 60 large fires burning across the country. So far this year, more than 8 million acres have been destroyed by fire, a level of devastation seen in only six other years since 1960.

It is the fourth consecutive year of drought for most of the western United States. The dry summer has raised particular concern about California, where 46% of land area is in a state of exceptional drought conditions — the worst level of drought — up slightly from the already especially bad drought level in the spring. This was the highest such share nationwide and the kind of water shortage that happens only once a century.

According to a study by the National Aeronautics and Space Administration (NASA), “Droughts in the U.S. Southwest and Central Plains during the last half of this century could be drier and longer than drought conditions seen in those regions in the last 1,000 years.”

Based on the most recent drought levels estimated as of the week ended Sept. 1 from the U.S. Drought Monitor, 24/7 Wall St. identified the eight states with the most widespread severe to exceptional drought conditions. During periods of severe drought or extreme drought, crop or pasture losses are likely, and water shortages and restrictions are common. During times of exceptional drought, these conditions are intensified and water shortages are considered water emergencies.

In an interview with 24/7 Wall St., Brad Rippey, agricultural meteorologist with the U.S. Department of Agriculture (USDA), said, “Where people live and where the precipitation falls are two completely different areas.” Consequently, states rely on a range of water sources, and water needs to be transported to meet water demands in each state.

While Great Plains states rely heavily on groundwater, the western part of the country relies more heavily on surface water, which depends on precipitation and is replenished each year primarily by the spring thaw. Snowpack levels, therefore, are very important for water supplies.

The U.S. climate is also highly variable, which means wet seasons in different parts of the country occur at different times during the year. For large swaths of the nation, the wet season is primarily in the early spring. Across the Great Plains and southward, on the other hand, the wet season typically peaks during May, June and July. In June, because of extended rainfall, the country experienced a one-year low in drought levels nationwide. Unfortunately for many of these states that experienced severe flooding during the wet season, conditions have deteriorated again. “It is a bit ironic that some of these western Gulf Coast region areas like eastern Texas had

the worst flooding in at least 25 years just three months ago, but they've had hardly a drop of rain since, so they've slipped back into drought fairly quickly," Rippey said.

The ramifications of such severe drought conditions for these states and for the nation are manifold. In California alone, the drought has resulted in the loss of \$900 million in crop revenue and \$350 million in dairy and live stock revenue.

Beyond the economic impacts, municipal cutbacks and water restrictions have a tangible impact on individuals living in these areas. In addition, "things have gotten worse particularly in the interior," Rippey said. "They didn't get (a spring rainfall) this year — it has been very hot, very dry, on top of lack of snowpack. For that reason, we had a couple million acres burned due to wildfires across the Northwest. A really devastating wildfire season, especially for the Northwest." As of the middle of August, California, Idaho, Montana, Oregon and Washington — states with the worst drought conditions in the nation — were reporting at least five large active fires each. In Montana and Washington, there are 14 fires, trailing Idaho, that are at least 16 large fires raging across the state.

On the bright side, Rippey noted that the current drought in California is approaching the level of drought experienced in the late 1970s — the last time such drought levels affected the state. This time, reservoirs are at higher levels than they were in the '70s, and water consumption is lower. It appears that people are more conscious of the situation, and there may be ways for state officials to adjust to the problem.

To identify the states running out of water, 24/7 Wall St. reviewed the percentage of land area in severe to exceptional drought from the U.S. Drought Monitor as of the week ended Sept. 1. To be considered, a state needed to have at least 20% of its land area in severe to exceptional drought conditions.

These are the eight states running out of water.

## **8. South Carolina**

- Pct. Severe drought 26.7%
- Pct. extreme drought: 0.0%
- Pct. exceptional drought: 0.0%

With more than one-quarter of the state's land under severe drought conditions, nearly 2.8 million people in South Carolina live in drought areas. Earlier this summer, local governments encouraged several counties, including York and Lancaster, to adhere to water restriction policies. The effects of the state's dry conditions extend beyond the limits of the drought's borders. Agriculture is crucial to the South Carolina economy, and severe droughts are often responsible for crop or pasture losses. Though the worst drought conditions are confined to a stretch of land across the middle of the state, the vast majority of South Carolina is either under

moderate drought conditions or is abnormally dry. Only a sliver of land along the coast and the westernmost half of Oconee County remain unaffected.

## **7. Utah**

- Pct. Severe drought 26.8%
- Pct. extreme drought: 0.0%
- Pct. exceptional drought: 0.0%

During the past three years, most of Utah has experienced abnormally dry to extreme drought conditions. Heavy August rainfall, which increases reservoir levels for the fall and winter months, have helped mitigate drought conditions. Despite this, the drought is parching 26.8% of Utah and is affecting an estimated 2.6 million people. In severe drought conditions, where crop and pasture losses are likely, farmers are especially vulnerable. The agricultural industry, which makes up 14% of the state's economy, depends heavily on water supply and accounts for 82% of statewide water usage. Earlier this year, when statewide precipitation was just 47% of the yearly average, the USDA designated seven Utah counties as primary natural disaster areas. Farmers in the designated counties were eligible for emergency low-interest loans. Around this time, Utah's Legislature approved a bill that grants about \$8 million every year to preconstruction of the Lake Powell Pipeline, infrastructure that would help the state deal with future droughts by routing water from a dam site in Arizona to reservoirs in Utah.

## **6. Montana**

- Pct. Severe drought 10.1%
- Pct. extreme drought: 18.8%
- Pct. exceptional drought: 0.0%

Over one-quarter of Montana is currently experiencing either severe or extreme drought conditions. In mid-July, U.S. Secretary of Agriculture Tom Vilsack informed Gov. Steve Bullock that 15 state counties are considered natural disaster areas due to the ongoing drought. Though the worst conditions are confined to the western third of state, the drought is affecting roughly half of the state's 1 million residents. In Butte, water usage restrictions are in effect. Households that water their lawns have to do so on certain designated days and never between the hours of 10 a.m. and 6 p.m. Violators can be fined and lose watering privileges altogether. Roughly a decade ago, the state's Department of Agriculture established The Hay Hotline. Still active today, the service is intended to help ranchers who lost pasture land due to wildfires that can be common in droughts.

## **5. Idaho**

- Pct. Severe drought 18.8%
- Pct. extreme drought: 29.3%

- Pct. exceptional drought: 0.0%

Nearly 50% of Idaho is currently in a state of either severe or extreme drought conditions. The worst of the drought stretches along Idaho's western border and encompasses the entire northern tip of the state, from the top of Idaho County through Boundary County. Nearly 1.5 million state residents are affected by the drought. Droughts create dry conditions that increase the likelihood of wildfires. Currently, there are wildfires burning in west-central and northern Idaho that have led to the evacuation of residents and the deployment of over 1,000 firefighters. The drought in Idaho is a part of a much larger national pattern that encompasses much of the western United States. Idaho has experienced severe drought conditions every year since 2012. The state's Department of Agriculture reinitiated the Idaho Rangeland Drought Task Group last year to help drought-affected farmers take advantage of assistance provided by federal and state agencies.

#### **4. Nevada**

- Pct. Severe drought 38.6%
- Pct. extreme drought: 21.6%
- Pct. exceptional drought: 15.9%

Divided into arid and semi-arid climatic regions, Nevada has the driest climate of any other state in the country. Due to the state's dry conditions, laws have been put in place that prohibit new homes from planting grass in their front yards and that provide incentives for homeowners to get rid of existing lawns. However, this summer has been even drier than usual. Slightly more than 76% of Nevada is currently in a state of severe to exceptional drought conditions. Nearly 2.6 million Nevada residents live in drought areas. The Sierra Nevada Mountains and Lake Mead supply Nevada and much of the region with water. Both supplies are weak compared to historical levels. Snowmelt from the Sierra Nevada range is low because of the warm winter, and Lake Mead's water level has dropped steadily since the regional drought began.

#### **3. California**

- Pct. Severe drought 21.3%
- Pct. extreme drought: 25.1%
- Pct. exceptional drought: 46.0%

More than 92% of California is currently in a state of severe to exceptional drought, one of the highest such shares nationwide. About 46% of the state experienced exceptional drought conditions, the worst possible drought level and by far the highest such share nationwide. By contrast, only about 3% of the nation was in a state of exceptional drought, and only one other state, Nevada, was afflicted by exceptional drought conditions.

California's current water shortage crisis is in the midst of its fourth straight year. Severe to exceptional drought conditions affected the entire state for two straight months in summer 2014.

More than 36.6 million Californians live in areas affected by drought, the highest number of people living in such conditions. However, the number of people affected by the California drought may be far larger as the drought's impact can extend far beyond the state. Most of California's water usage is for agriculture, and the state generates a huge portion of the nation's food, including more than two-thirds of the country's fruits and nuts. The exceptional drought conditions affecting nearly half of the state can cause widespread crop and pasture losses.

## **2. Washington**

- Pct. Severe drought 32.0%
- Pct. extreme drought: 68.0%
- Pct. exceptional drought: 0.0%

All of Washington is experiencing either severe or extreme drought conditions. The state's natural resources are also strained. In July, the Washington Department of Fish and Wildlife restricted fishing on more than 60 rivers and streams across the state to protect wildlife already under stress from low water flows due to the drought and the resulting increasing water temperatures. Seattle, Washington's largest city, is notorious for its rainy weather. However, it is currently going through a severe drought after four consecutive months from the spring through summer of well below average rainfall. On the other side of the state, Spokane, Washington's second-largest city, is experiencing even worse drought conditions.

## **1. Oregon**

- Pct. Severe drought 32.7%
- Pct. extreme drought: 67.3%
- Pct. exceptional drought: 0.0%

All of Oregon is currently in a state of severe to extreme drought, making it the driest state in the country. At 67.3%, a majority of the state is in extreme drought conditions, the second-largest share of any state in the country. As is the case with much of the western United States, Oregon relies on snowmelt for its water supply. This year, due to low snow precipitation, the snowpacks have been smaller than average. As a result, the contribution from the annual snowmelt to the state's water reservoirs was also below average. Many cities across the state have already asked residents to minimize water usage. Vancouver, one of the largest cities in Canada that is just north of the Washington border, is affected by the same drought system. The coastal city in British Columbia has already imposed mandatory restrictions, forbidding residents to water their lawns, refill swimming pools or wash their cars.

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## **Purified wastewater triggers release of arsenic within aquifer, study finds**

LA Times | September 4, 2015 | Monte Morin

When it comes to the science of transforming sewage into tap water - or potable reuse - engineers say there's no question the product is clean enough to drink..

The trouble is, researchers are now learning that this drinking water may be too clean to store underground without special treatment.

A study published this week in the journal *Environmental Science & Technology* found that when highly purified wastewater was stored in an Orange County aquifer, the water caused arsenic to escape from clay sediments in a way that naturally infiltrating water did not.

In some instances, researchers said that arsenic concentrations exceeded the drinking water limit of 10 micrograms per liter, although the increases were only temporary and levels eventually returned to normal. None of the affected water entered the public tap system, officials said.

The root of the problem, according to researchers at Stanford University and the Orange County Water District's Groundwater Replenishment System, was that the purified, recycled water lacked the minerals that native water acquires as it soaks into the earth or flows along rivers.

"Basically the water was too pure," said senior author Scott Fendorf, a Stanford geochemist. "It was devoid of everything other than water molecules."

The solution, according to the researchers, was to add quicklime or another calcium-rich substance to the purified water before adding it to the aquifer – essentially dirtying it up a bit.

Jason Dadakis, the OCWD's director of health and regulatory affairs and a study co-author, said the added calcium appears to be working.

"The initial results look positive," Dadakis said. "We still have more long-term monitoring we want to do."

Although scientists have identified several other methods by which arsenic can contaminate groundwater – lack of oxygen can be one of them – Fendorf said this may be the first time highly purified water was identified as a trigger.

The finding may prove to be a significant factor in future efforts to recycle and store wastewater.

As severe drought continues to strain water resources throughout California and the West, planners and officials are increasingly considering potable reuse facilities and aquifer recharge systems as an answer to the crisis.

At the same time, however, researchers are becoming increasingly aware of problems that arise when waters of varying chemistries are pumped or filtered underground. Mismatched waters can trigger the release of small solid contaminants that may lead to widespread contamination of an aquifer, they say.

“What you’re seeing in Orange County is something we have to be very careful of across the globe,” Fendorf said.

Arsenic is a natural and ubiquitous component of the Earth’s crust, according to the World Health Organization, and prolonged exposure can cause skin cancer and other serious health problems.

While arsenic has contaminated drinking water everywhere from the United States to East Asia, it wasn’t entirely clear why levels were rising and falling in Orange County’s recharge system.

To find the answer, Fendorf and his colleagues took columns of sediment from beneath the Miraloma Basin, a surface recharge basin in Anaheim, and exposed them to a variety of different water samples: purified recycled water, water that was saturated with minerals or salts, and waters with different pH values.

What they discovered was that a layer of clay beneath the basin contained naturally occurring arsenic. However, this arsenic was usually held in place by a coating of positively charged calcium and magnesium particles. When natural, mineral-rich water percolated through this clay sediment, the calcium, magnesium and arsenic usually stayed put.

Yet when the purified H<sub>2</sub>O soaked through, calcium and magnesium were more likely to leave the clay and hitch a ride with the water, because the water wasn’t already crowded with other minerals. When this happened, the arsenic was set free and essentially “piggybacked” its way into the water, Fendorf said.

As the purified water flowed deeper and deeper into the aquifer, it acquired more and more minerals from other sediments. At the same time, its arsenic level declined, Fendorf said.

The researchers note that this phenomenon may also play a role in future efforts to establish so-called direct potable reuse facilities. Unlike Orange County’s indirect potable reuse facility, which mixes purified recycled water with water from other sources and stores it in an aquifer before using it as drinking water, direct potable reuse systems pump purified recycled water directly in the public water system.

Historically, the public has been less open to direct potable reuse projects, which are often called “toilet to tap.” Although advocates insist direct potable reuse is safe and efficient, the public has been more accepting of potable reuse if it involves aquifer storage.

“This is the benefit of direct potable reuse,” Dadakis said. “You eliminate the potential of environmental degradation. You don’t compromise the quality of the water you’ve worked so hard to put together.”

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## **State orders California firm to stop tapping Sierra springs**

Associated Press | September 2, 2015 | Scott Smith

FRESNO, Calif. — Armed with evidence captured by surveillance cameras, California regulators have ordered a business to stop tapping Sierra Nevada spring water that is later bottled and sold in stores, officials said Wednesday.

It would be the first such action taken this year against a commercial water bottling business under tight drought restrictions, said Kathy Mrowka, enforcement manager of the state Water Resources Control Board.

Sugar Pine Spring Water in the foothills of Tuolumne County also faces fines of nearly \$225,000 for collecting and trucking the water to commercial bottling companies for two years despite notices to stop, according to the proposed sanctions by the state Water Resources Control Board.

With California in its fourth year of historic drought, residents are being told to cut back, and thousands of farmers and other users such as Sugar Pine have been notified they must stop using waters as streams and rivers run dry.

The state earlier this year proposed a \$1.5 million fine against the Byron-Bethany Irrigation District east of the San Francisco Bay Area, accusing it of taking water despite similar drought restrictions. The district is challenging the case.

Springs tapped by Sugar Pine feed into the Tuolumne River watershed and drain into New Don Pedro Reservoir. The city of San Francisco and farmers in Turlock and Oakdale irrigation districts rely on the watershed, the complaint says.

Sugar Pine was launched in the early 1990s and holds junior water rights, which have been curtailed in 2014 and 2015 because of the drought.

Scott Fahey, the owner of the company, continued to divert a total of 22 acre feet of water over 170 days in the past two years after being notified no water was available under his rights, the complaint says.

One acre-foot is the volume of water sufficient to cover an acre of land to a depth of one foot, enough water to sustain a typical California household of four for one year.

The company pumps water captured from four springs to a transfer station before it is trucked to commercial bottling firms, the complaint says. The bottling firms are not identified in a complaint and Mrowka declined to name them.

Fahey can challenge the state action before the measures take effect. Fahey did not respond to a call seeking comment. His attorney, William "Bart" Barringer, declined to comment in an email, saying he anticipates a hearing before the state water board.

Officials say Fahey has refused requests to show state inspectors his operations behind locked gates on a remote road. Investigators said they mounted surveillance cameras outside the gates, capturing tanker trucks traffic. They also reported seeing tanker trucks rumble past them during a 90-minute visit in July to the site.

Despite opposition from residents, Crystal Geysers Water Co. plans to tap an aquifer at the base of Mount Shasta. Residents fear it would deplete nearby wells and the aquifer, which feeds headwaters of the Sacramento River.

State regulations didn't intervene because groundwater monitoring in the state is years from implementation, said Tim Moran, a state water board spokesman.

Tuolumne County springs are considered surface water and within the state's jurisdiction, he said.

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## **Time for another water bond? Draft language floating**

Sacramento Bee | August 30, 2015 | David Siders

It hasn't been a year since Californians approved a \$7.5 billion water bond. But with drought still ravaging the state – and Democratic-heavy turnout expected in November 2016 – a former Brown administration official is mulling asking voters to approve a follow-up measure.

Gerald Meral, a former deputy secretary of the state's Natural Resources Agency, sent draft language for "The Water Supply Reliability and Drought Protection Act of 2016" to water agency officials, environmentalists and others in recent days.

In an email to associates over the weekend, Meral said his organization, the San Francisco-based Natural Heritage Institute, is considering sponsoring a bond on the November 2016 ballot to "fund programs which were not funded or were underfunded" in the water bond last year.

The draft language leaves the amount of the measure blank, and Meral said Sunday that he doesn't know how big it would be.

"Not too big," he said. "We shouldn't get carried away."

The follow-up bond would include funding for water recycling, water conservation, groundwater desalination and watershed management, among other measures. It would also provide money for property owners to install drought-tolerant landscaping, with extra incentives for low-income homeowners.

"The public seems pretty receptive to doing something about water," Meral said. "Whether they still will be next year, who knows? ... We're looking at it, anyway."

The proposal does not include additional money for storage, a priority of many Republicans, except for grants to local agencies to repair reservoirs principally used for flood control.

Before retiring from the state in 2013, Meral served as the chief steward of Gov. Jerry Brown's controversial proposal to build two tunnels to divert water around the Sacramento-San Joaquin Delta to the south.

The draft measure includes language prohibiting bond money from being used for Delta conveyance facilities.

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## **A future of dams**

*Floodgates open for adding barriers to combat drought*

SF Chronicle | August 28, 2015 | Carolyn Lochhead

FRIANT DAM, Fresno County — Driven by drought, California stands ready to build a water system for the 21st century. Ideas are flowing: conservation, recycling, desalination, aquifer recharge, floodplain restoration, storm water capture.

But the biggest, most expensive, most popular item of all is the foundation of the 20th century water system — dams. Even if El Niño rains bring a bounty of water to the state this winter, the momentum for dam building is unlikely to fade.

Farmers stand to benefit. So do many urban users. The losers would be people like Anita Lodge.

Lodge, 58, clings to the last remnant of a Gold Rush homestead deep in the San Joaquin River Gorge 33 miles north of Fresno, where her ancestors mined ore by wheelbarrow and her mother hung laundry on the willows. Now the 7-acre spread is surrounded by a federal preserve alive with bears and bobcats, herons and eagles, and in spring, a profusion of wildflowers.

Behind a bend downstream lies a linchpin of California's water system: Friant Dam, snaring the river on its path from the Sierra foothills to Fresno and the San Joaquin Valley. Completed in 1942, Friant can hold 520,500 acre-feet of water for farmers and cities in the southern San Joaquin Valley. That's almost twice what the 2.6 million customers of the Hetch Hetchy system used in a year, even before drought-prompted conservation measures kicked in.

The gorge draws hikers, equestrians and mountain bikers to the national San Joaquin River Trail, which, when complete, will reach 80 miles across the Sierra to Devil's Postpile National Monument near Mammoth Lakes.

What was gained, lost

All of it will be inundated if a giant new dam 7 miles east of Friant, called Temperance Flat, is built. The drought has made that a strong possibility.

"Maybe I'd feel better about it if I thought it was going to take all this away from us and they were going to have all this fabulous water that was going to water all these farms and take care of all these other families," Lodge said.

But with the prospect that climate change could bring ever-less rain and snow to California, "I'm thinking, this reservoir will never be filled again," Lodge said. "It's going to be this dirty bathtub ring where there was once a beautiful canyon. It's not going to help any farmers. It's not going to help any farmworkers."

Dams, 1,400 of them blocking every river in the state, were California's deal with the devil in the 20th century. They trapped the water that helped small towns spread across arid landscapes and become cities, providing homes and jobs for millions of people who wanted to live here. They made the Central Valley one of the world's most productive farming zones.

They also proved ruinous to wildlife that depend on free-flowing rivers. Nearly three-quarters of the state's native fish — from salmon and sturgeon to obscure endemics like the Red Hills roach and the much-maligned delta smelt — are threatened or will soon be listed as such, in no small part because of the loss of habitat caused by dams, said Peter Moyle, a biologist at the UC Davis Center for Watershed Sciences.

Recognizing the damage done, a rising chorus of water managers and politicians from both parties is making a new argument for new dams: They will help repair the environmental devastation caused by the old dams. If the state had more water stored during droughts, they say, more water could be sent downstream to fish and wildlife refuges.

“Old is new again,” said Rep. John Garamendi, a liberal Democrat from Walnut Grove (Sacramento County) who supports both Temperance Flat and Sites Reservoir, which would flood a dry valley north of the delta with water pumped from the Sacramento River in wet times.

The main argument for new dams is that they will store more water for people and make it easier to shift water to where it is most needed. “When you have a lot of water you have to store it, and when you don't have water you have to take it out of storage,” Garamendi said. “That's the fundamental underlying principle for California's water future.”

Sens. Dianne Feinstein and Barbara Boxer, both Democrats, introduced a \$1.3 billion drought bill in July, half of it for dams. House Republicans, led by Majority Leader Kevin McCarthy of Bakersfield, passed a bill that would speed dam approvals. The California Department of Water Resources heralds a “new era of surface water storage,” arguing that new dams “would help the state cope with drought and climate change and benefit both people and the environment.

Different kind of reservoir

Temperance Flat, the \$3.1 billion dam-behind-a-dam, is one of four long-mothballed reservoir proposals that would together cost more than \$9 billion and enlarge the state's storage capacity by 9 percent. They've gotten new life with voter approval last fall of the bond measure Proposition 1, whose biggest chunk of cash, \$2.7 billion, goes toward storing more water. The bond could pay up to half the cost of any new project.

The measure would also pay for another method of storage — putting water not above the ground, as in a reservoir, but in the ground. It's an idea that is gaining traction around the state. The fight for Prop. 1 funding is likely to play out between advocates of these two very different schemes.



About 150 miles south of the Lodge homestead lies a pool of water that is bigger than Temperance Flat ever would be. Stretching 32 square miles, yet all but invisible, this reservoir is the antithesis of a dam.

The Kern Water Bank was created 20 years ago by a consortium of irrigation districts that retired farmland and installed a new kind of water collection system in the flat fields west of Bakersfield.

No rivers were diverted, no gorges were swamped — the water puddles in ponds that fill during wet periods, then percolates into a vast natural aquifer.

The water bank can hold at least 1.5 million acre-feet, on par with Lake Berryessa in Napa County, the state's seventh-largest reservoir. Its capacity is not limited by physical barriers, only by the amount of water that nature delivers.

Situated on a porous alluvial fan, the bank gets its water from the dams and canals of the state's surface reservoir system and the Kern River, which intersects it.

Unlike the barren channels typical in the valley, with their near-vertical embankments, the canals used on the bank have gradual slopes and vegetation for wildlife. The ponds are feathered at the edges to follow the topography.

The ponds “really mimic predevelopment conditions,” said Jon Parker, general manager of the water bank. “Before irrigation canals were built, natural flooding would occur in the area and you would have water spread out in the basin, creating wetlands when it was wet. When it was dry, they would dry up. That's essentially what we're doing.”

The surface is a bird paradise of intermittent wetlands that draws not just eagles but white pelicans, a bird rivaling condors in wingspan that lost its breeding grounds in the valley to development. Endangered mammals such as the San Joaquin kit fox thrive here.

Parker pointed to the crystalline water pumped from the ground into canals after being “perfectly filtered by mother nature” and said, “That's a really good place to snorkel there.”

Snorkeling and providing a landing place for birds aren't the reason for the water bank's existence, though. Hit by a series of droughts decades ago, farmers developed the bank to guard against being cut off from state and federal surface supplies. The water goes to a chain of large farming operations, including billionaire mega-farmer Stewart Resnick's 125,000-acre Paramount Farms, which grows almonds and pistachios on the west side of the valley.

Resnick isn't exactly a friend of environmentalists — the Kern Water Bank has been the subject of serial lawsuits over its tapping of public water sources — but the concept of storing water below ground instead of above it has many green allies.

“Banking water in the ground makes sense,” said Gary Bobker, program director at the Bay Institute, an environmental group.

### Underground advantages

Underground storage is much cheaper than building dams. It recharges groundwater, which drought-panicked farmers and cities in the valley are draining at a furious clip. Evaporation, a scourge of surface reservoirs, is minimal. It helps, rather than destroys, the environment. And California has much more storage capacity below the ground than above it.

Santa Clara County and many urban water districts in Southern California have copied the concept, recycling wastewater to store underground until it’s needed for industrial or landscape uses.

Dam supporters acknowledge the virtues of aquifer storage, but say there has to be a place to park water before it can go underground. Percolation takes time, and spring floodwaters don’t wait. To capture surplus water when it arrives, they say, the state needs dams.

“Some dams need to be built,” said Tim Quinn, executive director of the Association of California Water Agencies, which represents urban and farming water districts. “If you really want to get water underground so it’s there during the dry times, you’re going to have to marry it to a surface storage strategy.”

### The view from the dam

Deep inside the aging buttress of Friant Dam, operations chief Nick Zaninovich of the U.S. Bureau of Reclamation bounds up the metal stairs of the 319-foot edifice. He thinks of the dam as “a living organism” that shifts and changes with time, and marvels at the cleverness of the engineers who designed it in the 1930s, at the start of the great “hydraulic age” when California’s water system was built.

Zaninovich has a bird’s-eye view of the the battles below the dam. California’s water system and its many trade-offs are “so complex you can’t even begin to describe it,” he said. “Everything with water is contentious. Where somebody wants something, there’s 10 other people that want it a different way, and it’s usually 10 different ways.”

Friant dried up the San Joaquin River and killed its salmon runs. A restoration program authorized by Congress is trying to get the river flowing again, but it’s been too dry for the past two years to do that. Senior water rights holders who are first in line for Friant water have been demanding their share.

Delivering water to all who need it is “a very delicate balance,” Zaninovich said, “and the less and less water we have, the more delicate that balance becomes.”

He said people often confuse the capacity of a reservoir with its ability to deliver water. “Building another dam, unfortunately, doesn’t increase the capacity of the watershed,” Zaninovich said. “There’s no guarantee that we’re not just going to get less water.”

He pointed to the Colorado River basin, now in its second decade of drought. The giant reservoirs at Lakes Powell and Mead are dropping precipitously. But even when they were new, they took decades to fill.

“A lot of people don’t put that together,” Zaninovich said. “They think that if we build a reservoir, a year after it’s constructed it’s going to be full. It could be, if we get a big enough rain year. But generally speaking, I certainly would not expect that. I think we would be in for a very slow fill period.”

But if and when the reservoir does fill, it could help store more water for droughts.

#### Tripling water capacity

Right now, Millerton Lake behind the Friant Dam holds about a third of what it can store in wet years. But those wet years, when they come, provide three times more water than will fit into the lake. That’s where Temperance Flat comes in.

From a motorboat at the outer reaches of Millerton Lake, Michelle Denning, the federal Bureau of Reclamation planning officer in charge of the Temperance Flat proposal, points to a pinch in the gorge where the new structure would be built, tripling the capacity of the current reservoir to 1.26 million acre-feet.

Millerton is “a small reservoir in a large watershed,” Denning said. Its original design was scaled back, she said, because of the demands of World War II.

Unable to hold all the water that comes to it in most years, Millerton Lake “empties and fills,” Denning said, delivering water as soon as it comes to make room for the next flows from the river.

“With Temperance Flat,” she said, “you would be able hold it and then deliver it at times when it’s hotter, the drier part of the year, or in drought years.”

As the climate warms, the Sierra snowpack, which acts as the state’s biggest surface reservoir, is predicted to shrink. More precipitation may fall as rain, “so that means more runoff and that makes reservoirs actually more important,” Denning said.

Still, she said, “there are huge demands on our budget, and a lot of our facilities are 60 to 100 years old and they need major rehabilitation investments.”

#### Public benefits, dollars

The Bureau of Reclamation calculates that half the water from the new dam would go toward helping fish, a “public benefit” that would allow taxpayers to pick up half the cost with Prop. 1 bond money.

No new dam in California would pencil out financially without this benefit. Farmers cannot afford the multibillion-dollar price tags, and the only way taxpayers are legally allowed to help is if the dams provide a public benefit, and the biggest one by far is ecosystem restoration.

Fish biologists say the environmental benefits are overstated. Rene Henery, California science director for Trout Unlimited, a group working on salmon restoration on the San Joaquin, said “there’s essentially no basis” for claims that Temperance Flat would help fish.

Jon Rosenfield, a Bay Institute biologist, pointed to operations on Shasta Dam that were intended to help fish survive the drought but wound up killing them two years in a row. “It’s a total fiasco,” he said.

Using new dams to help fish “to me is partly just a way to try to get the taxpayers to pay for everything,” said Moyle, the UC Davis biologist.

Whether Prop. 1 funds any dams will be up to the California Water Commission, an obscure nine-member agency appointed by the governor that now has the eyes of every water interest in California bearing down on it.

The commission expects to start making final decisions in early 2017, said Commissioner David Orth, and is eyeing a combination of groundwater storage, better use of natural floodplains and dams.

Sometimes water comes “in such large gulps that it’s hard to capture them all and convey them to the prime recharge sites without some type of a large upstream detention facility,” Orth said.

Temperance Flat is “well positioned,” he said, but “ultimately these projects are going to require water users to be willing to pay for them. And if they become too expensive, then they’re going to fall flat on their face.”

A boat passes through the spot where Temperance Flat Dam would be built on Millerton Lake in Fresno County, near Friant. Photo: Leah Millis, The Chronicle

Photo: Leah Millis, The Chronicle

A boat passes through the spot where Temperance Flat Dam would be built on Millerton Lake in Fresno County, near Friant.

## Seeking new storage

Last year's landmark state groundwater law, which for the first time requires California water districts to limit aquifer pumping, is also accelerating the search for new groundwater storage projects such as the Kern Water Bank. On the eastern side of the San Joaquin Valley in particular, Orth said, there are "fairly shallow groundwater aquifers with good, rechargeable sandy soils" that could be candidates.

The federal government, a key player in any funding strategy, is keeping an open mind.

"We need to broaden our perspective on storage," said Michael Connor, deputy U.S. interior secretary. "We recognize it's incredibly important to the overall water resources strategy in California."

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