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Water Rights, Water Quality & Water Solutions in the West

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WATER STORAGE IN CALIFORNIA

DECISION TIME FOR NEW WATER STORAGE IS FAST APPROACHING

by Bill Swanson, PE, MWH, now part of Stantec (Walnut Creek, CA)

INTRODUCTION

The growth that California experienced over the past 100 years was largely made possible by the construction and operation of water storage projects that capture and move water from source areas to population centers, industry, and agricultural users. An era of rapid reservoir construction in the early- to mid- 20th century came to an end as reservoirs became subject to regulatory requirements that limited their operation and water managers made investments in local and regional water management solutions. But a new period of reservoir construction is upon us, prompted by the CALFED Bay-Delta program and facilitated by State bond funding.

After several years of rigorous study, decision time is nearing for major surface water storage projects in California. During the next two years, major decisions will be made at the Federal, State, and local levels on the construction of expanded or new reservoirs. This article discusses the progression of large surface water storage projects recommended by the CALFED Record of Decision, and highlights the challenges facing their implementation. Topics addressed include: the historical development of reservoirs in California; how reservoir operations have adapted to support ecosystem requirements; the CALFED Storage Program; the process and timeframe for distribution of state bond funding to finance public benefits of new water storage; and other drivers that may motivate local and regional water users to consider investments in expanded surface and ground storage.

BACKGROUND

California is often referred to as "the hydraulic society" in recognition of the complex and inter-connected water management infrastructure that serves the State. Water has shaped California's past, continues to shape its present, and will help define its future. A series of dams and reservoirs, pumping plants, canals, aqueducts and pipelines provide the backbone for an integrated state-wide water management system. Storage performs a crucial role in managing California's water — it transforms the highly variable supply to meet the quantity, timing, and location of demands for a vast array of uses. The storage of water changes the timing and quantity of natural supplies to more closely meet human needs and provides flexibility in managing water supplies.

Water storage projects developed in California during the early- and mid- 20th century promoted vigorous economic growth by providing water supply, flood protection, hydroelectricity, recreation opportunities, and the environmental protections required at the time they were envisioned. However, many of these facilities, developed prior to the passage of Federal and California environmental protection laws, were not designed, constructed, or operated as integrated water management systems.

California Storage

Reservoir Capacity

Storage & Delivery Projects

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Reservoir construction in California began in the late 1800's, with the most intense era occurring between about 1940 and 1980. During this period, statewide cumulative reservoir capacity increased from less than eight **m**illion **a**cre-**f**eet (MAF) to nearly 40 MAF — a five-fold increase. At the same time, the population roughly tripled, swelling from less than eight million to over 23 million. The population of California is now about 39 million and is projected to grow to over 52 million by the year 2060 (*see* California Department of Finance Demographic Research Unit, 2013. *Report P-1, State and County Population July 1, 2010-2060 (5-year increments)*. January), as shown in Figure 1.

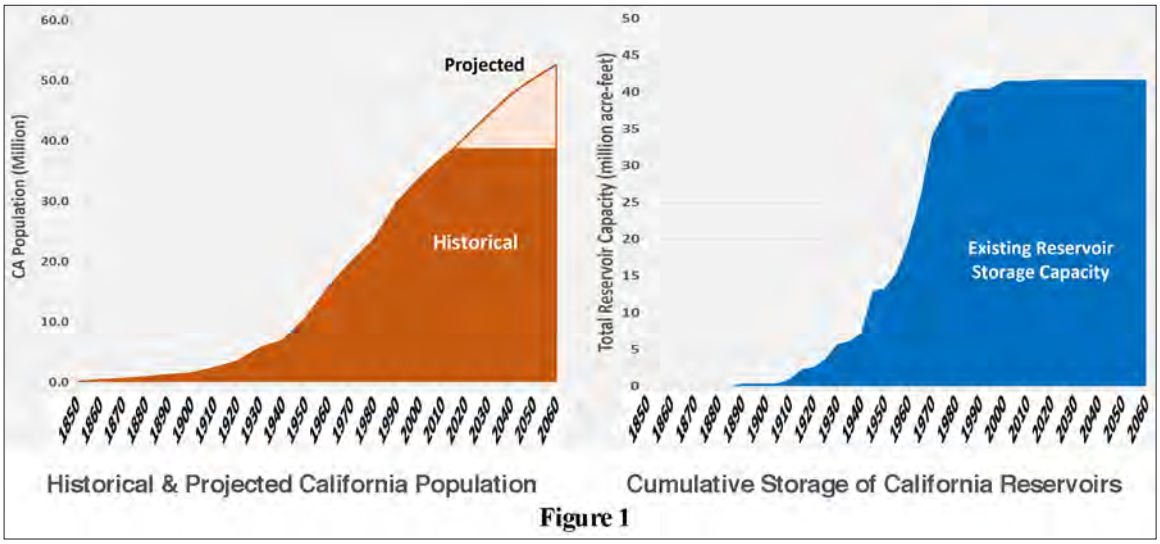


Figure 1

California now has about 1,400 regulated surface water reservoirs with a total storage capacity of nearly 42 MAF. These reservoirs are owned and operated by a mix of federal, state, and local agencies for multiple purposes. Overall, the statewide water system includes many local, state, and federal projects that encompass: dams and reservoirs; hydropower plants; canals; water diversion structures; groundwater recharge basins; extraction wells; water banks; and other water-related water management infrastructure.

The two largest water storage and delivery projects in the state, the Central Valley Project (CVP), operated by the US Bureau of Reclamation (Reclamation), and the State Water Project (SWP), operated by the California Department of Water Resources (CDWR), are located in the Central Valley. Both projects capture surface water in Northern California reservoirs and convey released water through the Sacramento-San Joaquin River/San Francisco Bay Delta (Delta) to large pumping plants that send water south through the San Joaquin Valley and, in the case of the SWP, to Southern California, as illustrated in Figure 2.

The CVP consists of 20 reservoirs, 11 power plants, and more than 500 miles of canals and aqueducts, with a total storage capacity of more than 11 MAF. Project purposes include: flood management; navigation; provision of water for irrigation and domestic uses; fish and wildlife protection, restoration, and enhancement; water quality; power generation; and recreation. The SWP consists of: 34 storage facilities, reservoirs, and lakes; 20 pumping plants; four pumping-generating plants; five hydroelectric power plants; and about 700 miles of open canals and pipelines. The SWP's purpose is to store and distribute water for agricultural, municipal, and industrial uses in Northern California, the San Francisco Bay area, the San Joaquin Valley, the Central Coast, and Southern California. Other SWP functions include flood management; water quality maintenance; power generation; recreation; and fish and wildlife enhancement (*see* California Water Commission, 2015. *Water Storage Investment Program Goals, Objectives, and Principles* (Water Bond, Chapter 8) — *Final,* July).

CVP and SWP deliveries supplement local surface water and groundwater supplies and provide water to nearly four million acres of irrigated farmland and over 25 million people. Since the 1970's, the operations of the CVP and SWP have been integrated through the Coordinated Operations Agreement (COA), which was finalized in 1986. The Agreement between the United States of America and the State of California for Coordinated Operation of the Central Valley Project and the State Water Project was authorized by PL 99-546 in 1986. *See also* CDWR, 2014a. *System Reoperation Study Phase 2 Report. Strategy Formulation and Refinement.* February.

The California Water Plan Update for 2013 reports that in an average water year — such as 2010 — the total water used in California was just over 40 MAF, of which about 23 MAF (58%) is from surface water and about 15 MAF (38%) is from groundwater (CDWR, 2014b. *California Water Plan Update 2013.* Bulletin 160-13. Volume 1 – The Strategic Plan). Both surface water storage and groundwater storage are critical to meeting the State's water needs, and in many areas, they are operated conjunctively.

California Storage

Operating Guidelines

EVOLVING REGULATION & PHYSICAL CONSTRAINTS

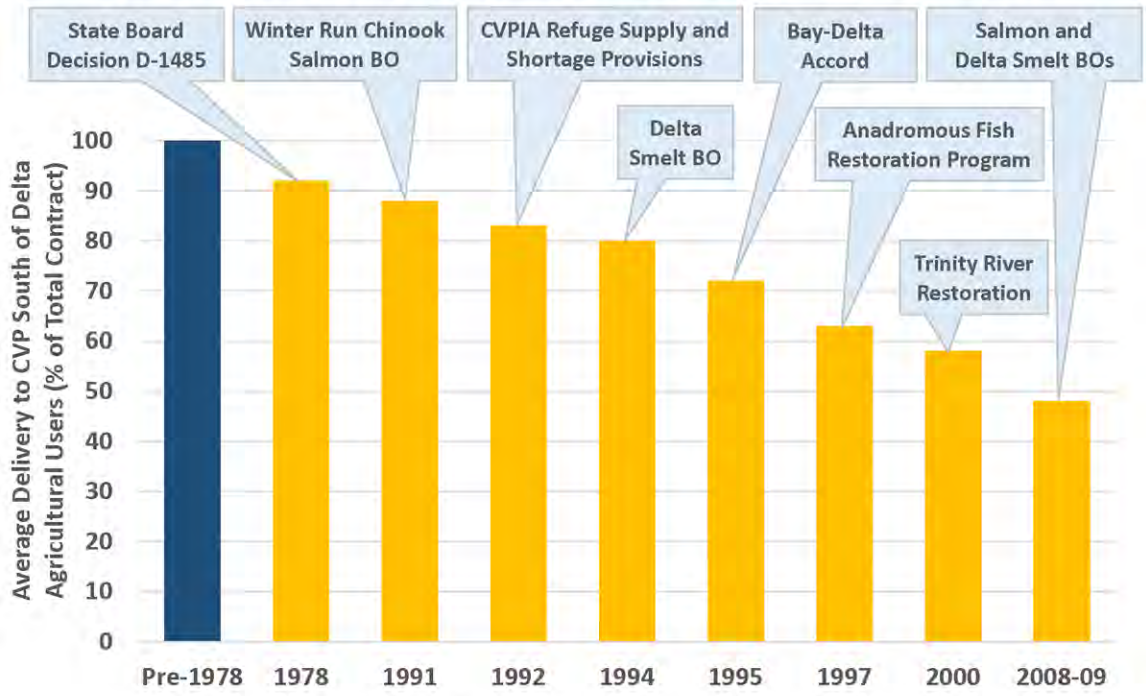
Over the past several decades, operating guidelines for the CVP, SWP, and other storage projects have profoundly changed in response to environmental requirements and as water use patterns changed in response to a growing population and implementation of other local and regional water management actions. This physical system is governed by a complex set of rules that set the operational priorities for water management. Requirements include: regulations established pursuant to the federal Endangered Species Act (ESA) for Chinook salmon and Delta Smelt, the federal Clean Water Act (CWA), and other federal legal requirements; senior water rights; water right settlements and exchange agreements; water contract provisions; water transfer agreements; and other requirements. The cumulative effect of regulatory

California Storage

CVP Delivery

actions has reduced the delivery capability of the CVP and SWP, particularly to water users south of the Delta. The most vivid illustration of this is shown in Figure 3, which depicts the effect of successive regulatory actions on the average delivery capability to south of Delta CVP agricultural water users.

Figure 3. Water Delivery Capability to CVP South of Delta Water Users



Sources: Pre-1978, CVP Water Delivery Records; 1978 – 2000, San Luis Delta Mendota Water Authority, extracted from various California Department of Water Resources (DWR) and U.S. Department of the Interior, Bureau of Reclamation (Reclamation) CalSim-II benchmark studies; 2008/2009, Reclamation & DWR CalSim-II Benchmark BO Study.

Groundwater Limits

California has approximately 850 MAF to 1.3 billion acre-feet of groundwater in storage. However, much of this is of poor quality or too deep to be economically extracted for drinking or agricultural use and only a small portion is within the reach of extraction wells. Hence, only a small portion of California's total combined surface water and groundwater resources can be managed to meet the timing, location, quantity, and quality requirements for human and environmental needs.

Given these and other exigencies, it is readily apparent that the importance for *integrated operation* of the state-wide water system, groundwater resources, and local projects is greater than ever.

Long-Term Strategy

THE CALFED WATER STORAGE PROGRAM

In 1995, a consortium of State and Federal agencies initiated the CALFED Bay-Delta Program to develop a comprehensive, long-term strategy to provide reliable water supplies to California cities, agriculture, and the environment while restoring the overall health of the San Francisco Bay-Delta Estuary. The CALFED Record of Decision (ROD) in 2000 recommended numerous actions to address state-wide water use efficiency, ecosystem improvements to the Delta watershed, levee strengthening in the Delta, and water storage in the Central Valley — both surface water and groundwater. An initial review of over 50 potential reservoir sites led to a selection of five projects to be evaluated in greater detail, including:

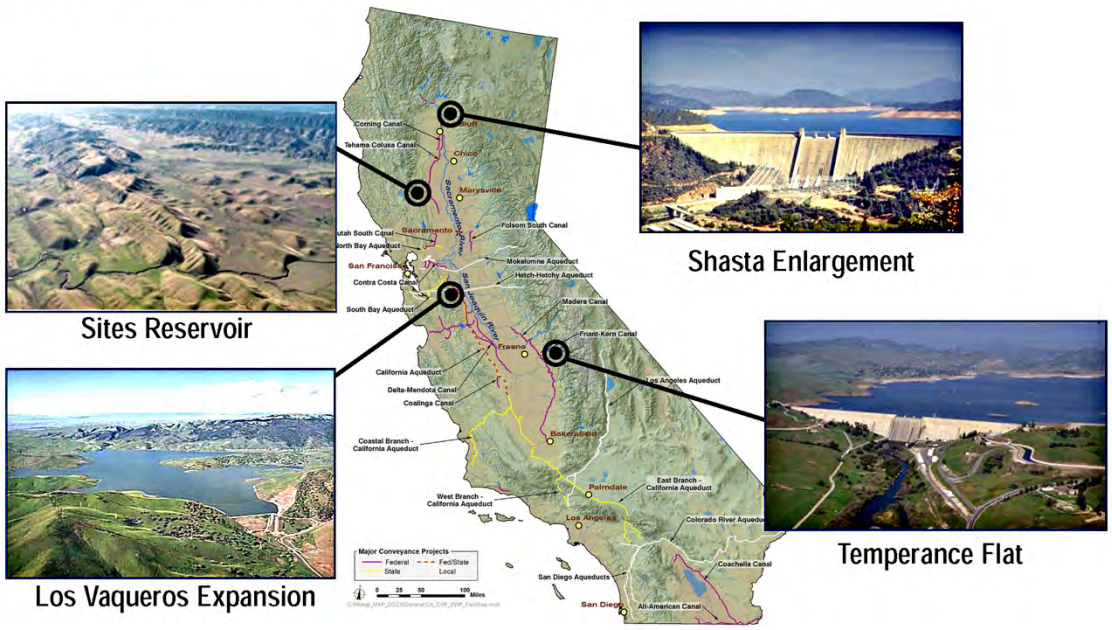
Reservoir Sites

enlarging Shasta Lake; constructing a new off-stream reservoir north of the Delta (commonly referred to as Sites Reservoir); constructing in-Delta storage through the inundation of four Delta islands; enlarging the then recently-completed Los Vaqueros Reservoir in Contra Costa County west of the Delta; and increasing the storage of San Joaquin River water by enlarging Friant Dam (Millerton Lake) or other equivalent actions. Feasibility and environmental compliance efforts have progressed for the four projects — shown in Figure 4.

California Storage

Project Investigations

Figure 4. On-Going CALFED Surface Water Investigations



Evaluations

The CALFED ROD identified objectives for each storage project, in recognition of their locations and distinct needs that each could address. Feasibility studies began in 2003, with Reclamation leading the evaluations of Shasta Enlargement and San Joaquin Storage, CDWR leading the evaluations of In-Delta Storage and Sites Reservoir, and Contra Costa Water District leading the evaluation of expanding the then recently-completed Los Vaqueros Reservoir with assistance from Reclamation. Regular coordination between Reclamation and CDWR on the CALFED storage program led to the development of a set of common tools and assumptions to provide consistency in project evaluations.

Revised Baselines

While the CALFED storage projects were being evaluated over the past several years, baseline conditions that affect the project formulation and benefits have changed, new groundwater management requirements have been implemented, and funding for State participation has been made available. For example, all of the ongoing CALFED storage projects would affect the Delta to some degree, either to convey stored water from Northern California reservoirs or through modified operations. Progress on all studies has been affected by changing Delta regulatory conditions. When studies began, Delta regulatory conditions in place in 2004 were used as a baseline for operational evaluation. In 2008 and 2009, the US Fish and Wildlife Service and the National Marine Fisheries Service issued updated **b**iological **o**pinions (BOs) for the protection for Delta Smelt and Chinook salmon, respectively. Several measures contained in the BOs, including **r**easonable and **p**rudent **a**lternatives (RPAs), are based on real-time conditions. Their simulation in the analytical tools presented considerable challenges. The updated model was applied to the feasibility studies to reflect the revised baseline, which affected project benefits and triggered changes to operational objectives.

Funding

Reclamation is coordinating with storage program stakeholders to identify potential cost-sharing partners and alternative sources of funding. Memoranda of Understanding (MOUs) are in place between Reclamation and local entities for Temperance Flat Reservoir, Sites Reservoir, and Los Vaqueros Enlargement, and an agreement in principal is in place for Shasta Enlargement. Additional feasibility, cost allocation, and environmental compliance may be needed to identify and recommend locally-preferred alternatives for these projects. The locally-preferred alternatives will form the basis for local financial commitments and funding applications pursuant to Chapter 8 of California Proposition 1 (discussed below).

A summary of the four surface water storage projects, and their status, follows.

Shasta Lake

Shasta Enlargement

Shasta Lake is the largest reservoir in California, located on the Sacramento River below its confluences with the McCloud and Pit rivers. A 602-foot tall dam forms Shasta Lake, which has a storage capacity of about 4.5 MAF. The feasibility study and Environmental Impact Statement (EIS) evaluated alternatives to enlarge the reservoir by increasing the height of the dam between 6.6 and 18.5 feet. An 18.5 foot raise would avoid relocation of a combined Union Pacific Railroad and Interstate 5 bridge that crosses the reservoir and increase the storage capacity of Shasta Lake by up to 634 **t**housand **a**cre-feet (TAF).

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Shasta Purposes

The project would involve raising the height of Shasta Dam by adding concrete mass and raising the top of a temperature control facility that allows for selective withdrawal of water from the reservoir into the hydropower plant. Shoreline infrastructure (including roads, bridges, buildings, and recreation facilities) would be relocated and/or replaced. Improvements downstream from Shasta Dam (including riparian, floodplain, and side channel restoration, and gravel augmentation) would be implemented to enhance habitat for aquatic species, particularly salmon. The additional storage capacity would be operated to enhance flow and temperature conditions in the Sacramento River for fishery objectives and to provide additional water supply, particularly during dry years.

McCloud River Free-Flowing

The McCloud River is not formally designated as a national or state Wild and Scenic River. However, Section 5093.542 of the California Public Resources Code specifies that the McCloud River should be maintained in its free-flowing condition, and its wild trout fishery protected, from 0.25 miles below McCloud Dam downstream to the McCloud River Bridge (located within the existing limits of Shasta Lake). Consequently, participation by the State of California in the feasibility study has been limited. The US Department of the Interior transmitted the final feasibility Report to Congress in July 2015 without a recommendation for construction due to outstanding issues needing resolution prior to recommendation. Outstanding issues included the need to identify non-Federal cost-share partners and develop an operating plan.

Sites Reservoir

Sites Purposes

Sites Reservoir would be a new off-channel reservoir located west of the Sacramento River in Colusa County, approximately 10 miles west of the town of Maxwell, California. It is being evaluated by CDWR, Reclamation, and the Sites Reservoir Joint Powers Authority (JPA), a public agency formed specifically for the project development. The project could enhance water management flexibility in the Sacramento Valley by reducing water diversion from the Sacramento River during critical fish migration periods and increasing the reliability of water supplies. It can also provide storage and operational flexibility for other CVP and SWP facilities, helping the overall water system adapt to changing requirements.

A storage capacity ranging from 1,200 TAF to 1,800 TAF would be created through the construction of up to 11 dams that would contain water in a valley currently in agricultural production. Water would be conveyed to Sites Reservoir from the Sacramento River through two existing canals (Tehama-Colusa and Glenn-Colusa canals) and a pipeline from a new diversion and release facility on the Sacramento River. Water would be pumped into and released from the reservoir using a pumping/generating plant.

Benefits

The Sites Reservoir project is being developed with a focus on improving water supply, ecosystem restoration, and water management resiliency. Potential benefits include: increased water supply reliability for municipal and industrial users, agriculture, and wildlife refuges; ecosystem enhancement actions to improve instream and Delta fish survival; water quality improvements for Delta water users and estuarine species; flexible hydropower generation to support renewable energy sources such as wind and solar; recreation opportunities at the new reservoir and improved recreation at existing reservoirs; and local flood damage reduction. Proposed operations focus on water needs during dry and critically dry years. A final feasibility study and associated environmental compliance documentation is planned to be completed in 2017.

Los Vaqueros Reservoir Enlargement

Los Vaqueros Purposes

Los Vaqueros Reservoir is an off-channel reservoir in Contra Costa County that was constructed and is owned and operated by Contra Costa Water District (CCWD). The original reservoir was completed in 1998 with a capacity of 100 TAF and included a new screened intake located in the Delta. The project was designed and operated to provide improved water quality, supply reliability, and emergency storage to CCWD. The CALFED ROD recommended enlarging Los Vaqueros Reservoir up to a capacity of 500 TAF to extend these benefits to other water users in the Bay Area and potentially beyond.

2012 Enlargement

As the feasibility study to enlarge the reservoir progressed in the 2000's, CCWD proceeded with the development of an additional screened intake in the Delta, which was completed in 2010. CCWD then enlarged Los Vaqueros Reservoir to 160 TAF by raising the dam about 35 feet. The enlarged reservoir, completed in 2012, provides greater operational flexibility to achieve CCWD water quality and supply reliability objectives, and increases emergency supply.

Expansion Study

The implementation of these modifications to the Los Vaqueros Project required revision to the planning baseline for evaluating reservoir enlargement under the CALFED Program. Studies to further expand Los Vaqueros to a capacity of 275 TAF are continuing. These studies are focused on: increasing water supply reliability (**m**unicipal and **i**ndustrial (M&I) and emergency); environmental water management; recreation; and water quality benefits. An expansion would involve raising the dam further and potentially constructing additional conveyance infrastructure to connect the reservoir directly to the South Bay Aqueduct to expand water supply reliability and water quality benefits to other Bay Area water users. A final feasibility study and associated environmental compliance documentation is planned to be completed in 2017.

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Temperance Flat Dam

Temperance Flat Reservoir

The Upper San Joaquin River Basin Storage Investigation evaluated 22 potential reservoir sites and sizes to select Temperance Flat Reservoir with a dam located at river mile 274, in the historic San Joaquin River channel at the approximate mid-length of Millerton Lake. Temperance Flat dam would be about 665 feet tall and would form a reservoir with a storage capacity of about 1.3 MAF, increasing the combined capacity of Millerton Lake and Temperance Flat to about 1.8 MAF. The CALFED ROD indicated that storage of additional San Joaquin River water supplies could support restoration of the San Joaquin River, facilitate greater conjunctive management in the region, and improve the quality of water delivered to urban water users.

2006 Settlement

San Joaquin River Restoration Settlement

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC) filed a lawsuit challenging the renewal of the long-term water service contracts between the United States and the Central Valley Project (CVP) Friant Division contractors. After 18 years of litigation, a Stipulation of Settlement (Settlement) was reached in September 2006 by the Settling Parties and subsequently approved by the Court. [For description of the Settlement and associated implementation under the San Joaquin River Restoration Program (SJRRP) see Gasdick & Gidding, *TWR* #76; see also Dunning, *TWR* #33 regarding the San Joaquin Settlement.]

Settlement Goals

The Settlement is founded on two parallel goals:

Restoration Goal: To restore and maintain fish populations in good condition in the mainstem of the San Joaquin River below Friant Dam to the confluence of the Merced River (approximately 150 miles downstream), including naturally reproducing and self-sustaining populations of salmon and other fish.

Water Management Goal: To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the release of Interim and Restoration flows provided for in the Settlement. Implementation of the Settlement will reduce CVP Friant Division water supplies by nearly 20 percent if no water management goal actions are taken. Impacts would be greatest in wet years when deliveries replenish groundwater for this conjunctive use region.

The Settlement Effect on Temperance Flat

Natural Runoff Mimic

The Settlement and subsequent Federal legislation authorizing its implementation in 2009 affected the analysis of Temperance Flat Reservoir. The Settlement established a flow regime for San Joaquin River restoration, and required that a set of guidelines be developed to define operational priorities and water accounting methods. The flow regime includes flow targets under the range of hydrologic conditions that have occurred over the past century that generally mimic the natural runoff pattern. That pattern is characterized by high flows in the spring, base flows through the summer, a minor pulse flow in the fall, and base flows in early winter months. The Settlement reduced the available water supply that can be developed by Temperance Flat Reservoir, particularly during wetter years when inflow that otherwise would have been available for storage is required to be released to meet restoration flow objectives.

Objectives Revised

At the time the restoration flow guidelines were being developed, the Temperance Flat study focused on the physical aspects for facilities and verified field conditions and refined designs. Once the SJRRP established an operating plan that was accepted by all Settling Parties, planning for Temperance Flat Reservoir could resume. The first action involved revising the project objectives to be compatible with the Settlement and remain consistent with the CALFED ROD. The revised objectives include: increasing water supply reliability and system operational flexibility for agricultural, M&I, and environmental purposes in CVP San Joaquin Valley areas, and other regions of California; and enhancing water temperature and flow conditions in the San Joaquin River downstream from Friant Dam for salmon and other native fish.

Reclamation evaluated a set of alternative operations of Temperance Flat Reservoir/Millerton Lake to deliver water to the Friant Division using existing canals, and to other CVP and SWP water users through river releases that would be diverted at a downstream location. The analyses show that both water supply and ecosystem restoration can be realized using the same water supply.

Hydropower Impact

The development of Temperance Flat Reservoir would inundate two existing hydropower plants owned and operated by Pacific Gas and Electric as part of the Kerckhoff Power Project. Mitigation measures to address power generation and remaining losses will be included as part of the Temperance Flat project.

Wild & Scenic Designation?

Recently, the US Bureau of Land Management found that the reach of the San Joaquin River between Kerckhoff Dam and the first downstream powerhouse is eligible for Federal designation as a Wild and Scenic River and recommended this reach for Congressional designation in the National Wild and Scenic Rivers System. A Wild and Scenic designation of this reach would preclude development of Temperance Flat Reservoir.

Reclamation prepared a draft feasibility report and circulated a Draft EIS for public review during 2014 and is completing review and approval of final versions of both documents. Interior plans to release the final feasibility report to Congress during 2016.

California Storage

Conjunctive Management

Operational Flexibility

Surface Water Storage

Water Action Plan

Sustainability

Climate Change

Groundwater Declines

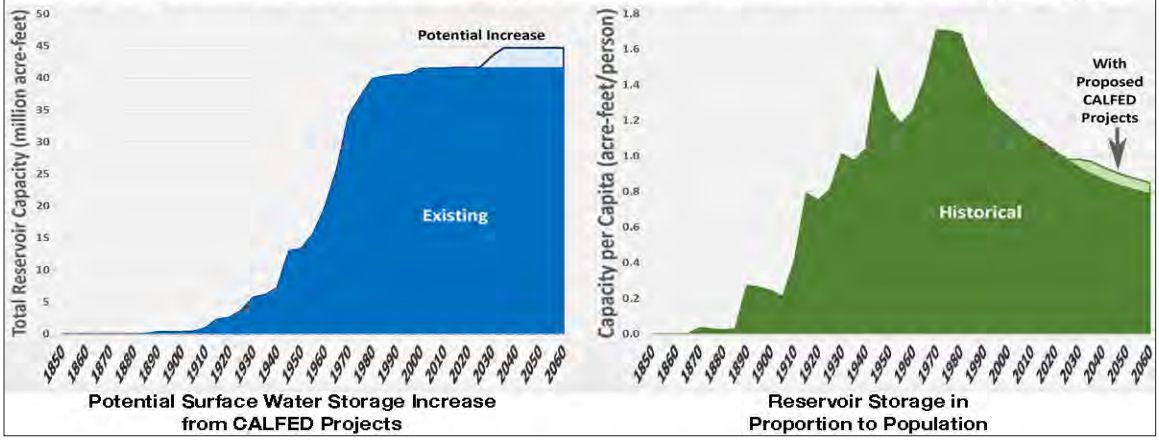
Groundwater Storage

The CALFED ROD recommended that groundwater storage projects be developed in addition to the surface water storage projects described above. A total of one MAF of additional managed groundwater storage capacity was recommended, although no specific projects were identified at the time. Interest in developing groundwater projects that could be operated conjunctively with surface water storage is high, particularly with the availability of funding through Proposition 1 and recent passage of the Sustainable Groundwater Management Act, as discussed later in this article.

How the CALFED Storage Projects Can Affect Water Management

The four CALFED surface water storage projects would increase the total surface water storage capacity in California by just over three MAF, but would not be implemented in isolation. As shown in Figure 5, this would represent a relatively modest increase to the existing total storage capacity, however it would be valuable in improving operational flexibility for the state-wide system. As also shown, historical development in California was propelled in part by the large available capacity of surface water reservoirs in comparison to population. The greatest amount of storage on a per capita basis occurred in the late 1970s as the SWP and other major projects were completed. Since that time, population growth and operational regulations have profoundly changed the management of surface water and groundwater reservoirs to produce a more integrated system. The operations of projects that once delivered water on a relatively consistent basis have become more coordinated with regional and local storage projects (surface water and groundwater) and the supplies are becoming more integrated with local water management actions — such as conservation, stormwater management, reuse, desalination, and cleanup of contaminated groundwater. New surface water storage can be implemented only if it can be demonstrated to increase the flexibility in managing a complex system that must meet a variety of needs and adapt to future uncertainty.

Figure 5. Additional Capacity of Proposed CALFED Surface Water Storage Projects



The California Water Action Plan

The 2014 California Water Action Plan articulated a series of actions to meet three broad objectives: more reliable water supplies; the restoration of important species and habitat; and a more resilient and sustainably managed water resources system (supporting water supply, water quality, flood protection, and environmental objectives). These objectives are aimed at better withstanding inevitable and unforeseen pressures in the coming decades. The ten recommended actions will move California toward more sustainable water management by:

- providing a more reliable water supply for farms and communities;
- restoring important wildlife habitat and species; and
- helping the state's water systems and environment become more resilient.

The Water Action Plan recognized the need to expand the state's surface water and groundwater storage capacity, including large and small projects. More storage will aid in adapting to the effects of drought and climate change on water supplies for both human and ecosystem needs. Climate change is expected to bring more frequent drought conditions and could reduce by half California's largest natural storage system — the Sierra snowpack — as more precipitation falls as rain rather than snow, and as snow melts earlier and more rapidly. Additional storage will also help in managing groundwater basins to reverse alarming declines in groundwater levels that could lead to irreversible land subsidence, poor water quality, reduced surface flows, ecosystem impacts, and the permanent loss of capacity to store water as groundwater (*see* California Department of Food and Agriculture, California EPA, 2014. *California Water Action Plan: Actions for Reliability, Restoration and Resilience.* January).

California Storage

Public Benefits

The California Water Action Plan acknowledges that demand for water goes well beyond water supply and flood management, the traditional purposes for which California's major reservoirs were built. Today, and into the future, water storage is expected to also help provide widespread public and environmental benefits. These benefits include: seasonal fish flows; improved water quality; water cool enough to sustain salmon; and increased flexibility to meet multiple demands, especially in increasingly dry years. As a result, the financing of additional water storage in California should reflect not just specific local benefits, but also these broader public benefits.

PROPOSITION 1 – THE 2014 CALIFORNIA WATER BOND

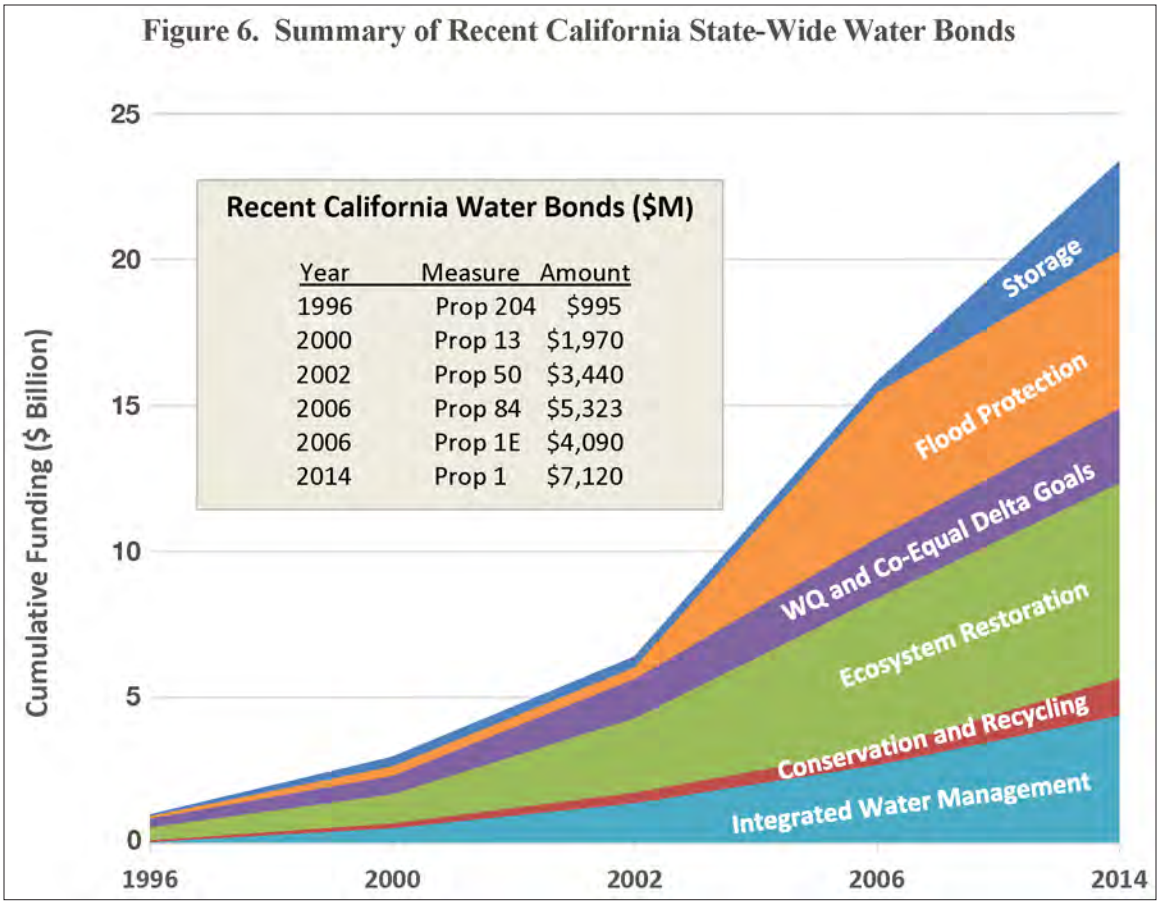
Water Bond

In November 2014, California voters overwhelmingly approved Proposition 1, the *Water Quality, Supply, and Infrastructure Improvement Act of 2014*, affirming the need for a safe and reliable supply of water to support the State's economy, environment, and quality of life. Development of this bond was a long and arduous process. In 2009, the State legislature passed a bond measure for $11.14 billion that was planned to be placed on the 2010 ballot. Financial conditions in 2010, and again 2012 caused the legislature to delay placing the measure before the voters. In 2014, the legislature passed a replacement measure that authorized about $7.1 billion of new funding and re-directs about $400 million of previously authorized but unspent funding from other measures. The priorities for Proposition 1 closely align with those identified in the Water Action Plan. *See* "*The Making of California's Water Bond*" Brandt & Rendon, *TWR* #134.

Bond History

California has a long history of passing state bond measures to promote water management improvements, dating back to 1960 to finance construction of the SWP. As shown in Figure 6, Proposition 1 is the latest in a series of recent state bond measures that provided over $23 billion for wise water management. Each bond measure includes funding for multiple objectives and directs the use of funds at both state-wide and local levels. Similar to previous State water bond measures, Proposition 1 requires a commitment of local funding, thereby stimulating significantly greater investment in system-wide water management improvements than would be possible through local measures alone.

Figure 6. Summary of Recent California State-Wide Water Bonds



California Storage

Public Benefits

Proposition 1 includes $2.7 billion for the public benefits that can be provided by water storage projects. Public benefits include: ecosystem improvement; water quality improvement; flood protection; emergency response; and recreation. Public benefits can be provided by multi-purpose storage projects that also provide non-public benefits, such as water supply and hydropower benefits that are paid by the users.

Chapter 8 of Proposition 1 defines the public benefit categories and sets qualifying criteria. Ecosystem restoration benefits include measurable improvements to the Delta ecosystem or its tributaries. Measurable ecosystem changes may include: beneficial effects that result from changing the timing of water diversions; improving flow conditions; temperature improvements — or other benefits that contribute to restoration of aquatic ecosystems and native fish and wildlife.

Emergency Response

Emergency response includes water supplies and flows for dilution and salinity repulsion following a natural disaster or act (such as Delta levee failure or terrorism). Emergency water supply could be used to repel salinity if released from an upstream reservoir or to meet water demands that could not be satisfied with Delta supplies because of catastrophic damage.

The legislation also specifies that Chapter 8 funds can provide no more than 50 percent of the total capital cost of a project and that ecosystem benefits must constitute at least 50 percent of the funded benefits. In addition, applicants for bond funding must have commitments for 75 percent of the remaining capital costs. Proposition 1 funds cannot be used for operations and maintenance costs.

Water Storage Investment Program

Environmental Benefits

The authorizing legislation for Proposition 1 assigns the California Water Commission (Commission) responsibility for distributing Chapter 8 (storage) funds based on a competitive basis. The Commission is required to consult with the California Department of Fish and Wildlife, the State Water Resources Control Board (State Board), and the California Department of Water Resources, to develop and adopt by regulation, methods for quantification and management of public benefits described in Section 79753 by December 15, 2016. The regulations shall include the priorities and relative environmental value of ecosystem benefits as provided by the Department of Fish and Wildlife and the priorities and relative environmental value of water quality benefits as provided by the State Board.

Investment Program

The Commission will fund the public benefits of eligible water storage projects through the Water Storage Investment Program (WSIP). The WSIP will support the California Water Action Plan and its call for a safe and reliable supply of water to support the State's economy, environment, and quality of life. It is being developed in an open, transparent, fair, and cost-efficient manner, with the objective to maximize the sound and responsible investment of public dollars. The Commission is working with a broad array of stakeholders including: water agencies; conservation organizations; tribal governments; public agencies; and communities throughout the state to develop the regulations and guidelines for the WSIP.

The Commission will select projects for funding on a competitive basis based on expected return for public investment. Eligible projects must provide measurable benefits to the Delta ecosystem or its tributaries.

Project Goals

Eligible projects include the following types (*see* California Water Commission, 2015):

Surface storage projects identified in the CALFED Record of Decision, with the exception of projects that are prohibited by the California Wild and Scenic Rivers Act

Groundwater storage projects and groundwater contamination prevention or remediation projects that provide storage benefits

Conjunctive use and reservoir reoperation projects

Local and regional surface storage projects that improve the operation of water systems in the state and provide public benefits

One of the first steps in developing the WSIP was an initial scoping survey in early 2015 to collect cursory information about potential water storage projects from project proponents that may request Proposition 1 funding. The survey requested general agency information and project information, such as: project type; anticipated completion dates for feasibility studies and environmental documentation; permit requirements; potential public benefits provided; project cost; and potential funding partners. Response to the survey was strong, with nearly 100 potential surface water and groundwater storage projects identified throughout the state. In response to a recent request for concept papers that provide more detail on possible projects, the Commission received over 40 responses from potential applicants. The WSIP will be implemented over many years on a schedule with the following anticipated major milestones:

WSIP Schedule

By December 15, 2016, the Commission will develop and adopt by regulation methods for the quantification and management of the public benefits of water storage projects (Water Code § 79754).

By March 2017, the Commission will release draft project solicitation and evaluation guidelines for the Water Storage Investment Program and conduct meetings to consider public comments before finalizing the guidelines.

After December 15, 2016 and before January 2022, the Commission will select projects through a competitive public process that ranks proposed projects based on expected return of public investment.

California Storage

Multiple Actions

Groundwater Regulation

Local Power

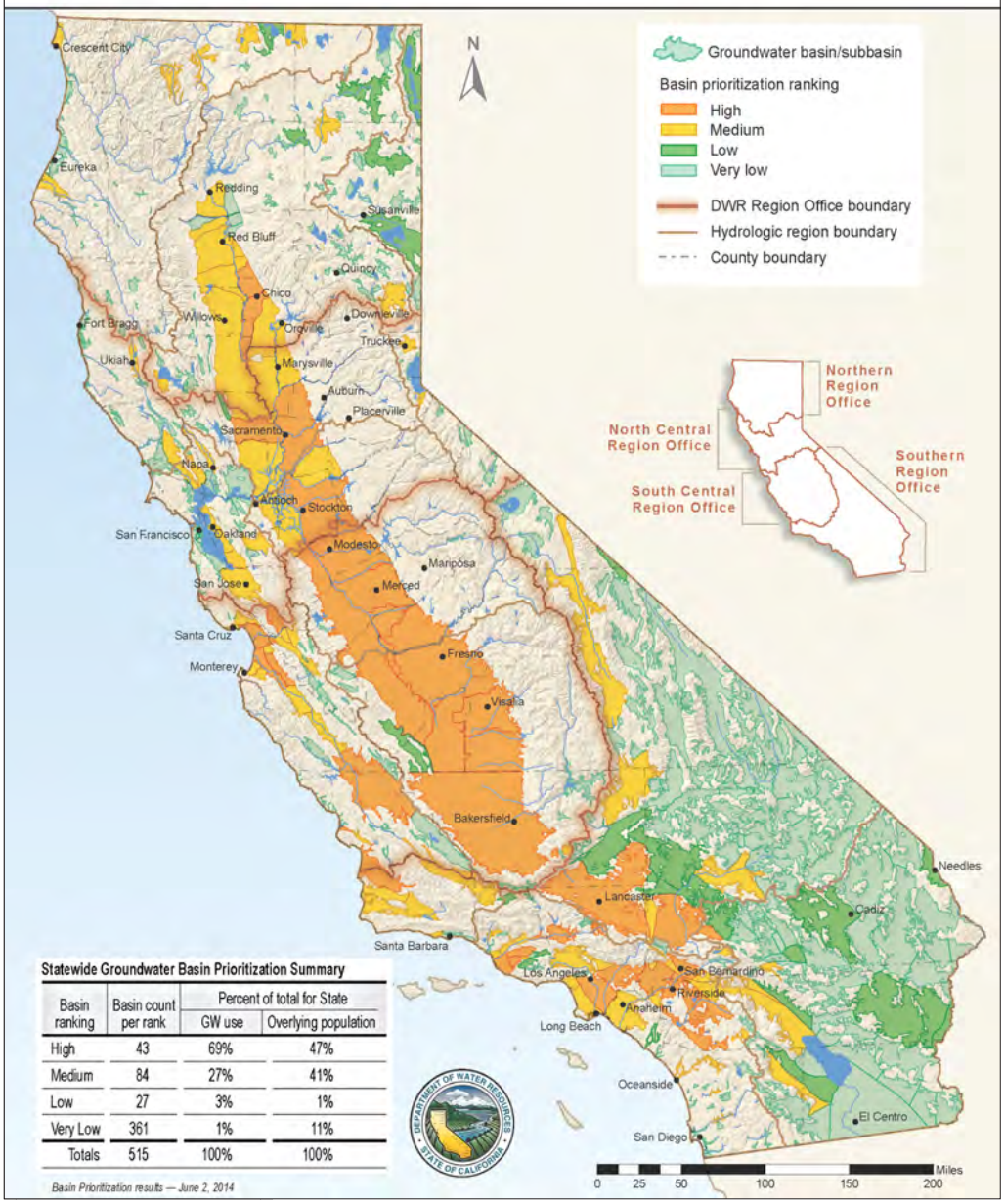
The Commission has encouraged potential project applications to develop a plan for multiple projects and actions that can maximize the benefits of new storage. Plans should identify groundwater banking, water conveyance, water treatment, watershed management, and other projects or actions that would enhance or be enhanced by new storage. Some related projects may also be eligible for funding through other chapters of Proposition 1. Where possible, applications should demonstrate how additional storage and related projects can provide benefits to disadvantaged communities.

Sustainable Groundwater Management Act

Groundwater is a critical water resource in California, providing long-term supply and an important buffer against drought shortages. Groundwater use is largely unregulated in many areas of California, and its overuse has led to severe declines in groundwater levels in many places, particularly in the Central Valley.

In 2014, California's severe and ongoing drought helped spur the passage of the Sustainable Groundwater Management Act (SGMA), the first-ever state-wide effort to comprehensively measure and manage groundwater (*see* Moon, *TWR* #128; Aladjem, *TWR* #135). SGMA is a package of three bills (AB 1739, SB 1168, and SB 1319) that create a framework for sustainable, local groundwater management for the first time in California history. It is based on a recognition that groundwater management in California is best accomplished locally. Local agencies will have the power to assess the conditions of their local groundwater basins and take the necessary steps to bring those basins in a state of chronic long-term overdraft into balance.

Figure 7. Groundwater Basin Priorities under SGMA



Statewide Groundwater Basin Prioritization Summary

Basin ranking	Basin count per rank	Percent of total for State	
		GW use	Overlying population
High	43	69%	47%
Medium	84	27%	41%
Low	27	3%	1%
Very Low	361	1%	11%
Totals	515	100%	100%

Basin Prioritization results — June 2, 2014

SGMA requires local agencies to achieve sustainability within 20 years. It establishes minimum standards for sustainable groundwater management, provides local groundwater agencies with the authority and tools necessary to sustainably manage groundwater, and allows for state oversight and intervention if locals do not act.

SGMA requires the formation of Groundwater Sustainability Agencies (GSAs) that will develop and implement Groundwater Sustainability Plans (GSPs) for basins that are designated medium or high priority. GSPs must consider all beneficial uses and users of groundwater in the basin, have measurable objectives, and include interim milestones that ensure basin sustainability. A GSA may be a local agency, combination of local agencies, or a county may establish a GSA.

*As shown in **Figure 7,** many high and medium priority groundwater basins are located in the Central Valley, particularly in the San Joaquin Valley. The water management benefits of additional surface water will be of interest to GSAs to help achieve sustainability objectives.*

California Storage

"Sustainable Yield"

Sustainable yield for a groundwater basin is defined as the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply without causing one of the following undesirable results:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable seawater intrusion.
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

CONCLUSIONS

Water management in California has changed dramatically from the time that most surface water storage was planned and constructed. Operating rules to address ecosystem needs, in combination with increased water demands, have reduced the operational flexibility needed to adapt to changing hydrologic, climatic, and environmental conditions. Over the past few decades, local projects designed to increase local supplies and reduce direct reliance on the state-wide water systems have helped fill the gap caused by reduced system-wide flexibility.

Dramatic Changes

During the next two years, important decisions will be made that will affect long-term water management in California. The expansion of surface water and groundwater storage as envisioned by Proposition 1 will improve the operational flexibility of state-wide water systems to provide both public and non-public benefits. The recent requirements to develop and implement plans for groundwater sustainability will cause some water users to consider the value of new water storage projects differently. As water users consider their interest in making significant investments in new water storage, they also will be concerned about the outcome of decisions on the California Water Fix, a plan to construct tunnels below the Delta would affect the role and benefits of storage.

Important Decisions

In their evaluation of applications for Proposition 1 funding to finance public benefits of new storage, the California Water Commission will consider the interdependent value that water storage provides in combination with other water management investments. In light of the recent and on-going drought in California, the public will expect decisions to be made quickly.

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will be
Moderator
for the Session:
"**Expanding Surface Water Supplies**"
at upcoming
California Water Conference
Oct 25 & 26
in LA

For Additional Information

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Bill Swanson, PE, serves as the Global Practice Leader for Water Resources for MWH, now part of Stantec. He has supported the US Bureau of Reclamation, California Department of Water Resources, US Army Corps of Engineers, and many local water agencies in California in the evaluation of water storage, both surface water and groundwater. He leads inter-disciplinary teams in evaluating proposed changes to water management systems, including modified operations and new infrastructure to achieve multiple objectives, such as increased water supply reliability, flood protection, ecosystem restoration, hydropower generation, and recreation. Recently, he directed the consulting team in the evaluation of Temperance Flat Reservoir and provided review and strategic advice in the evaluation of enlarging Shasta and Los Vaqueros reservoirs. He also led the consulting team in preparing the San Joaquin River Restoration Program EIS/EIR, which addressed actions to re-establish naturally-producing and self-sustaining salmon in the San Joaquin River downstream from Friant Dam. Bill is located in northern California in the MWH Walnut Creek and Sacramento offices and is a registered professional engineer in California and Texas.

