Proposed Regulatory Framework for Extended Emergency Regulation for Urban Water Conservation
Fiscal and Economic Impact Analysis

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Executive Summary

For the past month rain and snow have returned to much of California, lending hope that the state may be emerging from a four-year drought, the worst in recorded history. A strong El Niño in the Pacific has spurred storms, leading to improvement at the state's reservoirs, which stood at 22 to 55 percent of their historical averages at the end of 2015. The Folsom reservoir that supplies Sacramento suburbs, for example, has risen 28.5 feet. More importantly, the Sierra Nevada snowpack, which had reached a 500-year-low, is already 103% of average for this time of year.

However, the rain and snow that have fallen so far are not nearly enough to end the drought. Most of the precipitation hitting Southern California will not refill reservoirs. It may help replenish aquifers, but much of it will simply flow into the sea. It is the moisture that falls as mountain snow that is the most important for water supplies. The pace of that snow needs to continue during much of the next four months, the region's wet season, for the drought to end.

In response to Governor Edmund G. Brown, Jr.'s fourth drought-related Executive Order (EO), issued April 1, 2015, the State Water Resources Control Board (State Water Board, Board, or SWRCB) on May 5, 2015 updated and readopted a drought emergency water conservation regulation (May 2015 emergency regulation, or current regulation) to, among other things, achieve a 25 percent statewide conservation target for urban areas through February 2016, as compared to water use in the corresponding months of 2013. Based on data submitted pursuant to the May 2015 emergency regulation, the state, through the November reporting period, is currently exceeding the 25 percent mandate, with cumulative savings of over one million acre-feet of water between June and November 2015. Water Code section 1058.5, under which the Board adopted the current regulation, provides that emergency regulations adopted by the Board pursuant to that section may remain in effect for up to 270 days. In consideration of the fact that the current regulation is set to expire on February 13, 2016 without further action by the Board, and the Governor's November 13, 2015 EO B-36-15, which directs the Board to extend until October 31, 2016 restrictions to achieve a statewide reduction in urban potable water usage, if drought conditions persist through January 2016, the State Water Board has issued a draft *Proposed Regulatory Framework for Extended Emergency Regulation for Urban Water Conservation* (Framework) on December 21, 2015 and draft proposed updated regulatory text (proposed regulation) on January 15, 2016. Under the Framework and draft proposed regulatory text the current regulation would be extended with minor but important adjustments to achieve a statewide reduction in urban potable water usage through October 2016. The proposed adjustments, discussed below, are being considered that could lower individual water district conservation targets by up to eight percent.

Understanding the proposed regulation's potential fiscal and economic impacts requires segregating outcomes created by the drought itself, and measures that would have been taken by water suppliers even without the current regulation or the proposed regulation. That is, proposed regulation revenue losses/costs are related to *additional* actions water suppliers will have to undertake. This analysis does not estimate the totality of the fiscal and economic impacts of water shortages resulting from the drought, but rather the fiscal and economic impacts attributable to implementation of the proposed regulation after accounting for what water suppliers likely would have saved if the drought were to continue but the current regulation was not extended as proposed. Estimated impacts are maximums in that full compliance is assumed and required reductions are allocated pro-rata over sectors, rather than being targeted to sectors that have lower shortage costs. Estimated impacts are also maximums in that potential benefits of the proposed regulation in the form of future avoided fiscal and economic impacts are not credited against the estimates of near-term costs presented in this report.

During 2015, the Board received many comments regarding how conservation requirements might be applied more equitably among water agencies. Under the proposed regulation, several adjustments potentially would be made to the current regulation in addition to extension of the regulation. The primary modifications proposed by Board staff to the current regulation are as follows:

- Incorporate a climate adjustment that reduces individual urban water suppliers' conservation standards between 2 and 4 percentage points for water suppliers located in the state's warmest regions.
- Adjust individual urban water suppliers' conservation standards to reflect water efficient growth since 2013.
- Provide a reduction to the individual conservation standards of urban water suppliers, varying between 4 and 8 percentage points, which rely on new, local drought resilient water supplies.
- Modify the Commercial Agriculture Exclusion to require certification that customers whose water use is subtracted under the exclusion produce, or would normally produce, a minimum of $1,000 per year in revenue from agricultural sales and are not subtracting water used on ornamental landscapes.

We estimate fiscal impacts for three alternative regulatory scenarios. In all scenarios, the current emergency regulation is extended to keep conservation requirements and reporting requirements in place for the remainder of February, 2016, through October 31, 2016.

- **Scenario 1: Existing Conservation Requirement**. Under this scenario, the Board leaves unchanged water supplier conservation requirements.
- **Scenario 2: Existing Conservation Requirement with Credits Capped at 4%**. Under this scenario, the Board adopts the credits proposed by its staff with the provision that the total credit any given supplier can receive is capped at 4 percentage points.
- **Scenario 3: Existing Conservation Requirement with Credits Capped at 8%**. Under this scenario, the Board adopts the credits proposed by its staff with the provision that the total credit any given supplier can receive is capped at 8 percentage points.

Impacts principally consist of (1) reductions in local governmental revenue associated with forgone water sales by retail and wholesale urban water suppliers; (2) additional costs imposed on water suppliers as a result of the need to adopt enhanced conservation and administrative programs; and (3) economic welfare effects associated with an inability of water users to buy water supplies they otherwise would have purchased.

Fiscal impacts (1) and (2) represent real financial losses to water agencies in the state. Impact type (3) is known as "consumer surplus loss." The proposed regulation essentially rations water which deprives residences and businesses of a commodity they value and would have otherwise purchased. Impact type (3) is a measure of the economic value of this forgone consumption.

Table ES-1 summarizes results for the entire State. Under Scenario 1, where the existing conservation requirements are extended until October 31, 2016, fiscal impacts are estimated at $673 million, of which $572 million would accrue to local governmental entities and $101 million would accrue to investor-owned and mutual water companies. Approximately 90 percent of the fiscal impact is associated with

lost sales revenue. The remaining impact is associated with expenditures by water suppliers to comply with the conservation requirements. Net water saved under Scenario 1 is projected to be approximately 850,000 acre-feet (AF).[1]

Both Scenario 2 and 3 result in smaller fiscal impacts, but also less net water saved. Under these two scenarios, which give climate, growth, and drought supply credits to water suppliers, estimated fiscal impacts are approximately $100 million less. Water savings under Scenarios 2 and 3 are 130,000 to 140,000 AF less than under Scenario 1, respectively.

It is important to reiterate that the fiscal impact estimates shown in Table ES-1 are not measuring the total revenue losses and costs water suppliers are expected to incur during the drought. First, the estimates in Table ES-1 only cover the period February 1 to October 31 2016, not the full duration of the drought. Second, the fiscal impact estimates are net of the water savings realized over the corresponding period in 2014, which is used as a proxy measure of what water suppliers would likely save assuming the drought continues and the current regulation is not extended. Third, the estimated revenue losses are net of avoided variable costs of production. Gross revenue losses are $200 to $250 per AF greater.

The underlying assumptions used in this and our previous analysis of the current regulation result in revenue loss estimates that closely match revenue losses reported by water suppliers surveyed by ACWA and CMUA. In our previous report to the Board, we estimated the average loss in gross revenue per AF would range between $850 and $975 per AF. The median loss per AF reported by the ACWA/CMUA survey respondents was $780 per AF and the mean loss was $960 per AF.

The fiscal impacts to local government shown in Table ES-1 are non-reimbursable costs under Government Codes 17500 et seq. Local revenue losses, which comprise about 90 percent of the fiscal impact are not reimbursable under state law. Costs incurred by public water agencies to comply with the proposed regulation extension also are not reimbursable under state law because the public water supply agencies have existing authority to recover such costs from their customers.[2]

[1] This amount represents net water savings attributable to the proposed extension of the current regulation after accounting for savings water suppliers would be likely to realize if the current regulation is not extended and the drought were to continue; gross savings figures have been suggested in other documents, currently estimated to total approximately 1.1 MAF of water saved pursuant to the January 15, 2016 proposed regulatory text, as compared to the same period in 2013.

[2] Per Government Code Section 17556, subdivision (d), costs incurred by a local agency to comply with a state mandate are not reimbursable if the "local agency or school district has the authority to levy service charges, fees, or assessments sufficient to pay for the mandated program or increased level of service. This subdivision applies regardless of whether the authority to levy charges, fees, or assessments was enacted or adopted prior to or after the date on which the statute or executive order was enacted or issued."

Table ES - 1. Summary of Fiscal Impacts of Proposed Regulation Extension by Policy Scenario

	Scenario 1: Current Policy	Scenario 2: Credit up to 4%	Scenario 3: Credit up to 8%
Net Water Saved (taf)[1]	848	718	706
Fiscal Impacts in Mil $			
Net Revenue Losses	$610	$523	$514
Compliance Costs	$64	$54	$53
Total Impact	$673	$577	$567
Fiscal Impact by Local Entity in Mil $			
Public Water Agencies (local government)	$572	$490	$482
Investor-Owned & Mutual Water Companies	$101	$87	$85
Statewide Fiscal Impact in Dollars			
Per AF	$794	$803	$803
Per Capita	$19.10	$16.36	$16.09

1. This amount represents net water savings attributable to the proposed extension of the current regulation after accounting for savings water suppliers would be likely to realize if the current regulation is not extended and the drought were to continue.

Table ES-2 provides a summary of the economic impacts expected to accrue to water users by scenario. Under Scenario 1 in which the existing conservation standards are unchanged, estimated economic impacts are about $1.23 billion. Average consumer surplus loss per AF saved varies across regions, from a low of about $480 per AF in the North Coast region to nearly $2,570 per AF in the Bay Area. For the state as a whole, the average consumer surplus loss per AF is about $1,500.

Scenario 2 and 3 reduce the economic impacts by $300 to $400 million. The 4 percent cap in Scenario 2 increases the consumer surplus loss by about $31 million relative to Scenario 3.

In the longer run, the cost of extending the current regulation will be determined by weather conditions in 2016 and 2017. Significant uncertainties are associated with policies predicated on unknown futures. The proposed regulation is intended to address potential vulnerabilities, not probabilistic expectations. While a return to a normal, or above average, hydrologic water conditions may be likely in 2016, such an outcome is far from certain. For this reason, the proposed regulation must be evaluated against the reasonable possibility of continued drought conditions. In such a situation, extending the current regulation would help offset what would likely be even greater economic and fiscal impacts in the event the drought continues. If the drought continues, water saved as a result of the extension of the current regulation will become increasingly valuable. Under these circumstances, estimated 2016 costs would be offset by similar or even greater costs that would be avoided next year. That is, if the drought continues, the proposed regulation will have helped to safeguard the state's future water supplies, thereby forestalling potentially dramatic economic consequences.

Table ES - 2. Summary of Economic Impacts of Proposed Regulation Extension by Policy Scenario

	Scenario 1: Current Policy	**Scenario 2: Capped Credits**	**Scenario 3: Uncapped Credits**
Net Water Saved (taf)[1]	848	718	706
Economic Impacts in Mil $	$1,300	$967	$936
Statewide Economic Impact in Dollars			
Per AF	$1,532	$1,346	$1,325
Per Capita	$36.86	$27.41	$26.54

1. This amount represents net water savings attributable to the proposed extension of the current regulation after accounting for savings water suppliers would be likely to realize if the current regulation is not extended and the drought were to continue.

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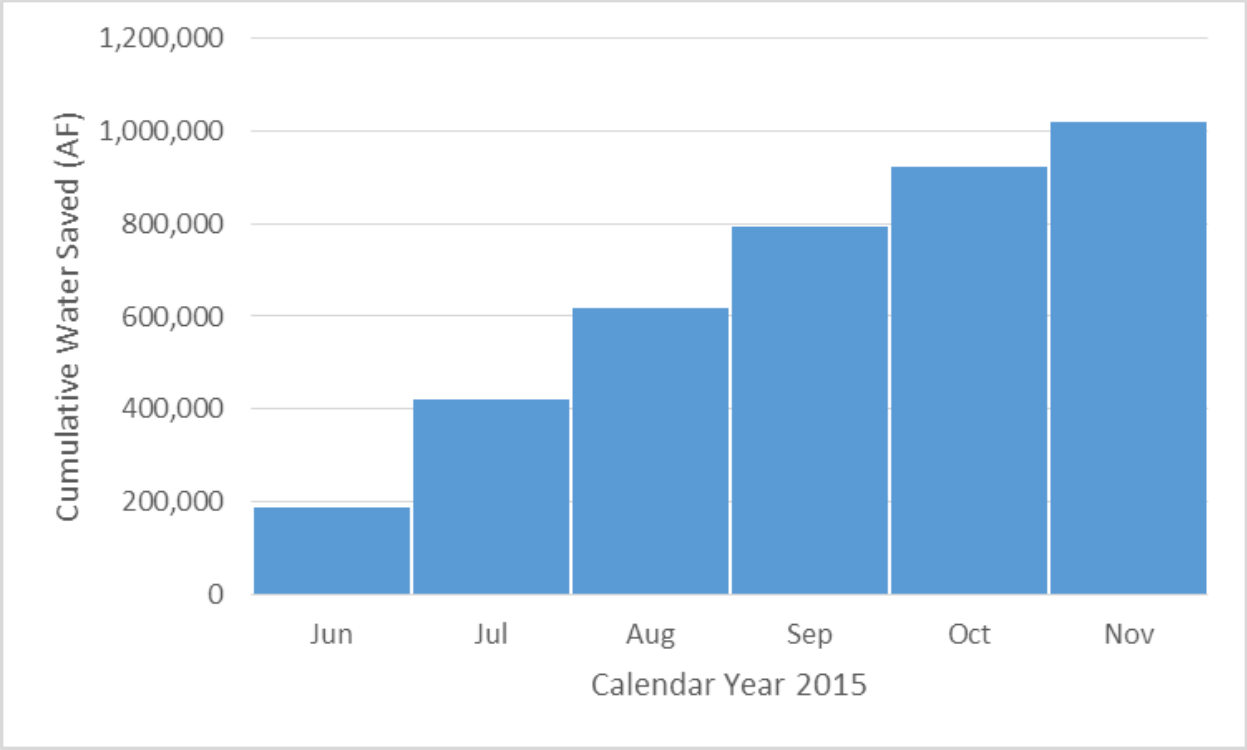
Previous Regulation on Track to Achieve Reduction Target

On April 1, 2015 Governor Brown issued a first-ever executive order (EO) – B-29-15 – mandating reductions in water use. The EO aimed to reduce the amount of potable water consumed statewide in urban areas by 25 percent from 2013 levels – roughly 1.2 million acre-feet (AF) of water – through demand management and pricing policies, and heighten public awareness about the need to lower water consumption. The State Water Resources Control Board (State Water Board, Board, or SWRCB) was responsible for developing the regulatory framework to implement the EO. On April 18, 2015, the State Water Board issued updated proposed regulatory instructions that grouped urban water suppliers into nine tiers, with conservation standards ranging from 8 percent to 36 percent.

In the six reported-on months since the current emergency conservation regulation reduction requirements took effect on June 1, 2015, Californians have reduced urban water use by just over 26 percent. This equates to slightly more than one million acre-feet of water; enough water to completely fill Folsom Lake.[3] Cumulative water savings in acre-feet since June are shown in Figure 1. Monthly percentage water savings by hydrologic region are shown in Table 1.

Residential per capita water use has fallen significantly every month relative to the same month in 2014, when most state regions were under voluntary conservation orders. As shown in Table 2, statewide residential daily per capita water consumption has, on average, been about 19 percent lower than it was in 2014.

Figure 1. Statewide Cumulative Water Savings June-November 2015



[3] Folsom Lake has a total reservoir capacity of 977,000 AF.

Table 1. 2015 Monthly and Cumulative Percentage Water Savings by Hydrologic Region

Region	Jun	Jul	Aug	Sep	Oct	Nov	Cumulative Jun-Nov
Central Coast	30%	31%	28%	27%	24%	26%	28%
Colorado River	25%	34%	25%	17%	25%	22%	25%
North Coast	16%	33%	20%	20%	17%	18%	21%
North Lahontan	30%	32%	25%	16%	10%	13%	24%
Sacramento River	36%	38%	35%	28%	27%	33%	33%
San Francisco Bay	32%	32%	31%	25%	23%	27%	29%
San Joaquin River	33%	35%	30%	27%	27%	31%	31%
South Coast	23%	28%	24%	27%	21%	14%	23%
South Lahontan	31%	36%	29%	26%	23%	19%	28%
Tulare Lake	29%	32%	28%	26%	22%	28%	28%
Statewide	27%	31%	27%	26%	22%	20%	26%

Table 2. Statewide Average Residential Daily Per Capita Water Use in Gallons: 2015 vs 2014

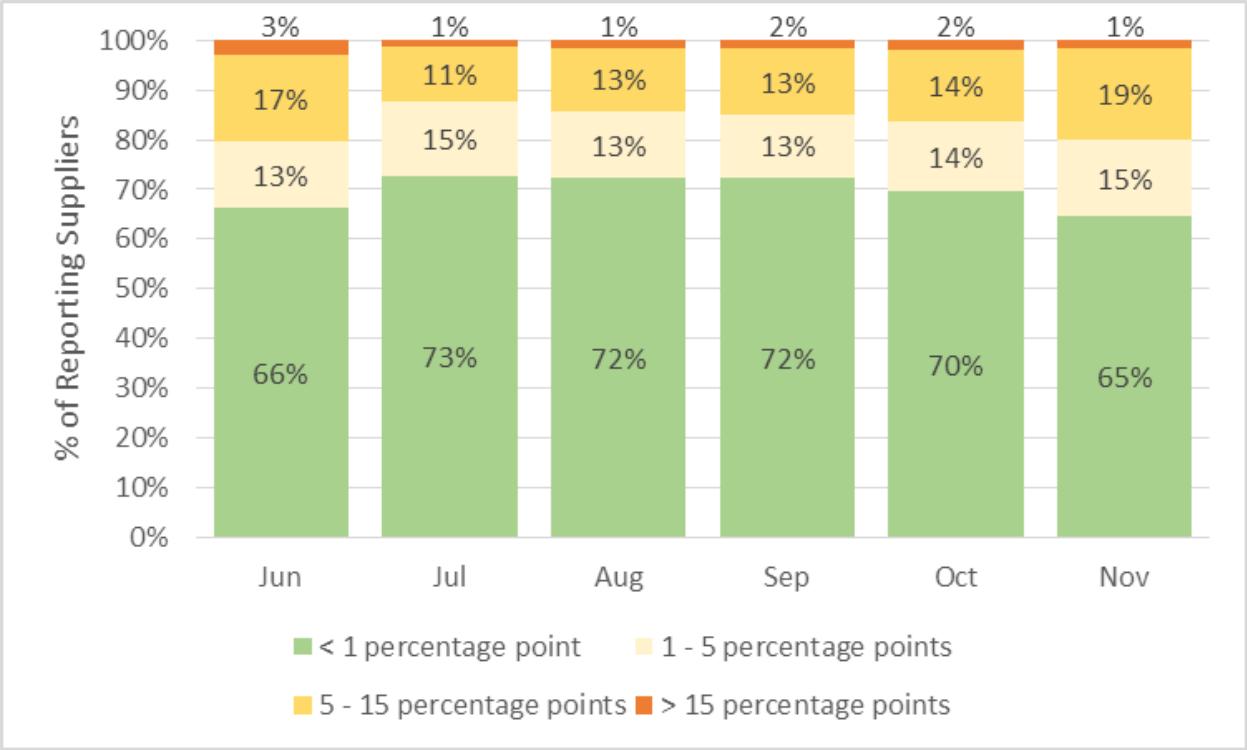
Month	Jun	Jul	Aug	Sep	Oct	Nov
2014 R-GPCD	133	133	123	118	105	86
2015 R-GPCD	98	98	102	97	87	75
% Difference	26%	26%	17%	18%	17%	12%

Compliance with the current regulation has been high. The Board considers water suppliers within one percentage point of their conservation standard to have met their requirement. As shown in Figure 2, monthly compliance by suppliers has ranged from a low of 65 percent in November to a high of 73 percent in July. Importantly, during the hot and dry summer months of July to September, when urban water use is at its greatest, water supplier compliance averaged 72 percent.

Compliance among small water suppliers, which have different water use reduction and reporting requirements, has also been high.[4] Based on the latest data compiled by the Board, of the more than 1,500 small water suppliers reporting in December, approximately 80 percent were in compliance with their water use reduction requirements.

[4] Small water suppliers are those with 3,000 or fewer customers.

Figure 2. Monthly Water Supplier Compliance with Conservation Standards



Extension of Emergency Regulation

M.Cubed,[5] in collaboration with RMann Economics, was asked by the Board to develop an analysis of the economic and fiscal impacts of the *Proposed Regulatory Framework for Extended Emergency Regulation for Urban Water Conservation* (Framework) released December 21, 2015, and draft proposed updated regulatory text released January 15, 2016. Under the Framework and proposed regulation several adjustments potentially would be made to the Emergency Regulation adopted on May 5, 2015 (May 2015 emergency regulation, or current regulation), which reflected a mandatory 25 percent statewide reduction in potable urban water use between June 2015 and February 2016; and the current regulation would be extended to October 31, 2016.[6]

Modifications proposed by Board Staff to the current regulation are as follows:

- **Incorporate a climate adjustment that reduces individual urban water suppliers' conservation standards by between 2 and 4 percentage points for water suppliers located in the state's warmest regions.** The climate adjustment would be based on each urban water supplier's

[5] M.Cubed is a resource economics and policy analysis consulting firm with offices in Davis, Oakland, and San Francisco.

[6] To reach the statewide 25 percent reduction mandate the May 2015 emergency regulation assigned each urban water supplier a conservation standard that ranged between 8 and 36 percent based on residential per capita use of potable water for the months of July to September 2014, with a few suppliers eligible for a reserved 4 percent conservation standard based on, essentially, those areas not experiencing local surface water shortage conditions.

approximate service area evapotranspiration (ET) for July through September as compared to statewide average ET for the same months. The adjustment would range from a 2 to 4 percentage point decrease in an urban water supplier's conservation requirement, depending on service area ET. Board Staff estimates that this adjustment will result in up to a 1.4 percentage point reduction in statewide water savings from that currently required.

- **Adjust urban water supplier conservation standards to reflect water efficient growth since 2013.** The adjustment would be equal to the ratio of the additional volume of water used since 2013 to the baseline water use for 2013, multiplied by the water supplier's conservation standard. The volume of water added due to growth would be calculated as the sum of:

  1. Number of new permanent residents since 2013 multiplied by 55 gallons per person per day multiplied by 270 days (duration of the proposed regulation, pursuant to Water Code section 1058.5).
  2. Area of new residential landscaped area (square feet) served by connections since 2013 multiplied by 55% of total service area ET (inches) for the months of February through October multiplied by a conversion factor of 0.623 (converting inches to gallons).
  3. Number of new commercial, industrial, and intuitional (CII) connections since 2013 multiplied by the average commercial, industrial, and institutional water use per connection during February through October 2015.

  Board staff estimates that this adjustment could result in up to approximately a one percentage point reduction in statewide water savings compared to current requirements, assuming that growth has increased by 4% since 2013 for every urban water supplier.

- **Provide a reduction, varying between 4 and 8 percentage points, to the conservation standard of urban water suppliers that rely on new local drought resilient water supplies**. The credit would apply to urban water suppliers that certify that, and provide supporting documentation upon request, at least 4 percent of their potable supply is comprised of local, drought-resilient source(s) of supply (e.g. indirect potable reuse of coastal wastewater or desalinated seawater) developed since 2013[7] and that the use of those supplies do not reduce the water available to another legal user of water or the environment. Board Staff estimates that this credit could result in a less than one percentage point decrease in statewide water savings.

- **Modify the Commercial Agriculture Exclusion to require certification that customers whose water use is subtracted under the exclusion produce, or would normally produce, a minimum of $1,000 per year in revenue from agricultural sales and are not subtracting water used on ornamental landscapes.** This change would limit use of the exclusion for properties with minimal agricultural sales or mixed commercial agricultural and ornamental landscape use. The $1,000 threshold is consistent with the U.S. Department of Agriculture's definition of a farm. Board staff estimates that the existing agricultural exclusion has resulted in approximately an 11,000 acre feet reduction in conserved water since June 2015. Modifying the commercial agriculture exclusion as proposed could result in a slight increase of conserved water.

[7] The credit would not be extended to Colorado River water received through long-term transfer of conserved water.

Board staff recommends that all credits and adjustments be capped to allow up to a maximum of an eight percent reduction for any individual water supplier, with no supplier's conservation standard dropping below eight percent based on these adjustments.

In the forgoing analysis, we estimate fiscal impacts for three alternative regulatory scenarios.

- **Scenario 1: Existing Conservation Requirement**. Under this scenario, the Board leaves unchanged water supplier conservation requirements. The current regulation is extended to require existing conservation requirements for the remainder of February 2016 through October 31, 2016.

- **Scenario 2: Existing Conservation Standards with Credits Capped at 4% (Framework Proposal)**. Under this scenario, the Board adopts the credits proposed by its staff with the provision that the total credit any individual supplier can receive is capped at 4 percentage points. The current regulation is extended to require existing conservation requirements for the remainder of February 2016 through October 31, 2016.

- **Scenario 3: Existing Conservation Standards with Credits Capped at 8%**. Under this scenario, the Board adopts the credits proposed by its staff with the provision that the total credit any individual supplier can receive is capped at 8 percentage points. The current regulation is extended to require existing conservation requirements for the remainder of February 2016 through October 31, 2016.

Of the three scenarios, Scenario 1 generates the largest and Scenario 3 generates the smallest expected water savings. Scenario 2 expected savings fall between these two scenarios.

Analytical Framework

This analysis addresses Office of Administrative Law (OAL) requirements[8] to estimate the following fiscal impacts: costs to any local agency or school district requiring reimbursement pursuant to 17500 et seq.; costs or savings to any state agency; other non-discretionary cost or savings imposed on local agencies; costs or savings in federal funding to the state. Additionally, pursuant to Section 6610 of the State Administrative Manual (SAM), the Board must prepare an estimate of any revenue changes at the local level as a result of the ER, noting, however, that any local revenue losses are not reimbursable under Government Codes 17500 et seq.

Baseline for Estimating Fiscal and Economic Impacts

The current regulation was issued as a result of continuing uncertainty about the longevity of drought conditions in California. It follows Governor Edmund G. Brown, Jr.'s proclamation of a State of Emergency on January 17, 2014, and issuance of the fourth drought-related Executive Order on April 1, 2015 outlining actions to address California's drought. As a result of the Executive Orders and associated Board-adopted emergency regulations, urban water suppliers have reduced their water consumption, including by adjusting water rates, implementing conservation measures, and prohibiting specific uses. Without the current regulation, many of the actions taken by urban water suppliers would

[8] See http://www.oal.ca.gov/res/docs/pdf/checklist/Emergency_Checklist_1-2014.pdf.

have still occurred given the underlying realities of the drought and the imbalances between available water supplies and expected water demands.

From this perspective, impacts of the proposed regulation should be measured relative to what would have occurred in the absence of the proposed regulation. The analysis uses the percentage water savings realized by urban water suppliers in 2014, prior to the adoption of the current regulation, as a proxy for the actions and resultant percentage water savings water suppliers would have achieved on a voluntary basis over the proposed extension period. That is, this analysis does not estimate the totality of the fiscal and economic impacts of water scarcity as a result of the drought, but rather the fiscal and economic impacts attributable to extension of the emergency regulation after accounting for the water savings urban water supplies likely would have achieved on their own without the emergency regulation.

Water scarcity imposes costs; prompts investment

Typically, natural catastrophes – such as hurricanes and earthquakes – result in immediate economic and fiscal losses, and a muffling of growth. Droughts impose less abrupt, but no less real outcomes. Depending on the resiliency of the existing water supply system (e.g., conveyances, storage facilities, low- or no-cost conservation measures), there may be minimal adverse implications from water scarcity until the third or fourth year of dry conditions.

However, if a drought continues over multiple years the risk that it will trigger rationing will cause some households and businesses to defer or cancel water-intensive investments (e.g., a new lawn or a food processing plant), dampening economic activity. When water scarcity prompts the need to reduce consumption hard costs start to accrue in the form of the loss of water-dependent items and activities (e.g., landscaping, pools), and/or the need to pay higher costs to maintain those items and activities.

Responses to catastrophes, however, can also prompt greater economic activity, as the public and private sectors invest in addressing the "damage" and changing their behaviors. For example, replacing landscaping disrupts existing supplier relations, but creates new demand for alternatives. Likewise, subsidizing water efficient appliances prompts consumer purchases, and potentially reduces household electricity bills.

Methodology

The methodological approach on which the estimates in this report are based is founded on standard fiscal and welfare analytical methods of public resource allocation. In this context, the anticipated fiscal and economic effects of mandatory water supply reductions are largely determined by water prices and Californians' willingness to pay for water, as evidenced by end-use demand functions.

We use the methodology expounded in Griffin (1990) to estimate consumer willingness-to-pay for the increment of water forgone by water users due to the proposed regulation. This is a widely used methodology for valuing increments (or decrements) of water supply. For example, it provided the basis for the calculation of water supply benefits of Alternative 4a of the Bay Delta Conservation Plan (Sunding, et al., 2013). It is also the primary methodology used to value water supply increments (or

decrements) in numerous other statewide and regional water resources planning studies and models (e.g., Jenkins, et al., 1999; Jenkins, et al., 2003; EBMUD, 2012).[9]

The methodology rests on the basic theory of economic demand, which posits that consumers order their preferences for a good such as water from most to least valuable and consume up to the point where the value of the last unit of consumption equals the marginal cost or price of the good. Thinking about this construct in terms of consumer demand for water, we can envision each water user as having a schedule of demands for water that is based on the values they place on different water uses. For example, residential water users are likely to place the highest value on water used for drinking and basic sanitation, a somewhat lesser value on water used for bathing and laundry, and even lesser values on water used for landscaping and other less essential uses, such as car and hard surface washing. Thus, if each consumer was given the task of ordering their preferences for water from highest valued to lowest valued and giving a value to each use, we might wind up with a set of water demand schedules like the ones shown in the left-hand panel of Figure 3. Aggregating these schedules would then yield a total demand schedule like the one shown in the right-hand panel of Figure 3.

There are three key points to note about the demand schedules shown in Figure 3. First, each point on a schedule indicates the value of an additional unit of water (i.e. the marginal value) at that level of consumption. When water is very scarce marginal values are high, since consumers would allocate this scarce water to their highest valued uses and forgo their lower valued uses. When water is very abundant marginal values are low, since consumers have already satisfied their high valued uses and therefore apply the water to less important uses.[10] Thus demand schedules are downward sloping. Second, the slope of the demand schedule at any point of consumption measures the rate at which the marginal value is changing. Steeply sloped schedules indicate rigid demands for water. In such cases the marginal value of water declines rapidly as additional units are added. By the same token, however, the marginal value of water increases rapidly as additional units are taken away.[11] Third, the area under the demand schedule between two points of consumption, such as between Q_A and Q_B in Figure 3, yields the total value consumers assign to this increment of consumption.

If the price of water in Figure 3 is P, then consumers 1, 2, and 3 would choose to consume quantities q_1, q_2, and q_3, in accordance with the values they place on additional units of water. Aggregate demand would settle at Q_B. The value of the last unit consumed by each consumer and in aggregate is P, but the value placed on the earlier units (the inframarginal units) is greater than P. Since consumers pay P for all units consumed they receive a benefit on every unit except the last or marginal unit. The sum of these benefits is called consumer surplus and it is equal to the area under the demand curve and above the price line in Figure 3. The concept of consumer surplus is important because it tells us that the average

[9] A comprehensive discussion of the methodology is provided in Chapter 5 of the textbook Water Resource Economics by Ronald C. Griffin. The methodology is also discussed in Chapter 7 of Robert A. Young's book Determining the Economic Value of Water: Concepts and Methods.

[10] Indeed, when water is super abundant we can imagine the marginal values being negative. Unmetered households, for example, do not consume unlimited amounts of water even though the marginal cost of water is zero because at some point the marginal value of an additional unit of water is zero and consuming beyond this point would be detrimental to the household's welfare.

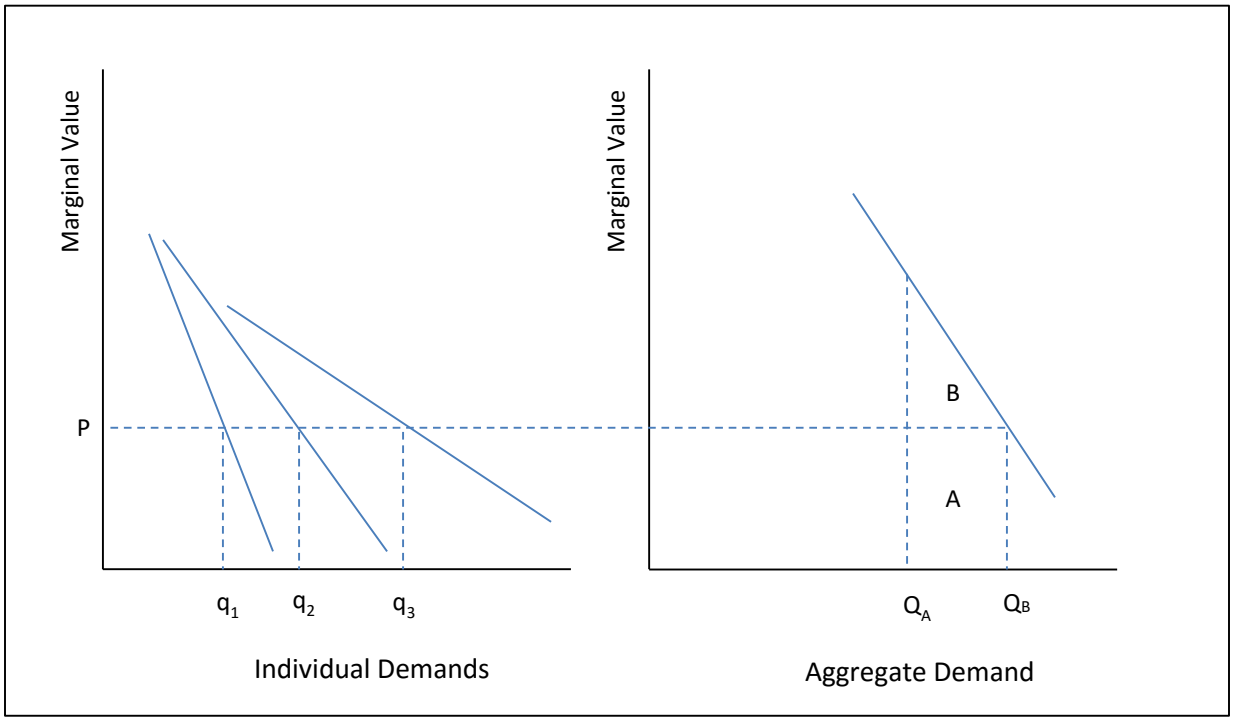
[11] It may help to think about a typical household endowed with an established landscape, irrigation system, and set of water using appliances and fixtures. Assuming it starts with a quantity of water sufficient to run its appliances and fixtures and irrigate its landscape, then providing it additional water may be of little value to the household. However, taking away increasing amounts of its initial allocation of water may mean that it no longer has enough water to maintain its landscape and run its appliances and fixtures. In this case, the household's willingness to pay to avoid increasingly large cutbacks might increase rapidly in order to avoid increasing levels of hardship. Similar logic can be applied to businesses facing cutbacks in their water supply. In the case of businesses, the concern is with the impact water cutbacks have on production costs and profitability.

value of water consumed will always be greater than or equal to the equilibrium price paid for the water. It is this surplus value that makes water a valuable economic resource. In the case of commercial and industrial uses of water, the surplus value measures the profitability of water in its various economic applications (Griffin, 2006). In the case of domestic uses of water, the surplus value measures the net gain in welfare households receive from the consumption of water.

The primary source of fiscal impact to local government from the proposed regulation is the loss of water sales revenue. Revenue loss is represented as area A in Figure 3, and is equal to the difference between the level of consumption without the proposed regulation (Q_B) and the level of consumption with the proposed regulation (Q_A) multiplied by the retail price of water (P). A secondary source of fiscal impact to local government from the proposed regulation is the cost local water supply agencies incur to comply with the regulation. This cost includes costs to implement and administer conservation programs, water use reduction enforcement policies, and state-mandated reporting requirements.

The economic cost to water users is equal to the value they place on forgone units of water consumption less the cost they avoid by not purchasing these units. This impact is represented by area B in Figure 3. If in the longer-run water suppliers recover their revenue losses by adjusting their water rates, then the total cost to consumers will be areas A and B in Figure 3, less any variable production costs water suppliers avoid (and hence do not need to recover) by not delivering water.

Figure 3. Graphical Representation of Fiscal and Economic Impact of Proposed Regulation



Data and Calculations

The baseline for this analysis is the effective water conservation percentage for each urban supplier for the period February 1 to October 31, 2016. The effective water conservation percentage is equal to the state-mandated conservation percentage (including any credits) less the expected water savings percentage in the absence of the proposed regulation. The expected water savings percentage in the absence of the proposed regulation is taken as the percentage difference in water consumption for the

periods February 1 to October 31, 2013 and February 1 to October 31, 2014. If a water supplier's expected water savings percentage in the absence of the proposed regulation exceeds its state-mandated percentage, then its effective water conservation percentage is set to zero in the analysis.

A mandated reduction in water use causes two primary effects: fiscal and economic. The fiscal effect is dominated by reductions in water supplier revenues due to the effective conservation requirements, but also includes costs incurred by water suppliers to comply with reporting requirements and the implementation and administration of conservation programs and water use reduction enforcement policies. In the near-term, the analysis assumes water suppliers do not immediately adjust their rates in response to the decrease in water sales.[12] The economic effect is calculated as the difference between total consumer willingness-to-pay for forgone water consumption, as evidenced by water demand functions, less the avoided purchase cost of this water.[13]

The analytical approach relies on the following calculations:

1. Calculate the 2016 effective conservation percentage for each water supplier, which consists of the state-mandated conservation standard (including any credits) less the percent conservation achieved in 2014.[14] Multiply the result by the 2013 base period demand for the period February 1 to October 31 to calculate the net quantity of water savings required of each water supplier by the proposed regulation.
2. Multiply the net quantity of water savings by the retail commodity rate to calculate the reduction in water sales revenue due to the proposed regulation. Subtract from this amount the cost savings from reduced variable production costs to estimate the impact to net revenue.
3. Estimate the administrative costs associated with proposed regulation compliance, including costs incurred by water suppliers to comply with proposed regulation reporting requirements and the implementation and administration of conservation programs and water use reduction enforcement policies.
4. Calculate the fiscal impact to local agencies as the sum of the net revenue loss and the administrative costs associated with proposed regulation compliance.
5. Calculate the economic cost to water users as the difference between total willingness-to-pay for forgone water consumption, as evidenced by water demand functions, less the avoided purchase cost of the water.

To undertake these analytical steps the M.Cubed team relied on the following data:

- State Water Board estimates of water supplier conservation standards with proposed credits, both capped at four percent and at eight percent.

[12] This assumption is consistent with findings from a survey of retail water suppliers conducted by ACWA and CMUA, which found that only eight percent of surveyed water suppliers adjusted their rates in direct response to the drought. The overwhelming majority reported they would adjust their rates according to already adopted plans and schedules. Eventually, however, water suppliers will have to adjust their rates to recoup the revenue losses associated with the proposed regulation in order to restore their balance sheets.

[13] Note the avoided purchase costs equal the forgone revenues of water suppliers. Because water suppliers will eventually recoup these revenue losses to preserve their revenue neutrality, all costs of the proposed regulation will eventually get shifted to water users.

[14] The State Board provided the M.Cubed team with estimated credits for each water supplier included in the analysis.

- State Water Board data on monthly potable water production for January-December 2013, June-December 2014, and June-November 2015 are used to estimate potable water production for each water supplier for the base period February 1 to October 31, 2013 and the corresponding period February 1 to October 31, 2014.

- Data for the period Feb-May 2014 were not available, so they were estimated in two ways:

  1. Use Feb-May 2015

  2. Multiply Feb-May 2013 by (1 – Avg Savings Jun-Dec 2014)

  In most cases the two estimates are quite close. Since there is no strong basis for preferring one estimate to the other, the one that results in the largest fiscal impact for the water supplier was selected. The result from the second method was selected for about 89 percent of the water suppliers included in the analysis.

- The percentage difference in potable water production between Feb-Oct 2013 and Feb-Oct 2014 is used as an estimate of the level of conservation each water supplier would have achieved in the absence of the proposed regulation and assuming the drought were to continue.[15]

- Additional data on expected 2016 use, and sector-specific consumption, was extracted from the California Department of Water Resources' Urban Water Management Plans (UWMP) database, which includes sector data for 363 agencies – for which costs by sector can be calculated – with no sector data available for 48 agencies. There are 11 agencies in the UWMP database that are not on the Board's list; some of these are wholesale providers.

- Data on additional costs incurred by water suppliers to comply with proposed regulation reporting requirements and the implementation and administration of conservation programs and water use reduction enforcement policies come from anonymized results from an ACWA/CMUA survey administered to their member agencies. The anonymized survey results cover responses from 85 retail water suppliers reporting cumulative water savings of 329,213 AF for the period June 1 to September 30, 2015. Average incremental compliance costs incurred by water suppliers are estimated to range between $50 and $100 per AF of 2015 savings. Some agencies reported conservation actions that should continue to produce water savings in future years, so some of the reported costs might reasonably be allocated to those future savings rather than to the proposed regulation, though this analysis does not make this adjustment.

- Data on commodity and service charges primarily come from the Black and Veatch (B&V) 2006 water rate survey, which provided typical commodity charges and monthly service costs. Commodity charges were updated to 2015 dollars for use in the analysis using the nominal increase factors in Table 3. In cases where no data from the B&V survey were available for a water supplier the default water rates in Table 3 were used.

[15] If the drought were to end during the period when the proposed regulation were in place, pursuant to Water Code section 1058.5, the regulation "is deemed repealed immediately upon a finding by the board that due to changed conditions it is no longer necessary for the regulation to remain in effect."

Table 3. Default Commodity Charges used to Calculate Local Revenue Losses

Region	Nominal Increase in Commodity Charge 2006 to 2014	Default Commodity Charge $/AF
San Francisco Bay	2.00	$1,500
South Coast	1.80	$1,200
Central Coast	1.80	$2,000
Others	1.14	$500

Water rate data for some more-affected agencies were obtained directly from their rate structures information. The agencies with 2015 data in the analysis are:

- Carlsbad Municipal Water District
- Coachella Valley Water District
- Contra Costa Water District
- City of Corona
- Cucamonga Valley Water District
- Desert WA
- Eastern Municipal Water District
- Elsinore Valley Municipal Water District
- City of Fullerton

The water rate assumptions used in the analysis result in average revenue per AF losses that closely match the losses reported by ACWA/CMUA survey respondents. In our previous report to the Board, we estimated the average loss in gross revenue per AF would range between $850 and $975 per AF. The median loss per AF reported by the ACWA/CMUA survey respondents was $780 per AF and the mean loss was $960 per AF.

Assumptions

Variable production cost

The revenue loss estimates are adjusted to remove variable cost savings assumed to be $200 per AF in most regions, and $250 per AF in the South Coast, Central Coast and Bay Area. These cost savings are primarily reduced energy and operating expenses associated with not conveying, pumping, treating and distributing the water. The resulting net revenue loss is equal to the product of the amount of required savings and the water price less variable cost.

Water Demand Specification

The estimates of consumer welfare losses due to the proposed regulation, measured as the difference between total willingness-to-pay for forgone water consumption and the avoided cost of this consumption, are based on the following assumptions used to characterize residential and non-residential demands for water:

1. A constant price elasticity of demand specification for end-use demand functions is assumed to provide a reasonable approximation of the marginal values of water over the range of curtailment considered by the analysis for residential, commercial, industrial, and landscape end

uses of water.[16] The chosen functional form assumes price responsiveness does not vary over the consumption range. This is equivalent to assuming that so-called demand hardening is not present, at least in the near-term. The constant price elasticity demand specification is the standard approach for estimating consumer welfare loss of water shortage.[17]

2. Assumptions of price elasticity of demand for residential, commercial, and industrial water demand are as follows:

   Residential: Three studies were relied on to determine elasticities to reflect residential urban water demand. These reports found summer short-run single family dwelling elasticities as follows:
   - Renwick and Green (2000): -0.2;
   - Olmstead et al. (2007): -0.33 to -0.58; and
   - Klaiber et al. (2011): -0.13 to -0.35.

   A range of -0.2 to -0.35 is used to capture uncertainty associated with this elasticity. This spread is largely consistent with estimates used in the November 2013 Bay Delta Conservation Plan Public Draft.[18]

   Commercial: A review of the literature on short run commercial water use elasticities finds a range of -0.12 to -0.48. Lynn et al (1993) reported a range of -0.48 to -0.12. These results are supported by studies by Schneider and Whitlach (1991) who find elasticities ranging from -0.4 to -0.36, and by Williams and Suh (1986) who estimate an elasticity of -0.23 for short-run commercial water use. Accordingly, this analysis uses the mid-point value of -0.3 for commercial water use demand elasticity. The demand elasticity for landscape and institutional/governmental use is set equal to the commercial elasticity of -0.3.

   Industrial: Renzetti (1992) identified a consensus for industrial water use elasticities of between -0.15 and -0.59. This range is supported by other studies of industrial firms, which find an elasticity of -0.77, and Reynaud (2003) who identifies an elasticity of -0.29. Accordingly, this analysis uses an industrial demand elasticity of -0.37.

While the fiscal impact estimates are invariant with respect to the demand elasticity assumptions, the economic welfare loss estimates are not. The elasticity parameters determine the slopes of the demand functions, which in turn determine the magnitudes of welfare loss for given levels of residential, commercial, and industrial curtailment. The smaller the elasticity parameter in magnitude, the larger the calculated welfare loss. The economic welfare loss estimates presented in this report, therefore, are sensitive to the underlying demand elasticity assumptions upon which they are based.

[16] The functional form of the demand function is $Q(P) = \propto P^{\varepsilon}$, where ε is the price elasticity of demand, which measures the percentage change in demand given a one percent change in price. The scaling parameter α is estimated using base period demand and water rates.

[17] See, for example, Griffin (1990), Griffin (2006), Jenkins and Lund (1999), Jenkins, Lund, and Howitt (2003), Sunding, Buck, and Hatchett (2013), Young (2005).

[18] This study indicted a range is -0.15 to -0.32, with a simple average is -0.24. BDCP. November 2013 Draft. "Appendix 9.A Economic Benefits of the BDCP and Take Alternatives."

Estimated Fiscal and Economic Impacts

Water Use and Savings

Figure 4 illustrates annual residential water use per capita for agencies with residential water use data available. The largest per capita residential use is the North Lahontan region and the Colorado River region. In response to the drought, most water districts implemented conservation measures by 2014. Figure 5 shows the simple average across agencies of the percent conservation achieved in March to October of 2014 compared to 2013, and the simple average of additional percent conservation required in February to October 2016 for Scenario 1, by hydrologic region.

Figure 4. Residential Annual Use per Capita Summary by Hydrologic Region

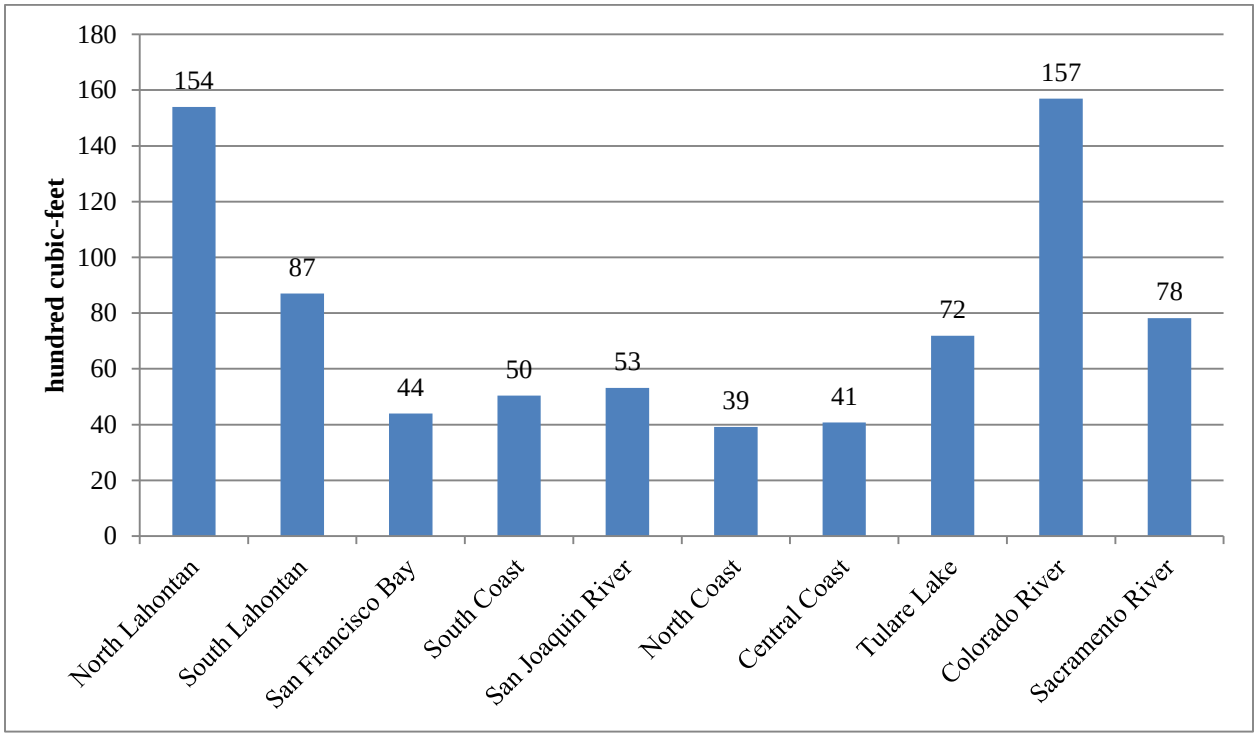
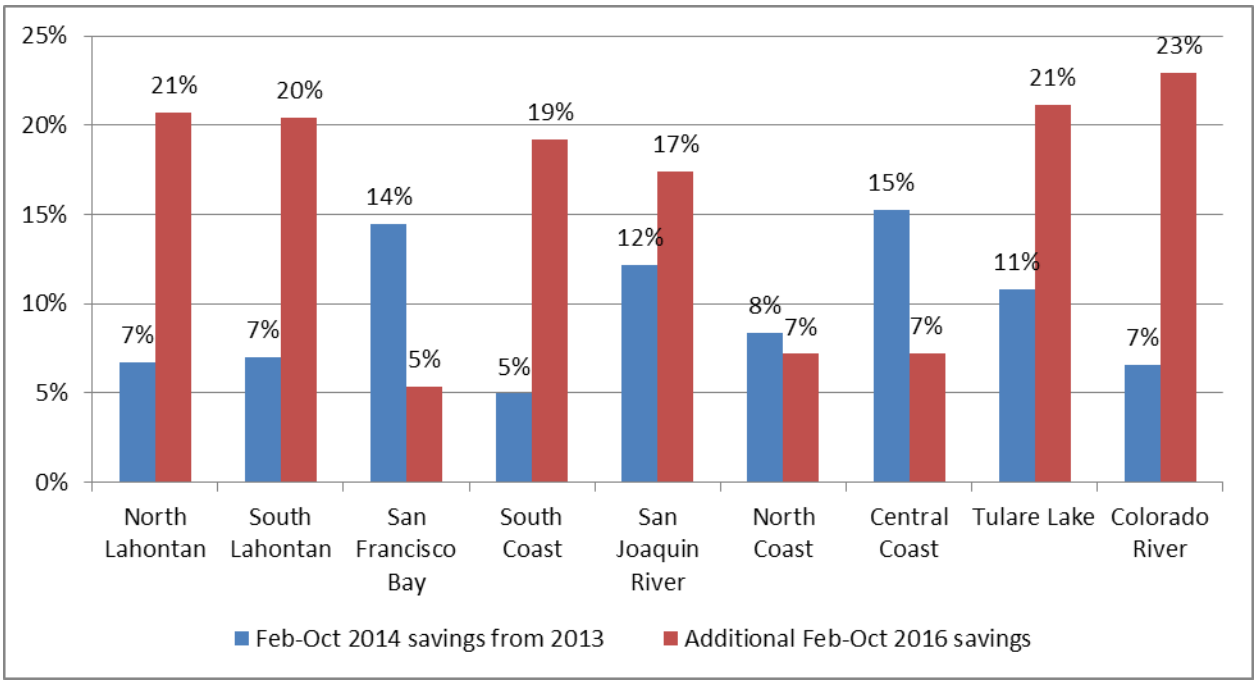


Figure 5. February to October 2014 Percent Savings and 2016 Additional Savings by Region



Fiscal Impacts: Water Supplier Revenue Losses and Compliance Costs

Most of the proposed regulation's fiscal impact is the revenue losses incurred by water suppliers due to the effective percentage reduction in water sales.[19] The total revenue impact for each agency is equal to the product of the unit price charged by the agency and the units of 2016 water demand reduced by the proposed regulation. This revenue impact is offset by water supply cost savings of $200 to $250 per AF. Additionally, the fiscal impact includes the costs water suppliers are expected to incur to continue conservation programs, water use reduction enforcement policies, and reporting to the State Board during the proposed regulation period. These costs are expected to range between $50 and $100 per AF. The fiscal impact summary, shown in Table 4, uses $75 per AF for these costs.

Under Scenario 1, which leaves the current conservation standards in place, statewide fiscal impacts of the proposed regulation are estimated at approximately $673 million. Revenue losses account for about 90 percent of the fiscal impact estimate. Net water savings under Scenario 1 approach 850,000 AF. Under Scenarios 2 and 3, which give climate, growth, and drought supply credits to water suppliers, estimated fiscal impacts are approximately $100 million less. Water savings under Scenarios 2 and 3 are 130,000 to 140,000 AF less than under Scenario 1. Reflecting the distribution of California's urban population and water use, the largest impacts occur in the South Coast hydrologic region, followed by the San Francisco Bay Area. Average fiscal impacts per AF saved vary across regions, from about $300 to $500 in most regions to almost $1,000 in the South Coast and almost $1,500 in the Bay Area.

It is important to reiterate that the fiscal impact estimates shown in Table 4 are not measuring the total revenue losses and costs water suppliers are expected to incur during the drought. First, the estimates

[19] In the longer-run, consumers will not avoid the net revenue cost. It represents a fixed water supply expense that must be paid regardless of water delivery. Water suppliers will make it up by drawing down cash reserves, which will then have to be replenished, or by raising rates. Either way, consumers will ultimately bear the cost.

in Table 4 only cover the period February 1 to October 31 2016, not the full duration of the drought. Second, the fiscal impact estimates are net of the water savings realized over the corresponding period in 2014, which is used as a proxy measure of what water suppliers would likely save assuming the drought continues and the current regulation is not extended. Third, the estimated revenue losses are net of avoided variable costs of production. Gross revenue losses are $200 to $250 per AF greater.

Table 5 separates the fiscal impacts between public water agencies and investor-owned water utilities and mutual water companies to show the fiscal impacts of the proposed regulation expected to accrue to local government. As shown by Table 5, local government fiscal impacts are estimated at $572 million under Scenario 1, and between $482 and $490 million under Scenarios 2 and 3.

The fiscal impacts to local government shown in Table 5 are non-reimbursable costs under Government Codes 17500 et seq. Local revenue losses, which comprise 90 percent of the fiscal impact are not reimbursable under state law. Costs incurred by public water agencies to comply with the proposed regulation also are not reimbursable under state law because the public water supply agencies have existing authority to recover such costs from their customers.[20]

[20] Per Government Code Section 17556, subdivision (d), costs incurred by a local agency to comply with a state mandate are not reimbursable if the "local agency or school district has the authority to levy service charges, fees, or assessments sufficient to pay for the mandated program or increased level of service. This subdivision applies regardless of whether the authority to levy charges, fees, or assessments was enacted or adopted prior to or after the date on which the statute or executive order was enacted or issued."

Table 4. Fiscal Impact of Proposed ER Extension, March 1 to October 31 2016

Region	Scenario 1: Continue 2015 policy				Scenario 2: Credit up to 4%				Scenario 3: Credit up to 8%			
	AF Saved (taf)	Water Supplier Revenue Loss (mil $)	Water Supplier Cost[1] (mil $)	Fiscal Impact (mil $)	AF Saved (taf)	Water Supplier Revenue Loss (mil $)	Water Supplier Cost[1] (mil $)	Fiscal Impact (mil $)	AF Saved (taf)	Water Supplier Revenue Loss (mil $)	Water Supplier Cost[1] (mil $)	Fiscal Impact (mil $)
North Lahontan	7.0	$2.1	$0.5	$2.6	5.8	$1.8	$0.4	$2.2	5.8	$1.8	$0.4	$2.2
South Lahontan	33.0	$12.8	$2.5	$15.2	27.3	$10.6	$2.0	$12.6	26.0	$10.1	$1.9	$12.0
San Francisco Bay	38.4	$54.0	$2.9	$56.8	34.5	$48.7	$2.6	$51.3	34.5	$48.7	$2.6	$51.3
South Coast	497.9	$471.8	$37.3	$509.2	429.8	$405.5	$32.2	$437.7	421.7	$397.8	$31.6	$429.4
San Joaquin River	44.8	$14.6	$3.4	$18.0	37.5	$12.3	$2.8	$15.1	37.5	$12.3	$2.8	$15.1
North Coast	1.8	$0.7	$0.1	$0.8	1.7	$0.6	$0.1	$0.8	1.7	$0.6	$0.1	$0.8
Central Coast	11.4	$7.3	$0.9	$8.1	10.6	$6.8	$0.8	$7.6	10.5	$6.8	$0.8	$7.6
Tulare Lake	79.9	$14.8	$6.0	$20.8	66.2	$12.0	$5.0	$16.9	66.0	$11.9	$4.9	$16.9
Colorado River	65.3	$14.5	$4.9	$19.4	56.5	$12.4	$4.2	$16.7	54.7	$12.0	$4.1	$16.1
Sacramento River	68.7	$17.3	$5.2	$22.4	48.0	$12.3	$3.6	$15.9	48.0	$12.3	$3.6	$15.9
Total	848.2	$609.7	$63.6	$673.4	717.9	$522.9	$53.8	$576.8	706.5	$514.3	$53.0	$567.3

1/ Water supplier costs are based on results of an ACWA/CMUA survey and are expected to range between $50 and $100 per AF of saved water. Estimated water supplier costs in the table are based on the mid-point of this range -- $75 per AF saved water.

Table 5. Local Government Fiscal Impact of Proposed ER Extension (Mil $)

Water Suppliers	Scenario 1: Continue 2015 Policy	Scenario 2: Credit up to 4%	Scenario 3: Credit up to 8%
Public Water Agencies (Local Government)	$572	$490	$482
Investor-Owned & Mutual Water Companies	$101	$87	$85
Total Fiscal Impact	$673	$577	$567

Economic Welfare Effects: Consumer Surplus Losses

Consumer surplus losses are measured for the increment of forgone water consumption attributed to the proposed regulation. Recall that this increment is equal to the 2013 baseline consumption level less the proposed regulation conservation standard (with credits) net of the amount of water savings that likely would have occurred assuming the drought continues but the proposed regulation was not extended. This is illustrated in Figure 6. In the figure, Q_B is the 2013 baseline level of consumption; $Q_{No\ ER}$ is the level of consumption assuming the drought continues and the proposed regulation is not adopted; and Q_{ER} is the level of consumption assuming the proposed regulation is adopted. The consumer surplus loss attributable to the proposed regulation is area A in Figure 6. The total consumer surplus loss associated with the drought is the sum of areas A and C.[21]

Figure 6. Graphical Representation of Economic Loss Estimate

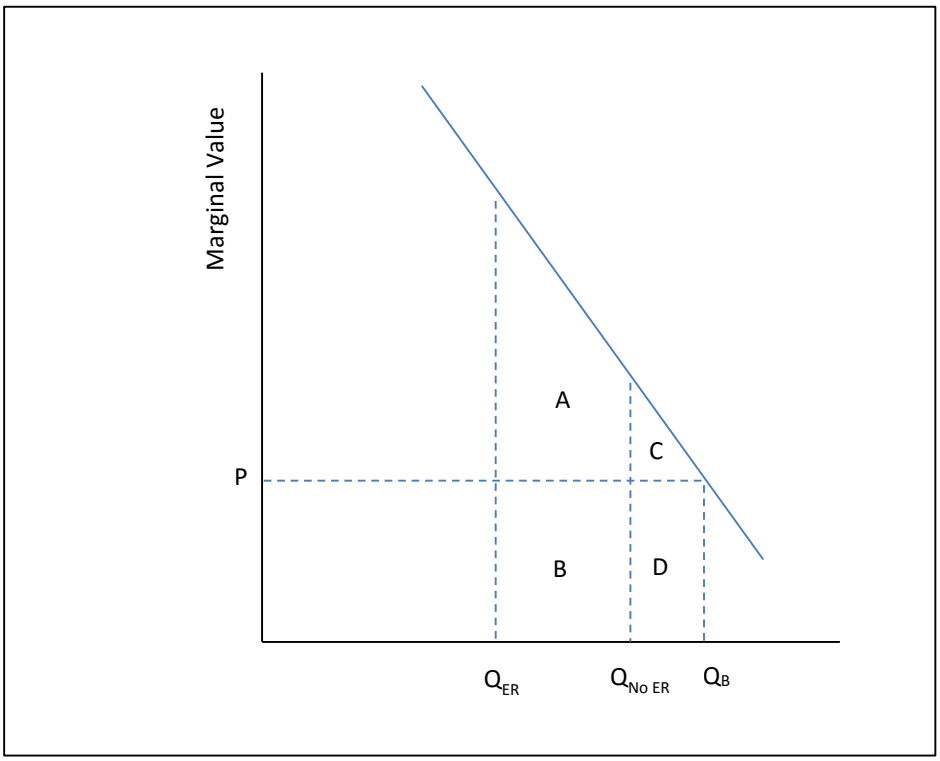


Table 6 provides a summary of consumer surplus losses by scenario and region. Under Scenario 1 where the current conservation standards are extended without credits, statewide consumer surplus losses,

[21] By the same token, the revenue loss associated with the proposed regulation is area B in Figure 6 while the total revenue loss associated with the drought continuing through October 2016 is the sum of areas B and D.

above and beyond 2014, will be about $1.3 billion. Average consumer surplus loss per AF saved varies across regions, from a low of about $500 per AF in the North Coast region to nearly $2,600 per AF in the Bay Area. For the state as a whole, the average consumer surplus loss per AF is about $1,500.

Scenario 2 and 3 reduce the consumer surplus impacts by $300 to $400 million. The 4 percent cap in Scenario 2 increases the consumer surplus loss by about $30 million relative to Scenario 3.

Table 6. Consumer Surplus Loss by Scenario and Region

Region	Scenario 1: Continue 2015 Policy (mil $)	Scenario 2: Credits with cap (mil $)	Scenario 3: Credits with no cap (mil $)
North Lahontan	$6.8	$4.9	$4.9
South Lahontan	$41.9	$28.7	$25.7
San Francisco Bay	$98.7	$80.7	$80.7
South Coast	$845.6	$655.1	$630.8
San Joaquin River	$53.8	$37.4	$37.4
North Coast	$0.8	$0.8	$0.8
Central Coast	$14.6	$14.9	$14.8
Tulare Lake	$74.6	$50.8	$50.5
Colorado River	$67.3	$48.9	$45.8
Sacramento River	$95.5	$44.4	$44.4
Total	$1,299.7	$966.5	$935.8

These results are sensitive to the residential price elasticity of demand assumption. For scenario 1, for example, a more inelastic demand elasticity of -0.20 increases the total consumer surplus loss to $1.9 billion, and a more elastic demand of -0.35 decreases the total to $810 million.

Long Run Costs of Proposed Regulation Depend on the Weather

In the longer run, the cost of adopting the proposed regulation will be determined by weather conditions in 2016 and 2017. Significant uncertainties are associated with policies predicated on unknown futures. The proposed regulation is intended to address potential vulnerabilities, not probabilistic expectations. While a return to a normal, or above average, hydrologic water conditions may be likely in 2016, such an outcome is far from certain. For this reason, the proposed regulation must be evaluated against the reasonable possibility of continued drought conditions. In such a situation, extending the regulation would help offset what would likely be even greater economic and fiscal impacts in the event the drought continues. If the drought continues, water saved as a result of the extension of the regulation will become increasingly valuable. Under these circumstances, estimated 2016 costs would be offset by similar or even greater costs that would be avoided next year. That is, if there is a fifth, or even sixth, year of drought, the proposed regulation will have helped to safeguard the state's future water supplies, thereby forestalling potentially dramatic economic consequences.

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Appendix A: Hydrologic Region Map