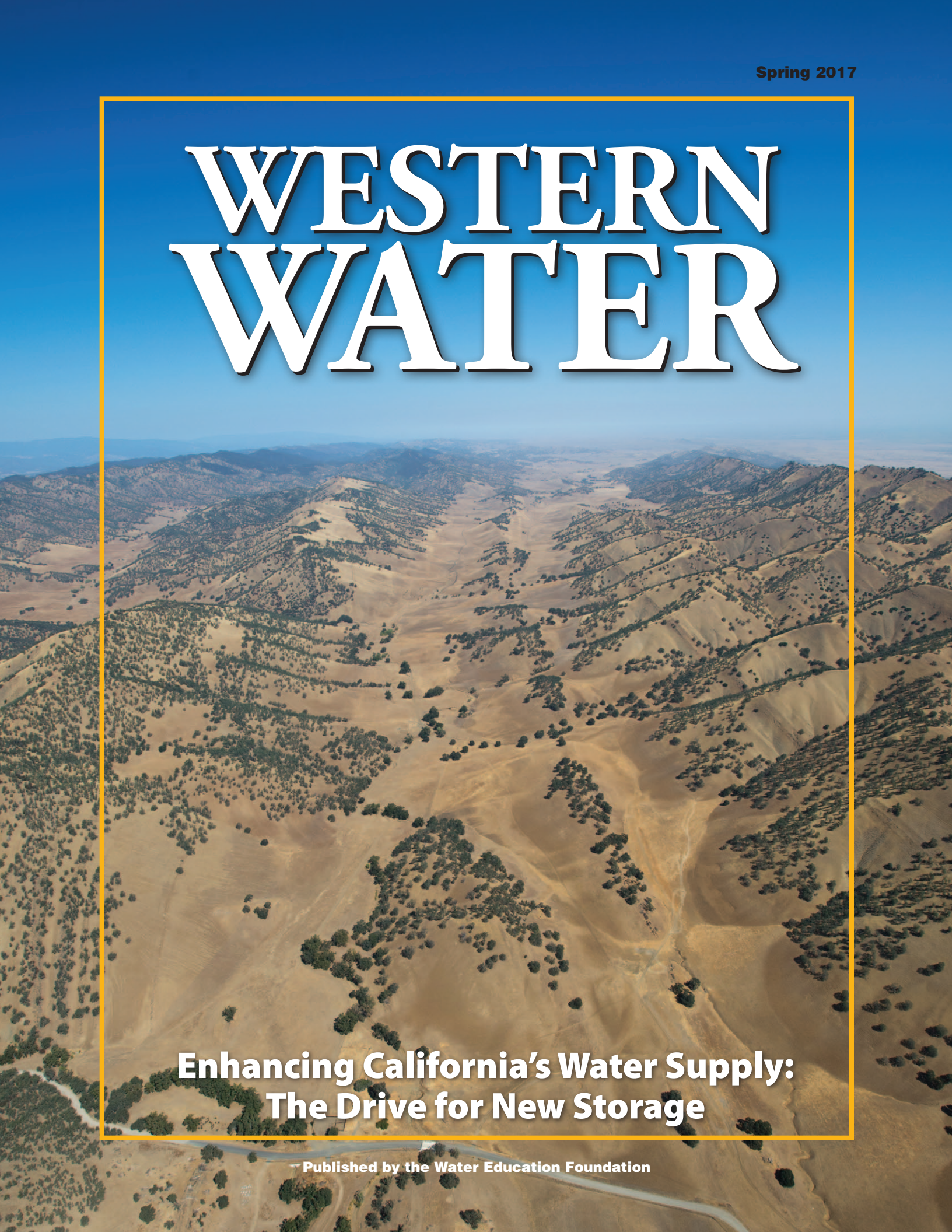
Spring 2017

WESTERN WATER



Enhancing California's Water Supply: The Drive for New Storage

Published by the Water Education Foundation

Editor's Note

Women in Water

Have women made a name for themselves in the water world?

Like Cher, Madonna, Beyoncé and Rihanna in the entertainment world, we no doubt have our own stable of leaders recognized by their first names alone: Lois (Krieger), Pat (Mulroy), Maureen (Stapleton), and Felicia (Marcus), among them.

Earlier this year I attended and spoke at what is believed to be the first-ever water conference just for women in Santa Barbara, hosted by Stephanie Hastings and Amy Steinfeld, two attorneys at Brownstein Hyatt Farber Schreck and attended by women in the legal, engineering, consultant and management sectors.

"More than ever, an increasing number of powerful women are making waves in this historically male-dominated industry. … Thus, we believe that it is time to establish a formal opportunity for women leaders in the water industry to collaborate, coordinate, educate and support each other," they said in printed materials.

During the panel discussions, there was some debate over what women bring to the water table, no pun intended. Are they more likely than men to listen and understand another side of the water debate? That seemed to be the initial consensus, but then one speaker correctly pointed out that women have had to be tough negotiators in the West where, as the old saying goes, "Whiskey is for drinking, water is for fighting."

Back in 2001, not long after transitioning my journalism career from breaking news coverage as an Associated Press reporter in Los Angeles to writing about water in Inland Southern California, I interviewed Lois Krieger, who passed away in 2014.

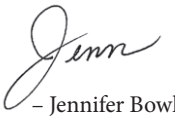
My article began: "Spunky, outspoken, even stubborn. No one would argue that Lois Krieger is all three, which is why, perhaps, she succeeded as a pioneer in the male-dominated world of California water politics."

Long a board member at Riverside-based Western Municipal Water District, Lois was the first female president of the Association of California Water Agencies and the first and, still, the only female chair of Metropolitan Water District of Southern California. Her term ran from 1989 to 1992.

"I don't know if I can brag about that or not," she said, seemingly disappointed that not more women had shared that throne with her.

Just after Lois left the Metropolitan board, women made up about 16 percent of the 37-member board. Today, that number has more than doubled to 34 percent of the now 38-member board. I think Lois would be happy.

At the Water Education Foundation, women have been a dominant force both in staff and leadership. Who could forget Rita? This year, she'll help us mark our 40th anniversary. Don't forget to mark your calendars for Oct. 26 in Sacramento for that celebration dinner. ❖



– Jennifer Bowles

Happenings...

Bay-Delta Tour

All roads in California water policy lead to the Bay-Delta. The Foundation's popular Bay-Delta Tour, June 14-16, offers you the chance to see this important region firsthand.

During the 3-day, 2-night tour you will learn about water exports, in-Delta farming, ecosystem challenges and more. This is a critical time for the Delta as regional water projects face pumping restrictions and fish populations continue to decline. And debate continues over the proposed tunnels that would carry water below the Delta to the state and federal pumping plants.

Tour stops include Delta islands and levees, the federal pumping plant in Tracy, Los Vaqueros Reservoir, the Bay-Delta Model in Sausalito and Suisun Marsh.

The tour is cosponsored by the Bureau of Reclamation, Mid-Pacific Region and the California Department of Water Resources. Additional tour sponsors are CH2M, ESA, MWH – now part of Stantec, GEI, Turlock Irrigation District and HDR. Learn more at http://www.watereducation.org/tour/bay-delta-tour-2017.

Foundation Celebrating 40 Years

In February, the Water Education Foundation marked the 40th anniversary of its founding and a celebratory dinner of this milestone is set for Oct. 26 at the Sterling Hotel in Sacramento. The dinner will recognize the supporters, partners and volunteers who have helped the Foundation fulfill its mission to offer nonpartisan, in-depth information on water issues through publications, conferences, its comprehensive website, tours, school programs, and much more.

At our fall anniversary dinner, we also will be celebrating the 20th anniversary of our popular Water Leaders program with a reunion for all classes dating back to 1997. Watch our website http://www.watereducation.org/foundation-event/water-education-foundations-40th-anniversary-celebration-dinner for more details.

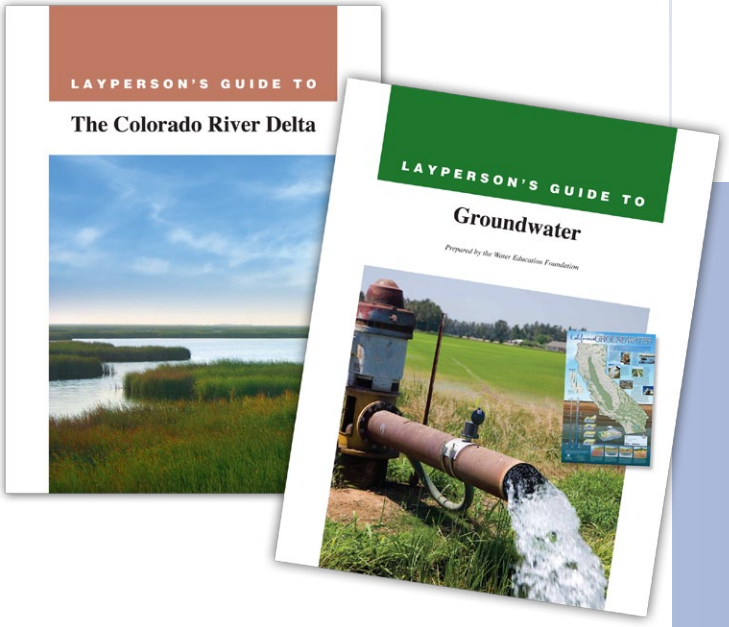
Or follow us on Twitter @WaterEdFdn and watch for posts with #40YearsStrong.

Update Your Library of Layperson's Guides

The Foundation recently released a revised and updated **Layperson's Guide to Groundwater**. Expanded to 28 pages, the popular title now includes more information about groundwater overdraft and subsidence, and explains efforts underway to implement California's Sustainable Groundwater Management Act. The guide also provides the basic explanation of what groundwater is, and the important role it plays in the story of water use in California.

In addition, a new title has been added to the acclaimed series. The **Layperson's Guide to the Colorado River Delta** provides readers with the facts about the past, present and future of this once-vast wetlands at the end of the Colorado River near the Gulf of Mexico. The 24-page guide also discusses issues related to its restoration – including the pulse flow in Minute 319 (the supplemental agreement to the 1944 U.S.-Mexican Water Treaty).

Copies of each guide are available for $15 each and can be purchased on our website, http://www.watereducation.org/laypersons-guides



Water Leaders - *Where Are They Now?*

Chris Scheuring

Managing Counsel, Natural Resources and Environmental Department, Legal Services Division, California Farm Bureau Federation

Class Year: 2004
Class Research Project: Water and Growth
What was your job when you were in the water leaders class? Associate Attorney for Somach Simmons & Dunn

What does your job focus on these days?

I'm the senior attorney in the department that handles the natural resources and environmental issues for our members across California with respect to water, land use, endangered species and air quality. As a practical matter, though, 70 percent of my work is water-related.

What is the most pressing water issue that you are dealing with?

System-wide, the most pressing issue is additional storage to bring supply back into line with demand. We have overlaid a network of after-the-fact environmental policy choices on to a system that stopped growing a generation ago. At the same time, the state continues to urbanize, so we're basically playing a game of musical chairs - and the question is not so much is someone going to lose, but who's it going to be?

What are you doing in terms of storage?

I'm keeping a close eye on regulations from the California Water Commission for Prop. 1 funding of new storage projects, as well as tracking and providing advice on new bills before the Legislature that may affect the development of new water storage. Going forward, on the administrative level, I will be commenting on the permitting of actual storage projects when that happens before theState Water Resources Control Board and other entities. And, of course, if it comes to it – I will be watching related lawsuits on behalf of our members.

Talk about your family farm.

We farm walnuts and almonds, and a couple of other things, organic citrus, mandarin oranges, but we're mainly nut farmers in western Yolo County. We moved out to California in the 1970s from the Midwest, where we grew corn and soy beans.

What memories do you have of your time in our Water Leaders program?

The tours were fabulous. I continue to be a huge proponent of the tours. It's the best way to see the reality of the landscape and infrastructure. You can sit at a desk and look at maps and read documents, but you don't get a sense of how big and geographically diverse this state and its hydrology is, and how critical it is to our pattern of human settlement.

Who was your mentor and what valuable advice did you get?

Fred Keeley (a former assemblyman from Santa Cruz who became the executive director of the Planning and Conservation League). He had quite a different perspective, being from the coast and a liberal area. So he opened up my mind to the differences in perceptions, from coast to inland, urban to rural. I don't know that the urban folks feel the immediacy of environmental regulation impacts. They see the good in them, but they don't see the immediacy of the trade-off in terms of water supply that farmers do.

What advice do you have for the young professionals in the water world?

Look at things from a landscape level from the beginning. Take a look at every large map from the Water Education Foundation that you can get your hands on. They show where the projects are, and the canals. Then take a look at California's precipitation, and where it falls. It's very helpful to get your career moving quickly to take a big picture view before you zoom in on any one particular area.

It can feel overwhelming, arcane, hard to understand, but if you look at water from a landscape level it's a fascinating field. It's always informed by scarcity, which makes it fascinating.

And be sure to start with your integrity and don't ever lose it.

Our one-year Water Leaders program began in 1997, and many graduates have gone on to achieve great things. We profile alums here so you can see where they are now and what they learned during their time with us. For more information on our program, visit www.watereducation.org/water-leaders

Sense of Place

Big Break Regional Shoreline

Along the banks of the Sacramento-San Joaquin River Delta in Oakley, about 50 miles southwest of Sacramento, is a park that harkens back to the days when the Delta lured Native Americans, Spanish explorers, French fur trappers, and later farmers to its abundant wildlife and rich soil.

That historical Delta was an enormous marsh linked to the two freshwater rivers and tidal flows from the San Francisco Bay. Today, the Delta has been transformed into a network of islands and levees that, among other things, serve as the switching yard for California's two largest water projects. But visitors at Big Break Regional Shoreline can catch a glimpse of the old Delta, still the largest estuary on the Pacific Coast.

The name "Big Break" comes from a 1928 break in the levee that separated an asparagus farm from the San Joaquin River and Dutch Slough. At the shoreline, the brackish water creates habitat for black rails, great blue herons and snowy egrets among its 70 bird species as well as several mammals.

A visitor's center functions as a natural history museum and science laboratory, as well as a staging area for paddling and hiking trips. Outside, visitors can walk over a massive, three-dimensional map of the Delta built into the ground that shows how water flows through the region. More info: http://www.ebparks.org.

We will stop at Big Break on our Bay-Delta Tour, June 14-16.
Check out www.watereducation.org/general-tours for more information

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California Department of Water Resources
California Farm Bureau Federation
Contra Costa Water District
San Joaquin Valley Water Infrastructure Authority
Water Education Foundation Staff

On the Cover

Aerial view of the proposed off-stream Sites Reservoir project, located near Maxwell in Colusa County (about 70 miles northwest of Sacramento). Photo taken by Kelly M. Grow, California DWR

The Water Education Foundation thanks all the sources and experts who reviewed this magazine for balance and accuracy.

The mission of the Water Education Foundation, an impartial, nonprofit organization, is to create a better understanding of water resources and foster public understanding and resolution of water resource issues through facilitation, education and outreach.

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Enhancing California's Water Supply: The Drive for New Storage

Flood control releases from Folsom Dam in mid-December 2016.

by Gary Pitzer

One of the wettest years in California history that ended a record five-year drought has rejuvenated the call for new storage to be built above and below ground.

In a state that depends on large surface water reservoirs to help store water before moving it hundreds of miles to where it is used, a wet year after a long drought has some people yearning for a place to sock away some of those flood flows for when they are needed.

"With recent storms bringing record rainfall to the state, California once again missed an opportunity to capture billions of gallons of water to help ease the drought," Republican Assemblymen James Gallagher of Yuba City and Vince Fong of Bakersfield wrote in a January commentary published in the *Bakersfield Californian*. "Now more than ever, we needed to capture that water to use once the rains stop. The lack of preparation and investment in water infrastructure will further hurt our vital agricultural industry."

The demand for new storage has echoed throughout California for decades but the process of planning,

designing, financing, permitting and construction is fraught with difficulty.

There are more than 1,400 dams and reservoirs (on-stream and off-stream) located throughout California providing flood protection, hydropower production and water storage. Chief among them are Lake Shasta and Lake Oroville, the anchors of the federal Central Valley Project (CVP) and the State Water Project, respectively. A key function of the CVP's Folsom Lake on the American River is releasing water to maintain water quality in the Sacramento-San Joaquin Delta. Farther south, Friant Dam's Millerton Lake on the San Joaquin River provides water for the east side of the San Joaquin Valley.

The construction of major dams by the state and federal governments generally ended after about a 20-year period between the 1940s and 1960s. Since that time, substantial investment has been made in regional water storage projects.

"The Bureau of Reclamation (Reclamation) and the Department of Water Resources (DWR), they just haven't built projects in a lot of years and if you look at the state, all the projects that have been built have been local," said David Guy, president of the Northern California Water Association (NCWA).

NCWA is among the 30 participants from the Sacramento Valley, Bay Area, San Joaquin Valley and Southern California that are funding the studies needed to advance the off-stream Sites Reservoir project in Colusa County (about 70 miles northwest of Sacramento).

On April 11, the board of directors for the Metropolitan Water District of Southern California (MWD) authorized $1.5 million for the first planning phase of the project with an eye toward possibly receiving an annual allocation of as much as 50,000 acre-feet.

"This modest stake gives Southern California a seat at the table as Sites Reservoir begins to take shape," MWD Chairman Randy Record said in a statement. "It also enhances the good faith effort being made by water agencies throughout the state to increase stored surface water in California, particularly in facing the uncertainties of climate change."

The Sites proposal is bookended to the south by the proposed Temperance Flat project on the San Joaquin River upstream of Friant Dam in Fresno and Madera counties. The relatively small size of Millerton Lake behind Friant Dam means water must be dumped from it more often during wet years than some of the state's larger reservoirs, something people in eastern San Joaquin Valley would like to change.

"The annual supply for the eastern valley is 800,000 acre-feet," said Mario Santoyo, executive director of the San Joaquin Valley Water Infrastructure Authority, a group of cities, counties and water agencies that support Temperance Flat. "We lost almost half a year's water supply due to the size of the existing reservoir. How does that make any sense in terms of water management?"

Adding a new reservoir with its 1.3 million acre-feet of storage above Friant would take the pressure off the valley's overburdened aquifers, Santoyo said.

"The idea here is if you build Temperance Flat, between the capacity of the new dam and the residual capacity of the old dam … you are looking at 1.7 million acre-feet altogether, which means we have more than tripled the capacity of the system."

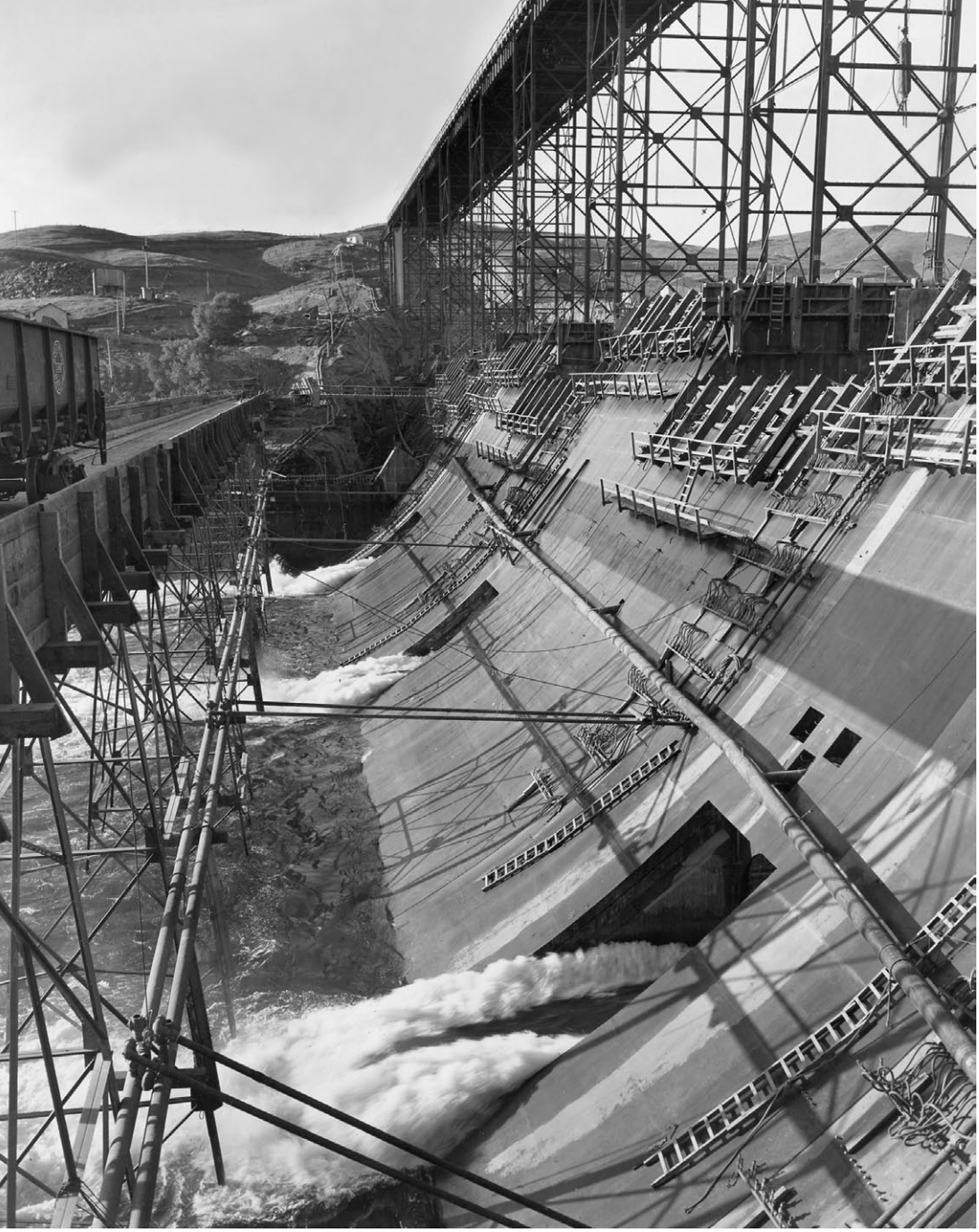
According to Reclamation, the increased water supply reliability for Temperance Flat ranges from 61,000 acre-feet to 87,000 acre-feet of long-term average annual deliveries. The construction cost estimate is about $3.2 billion.

One of the wettest years in California history that ended a record five-year drought has rejuvenated the call for new storage to be built above and below ground.

The debate about building new storage is a perennial issue that has galvanized people on both sides.

"There are two kinds of people," said Tim Quinn, executive director of the Association of California Water Agencies (ACWA). "Those that look at a year like this and say, 'Of course we need more storage,' and those that look at it and say, 'I'm not convinced.'"

The attitude about storage has changed during the last 10 years, highlighted by the 2014 voter-approved passage of Prop. 1, which established a competitive process to allocate $2.7 billion for the public benefits of qualified water storage projects. The 2016 federal Water Infrastructure Improvement for the Nation (WIIN) Resources Development Act also has the potential to provide funds for new storage.



Construction of Friant Dam on the San Joaquin River was completed in 1942. Its reservoir, Millerton Lake, has a capacity of 520,500 acre-feet.

There remain differing philosophies on how the state should achieve the task of expanding its water storage, with much of the debate centered on whether to construct above or below-ground storage. During the Water Education Foundation's Central Valley Tour in March, John Cain, director of conservation for California flood management with American Rivers, said constructing setback levees in certain areas could help recharge groundwater naturally.

"When we hear 'Build more dams,' our response is we think there are much more economical ways to use reservoir reoperation to do groundwater banking first," he said. With setback levees, rivers would have more room to meander with slower flows, flows that could then sink into aquifers below.

Building new surface storage is lengthy, complex, expensive and fraught with hurdles. There are many environmental issues to account for and proponents face difficulties in coordinating cost-sharing agreements and working with the state and federal governments in some cases. There's also the factor of limited geographical options.

"There aren't any really cheap surface water options available at this point because the folks who did the earlier planning and design of our water system picked all the good spots; plus the costs of infrastructure have risen as well," said Ellen Hanak, director of the Water Policy Center at the Public Policy Institute of California (PPIC).

With climate change, it is expected that the state's snowpack will decrease with much of the precipitation falling as rain; thus a system built to capture late-season snow runoff may have to be re-operated to handle high runoff from precipitation earlier in the season. "We will have to rethink the timing of those flood and storage space needs and extending them further into the winter and possibly also having a bigger amount of space," Hanak said. "If we are expecting flashier floods we are looking at likely increasing flood storage space so you lose even more of your surface storage."

Flood releases and having room to capture high inflows became an issue in February with the near-catastrophe at Oroville Dam when the main flood spillway was crippled, pushing the emergency spillway to near-failure and prompting the evacuation of more than 180,000 people from the city of Oroville and surrounding environs as a precautionary measure.

Noah Diffenbaugh, professor of Earth System Science at Stanford's School of Earth, Energy and Environmental Sciences, said the onslaught of rain that pummeled Northern California in the winter means it's time to reengineer how dams and reservoirs are operated.

"What we've seen in Oroville and in San Jose is that not only is our infrastructure old, and not only has maintenance not been a priority, but we're in a climate where we're much more likely to experience these kinds of extreme conditions than we were 50 or 100 years ago," Diffenbaugh said.

In his California Water Action Plan, Gov. Jerry Brown notes the new paradigm in which storage must be considered.

"Demand for water goes well beyond water supply and flood management, the traditional purposes for which California's major reservoirs were built," the Plan says. "Today, water storage is also needed to help provide widespread public and environmental benefits, such as seasonal fish flows, improved water quality, water cool enough to sustain salmon, and increased flexibility to meet multiple demands, especially in increasingly dry years. The financing of additional water storage in California must reflect not just specific local benefits, but also these broader public benefits."

New surface storage advocates hope their projects can be leveraged with available state money. Prop. 1 funds can only be used for the portion of construction costs that are dedicated to public benefits such as recreation, flood management, water quality and ecosystem improvements, as much as 50 percent of the total construction costs. Irrigation districts and other water users must pay for all the costs associated with improved water supply from storage projects.

Within the realm of new storage, the amount of available bond money for the public benefit portion of a project is limited.

"That $2.7 billion is not going to go very far," California Water Commission member Joe Del Bosque said during the March tour. "We have to see how we can stretch it out and get the biggest bang for the citizens of California."

Experts point out the vast potential available to the state by getting more water back into depleted aquifers for future use. It's a practice that benefits surface supplies and the environment, and is in line with the emerging oversight of groundwater pumping through the Sustainable Groundwater Management Act (SGMA).

"If you just look at total storage space, it's in the neighborhood of hundreds of millions of acre-feet," said Chris Petersen, senior hydrogeologist at GEI Consultants and president of the Groundwater Resources Association of California. "The estimates tend to vary between 500 million acre-feet and 1.3 billion acre-feet. It's big, it's vast and it's occupying the pore space of sands and gravels in every groundwater basin across the state."

Environmentalists champion groundwater storage as a way to meet future demands in a manner that benefits the environment. "There is a real opportunity for increased floodplain restoration that allows us to slow down some of this water and capture some of it for groundwater recharge, provide better flood protection for downstream communities, and also provide ecosystem benefits for salmon and other species," said Doug Obegi, staff attorney with the Natural Resources Defense Council (NRDC). "NRDC supported Prop. 1 because it provided substantial funding for sustainable water supplies and ecosystem restoration. With respect to storage, it only paid for new public benefits such as increased environmental flows into the Delta and required surface and groundwater projects to compete for funding on a level playing field."

Finding Consistency Amid Extremes

California regularly experiences drought and flood as part of its Mediterranean climate.

Surface water reservoirs do double duty – regulating the amount of flood flows and providing the storage needed during the summer and through droughts. Many reservoirs created by dams also provide recreation, hydropower production and needed environmental flows.

In its 2016 report *Storing Water*, PPIC noted that dams provide "a flexible form of storage that can be filled and emptied quickly to meet water supply and hydropower demand." New storage "could improve water system flexibility, but the average volume of new water from these facilities is small, and costs are high."

The storage dynamic is divided between storage and yield, and the corresponding per unit cost of the water that can then be delivered to various users. "Storage is how big a glass you have and yield is how far you fill it up each year, drink out of it and fill it back up," said Jim Watson,

general manager for the Sites Project Authority.

Ample storage space exists underground but methods must be found to deposit and retrieve the water.

"In the Central Valley and in some of the areas that are most overdrafted, there is plenty of land available, but getting the water there is the challenge," Petersen said. "A lot of it is the uncertainty in getting water through the Delta. I don't think finding the areas to do recharge is as challenging as building the infrastructure to get it there."

Boosting Flexibility – Los Vaqueros Reservoir

In the scenic foothills of the East Bay Area, plans are afoot to expand the storage capacity of one of the state's most high-profile local projects – the Contra Costa Water District's (CCWD) Los Vaqueros Reservoir.

When it was completed in 1998, the 100,000 acre-foot Los Vaqueros Reservoir was designed to improve delivered water quality during times of poor salinity levels and provide emergency supply for the district that directly taps the Delta. In 2012, the reservoir's capacity was increased to 160,000 acre-feet via a dam raise at a cost of $109 million to improve drought supply for CCWD. Its value as a regional water supply source is the basis of a proposed $800 million expansion through another dam raise to a 275,000 acre-feet capacity that could help water users in the Bay Area and beyond. The proposed expansion, which would boost water supplies for other agencies, will seek funding from the California Water Commission and a final funding decision is expected in December 2020.

"The drought actually provided an opportunity to demonstrate how a partnership in Los Vaqueros could work," said Jennifer Allen, spokeswoman for CCWD.

A bigger reservoir means an adjusted operations schedule in accordance with the project's funding partners. "It would depend on who needs what and when," Allen said. "We have the existing flexibility of the two existing intakes on either side of Victoria Island and then with a high lift pump station we would be able to use Rock Slough to potentially put water up into the reservoir as well."

Several water districts have been identified as potential partners and beneficiaries. Allen said wildlife refuges in the San Joaquin Valley, south of the Delta, also would benefit from the project.

"The idea is that the added capacity would be for the benefit of the partners," Allen said. "Costs of the expansion would be fairly divided using a 'beneficiaries pay' model, without eroding existing benefits."

Beginning in 2011 the Contra Costa Water District expanded its Los Vaqueros Reservoir to a capacity of 160,000 acre-feet. Now under consideration is an additional expansion through another dam raise to a 275,000 acre-feet capacity.

Managing a Budget of Water – Sites Reservoir

In a remote part of the northern Sacramento Valley sits the possible

location for Sites Reservoir, the $4.4 billion proposed project that would divert flows from the Sacramento River watershed off-stream for later use.

Sites was a key focus of DWR's North-of-Delta Off-Stream Storage Investigation that began more than a decade ago. Its course toward being shovel-ready is building through the commitment of the Sites Project Authority, which is a joint exercise of powers authority and through congressional legislation that would authorize the federal government's involvement in the project.

With a projected capacity of 1.8 million acre-feet, Sites is well situated to receive water from the Sacramento River via existing canals and a proposed pipeline. It will take the financial contributions of the Sites Project Authority to ensure its completion.

Sites would be "operated integrally" with Shasta Lake, Folsom Lake and Lake Oroville, Watson said. It would divert unregulated Sacramento River flows into the existing Tehama-Colusa and Glenn-Colusa canals and a new diversion on the Sacramento River. The water would then be released into the Sacramento River later in the year, augmenting natural flows and releases from other reservoirs.

Watson said the plan is to fill Sites "as Mother Nature, more senior water rights, and the regulations will allow," and that even during the drought there were storm events in which some flows could have been diverted. The 2016-2017 winter would have put Sites at full storage, he said.

More than a dozen agencies are members of the Sites Project Authority, including some that are miles away from the proposed reservoir. They see its construction as benefiting them because the additional water supply will, in part, ease pressure on Folsom Lake, located on the American River above Sacramento, to make releases to support water quality objectives in the Delta. Because Folsom is closer to the Delta than Oroville and Shasta dams, it is often operated first for necessary instream flows to manage Delta water quality. Watson said Sites can provide water to the Delta when it is needed the most.

"When it comes to the Prop. 1-eligible public benefits we can provide a large volume of water each year that can be actively managed by the state to improve ecologic conditions in the Sacramento River and contribute to improving the long-term ecologic health of the Delta," he said. "Part of our goal is to provide the state with a new management tool that they can use to help in the recovery of listed and/or threatened species of fish and birds. Each year, the state can decide what the priorities should be and how their water, which has been diverted into Sites, should be used. Currently, there is nothing like this in the state."

Determining the water supply allocation from Sites is being worked out.

"Today we don't have an asset in terms of a permitted project but the expectation is that as the project goes forward and the yield results remain the same, there would be a proportional share of water that a participating water agency would receive on an annual basis to use to augment their current portfolio of water supplies when the project is constructed and we turn the switch on," Watson said.

A Central Role in Water Management: Groundwater

Groundwater storage is increasingly looked upon as an important part of the supply portfolio and millions of dollars have been spent throughout the years to get water into the ground for later use and to remediate aquifers of marginal quality.

"It's really very different," said Petersen. "The thing about surface storage is it takes a huge capital outlay – a billion dollars or more to build one of these big surface reservoirs and you build it all at once and there you have it. With groundwater, it's more phasing in over time. It's a much smaller capital outlay. You build it as time goes on and as you come up with more money and as your needs change."

The cornerstone of groundwater storage is an understanding of the lay of the land.

"You have to develop a hydrogeologic conceptual model," Petersen said. "What that means is you want to understand the shape, the thickness, the lateral extent and the depth and breadth of the aquifer zone that you are trying to store water in."

There is interest in evaluating the potential of getting flood water into the ground to boost groundwater supplies.

"Flooding agricultural land during fallow or dormant periods has the potential to increase groundwater recharge substantially, but this approach has not been well studied," according to a 2015 article published in *California Agriculture*. "Soil suitability index identifies potential areas for groundwater banking on agricultural lands."

The article said 3.6 million acres of agricultural land statewide have

"excellent or good potential for groundwater recharge."

Establishing sites for groundwater replenishment and water banks stands apart from developing new surface reservoirs. Currently, there are more than 10 groundwater banks in Kern County alone, the largest of which are operated by the Arvin-Edison and Semitropic Water Storage Districts and the Kern Water Bank.

A proposed groundwater recharge project in Tulare County includes an 800-acre recharge basin, a 4.5 mile pipeline to the Friant-Kern Canal and 16 groundwater recovery wells within the Pixley Irrigation District.

"These actions would allow the Pixley and Delano-Earlimart irrigation districts to expand groundwater recharge efforts and improve groundwater levels," according to a statement by Reclamation. The federal agency is providing partial funding for the project under an existing law authorizing it to provide financial assistance to local agencies within the CVP for planning, designing and constructing local facilities for groundwater banking or recharge.

Perhaps the best way to increase groundwater storage is through in-lieu recharge, in which users back off pumping and instead use surface water when it is available to meet demand, allowing groundwater levels to recover. The next level is the use of large spreading basins to percolate water slowly into the aquifer, a process that requires a permeable pathway.

Finally, aquifer storage and recovery uses wells to inject water into the aquifer directly in wet periods and extract that stored water in dry years. The progression "goes from least expensive to most expensive," Petersen said.

The availability of flood water has allowed for some intentional recharge on farm land, which Hanak said "gets to the idea of taking advantage of the soil suitability to direct recharge to these areas, recognizing that irrigation return flows are already a major source of recharge in the Central Valley."

Much of the Central Valley's flood management system moves water quickly into areas that are natural floodplains, where silts and clays have accumulated over long periods of geologic time as flood waters have repeatedly overflowed their natural banks and spread over broad low-lying areas in the valley, but "this is not the most preferable outcome" for recharge, Petersen said.

"We need infrastructure to divert large volumes of floodwater, when available, into recharge basins located along the mountain front fringe areas of the basins where the groundwater aquifers are in contact with land surface and not covered with silts and clays," he said.

Comparing the costs of water supplied by surface storage with that

Experts point out the vast potential available to the state of using recharge ponds and spreading basins to get more water back into depleted aquifers for future use.

from aquifers "can be tricky to do in apples-to-apples terms," Hanak said.

"Do you include the cost of the water itself or just the infrastructure and are you averaging over all projects or just new ones?" she said.

In 2011, PPIC said the cost range for new groundwater storage was between $10 and $600 per acre-foot, with water from major surface storage ranging between $340 and $820 per acre-foot.

Obegi with NRDC said floodplain restoration can proceed with willing landowners and is "by and large compatible with growing operations because most flooding that occurs happens early in the year before planting." Complicating issues include working with the U.S. Army Corps of Engineers, which has authority over flood management, and ensuring that salmon have adequate passage, he said.

According to a 2016 article published in *California Agriculture*, 10 acres are needed to capture one cubic foot per second of diverted flood flow at the "relatively high" infiltration rate of 2.5 inches per day. "Based upon a 30-year record of Kings Basin surplus flood flows, we estimate 30,000 acres operated for on-farm flood recharge would have had the capacity to capture 80 percent of available flood flows and potentially offset overdraft rates in the Kings Basin," according to the article. "On-farm flood capture could reduce groundwater overdraft in Kings River Basin."

In the southern San Joaquin Valley, Semitropic Water wants to build as many as 120,000 acre-feet of storage facilities in the historic Tulare Lake bottom, with the water coming from Kings River and tributary flood flows.

In support of Temperance Flat, a diverse group of cities, counties and water agencies formed the San Joaquin Valley Water Infrastructure Authority.

One thing that remains an issue for these groundwater banks, however, is whether recharge water can be pumped through the Delta. Current pumping restrictions to protect endangered fish and maintain water quality have reduced the amount of water that can be exported south of the Delta.

Creating Supplemental Water – Temperance Flat

At the dedication ceremony for the completion of Friant Dam in 1949, Interior Secretary Harold Ickes was effusive in his praise of the project.

The dam was "a lifeline to preserve and enhance our American civilization," author Chris Brewer recounts Ickes saying in his book, *Historic Kern County: An Illustrated History of Bakersfield and Kern County*.

Gov. Earl Warren presciently noted at the ceremony that "we do not have an overabundance of water and need every drop that falls on the mountains and the plains."

Almost 70 years later, forces have converged to spur local interests to aim for another reservoir on the San Joaquin River to provide additional surface water for east side users and that could also help solidify groundwater levels that, under SGMA, must be brought into balance. "We just came out of a five-year drought where water was extremely precious," Santoyo said. "It was selling for more than $1,000 per acre-foot if you could get it." Agricultural water generally sells for $70 to $100 per acre-foot. Santoyo said farmers on the east side of the San Joaquin Valley have been buffeted by a series of events that have crimped their water supply.

A major impact is the establishment of the San Joaquin River Restoration Program in which some instream flows are being dedicated to salmon restoration. NRDC has publicly opposed the Temperance Flat project and has warned that the reservoir would worsen conditions

for salmon in the San Joaquin River, which is the focus of a major restoration plan.

Pumping restrictions in the Delta also have affected the region in the recent drought when longstanding, but seldom used, water rights resulted in water that typically is distributed from Millerton Lake behind Friant Dam to eastside farmers instead was left in the river to flow downstream to the San Joaquin River Exchange Contractors.

> **"A key thing with any of these big investments is what's the probability for how often you get water and how it fits with the rest of the system."**
>
> *– Ellen Hanak, PPIC*

At the same time, under SGMA, the locally formed Groundwater Sustainability Agencies will ultimately adopt plans to bring overdrafted aquifers into balance through either water augmentation, pumping restrictions or both.

"We have a situation in the valley with severe groundwater conditions and SGMA makes it that much more challenging for farmers and cities to do their business unless they have extra water to put in the ground that they can show are complying with the law," Santoyo said. "If we don't have that supplemental water to recharge, it's going to be hard for these guys to show that."

Furthermore, because of its location south of the Delta pumps (and free of regulatory constraint), Temperance Flat is advantageous in its ability to quickly move water to the California Aqueduct if it's needed, Santoyo said.

Temperance Flat may be eligible for Prop. 1 funding and Santoyo said he hopes it can receive $1 billion for that purpose. Furthermore, there is expectation that part of the $335 million in the Water Infrastructure Improvement for the National Resources Development Act can find its way toward the project.

What's In Water Users' Best Interest?

A changing environment has altered what were once firm convictions about new storage. The California Water Action Plan has declared that "the bottom line is that we need to expand our state's storage capacity, whether surface or groundwater, whether big or small."

After years of drought, a very wet 2016-2017 has put the spotlight back on the need to collect and store more of that water when it's available.

"Right there you have powerful evidence of the importance of storing water for the next drought and powerful evidence of the importance of storage capacity that's providing flood protection," Quinn said. "As big as the problems were at Oroville, if not for the dam [the city of] Oroville would have been wiped out as it was in 1956."

In an era of limited funds, Hanak with PPIC said it is vital that water users know the level of their commitment and expected return.

"A key thing with any of these big investments is what's the probability for how often you get water and how it fits with the rest of the system," she said. "With Temperance Flat, does it pencil out better if it helps get more water into the ground? I don't know the answer to that but it's in the water users' interest to get a sense of that."

While the Water Commission's evaluation process will determine the allocation of public money, it will largely be left to local water users to foot the bill for new projects. ACWA's Quinn believes it can be done.

"The water industry in California has always been ready to step up and pay for a system that works," he said. "If storage can make its case as part of a system that works I think you'll find agencies coming together to pay for it."

Considering new storage projects must occur within the greater context of how California manages its water, Quinn said. "Frankly, I think water managers in this state know they need a system that works," he said. "The current system does not work and it needs more than just conveyance. It needs conveyance and storage and a water market and watershed and other investments."

The effort to build Sites represents a departure from the previous approach, said Thad Bettner, general manager of the Glenn-Colusa Irrigation District.

"The federal and state process was 'let's study it, let's get environmental documentation and at the end let's figure out how to pay for it,'" he said. "We never got to the part of how do you pay for it and I think that was one of the first hurdles that we took on with the JPA was let's put together local governance that sits where the reservoir is and let's show that to people that are actually interested in investing in the project."

Sites has not generated outright opposition from environmental

groups because it is an off-stream reservoir. However, in a March comment letter to the JPA, NRDC, Defenders of Wildlife and the Bay Institute said the environmental analysis of the project must include one or more operational alternatives that substantially reduce diversions to storage during dry and critically dry years, as the operations previously modeled by DWR would significantly harm the Delta environment and fisheries.

NRDC's Obegi believes it remains to be seen whether Sites could work ecologically and economically. "The public estimates of the annual water supply yield from Sites are substantially overstated, as the proposed operations developed by DWR would harm the Delta and are unlikely to be permitted when state and federal agencies know that more flow through the Delta is needed in most years," he said.

While Sites' potential has been linked to the completion of the California Water Fix Delta tunnels project, Quinn said he believes investments in storage will be necessary regardless of whether the Water Fix moves forward.

"I don't think storage will stop if the governor's Water Fix doesn't go forward," he said.

As *Western Water* went to press, ACWA was finishing a study that examines the benefits of integrating new storage investments with each other, with the existing system, with conveyance improvements and especially with groundwater basins.

"This water storage integration study clearly demonstrates that integrating these infrastructure investments is extremely important for system flexibility, groundwater recharge and environmental restoration efforts," Quinn said. "For example, storage investments without conveyance improvements can provide significant supply benefits, but improving Delta conveyance roughly doubles the productivity of those storage investments."

Transporting water through the Delta – whether for above ground or below ground storage – is one big issue in the quest to build new storage south of the Delta.

Storage proponents note that Prop. 1 provides the needed leverage to help some projects go forward.

"Prop. 1 is characterized as being for storage but what's really different about it is that it's an environmental water asset for the state of California," Guy with NCWA said, referring to Sites Reservoir's possible benefit to the Delta.

Petersen said he believes practicality and the need to budget groundwater will push people to do more.

"With SGMA in place, that's going to be a real driver for innovation because if you are not able to comply you run the risk of having the State Water Board step in and taking control, and nobody is going to want that," he said. "I think we are going to see more managed aquifer recharge as part of the solution."

In a state that went from small handmade dams and canals to an immense network of dams, reservoirs and conveyance facilities, it remains to be seen what the next iteration of storage looks like. It will not be for lack of planning and desire that California fails to finds new places to hold water for the next inevitable drought. ❖

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