

## Coping With the California Drought Crisis

On November 24, 2014 at the request of the Long Beach Water Department the Aquarium of the Pacific convened a group of 10 water experts from throughout California and one from Arizona to characterize the severity of the Southern California drought, and to recommend what actions should be taken now to reduce its impact.

This report is a brief summary of the deliberations of that working group. It begins with the statement made to the media the day of the forum that was endorsed by all the participants. Following that is a short statement that provides more extensive context for the group's findings and recommendations.

### Statement to Media on 24 November 2014

California has had droughts throughout history, but things are different now. A growing population and a growing agricultural economy have contributed to a substantial increase in the demand for water. One hundred years ago, California's population was less than 2 million. Today it is 38.5 million and is projected to reach 47.7 million by 2040. In 2007 there were 14,734,170 acres in agriculture and by 2012 the number had grown to 15,815,009 acres.

California is in a long-term drought, in which eleven of the last sixteen years have been dry. Right now, Southern California faces a water crisis. The State's reservoirs are at record low levels—down to about 33 percent of capacity. We anticipate next year's allocation from the State Water Project will be less than 5 percent of normal, perhaps as low as 0 percent. The Colorado River is also in decline, with Lake Mead at record lows. The deficit between supply and demand will most likely be filled by groundwater, a strategic reserve of unknown quantity that is being rapidly depleted by over-use.

Southern California currently has one year's supply in storage at the present rate of demand.

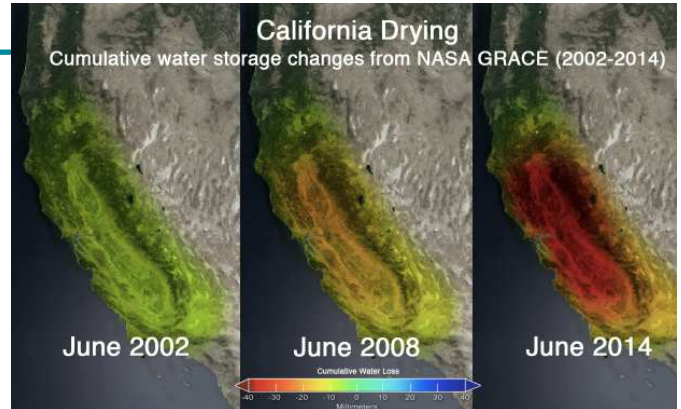
This group of experts believes that Californians must adopt a new, permanent culture of water conservation. We need to reduce urban water use in Southern California by 15 to 20 percent starting now and lasting forever.

These are not easy things to do, and every Californian has a part to play. Agriculture currently accounts for 60 percent of all water use in California; 15 percent goes to urban areas and to industry; and 25 percent goes to the environment, much of it as runoff that is not being captured.

Here is a list of urgent actions the group recommends necessary to reduce the impacts of a drought over the next twelve months and ensure our lives and livelihoods:

- Reduce outdoor water use significantly through mandatory restrictions with fines. Primary targets should include lawns and highway medians, cemeteries, large commercial landscapes, and golf courses. Public parks and areas that use recycled water could be exempt.
- Over the longer term we need to price water appropriately to reflect its value, with tier pricing to reflect high use while protecting those least able to pay. This may require legislation.

On December 1, 2014, the allocations from the State Water Project were made at 10% of each contractor's contractual amount.



Jay Famiglietti, NASA Jet Propulsion Laboratory, California Institute of Technology and University of California, Irvine

- A program should be started now to provide funds to cities to identify significant leaks and to eliminate them. Long Beach has a good record of doing this.
- Groundwater has been viewed as a safety net, but it is a limited resource that is declining. Our knowledge of how much water we have in groundwater is meager. An inventory should be made starting immediately so that both surface water and groundwater can be managed together more effectively.
- A comprehensive public education program is critical to help people understand where our water comes from, where it goes, and the changes in behavior we need to make on a permanent basis.

It is possible to manage our way through this and future water shortages, but current knowledge of hydrological processes dictates that outdated water policies be revised to reflect the current state of understanding. The realities of population growth, agricultural growth and climate change require that we develop new strategies to allocate available water among competing agricultural, municipal, domestic, industrial, energy, and environmental needs.

Over the longer term these emergency measures need to be institutionalized. In addition, the state needs to explore all ideas for reducing demand and increasing supply. Allocations among different uses should reflect those uses most important to the health and safety of Californians and to the state's economy.

We encourage continued dialogue among the State Water Board, the Governor's office, and the legislature to ensure that allocations reflect these priorities. These discussions should be expanded to include more of the public and a representative cross-section of stakeholders.

Because agriculture represents the largest water use in the state—60 percent of all water—it deserves particular scrutiny. There are opportunities to reduce agricultural water use through increasing irrigation efficiency, crop selection, and proper pricing without losing this important sector of the State’s economy.

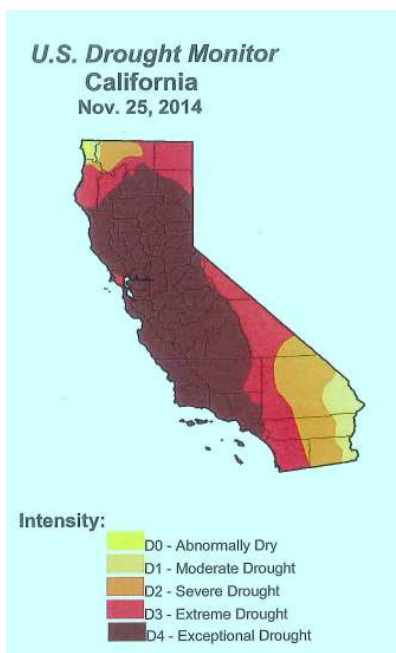
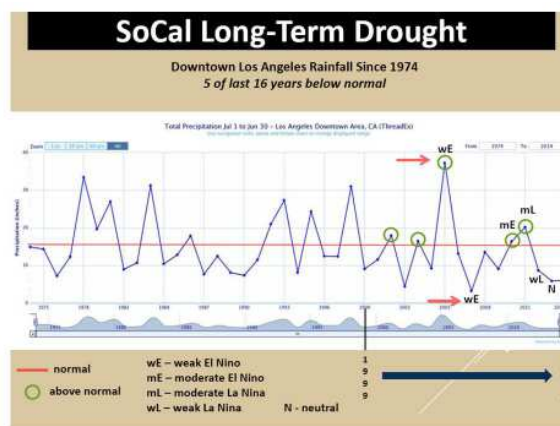
Improving the reliability of water supply is essential. Among the opportunities we noted:

- A greater emphasis on local water supplies through
  - Expanded use of water recycling
  - Capture and storage of storm water
  - Expand use of safe grey water systems
  - Use of smart meters to inform consumers about their water use and help detect leaks
  - Expanded use of permeable pavement and other strategies to capture stormwater runoff in under ground cisterns or groundwater basins
  - Desalination of saline and brackish waters
  - Ensuring adequate investment in water infrastructure to eliminate water loss
- Clean-up and management of groundwater for sustainable long-term use
- Improving reliability of the State Water Project
- Targeted research on topics critical to improving the management of the state’s water



## Additional Context for Findings and Recommendations

The 20th century was an unusually wet century with fewer drought years than in most of the previous 4-20 centuries. While California has less water now, the fundamental problem is in how that water is allocated and managed. The difference in precipitation between wet years and dry years is only about 15%. What is different now than even as recently as 14 years ago in 2000 is the population. It has grown from 34 million to more than 38 million over this brief period. A second factor is the growth and insatiable thirst of California’s agricultural industry. Sixty percent of all of California’s water goes to support the most important agricultural economy of any state in the nation, leading the second largest agricultural economy Texas by three-fold. While California’s agriculture plays a vital role in the nation’s food supply, it accounts for 60% of all the State’s water use, and less than 3% of the State’s economy.



On the surface, all seems well in Southern California, but it is deceptive—a new kind of “green washing.” Southern California’s lush green, well-watered landscapes are more a matter of traditional views of landscape aesthetics and what the landscaping industry has promoted than the kinds of landscaping consistent with our semi-arid environment. Continuing business as usual makes people think that there is no shortage at all, and belies the crisis that looms large on the immediate horizon. Southern California has in storage only enough water to meet current demand for 12 months.

One year! And the State acted late in the game to require mandatory conservation hoping that the drought would end soon.

California is in the midst of one of the worst droughts since record-keeping began more than 125 years ago, a drought that some experts believe could be the worst drought in 500 years. In October 2014, 58% of California was categorized by NOAA as being in “exceptional drought” (the most severe category) and more than 80% of the State was in the two worst categories of drought—exceptional and extreme. (NOAA Drought Monitor)

To make matters worse, the drought is combined with some of the warmest years on record which exacerbate the drought. The 2013-2014 winter was the warmest on record. According to NOAA, California’s average temperature during the first 9 months of 2014 was 4.1°F above the 20th century average (63.7° vs. 59.6°F).

The high temperatures and the lack of precipitation took a toll on California’s major water storage mechanism—snowpack in the Sierra Nevada. The 2013-2014 snowpack was at record lows—less than 15% of normal—depleting the supply to rivers that normally



replenish our reservoirs and groundwater. The State's surface reservoirs are at an average of 33% of capacity; some much less. And groundwater—long the State's safety net is being dangerously over-tapped. Groundwater levels throughout California are falling, some as much as 1-1.5ft/month.

No sector of human society is exempt from the drought. Drought is taking a toll on agriculture. Thousands of acres lay fallow. Ranchers are selling off cattle by the thousands. The price of food is rising.

Drought and high temperatures are increasing the risk of wildfires and extending the traditional fire season in southern California to nearly the entire year. Los Angeles, Orange, San Diego, and Riverside Counties are at the greatest risk.

The generation of hydroelectric energy is at 35% of normal and decreasing as river flows continue to decline.

Nature also loses. Species of anadromous and semi-anadromous fish such as salmonids, including Steelhead trout, don't have enough water in many southern California rivers and streams to make it to their natal spawning grounds. Many birds that follow the Pacific Flyway found neither enough water nor enough food left in the fields that are out of production to be able to survive their long migrations. The drought adds challenges for a number of threatened and endangered species.

Some people cling to the hope that an El Niño will save us and things will be back to normal. Even the strongest El Niño ever recorded would make only a dent in the accumulated water deficit, and the latest predictions by NOAA's Climate Prediction Center are for a weak El Niño. Many other experts believe that the current situation is a harbinger of the "new normal" that southern California must adapt to. Earth is warming; climate is changing. The scientific evidence is unequivocal. Warmer temperatures will only make the situation worse.

With higher temperatures both humans and nature use more water. Plants lose more moisture through evapotranspiration. This addition of water vapor—a greenhouse gas—to the atmosphere creates a feedback mechanism that accelerates warming.

Based on this assessment, James Famiglietti summed up what needed to be done in a July 8, 2014 LA Times Op-Ed "How Much Water Does California Have Left?" (<http://www.latimes.com/opinion/op-ed/la-oe-famiglietti-southern-california-drought-20140709-story.html>). Famiglietti pointed out three major steps were required to address the drought:

"The first (challenge) is awareness of our water supply situation. Our water has three main sources: snowmelt from the Sierra Nevada, local groundwater and imported water from the Colorado River basin.

Unfortunately, all three of these sources are drying up. The amount of available freshwater from each has declined significantly during the drought. Even worse, best available forecasts indicate that the declines will continue for decades.

Second, it is time, right now, for mandatory water restrictions, with enforcement and fines for violations.

*(Editor's Note: Famiglietti's comments were right on clearly the mark. The next day the State Water Resources Control Board authorized fines of up to \$500 for wasteful water use.)*

Voluntary measures such as Gov. Jerry Brown's emergency request to reduce water use by 20% are not working. Coastal communities in Southern California managed to reduce water use by only 5% between January and May, 2014. Los Angeles, Long Beach and San Diego all recorded increases of between 1% to 4%.

Third, we must press for better management of the state's groundwater supply. As the major source of irrigation water in California, and the critical reserve for all during drought, groundwater accounts for roughly 65% of the statewide water supply. Consequently, most of our aquifers are being rapidly depleted, with little regard for meeting future needs. These include the southern half of the vast Central Valley aquifer system, aquifers in Paso Robles, the Coachella Valley, the Imperial Valley and more."

Raising awareness and implementing these changes will require a knowledgeable, concerned, and committed public. That comes primarily through education and communication. Recent reports indicate clearly that the public is not getting the message on the severity of the situation and the need for them to take personal responsibility for reducing their water use.

The monthly Urban Water Conservation report of the State Water Board (See Fig. B) shows that in October 2014

the State reduced water use by only 6.7% compared with October 2013. The reductions year-over-year for June through September 2013 – 2104 are also shown. There were significant differences in reductions between Northern and Southern California. In October 2014 relative to October 2013 the Bay Area reduced its water use by 15.5% while Los Angeles Basin residents cut their water use by only 1.4% and San Diego actually increased its water use by 2.6% in October 2014 relative to October 2013. Some of the responsibility for the failure to communicate the seriousness of the situation falls to those water officials who are reluctant to state the facts clearly in unambiguous terms apparently fearing that it would reflect badly on their management of this vital public resource.

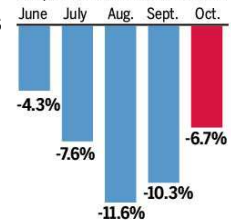
Forum participants endorsed the importance of a comprehensive public education and communications program in coping with the current drought and in changing behaviors to adapt to the likelihood of more frequent, more persistent, and prolonged droughts in the future as a result of climate change. It's a change in behavior that must also continue during wet periods when storage can be maximized to mitigate the impacts of droughts that are sure to follow. These are some of the characteristics identified for an effective educational and communications program.

### Conservation slows

After reducing water usage by 11.6 percent in August, California saved only 6.7 percent in October.

#### Water usage

Compared with same month from 2013



Source: State Water Resources Control Board  
BAY AREA NEWS GROUP

## Education and Communications

Initial steps in developing any comprehensive education and communications plan are identifying the primary audience and defining the outcomes one wants to achieve. Our discussions identified the general public as the primary audience and the following learning objectives:

1. Educate water consumers about where their water comes from and where it goes and the causes and extent of the current water crisis in hopes that they will make wise water conservation choices.
2. Encourage more Long Beach residents, and others throughout Southern California, to significantly reduce landscape watering by converting their lawns to drought tolerant gardens. The Aquarium might partner with the Long Beach Water Department and lawn-to-garden service providers) with on-site information, a model garden, and retail opportunities.
3. Encourage widespread water conservation across all of Southern California.

Some of the barriers that limit water conservation by individuals and households have been identified. Unlike the educational issues, these barriers are linked largely to factors that influence behavior as identified by social psychologists and social marketers.

- Perceptions about fairness: People often are reluctant to adopt conservation when they see others continuing to waste resources.
- Perceptions that drought resistant landscapes are ugly and may lower their property values: People are often reluctant to sacrifice.
- Fears about the initial cost of lawn-to-garden landscape: People often struggle to invest in long-term solutions. We recognize that even with the Long Beach Water Department's \$3.50/sq. ft. subsidy, the average lawn-to-garden conversion cost \$5-\$10/sq. ft.
- A sense that warnings about the crisis are hyperbole—equivalent to “crying wolf”: People have grown increasingly resistant to cries of alarm.

Education alone is rarely enough to correct these misperceptions and trigger behavior change, although it is usually a necessary prerequisite.

Social signaling is, perhaps, the most important psychological challenge to overcome. In social psychology experiments, people have shown an amazing tendency to defer to others who act as though there is no crisis, even when the evidence of a crisis is readily apparent to outside observers. People behave this way because we are acutely aware of how others perceive us, and people are reluctant to risk their reputations and social status by going against the grain.

Some of the most effective campaigns created opportunities for people to identify with desirable behaviors, often by celebrities, and communicate their attitudes and choices to their peers.

Smart sensors and programs that compare a consumer's water use to neighborhood averages make productive use of perceived peer pressure to get results. Simply providing real-time feedback about consumption has the effect of encouraging behavioral change.

Each of these techniques assumes and communicates that individuals and their communities will make a difference in solving the water crisis. Public health campaigners learned long ago that merely scaring people with a crisis can be demoralizing if realistic solutions are not offered as well. On the other hand, empowerment marketing and social signaling suggest that we need not shy away from scary or discouraging information if we also offer solutions.

### Participants

**Jonathan Bishop**, State Water Resources Control Board

**Tom Bowman**, Bowman Change, Inc.

**Michael Connor**, East Bay Dischargers

**James Famiglietti**, University of California, Irvine (UCI) and NASA's Jet Propulsion Lab (JPL)

**Madelyn Glickfeld**, University of California, Los Angeles (UCLA)

**Mark Jackson**, NOAA National Weather Service

**Jayne Laber**, NOAA National Weather Service

**Dave Meko**, University of Arizona

**Bill Patzert**, NASA's JPL

**Steve Richie**, San Francisco Public Utilities Commission

**Jerry Schubel**, Aquarium of the Pacific

**Kevin Wattier**, Long Beach Water Department

[http://www.aquariumofpacific.org/news/story/aquarium\\_convenes\\_forum\\_to\\_address\\_water\\_crisis](http://www.aquariumofpacific.org/news/story/aquarium_convenes_forum_to_address_water_crisis)

### A Concluding Comment

The challenges of dealing with climate change and the likely increase in more frequent, more intense, and more persistent droughts by the end of this century are daunting, but not impossible. And all challenges carry with them opportunities.

California has the natural, intellectual and fiscal resources to adapt to “the new normal” while conserving a high quality of life for which California is known. In doing so, California can set an example for other parts of the nation and the world facing similar situations. Seizing this leadership opportunity would result not only in a more resilient State, but to new economic opportunities.