Urban Water Use Efficiency Resource Management Strategy

CALIFORNIA WATER PLAN UPDATE 2023

October 2024

Urban Water Use Efficiency
Resource Management Strategy

CALIFORNIA WATER PLAN UPDATE 2023

Lead Authors:
Julie Ekstrom
Manucher Alemi

Contributing Authors:
Ryan Bailey
Sabrina Cook
Bekele Temesgen
Fethi Benjemaa
Shem Stygar
Julie Saare-Edmonds
Gwen Huff
Nancy King
Nirmala Mahadevan
Kyle Miller

Contents

Figures

Tables

Acronyms and Abbreviations

AB	Assembly Bill
AWSDA	annual water supply and demand assessment
AWWA	American Water Works Association
BMP	best management practice
CCR	California Code of Regulations
CII	commercial, industrial, and institutional
CPC	California Plumbing Code
CWSS	California Water Supply Strategy
Delta	Sacramento-San Joaquin River Delta
DIM	dedicated irrigation meter
DMM	demand management measure
DRA	drought risk assessment
DWR	California Department of Water Resources
eAR	State Water Board's Electronic Annual Report
EPA	U.S. Environmental Protection Agency
GPCD	gallons per capita per day
MWELO	Model Water Efficient Landscape Ordinance
RMS	resource management strategy
SB	Senate Bill
State Water Board	State Water Resources Control Board
URWS	urban retail water system
UWMP	urban water management plan
Water Code	California Water Code
Water Plan	California Water Plan
WSCP	water shortage contingency plan

1. Introduction

This resource management strategy (RMS) provides context and status for urban water use efficiency in California. It provides a summary of water suppliers' accomplishments and successes in water conservation, water use efficiency, drought planning, and drought response actions and assistance provided by the California Department of Water Resources (DWR) to further water use efficiency. RMSs are an integral part of the California Water Plan (Water Plan) to provide practices that water suppliers or water customers may implement in reducing water demand. The Water Plan, as a State strategic water plan, encourages approaches and practices that are outlined in this RMS and are expected to reduce water demand.

This RMS also summarizes DWR's recommendations on long-term water use efficiency as required by Senate Bill (SB) 606 (Hertzberg) and Assembly Bill (AB) 1668 (Friedman) 2018 legislation. Long-term urban water use efficiency includes, standards for outdoor water use for residential and commercial, industrial, and institutional (CII) landscape areas; performance measures for CII water use; appropriate variances for unique uses that significantly affect urban retail water suppliers' water use; and guidelines and methodologies for calculating urban water use objectives. The State Water Resources Control Board (State Water Board) is required by the legislation, in coordination with DWR, to adopt the long-term standards, CII performance measures, appropriate variances, and guidelines and methodologies by June 30, 2022.

2. Urban Water Use Efficiency Today in California

During the past few decades, Californians have made great progress in urban water use efficiency. Once viewed and invoked primarily as a temporary strategy in response to a drought or emergency water shortage situation, water use efficiency has become a permanent part of California's long-term water demand management. At the individual level, the benefits of water use efficiency may appear small, incremental, or difficult to see, but when Californians act together as a community to conserve water, the cumulative effect provides significant benefits that are widespread.

There are several factors that have contributed to increased water use efficiency, including outreach efforts that have increased awareness and changed behaviors, urban water suppliers' implementation of demand management measures (DMMs), plumbing codes requiring more efficient fixtures, implementation of requirements pertaining to the Model Water Efficient Landscape Ordinance (MWELO), advances in irrigation technology, new technologies in the CII sectors, and mandates requiring that water service connections are metered.

But, with tighter environmental constraints on the Sacramento-San Joaquin River Delta (Delta), increasing population, and the necessity of adapting to a changing climate, even greater efficiencies will be needed and are achievable. When faced with an increasing demand for water, water suppliers can consider a combination of options for increasing supplies or reducing demand to meet this need. Increasing water supply can be expensive and can include costs of purchasing additional water, capital cost of production and distribution systems, water supply treatment facilities, energy costs, and recycled water facilities. Reducing demand through increased water use efficiency is generally a lower-cost option and quicker to implement.

Benefits of Urban Water Use Efficiency

Using water efficiently yields multiple benefits, including:

- Increased reliability of water supplies.
- Increased capacity to meet the growing water demand of California's increasing population.
- Delayed capital costs for new infrastructure to treat and deliver water.

- Reduced contaminated irrigation runoff to surface waters.
- Increased availability of water for surface or groundwater storage.
- Reduced water-related energy demands and associated greenhouse gas emissions.

Legislation and Regulation

Water Conservation Act of 2009

In 2009 the California State Legislature (Legislature) directed urban retail water suppliers, as defined in California Water Code (Water Code) Section 10608.12, to reduce urban per-capita water use for a state goal of 20 percent reduction by 2020. This legislation, the Water Conservation Act of 2009 (Senate Bill [SB] No. 7 of the Seventh Extraordinary Session, or SB X7-7), was enacted as part of a five-bill package aimed at improving the reliability of California's water supply and restoring the ecological health of the Delta. SB X7-7 has multiple urban and agricultural water use efficiency provisions. The key urban conservation measure was a statewide goal of reducing urban per-capita water use by 20 percent by 2020. Urban retail water suppliers were required to report progress toward their targets in their urban water management plans (UWMPs).

Demand Management Measures and Best Management Practices

DMMs and best management practices (BMPs) are practices that can be used by urban water suppliers to conserve water. The implementation of these practices has been a major driving force behind urban water conservation and water use efficiency in California.

Table 1 Demand Management Measures

Demand Management Measure (DMM)	Description
DMM A	Water survey programs for single-family residential and multi-family residential customers.
DMM B	Residential plumbing retrofit.
DMM C	System water audits, leak detection, and repair.
DMM D	Metering with commodity rates for all new connections and retrofit of existing connections.
DMM E	Large landscape conservation programs and incentives.
DMM F	High efficiency washing machine rebate programs.
DMM G	Public information programs.

Demand Management Measure (DMM)	Description
DMM H	School education programs.
DMM I	Conservation programs for commercial, industrial, and institutional accounts.
DMM J	Wholesale agency programs.
DMM K	Conservation pricing.
DMM L	Water conservation coordinator.
DMM M	Water waste prohibition.
DMM N	Residential ultra-low-flush toilet replacement.

Table 1 Note: California Water Code, Section 10631 (f), requires urban water suppliers to provide a description of their demand management measures in their urban water management plans.

Urban Water Management Plans

UWMPs are prepared by California's urban water suppliers to support their long-term resource planning and ensure that adequate water supplies are available to meet existing and future water demands. UWMPs are required of urban water suppliers. Water Code Section 10608.12 defines *urban retail water supplier* as a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes. *Urban wholesale water supplier* is defined as a water supplier, either publicly or privately owned, that provides more than 3,000 acre-feet of water annually at wholesale for potable municipal purposes.

Water Loss

Drought and other water shortage issues highlight the need to manage water loss in water distribution systems. Water loss can result from seepage, leaks, and pipe failures resulting from aging infrastructure and water theft. Water utilities can increase water supplies and recover revenue by identifying the scale and cost of these losses.

Wholesale Water Suppliers

Senate Bill (SB) 606, adopted in 2018, requires DWR to submit to the Legislature a final report with recommendations on the feasibility of developing and enacting water loss reporting requirements for urban wholesale water suppliers. The report, *Recommendations for Urban Wholesale Distributions Systems Water-Loss Audit Reporting*, was submitted in May 2020. There is no water loss audit regulation or requirement at this time.

Urban Retail Water Suppliers

Water Loss Audit Reporting

SB 555 (Wolk), adopted in 2015 during the drought, requires urban retail water suppliers to submit annual water loss audits to the State by October 1.

The reporting deadline was subsequently modified by AB 1414 (Friedman, 2019), which requires fiscal year reporters to submit their reports by January 1 of each year starting January 1, 2021. Submitted water loss audits must be system-specific and, in the case of an urban retail water supplier with two or more separate public potable water systems, the urban retail water supplier must submit a separate report for each potable water system (California Code of Regulations [CCR] Section 638.5). Some of the relevant sources of information available at DWR's Urban Water Loss webpage are:

- DWR's Validated Water Loss Reporting Regulations for urban retail water supplier.
- The water loss audit reports for calendar years 2016 to the present.
- California-Nevada Section of the American Water Works Association Final Report summarizing the submitted reports for 2016.
- The American Water Works Association manual *M36: Water Audits and Loss Control Programs*, fourth edition, guidebook provides information on what steps are required to establish and perform a leak detection program, as well as more information on retailer water audits.

Water Code Section 10608.34(a) (1)

Through requirements set forth in the Water Code, DWR was required to establish regulations for conducting and validating water loss audits, technical qualifications for persons performing water loss audit validation, and reporting requirements for submitting validated water loss audits to DWR. After audits are validated by validators certified by the American Water Works Association (AWWA), the urban retail water supplier is required to submit it them to DWR. Title 23 of CCR Section 638.5(c) details the audit reporting requirements to DWR.

The water loss audit is the national standard and is documented AWWA M36 manual (American Water Works Association 2014). The software allows suppliers to input information regarding distribution system characteristics and annual operational data, estimates of unmetered water use needed for fire flows, and economic values such as customer retail unit cost and variable water production costs. Using the supplier data inputs, the AWWA water audit software calculates real and apparent

losses for the water system. Real losses are considered the physical water lost to the system. Apparent water loss is water that remains in the pipes, and not actually lost from the system, but is not accounted for because of inaccurate meter reads in under-registering meters, theft, or underestimation of fire or flushing flows. The software also calculates system performance metrics and water-loss-control cost effectiveness appropriate to retailer water systems.

Water Loss Performance Standards

California Water Code Section 10608.34 requires the State Water Board to develop water loss performance standards for urban retail water suppliers. The audit data submitted to DWR is being used by the State Water Board to develop water loss performance standards (including real and apparent loss standards) for urban retail water suppliers. The formal rulemaking process was completed, and the regulation was effective April 1, 2023. Suppliers must meet the standards on January 1, 2028.

The regulation is designed to bring water losses to levels that are cost effective and feasible for each urban retail water system (URWS), and the regulation will support each URWS in planning and implementing water loss control in a cost-effective manner. The intent of the regulation is to identify and require each retail supplier to reduce leakage to the level of a specific volumetric standard that is based on its unique characteristics and cost-effectiveness, while providing each supplier the flexibility to choose any effective approach best suited for its system and budget to meet its standard. Cost savings may be passed on to customers. URWSs supplying water to disadvantaged communities that face burdensome upfront costs will have additional time to comply if their standard requires at least a 25 percent reduction from their baseline. The source of the baseline data used to develop the standard is from the audits submitted to DWR pursuant to Water Code Section 10608.34(a) (1) (described above). At the time of publication of this RMS, annual water loss audit reports, submitted pursuant to Water Code Section 10608.34, are used by the State Water Board to calculate the water loss performance standard.

2018 Updates to the Water Conservation Act (Assembly Bill 1668 and Senate Bill 606)

In 2018, the Legislature approved, and the governor signed, two bills, SB 606 and AB 1668, to establish a new foundation for long-term improvements in water conservation, water use efficiency, and drought planning to adapt to climate change and droughts in California. DWR and the State Water Board developed a handbook that summarizes the 2018 Water Conservation Legislation, *Making Water*

Conservation a California Way of Life – Primer of 2018 Legislation on Water Conservation and Drought Planning, Senate Bill 606 (Hertzberg) and Assembly Bill 1668 (Friedman). The legislation requires DWR, in coordination with the State Water Board, to conduct necessary studies and investigations and recommend water use efficiency standards for residential and CII landscapes, as well as performance measures for CII water uses and variances for unique uses of water for adoption by the State Water Board. Following adoption by the State Water Board, urban retail water suppliers will use the standards and variances to calculate their annual water use objective. These water suppliers are required to submit annual reports to DWR on their actual water use and their water use objective starting in 2024.

To strengthen drought resilience, the 2018 legislation requires that each urban wholesale and retail water supplier prepare, adopt, and submit a water shortage contingency plan (WSCP) and conduct a drought risk assessment (DRA) every five years as a part of its UWMP. Then, using the WSCP, each supplier must conduct an annual water supply and demand assessment and submit a report of that assessment, known as a shortage report, to DWR. These requirements are in effect and are discussed in the Status of Urban Water Use section.

An expanded description of legislative and regulatory requirements to increase water use efficiency with the new long-term water use objectives and reporting and drought resilience is found in Section 3, "Urban Water Use and Efficiency in California."

Emergency Regulations to Eliminate Water Waste

In 2021, Governor Newsom proclaimed a drought state of emergency for all California counties, urging Californians to step up their water conservation efforts and encouraging the State Water Board to prohibit certain wasteful water uses. The State Water Board adopted two emergency regulations in 2022. Although these regulatory prohibitions were intended for a limited period of time to address drought emergency, they are practices that the water suppliers may encourage and promote in the future, as appropriate, to conserve water.

Prohibition of Wasteful Water Uses

CCR Sections 995 and 996,which apply to all Californians, are effective until December 2023 and include the following prohibitions against wasteful water use:

- Outdoor watering that lets water run onto sidewalks and other areas (except incidental runoff).

- Washing vehicles without an automatic shutoff nozzle.
- Washing hard surfaces, such as driveways or sidewalks, that don't absorb water.
- Street cleaning or construction site preparation.
- Filling decorative fountains, lakes, or ponds.
- Outdoor watering within 48 hours after at least 1/4 inch of rainfall.
- Watering ornamental turf on public median.
- Watering non-functional lawns in CII areas, including common areas of homeowners' associations. This prohibition is in effect until June 2024.

Model Water Efficient Landscape Ordinance

The purpose of the Model Water Efficient Landscape Ordinance (MWELO) is to establish a structure for planning, designing, installing, maintaining, and managing water efficient landscapes for new construction and rehabilitated projects, as well as improving the water use efficiency for existing landscapes greater than a certain size. The MWELO was created by DWR as a model ordinance for local agencies to enforce minimum standards in landscape design, construction, and management. This is achieved through specific requirements related to soil, plants, irrigation, stormwater, and non-potable water supplies. It sets an upper limit for the water budgets of landscape projects, thereby driving water-efficiency through the thoughtful selection of climate-appropriate plants, organic soil amendments, water-efficient irrigation devices, and the use of alternative water supplies. MWELO encourages landscapes that require less water than the water budget's upper limit. It also encourages the innovation of landscaping equipment, products, and materials that use resources as efficiently as possible. A landscape designed, built, and managed to meet MWELO standards is inherently more sustainable than historically designed landscapes. They provide multiple benefits which can be sustained with little to no negative impacts to the environment because of the limited resources required.

The requirements of the MWELO are found in the CCR, Title 23, Division 2, Chapter 5.7, Sections 490–495. Two additional standards apply to the MWELO:

Standard for Sprinkler Bodies. Effective October 1, 2020, the California Energy Commission adopted regulations for spray sprinkler bodies that will prevent excess water pressure and over-irrigation through better pressure regulation. Like fixtures, this regulation is enacted at point of sale. Consumers will not have to search for compliant spray bodies, as only compliant models are for sale in California after existing stock is sold out.

Landscape Irrigation Sprinkler and Emitter Standard for MWELO. The current standard for manufacturing irrigation emission devices is the 2020 American National Standards Institute and American Society of Agricultural and Biological Engineers'/International Code Council's 802 Landscape Irrigation Sprinkler and Emitter Standard. Although the standard is voluntary for manufacturer compliance, the MWELO requires all emission devices selected in irrigation plans to meet this standard.

DWR Guidance and Assistance to Urban Water Suppliers and Others

DWR's Water Use Efficiency webpage offers guidance, assistance, and other information on UWMPs, WSCPs, annual water supply and demand assessments (AWSDAs), landscape water use efficiency, and the MWELO, as provided below.

Guidance Documents

UWMP Guidebook. DWR updated and made available the *Urban Water Management Plan Guidebook 2020* to assist urban water suppliers in the preparation of their plans. The guidebook was developed with the assistance of the Guidebook Advisory Committee, consisting of representatives from urban water suppliers and others. The guidebook and resources available, including access to WUEData Portal, is available on DWR's Urban Water Management Plans webpage.

Annual Water Supply and Demand Assessment Guidance. DWR developed a guidance document for urban water suppliers to perform their AWSDA and to submit an annual water shortage assessment report to DWR. The guidance document is available on DWR's Annual Water Supply and Demand Assessment webpage along with other useful resources such as Excel Workbook, and a Guidance Addendum.

MWELO Guidebook. DWR developed a guidebook to assist local agencies and landscape professionals to design, review, install, and manage water efficient landscapes. The guidebook and MWELO resources can be found on DWR's Model Water Efficient Landscape Ordinance webpage.

Water Use Efficiency Data Portal

DWR developed and hosts the Water Use Efficiency Data (WUEdata) portal for urban water suppliers and local agencies to submit required reporting and data. The WUEdata online submittal tool allows urban water suppliers or local land use agencies to submit data to DWR. The data are made available to the public.

Also included in the portal are the following useful templates and workbooks:

- **DWR Population Tool**. DWR developed a population mapping tool that provides a simple and streamlined approach to estimating service area population using census and geographic information system data. Accurate population figures are critical to calculations of daily water use per capita.
- **Table Templates for Urban Water Management Plans**. DWR developed standardized forms and table templates for urban water suppliers to report their UWMP data.
- **Methodologies for Calculating Baseline and Compliance Urban Per Capita Water**. The Water Conservation Act of 2009 directed DWR to develop technical methodologies and criteria to ensure consistent implementations of the act and to provide guidance to urban retail water suppliers in developing baseline and compliance water use. The methodologies document was released in 2010 and revised in 2011 and 2016.
- **Drought Risk Assessment Planning Tool**. An optional planning tool has been prepared to assist urban water suppliers in evaluating water supplies and uses under the five-consecutive-year drought, characterized in the DRA.
- **Annual Water Supply and Demand Assessment Report (also known as the Shortage Report) Tool**. This tool provides table templates for submitting required annual reporting data.
- **Model Water Efficient Landscape Ordinance (MWELO) Tool**. This tool provides template and resources for annual reporting by local agencies to DWR.

Other Assistance

- **California Irrigation Management Information System**. DWR manages the California Irrigation Management Information System (CIMIS), which provides weather and estimated reference evapotranspiration (ETo) data used for irrigation scheduling.
- **Water Loss Technical Assistance**. Resources for preparing water loss audit reports are available at DWR's Urban Water Loss webpage. DWR regional offices can provide water agencies with leak detection equipment for a short-term loan.
- **In Person and Online Public Workshops and Stakeholders Engagement**. DWR conducted a series of public workshops and training events to assist urban water suppliers, consultants, planners, and other interested parties with UWMPs, MWELO, AWSDAs, and water loss reports. DWR has engaged

interested parties in conducting studies and investigations on developing new water use efficiency programs and policies.

Status of Urban Water Use

Distribution of Urban Water Use

As shown in Table 2, the majority of 2018 urban water demand was residential, accounting for approximately 60 percent of the 8.2 million acre-feet total volume.

Table 2 Breakdown of 2018 Statewide Urban Water Use (applied water) by Water Use Sector

Category	Percentage	Million Acre-Feet
Large Landscape (CII DIM)	10%	0.8
Commercial	14%	1.1
Industrial	4%	0.4
Energy Production	1%	0.1
Residential (Interior and Exterior)	60%	4.9
Conveyance	4%	0.3
Groundwater Recharge	8%	0.6
Total Urban Water Use in 2018	**100%**	**8.2**

Source: California Department of Water Resources, California Water Plan Update 2023.
Table 2 Note: CII DIM = commercial, institutional, and industrial with dedicated irrigation meter

Urban Water Management Planning

Urban Water Management Plans

DWR reviews the UWMPs and submits a report to the Legislature summarizing the status of UWMPs and embedded water shortage contingency plans (WSCPs). DWR has identified 438 urban water suppliers that provide water as either retail, wholesale, or both, as defined in Water Code Section 10608.12 and based on data collected through the State Water Board's electronic Annual Report (eAR). The data in eAR provides information on connections and amount of water delivered to help identify retail water suppliers that would be considered urban water suppliers. Of the 417 water suppliers that submitted UWMPs, 386 are retail suppliers, 16 of which are both retail and wholesale. Thirty-one are wholesale suppliers only. A summary of submittals is provided in Table 3. Table 4 provides historical information on past UWMP submittals. Since 2005, the number of urban water suppliers required to submit UWMPs has reduced, possibly because of mergers, while the number of UWMP submissions has increased.

Table 3 Urban Water Management Plan Submittals (2020)

Category	Retail Suppliers	Wholesale Suppliers	Both Retail and Wholesale Suppliers	Total
Submitted	370	31	16	417
Not Submitted	17	4	0	21
Total	387	35	16	438

Table 4 Urban Water Management Plans since 2000

Category	2020	2015	2010	2005[a]	2000
Identified as UWS	438	435	448	460	371
UWS Submissions	417	400	381	344	317
Did Not Submit by the Time of Report Submission	21	35	67	116	54
Percent in Compliance	95%	92%	85%	75%	85%
Under Threshold, Voluntarily Submitted	11	11	-	-	-

Table 4 Note: UWS = urban water suppliers

[a] In 2005, the number of urban water suppliers may have included water suppliers under threshold.

According to the data reported in their 2020 UWMPs:

- Approximately 36.5 million people are served by retail suppliers.
- 5.8 million acre-feet of water was purveyed by retail suppliers.
- Retail suppliers serve approximately 9.1 million municipal connections.

Retail suppliers range widely in size. Of those that submitted 2020 UWMPs:

- The largest retail supplier is the Los Angeles City Department of Water and Power, which had 745,489 service connections and provided 487,591 acre-feet of water.
- The smallest retail suppliers in terms of connections served and volume purveyed, respectively, are City of Vernon with 1,088 connections serving 6,547 acre-feet and Groveland Community Services District with 3,256 connections serving 396 acre-feet.

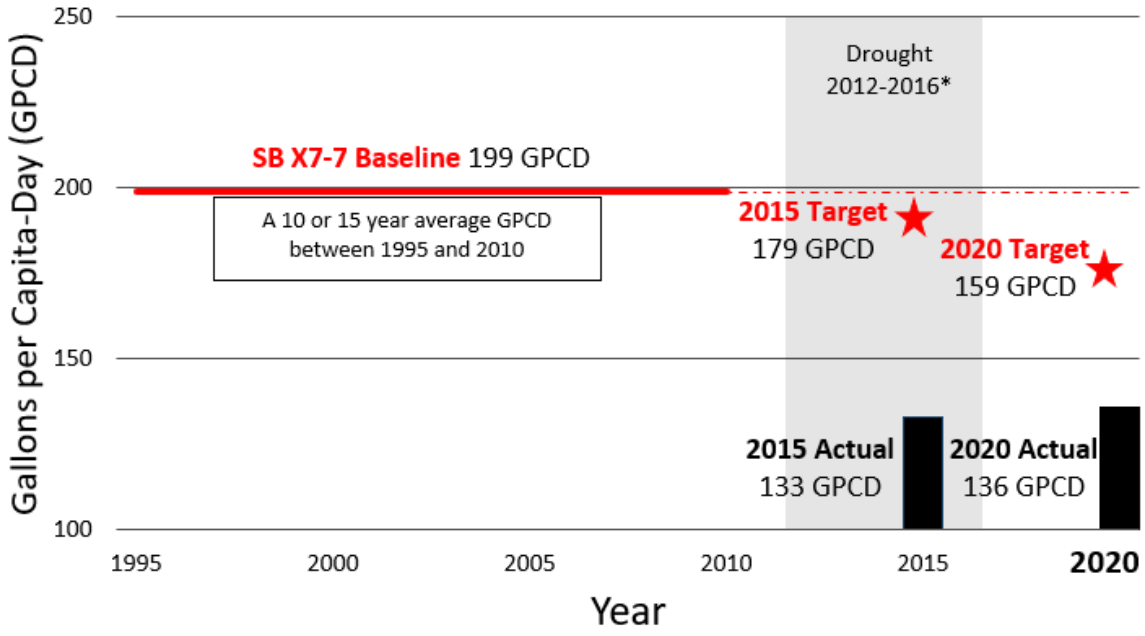
SBX7-7 Compliance

In summary, implementation of the SBX7-7 by the urban water suppliers resulted in significant reduction in water use from the 2010 baseline period (an annual average of 10 or 15 years between 1995 and 2010) to 2020.

Water use reduction is described at three levels: statewide, hydrologic region, and individual urban water supplier, as shown in Table 5 and Figures 1 and 2.

Statewide Water Use

Figure 1 Water Use Reduction from the Baseline Period to 2020



Sources: California Department of Water Resources 2010, 2015; and 2020 urban water management plans.

Figure 1 displays a population-weighted average of total annual water use in gallons per capita per day (GPCD) statewide. The 2015 and 2020 actual GPCDs represents the actual water use in GPCD values measured and reported in UWMPs. Targets are calculated based on SB X7-7 methodologies. The dates of the drought period are based on information in *California's Most Significant Droughts: Comparing Historical and Recent Conditions* (California Department of Water Resources 2020).

The state surpassed the 2020 goal with an additional reduction of 23 GPCD, equivalent to a total statewide reduction of 32 percent from baseline. Gray bars in this graph represent approximate timing of drought periods (California Department of Water Resources 2020).

Hydrologic Region Water Use

Table 5 displays the percentage of per capita urban water use reduction from the baseline period to the target year of 2020. Though the Water Conservation Act of 2009 did not set a target by hydrologic region, each region individually surpassed the statewide target of a 20 percent reduction in water use.

Table 5 Water Use Reduction by Hydrologic Region

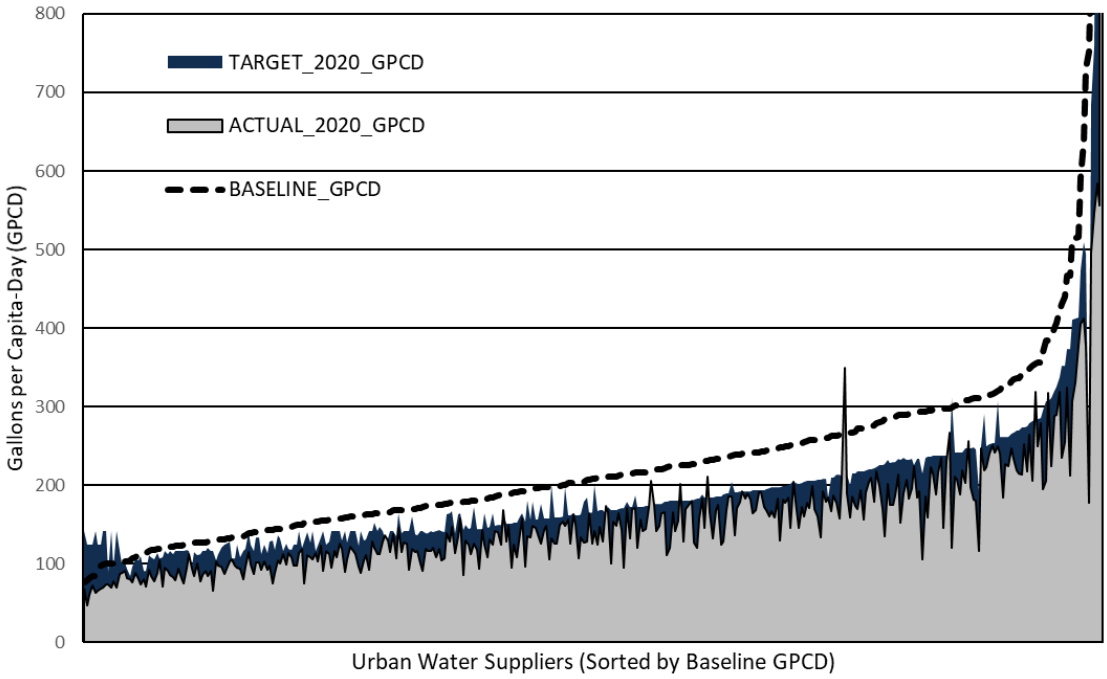
Hydrologic Region	Baseline GPCD	2020 Actual GPCD	Percent Reduction
Central Coast	149	108	27%
Colorado River	386	256	34%
North Coast	153	105	31%
North Lahontan	282	214	24%
Sacramento River	280	192	32%
San Francisco Bay	157	111	29%
San Joaquin River	239	165	31%
South Coast	189	125	34%
South Lahontan	256	156	39%
Tulare Lake	280	194	31%
Statewide	199	136	32%

Sources: Data Sources: 2010, 2015, and 2020 UWMPs.
Table 5 Note: GPCD = gallons per capita per day

Individual Retail Urban Water Suppliers' Water Use

Figure 2 displays the baseline, target, and actual 2020 water use for each urban retail water supplier, as reported in 2010, 2015, and 2020 UWMPs submitted by November 28, 2022.

Figure 2 Water Use Reduction Performance by Individual Retail Suppliers



Sources: 2010, 2015, and 2020 urban water management plans.
Figure 2 Note: Gallons per capita per day (GPCD) values greater than 800 are not shown in this graph. As a result, that excludes urban retail water suppliers such as the City of Vernon, which had an actual GPCD of 60,000 because of high industrial water use and low population.

Water Loss

DWR encourages water agencies to detect and resolve leaks when economically feasible. The Water Loss Audit Reporting Program provides guidance on how water agencies can identify and eliminate water loss in water distribution systems. The audit uses local water agency data over a defined period to identify water losses. After an agency has determined the water losses and performed a benefit-cost analysis to verify economic feasibility of addressing losses, a leak detection program may be established. The leak detection program, which is implemented in the field, requires knowledge of the distribution system layout and proficiency in using sonic equipment to identify areas with leaks.

Of urban water suppliers that are required to submit water loss audits, 94 percent have submitted water loss audits for the calendar or fiscal year 2020 (though some suppliers may have missing reports for some of their systems).

California Water Code Section 10608.34 requires the State Water Board to develop water loss performance standards for urban retail water suppliers. The formal

rulemaking process was completed, and the regulation was effective April 1, 2023. Retail suppliers must meet these new water loss standards by January 1, 2028. Details are available on the State Water Board's Water Loss Control website.

Annual Water Shortage Assessment Reporting Compliance

On July 1, 2022, there were 435 urban water suppliers (wholesale and retail) that were required to conduct an annual water supply and demand assessment and submit their water shortage assessment report. As of November 2, 2022, DWR received 424 water shortage assessment reports, of which 414 reports were submitted by urban water suppliers and 10 were submitted voluntarily by small water suppliers (suppliers serving less than 3,000 connections and supplying less than 3,000 acre-feet annually). The remaining 21 urban water suppliers had not submitted reports as of November 2, 2022. The 2022–2023 compliance rate of urban water suppliers required to submit a water shortage assessment report was 95 percent (Table 6).

Table 6 Water Shortage Assessment Report Submittals as of November 2, 2022

Category	Number
Urban Water Suppliers	435
Submitted Reports	414
Did not Submit Reports	21
Compliance Rate	95%
Voluntary Submittals by Small Water Suppliers	10
Total Submitted (Required + Voluntary)	424

Urban Water Suppliers' 2022–2023 Projected Shortages and Planned Actions

DWR's review of the submitted water shortage assessment reports (shortage reports) covering the year 2022–2023 found:

- There were 338 urban water suppliers (82 percent) that did not expect a shortage in 2022–2023 with continued conservation efforts, including a voluntary 15 percent water-use reduction, and activation of the emergency regulation, adopted by the State Water Board in response to the governor's proclamation requiring urban water suppliers to implement Level 2 demand reduction actions, as found in their water shortage contingency plans.
- There were 73 urban water suppliers (18 percent) which anticipated that they could fully address any shortage through increased conservation actions or increased supplies noted in their water shortage contingency plans, including stronger water-use reduction mandates.

- There were three urban water suppliers (0.7 percent) which projected that they might experience a shortage after implementing water conservation actions or increased supplies included in their current plans. DWR continued to work with these suppliers to include additional actions to adequately address expected shortages.

Review of the shortage reports indicates that water suppliers with similar conditions have differing estimates of water reductions for the same response actions. Studies are needed to determine water use reduction effectiveness of various drought response actions.

DWR is required to submit a report to the State Water Board summarizing the results of the shortage reports. DWR's *2022 Annual Water Supply and Demand Assessment Summary Report* to the State Water Board is posted on DWR's website.

Long Term Supply Reliability

Urban water suppliers' long-term supply reliability and drought risk assessment (DRA) is conducted as a part of a UWMP and summarized below.

Based on urban water suppliers' water supply reliability analysis and drought risk assessment information in the UWMPs:

- More than 94 percent of the urban water suppliers that submitted plans either did not anticipate any shortage in their DRA (for a single and multi-dry year scenarios) or they found that any anticipated shortage could be handled by implementing locally adopted water shortage response actions.
- Approximately 70 percent of urban water suppliers reported no anticipated shortage and estimated that projected supplies would meet or exceed the projected demand.
- Approximately 24 percent of urban suppliers projected an anticipated level of shortage that can be fully addressed by implementing stronger response actions from their WSCPs.

Less than 6 percent of suppliers (24 of 417) projected some level of shortage even after implementing their planned shortage response actions.

Model Water Efficient Landscape Ordinance

Local agencies are required to submit an implementation report to DWR. DWR's review of the submitted annual MWELO reports found:

- In 2020, approximately 55 percent of local agencies, out of approximately 540 agencies (cities, counties, cities and counties), reported on MWELO implementation.
- In 2021, approximately 45 percent of local agencies reported on MWELO implementation.
- There are known issues with data quality assurance and quality control from the MWELO reports because of inconsistent reporting across agencies. There is a need for further clarification to address these inconsistencies in MWELO reporting.

3. Urban Water Use and Efficiency in California

Indoor Residential Water Use

Indoor residential water use is comprised of uses associated with fixtures such as toilets, washing machines, showers, faucets, and dishwashers. Indoor efficiency can be improved by using efficient fixtures, customer changes in water use behavior, and through implementing plumbing code requirements by checking for compliance upon sale, resale, or permitted improvements of residential and non-residential properties. Additionally, as new technologies become available, State and federal plumbing codes and standards updates can contribute to improve fixture and appliance efficiencies.

Outdoor Water Use

Landscape irrigation remains a significant opportunity for increasing water use efficiency and reducing unnecessary demand. Urban landscapes can be divided into three categories: residential, CII landscape with dedicated irrigation meter (CII DIM) landscape, and CII landscapes irrigated through a mixed-use meter. Many factors contribute to the large amount of water used in landscapes, including population shifts to hotter interior regions that can have larger residential landscapes (Hanak and Davis 2006), the prevalence of cool-season turf grasses and other high-water-use plants, irrigation systems that are inefficient and poorly maintained, and overwatering of plants.

Increased landscape water use efficiency can be accomplished with a variety of tools that are effective in any landscape sector, whether residential, commercial, or institutional. Some of these tools include regular maintenance of irrigation systems, irrigation audits to identify deficiencies, selection of low-water-using plants, irrigation system upgrades, installing irrigation controllers, and development of landscape water budgets.

Model Water Efficient Landscape Ordinance Compliance

Landscape water budgets, based on landscape area and climate, are employed in the Model Water Efficient Landscape Ordinance (MWELO) (California Code of Regulations Title 23, Division 2, Chapter 2.7, Section 490). The MWELO formula for

calculating water budgets was updated in 2015, thus lowering the amount of water in a landscape water budget. DWR may update MWELO per AB 2515 (2016).

DWR contracted with the University of California, Davis, to conduct a survey on the barriers to MWELO implementation. This study, conducted in early 2022, surveyed 174 local agency staff that implement MWELO. The study found:

- MWELO lacks clarity about which sections of the ordinance are applicable to which project types including what documents are needed to be compliant and what data need to be reported.
- Local agencies with limited resources in staffing, funding, and training for implementation expressed that MWELO was technically complex. There is a lack of local political support because developer fees would need to increase to fund enforcement. There are also other issues, including high staff turnover.
- Water suppliers often do not have any land use authority.
- Within local agencies there can be a lack of coordination among departments tasked with different parts of MWELO enforcement causing frustration between local agency staff and land developers.
- Mid- to larger-sized agencies with resources and familiarity with MWELO have fewer issues with implementation. These agencies have requested DWR to make specific changes to MWELO to improve clarity and encourage enforcement.

Overcoming challenges identified in the survey could improve overall MWELO compliance and outdoor water use efficiencies. Examples of actions planned by DWR include:

- Technical assistance in the form of guidebooks, sample forms, and other outreach materials.
- Workshop content that includes project workflow and project management steps.
- Training materials for various levels of expertise.
- Examples of successful MWELO enforcement by experienced agencies.
- Update MWELO to clarify and simplify the requirements and include more checklist approaches.

Landscape Water Budgets

Landscape water budgeting is a straightforward method for determining whether a site is receiving the correct amount of water to keep the plants healthy without wasting water. A water budget is calculated using local reference evapotranspiration data, an evapotranspiration adjustment factor, and the area (in square feet) of the irrigated landscape. The landscape area can be captured from landscape plans, by measuring the site, or through aerial imagery, including free internet map applications. Historically, obtaining the landscape area has been a challenge for water suppliers, especially when more than one meter may serve a parcel, but new tools and technology are becoming available that will simplify the process.

- **Tracking Water Use**: With smart controllers and associated water use dashboards or apps, when the volume of water allowed in the water budget is compared with real time or frequently updated water use data, the irrigation manager can evaluate whether water use is on track and, if it is not, can make immediate changes to the irrigation schedule. Because weather conditions influence the water needs of plants, irrigation managers should assess compliance with the water budget weekly, or at least monthly.
- **Communicating and Incentivizing Improvements**: Water budgets are also valuable communication tools. An irrigator that keeps a site within a water budget can show their customer the water savings and cost savings achieved when compared with historical use. Water suppliers can assign a water budget to an account and notify the customer and the irrigation manager when the budget is exceeded. Water budgets, coupled with tiered water rates, send a pricing signal that discourages wasteful water use. As an example, the California Landscape Contractors Association has a Water Management Certification program where a water manager is certified to use water budgeting and advanced irrigation systems to reduce water use.

Commercial, Industrial, and Institutional Sectors

The commercial, industrial, and institutional (CII) sectors cover a broad range of water uses, from schoolyard playgrounds and drinking faucets to bottling plants and restaurants. Because of this diversity, it can be a challenge to address these sectors, whether trying to make broad generalizations about CII water use or trying to drill down and find detailed data. There is potential for water use efficiency in the CII sector through application of DMMs as well as CII performance measures

recommended by DWR for adoption by the State Water Board (Table 7c). Continued technology advances and replacement of older water-using equipment and processes also offer opportunities for installing water efficiency improvements for process water and non-process water uses.

Landscape Meters

Metering the amount of landscape water use enables water use tracking for improved management and efficiencies. Since 2008, water suppliers must install a dedicated landscape meter on new non-residential water service with a landscape area of more than 5,000 square feet. The California Green Building Standards Code requires dedicated meters, metering devices, or sub-meters to facilitate water management on non-residential landscapes from 1,000 square feet to 5,000 square feet. CALGreen requires new multi-family residential buildings in California, constructed after January 1, 2018, to include a submeter for each dwelling unit.

Factors Contributing to Increased Water Use Efficiency and Reduced Per Capita Water Use in California

Factors affecting water use efficiency in urban areas include the extent of water users' participation and the availability of programs to support public implementation of conservation or water use efficiency actions by local and State agencies. Adoption and enforcement of regulations can also affect water use efficiency. Another factor is the availability of water efficient devices, tools, or management systems and their ability to increase water use efficiency.

Water Users' Participation

Water users' participation in programs is critical for achieving water use efficiency. But water suppliers lack the authority to directly require water use efficiency actions with their customers or to adopt or enforce regulations unilaterally. Statewide and local outreach and education programs, such as Save Our Water campaigns, school programs, federal EnergyStar or WaterSense water efficient labeling program, and other messaging and education activities, can increase public participation, especially in times of drought. State and local incentive programs can also improve public participation by removing some barriers to implementation. Additionally, development and enforcement of regulations and codes, where authorities exist, or can be granted, can encourage active or passive public participation in improving water use efficiency.

Investments by Urban Water Suppliers and the State

Institutional programs supporting customer implementation of water use efficiency actions can be effective strategies for improving urban water use efficiency.

Examples of water use efficiency and water conservation assistance and incentive programs implemented by wholesalers, regional authorities, and local agencies include:

- Rebates and direct-install programs. These programs are set up to replace inefficient water fixtures and appliances (e.g., toilets, faucets, and washing machines), and to facilitate landscape conversions. Many urban water suppliers offer ongoing rebate programs to upgrade fixtures and some appliances.
- Implementation of leak detection sensor technologies. For example, San Francisco Public Utilities Commission completed its Automatic Water Meter Program in 2018 to upgrade retail water meters with wireless advance metering technology, which aids in identifying potential high or unusual water use. Single family residential customers are notified of potential leaks that may be occurring at their homes based on meter readings (San Francisco Public Utilities Commission 2021).
- Increased water metering. Water Code Section 527 requires urban water suppliers to install water meters on all service connections by January 1, 2025, as well as transition customers from flat rates to metered rates based on the water volume delivered. An example of a response to this requirement is an increase in meter installation from 20 percent of customers in 2005, to 99 percent of customers in 2022 by the City of Sacramento.
- Outreach and education. Most urban water suppliers provide programs to inform customers and the public of the importance of water conservation and techniques for decreasing water use.
- Turf removal and replacement programs. These programs provide an opportunity to conserve a substantial amount of water. Much of irrigated urban landscapes consist of high-water-using turfgrass. Many urban water suppliers have offered programs to provide rebates to their customers for turf replacement. Examples of turf replacement programs include:
    - Metropolitan Water District of Southern California's (MWD's) Turf Replacement Program. MWD spent $366 million in the 10-year period between May 2013 and May 2023 on turf removal and replacement.
    - City of Santa Rosa's Cash for Grass Rebate program. Since the program began in 2007 it has provided $2 million in lawn removal rebates.

Examples of water use efficiency and water conservation assistance and incentive programs implemented by the State include:

- Financial assistance. From 2022 through 2023 approximately $450 million in general funds and $200 million in Proposition 1 funds in State grant programs have been provided to assist urban water suppliers' implementation of water use efficiency and conservation incentive programs.
- Outreach and education. Increased statewide communication of the importance of water conservation and efficiency. As a result of messaging from the Governor's Office and programs such as the Save Our Water campaign, Californians have a heightened awareness of the reality of drought in the state and have reduced water use accordingly.

Regulatory Actions

The SBX7-7 legislative requirements for urban water suppliers to reduce per capita water use, implement DMMs and other locally appropriate policies and practices, and prepare and submit annual water loss audit report has resulted in a significant reduction in annual per capita water use (Figure 1).

MWELO requires new and rehabilitated landscapes be designed in accordance with a water budget to improve residential and non-residential landscape water use efficiencies.

Updated building codes include:

- California Green Building Standards Code (CALGreen), adopted in 2008.
    - CALGreen includes mandatory water efficiency and conservation measures (indoor and outdoor) for residential and non-residential construction.
    - CALGreen also requires dedicated meters, metering devices, or sub-meters to facilitate water management on non-residential landscapes from 1,000 square feet to 5,000 square feet, allowing for tracking of landscape water use to inform water management actions.
    - CALGreen was updated based on 2016 legislation to require new multi-family residential buildings in California, constructed after January 1, 2018, to include a submeter for each dwelling unit and to bill tenants in apartment buildings accordingly for their water use.
    - Incorporation of the MWELO reference in CALGreen has increased implementation and reporting on MWELO.

- California's graywater code (Chapter 15 of the California Plumbing Code [CPC]) allows washing machine greywater systems to be constructed without a permit in single family homes subject to specific guidelines for using graywater in irrigating landscapes. This reduces the amount of clean, potable water used for landscapes.
- Emergency regulations to eliminate water waste were adopted in 2021, when Governor Newsom proclaimed a drought state of emergency for all counties in California, urging Californians to step up their water conservation efforts and encouraging the State Water Board to prohibit certain wasteful water uses. The State Water Board adopted two (emergency) regulations in 2022 in response to the proclamation. Although these regulatory prohibitions were intended for limited time to address the drought emergency, they are practices that the water suppliers may encourage and promote in the future, as appropriate, to conserve water.
    - Prohibition of certain specific wasteful water uses (CCR Sections 995 and 996). These prohibitions, which apply to all Californians, were effective until January 2023.
    - Urban water suppliers were required to implement Water Shortage Level 2 demand reduction actions and, if needed, exercise authority to adopt more stringent local conservation measures. This requirement expired in June 2022.

Available Technologies

Advancements in water efficiency technologies can help address ongoing water supply challenges. Innovative technologies can offer great potential for increasing water use efficiency, but they often come with a high initial cost, general lack of awareness about the technology, and may only apply to unique situations or a specific class of customers. There may be high costs associated with the research, development, and implementation of new water efficiency technologies which can lead to limited adoption until economies of scale are reached resulting in decreased cost and increased availability.

Understanding of water efficiency practices constantly evolves. What was once considered an effective technology may, over time with more knowledge and understanding, find that there are limitations or unintended consequences. As more research is conducted and data are gathered, insights are gained into the effectiveness or inefficiencies of new technologies and practices. For example, outdoor irrigation technology has evolved from sprinklers to more efficient spray

heads, microsprays, and drip irrigation that increase water use efficiency and are often used in combination with other technologies such as automatic irrigation controllers. The scientific community, businesses, interested parties, and policymakers work together to identify and address these shortcomings. This ongoing process of evaluation and adaptation allows for refinement of strategies and adoption of more effective and sustainable water use efficiency technologies and practices.

Emerging Technologies and Solutions

New technologies are in constant development for improving urban water use efficiency. These include technologies such as fixture and appliance improvements, water-efficient standardization, and labeling (e.g., WaterSense-labeled irrigation system components and appliances); development and availability of low-water turf varieties; improved technologies for irrigation scheduling, such as irrigation apps for mobile devices; improved leak detection through universal adoption of Advanced Metering Infrastructure which allows water meters to be read remotely; water use dashboards for customers; and others.

The State can assist urban water suppliers with improving local and regional water use efficiency through financial assistance for supplier or regional incentive programs, outreach, and education; as well as through direct State-level education, outreach, incentive, and research and development programs. Development of State or federal regulations and enforcement authorities can also encourage public adoption of water use efficiency practices.

Future Urban Water Use and New Standards

In 2018, landmark water conservation legislation was signed into law. Together, AB 1668 (Friedman) and SB 606 (Hertzberg) provide the basis for a new approach to encourage all Californians to use water wisely by implementing a water-budget based approach to water use efficiency. In 2019, DWR and the State Water Board published *Making Water Conservation a California Way of Life*. This framework established by the legislation is far-reaching for the urban and agricultural sectors of California and represents a major shift in focus. The framework is organized around four primary goals:

1. Use Water More Wisely.
2. Eliminate Water Waste.
3. Strengthen Local Drought Resilience.

4. Improve Agricultural Water Use Efficiency and Drought Planning (not addressed in this RMS).

This approach advances the State's goals of reducing annual water demand in towns and cities by at least 500,000 acre-feet by 2030, as called for in California's Water Supply Strategy, and to mitigate and adapt to climate change. Progress made in response to the first three goals of the 2018 legislation is summarized below.

Use Water More Wisely

Recommended Standards

The 2018 legislation directed DWR, in coordination with the State Water Board and with input from other interested parties, to develop recommended standards for efficient use of water by urban retail water suppliers. These recommendations have been submitted to the State Water Board for consideration and possible adoption. These standards are for:

- Outdoor residential use.
- Outdoor CII use with dedicated irrigation meters.

It also directed DWR and the State Water Board to establish performance measures for:

- CII water use.
- Bonus incentives for use of recycled water.
- Appropriate variances for unique uses of water that can have a material effect on water use of an urban retail water supplier.

DWR recommendations were submitted to the State Water Board on September 29, 2022, and are summarized in Tables 7a, 7b, and 7c. The recommendations will be considered by the State Water Board in setting the long-term urban water use efficiency requirements. After the State Water Board adopts its regulation and the water use efficiency standards and performance measures are approved, this RMS will be updated to reflect the adopted regulation requirements.

In accordance with the 2018 legislation, DWR and the State Water Board made joint recommendations to the Legislature. The recommendations on the indoor residential water use standard were enacted into law by the passage of SB 1157 (Hertzberg 2022). This legislation sets indoor residential water use efficiency standards as 55 gallons per capita per day (GPCD) from 2023 to 2025, 47 GPCD from

2025 to 2030, and 42 GPCD beginning in 2030. This indoor residential standard will be a part of the implementation of the 2018 legislation, described below in "Urban Water Use Objectives." This standard will be implemented by water suppliers as part of an overall service area water budget.

Expected Water Savings

The new indoor residential water use standard coupled with DWR's recommended standards, submitted to the State Water Board in September 2022 (found on DWR's Urban Water Use Efficiency Standards, Variances and Performance Measures webpage), would result in expected long-term water savings of approximately 450,000 acre-feet per year starting in 2030 if adopted by the State Water Board. These savings are enough to supply the annual indoor and outdoor water needs for approximately 1.6 million homes or 4.7 million residents.

In August 2022, Governor Newsom's California Water Supply Strategy (CWSS) outlined several actions, including urban water demand reduction, to adapt to rising temperatures. The water savings from implementation of the recommended standards will satisfy the demand reduction expected in the CWSS.

Table 7a DWR Urban Water Use Efficiency Recommendations to the State Water Resources Control Board (Urban Water Use Efficiency Standards)

Category	Standard in 2023	Standard in 2030
Outdoor residential: existing (new) landscape	0.80 (0.55) factor	0.63 (0.55 or as MWELO updated) factor
CII landscape DIM: existing (new)	0.80 (0.45) factor	0.63 (0.45 or as MWELO updated) factor

Table 7a Note: CII = commercial, industrial, and institutional, DIM = dedicated irrigation meters, MWELO = Model Water Efficient Landscape Ordinance

Table 7b DWR Urban Water Use Efficiency Recommendations to the State Water Resources Control Board (Other Urban Water Use Efficiency Recommendations)

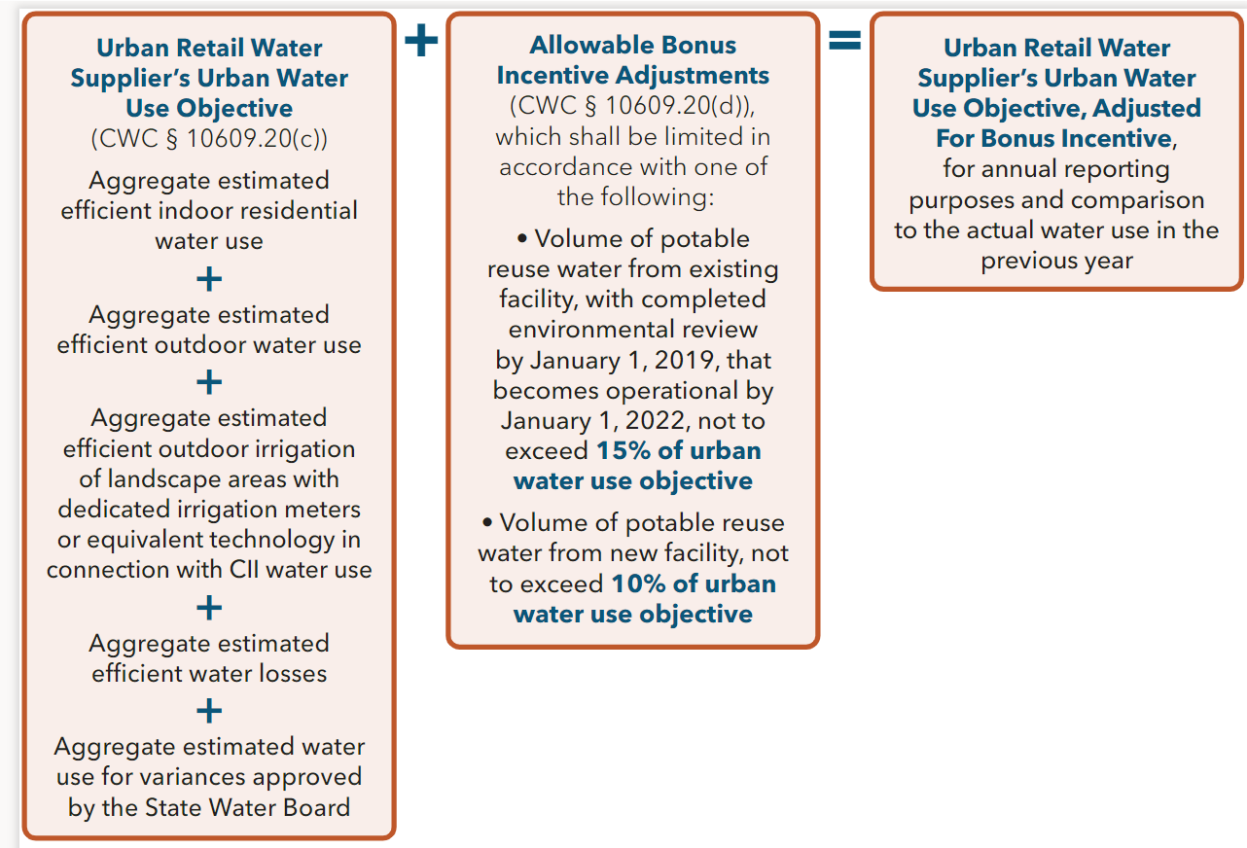
Category	Recommendation
Variances	DWR recommended appropriate variances for unique uses of water that could have a material effect on an urban retail water supplier's urban water use objective. *Summary of Recommendations for Variances*.
Bonus Incentives	Calculation methodologies to quantify bonus incentive based on delivery to eligible urban water use.

Urban Water Use Objectives

The 2018 legislation also requires urban retail water suppliers use the water use efficiency standards (including indoor residential, outdoor residential, outdoor CII landscapes with dedicated meters, and water loss standards) to calculate and report the following:

- Urban water use objectives (Figure 3).
- Actual water use in the previous year.
- Progress made in implementation of the CII performance measures following adoption by the State Water Board.

Figure 3 Calculation of the Urban Water Suppliers Urban Water Use Objective



Commercial, Industrial, and Institutional Sectors

Because of the recognized complexity and diversity in CII water use and necessity of maintaining economic productivity, except for the CII outdoor irrigation with dedicated meters, water use efficiency in the CII sectors is not based on standards or quantification of water use, but rather it is subject to compliance with "performance measures." *Performance measures* is defined as actions to be taken by urban retail water suppliers that will result in increased water use efficiency by CII water users.

Urban retail water suppliers must document implementation of the CII water use performance measures in their annual water use report to DWR. DWR recommendations transmitted to the State Water Board for adoption included the following CII performance measures:

- **CII Water Use Classification System**. Based on the evaluation of technical and financial feasibility and public feedback, DWR recommended a water use classification system that is water-centric with complete coverage of all CII water uses with 19 categories.
- **CII Conversion Threshold Performance Measure**. DWR recommended a minimum-size threshold for converting mixed-use CII meters to dedicated irrigation meters (DIM) (or equivalent technologies), or in-lieu technologies. DWR recommends a conversion threshold of one acre of landscape area irrigated by a mixed-use meter on a per parcel basis for converting to a DIM (or equivalent technology) or implementing in-lieu technologies.
- **Recommendations on Commercial, Industrial, and Institutional In-Lieu Technologies Performance Measure**. Related to the CII conversion threshold performance measure, is the performance measure for implementing technologies to be used in-lieu of requiring dedicated irrigation meters for those irrigated landscape areas served by mixed use meters that exceed the conversion threshold.
- **Recommendations on Commercial, Industrial, and Institutional Best Management Practices (BMP), Performance Measure, and Threshold for Implementation**. DWR recommends a performance measure requiring urban retail water suppliers to design a CII-BMP implementation program specific to their service area CII customers targeting water users that exceed the sector (classifications) and individual thresholds.

Table 7c DWR Urban Water Use Efficiency Recommendations to the State Water Resources Control Board (Urban Water Use Efficiency for CII Performance Measures)

Category	Details
CII Water Use Classification System	A water-centric system with 19 categories to cover all CII water use.
Dedicated Irrigation Meter Conversion Threshold	One acre on a per-parcel basis.

Category	Details
In-Lieu Technologies	Practices demonstrated to improve landscape water use efficiency such as: • Water budget-based rate structures. • Water budget-based management without a rate structure. • Hardware improvements with enhanced performance. • Remote sensing combined with other data and hardware improvements. • Landscape plant palette transformation programs.
CII Water User BMPs	Locally developed best management practices (BMP) implementation plan including the following types of BMPs: • Outreach, technical assistance, and education. Incentives. • Landscapes. Collaboration and coordination. • Operational. Threshold: at least the top 20% of CII water users (not including process water).
Guidelines and Methodologies	Calculation of water use objective (prior year: indoor efficient use, outdoor efficient use, CII dedicated irrigation meter efficient water use, efficient water loss, variances, bonus incentive, and actual water use) and annual report including progress on CII performance measures.

Table 7c Notes: BMP = best management practices, CII = commercial, industrial, and institutional, DWR = California Department of Water Resources

Eliminate Water Waste

Urban Retail Water Suppliers

The California Water Code requires the State Water Board to adopt standards for urban retail water loss no later than July 1, 2020. The formal rulemaking process ended, and the regulation was effective April 1, 2023. Suppliers must meet standards on January 1, 2028. Urban retail water suppliers were required, by July 1, 2021, to use the State Water Board's Water Loss Performance Standards Economic Model to calculate its water loss standards and include its compliance with water loss standards in its 2020 UWMP to DWR. This model calculates the urban retail water supplier's water loss performance standard based on an estimate of the economically feasible

level of water loss in 2028, assuming the urban retail water supplier undertakes a program of active leak detection and repair starting in 2022. Status of the water loss standards can be found on the State Water Board's Water Loss Control webpage.

Urban Wholesale Water Suppliers

The 2018 legislation required DWR and the State Water Board to recommend to the Legislature water-loss audit reporting for wholesale water suppliers. In response to the 2018 legislation, DWR conducted a study and developed recommendations to the Legislature on the wholesale urban water suppliers' water-loss audit reporting. DWR submitted a report to the Legislature in February 2020. DWR recommended that urban wholesale water suppliers submit an annual water loss audit report to DWR. DWR also recommended testing for meter accuracy, developing a reporting template, and offering training.

Strengthen Drought Resilience

Each urban wholesale and retail water supplier must prepare, adopt, and submit a water shortage contingency plan (WSCP) and conduct a drought risk assessment (DRA) every five years as a part of its urban water management plan (UWMP). Additionally, they are required to conduct an annual water supply and demand assessment.

The 2018 legislation requirements for drought resilience are effective beginning with 2020 UWMPs. Each urban wholesale and retail water supplier must prepare, adopt, and submit a WSCP and conduct a DRA every five years as a part of its UWMP. They are also required to conduct an annual water supply and demand assessment.

The WSCP describes the method, procedures, response actions, enforcement, and communications during six levels of water shortage conditions. The purpose of the WSCP is twofold. For water suppliers, a well-structured WSCP enables, (1) real-time water supply availability assessment and, (2) provides structured steps designed to respond to actual conditions and allow for efficient management of any shortage with predictability and accountability.

The DRA is to assess water supply reliability (or vulnerability) for a period of drought lasting five consecutive water years starting the year after the assessment is conducted. The DRA is to consider historical drought hydrology and reliability of each source of supply.

Required Elements of WSCP

Urban water suppliers must address 10 required elements in their WSCP. An urban water supplier can amend their WSCP in the interim of UWMP submission cycles without amending their UWMP, provided the adopted UWMP components still hold true.

Annual Water Supply and Demand Assessment

The 2018 legislation also required a report on the result of the suppliers' annual water supply and demand assessments (annual assessments). They are due to DWR every year by July 1. The annual assessments provide a mechanism for suppliers to demonstrate to the State that they have adequately developed and are following their locally adopted WSCP. As required by Water Code Section10632(a)(4), and to address potential near-term shortage, urban water suppliers are required to develop and implement, as part of their WSCP, appropriate shortage response actions that align with various shortage levels. When implemented correctly, this plan provides the supplier with the know-how to respond to varying degrees of anticipated shortage and to rebalance supply and demand to prevent the anticipated shortage from becoming a reality. During a drought emergency, Water Code Section 10632.3 directs the State Water Board to defer to the implementation of the locally adopted WSCPs, to the extent practicable. Urban water suppliers who do not submit annual assessments will not be eligible for any State grant or loan.

To support suppliers' annual assessments, DWR has provided resources and technical assistance including a guidance document, worksheets and reporting tables, an online submittal portal, and a dedicated email address for technical assistance.

4. Small Water Suppliers and Rural Communities

The Urban Water Use Efficiency RMS has historically addressed the urban water suppliers water use and efficiency issues. In this RMS, small water systems, domestic wells, and rural communities have been incorporated. Because of their importance, DWR may consider developing an RMS for small water systems, domestic wells, and rural communities in California Water Plan Update 2028.

Legislation in 2018 directed DWR, in consultation with the State Water Board and interested parties, to develop recommendations and guidance to address the planning needs of small water suppliers and rural communities (see "Water System Definitions" section) through the development and implementation of countywide drought and water shortage contingency plans.

In coordination with multiple State agencies and vetted through an extensive public process, DWR developed recommendations submitted in 2021 to the Legislature that would allow small water suppliers and rural communities to meet their drought and water shortage planning needs (see DWR's Countywide Drought and Water Shortage Contingency Plans webpage). These recommendations became the basis of Senate Bill 552 of 2021 (Water Code Section 10609.80) that was signed by Governor Newsom in September 2021.

As stated in this new section of the Water Code, State and local governments will share the responsibility in preparing and acting in the case of a water shortage event. These new requirements are expected to improve the ability of Californians to manage future droughts and help prevent catastrophic climate change effects on drinking water for vulnerable communities. The legislation outlines the new requirements for small water suppliers, county governments, DWR, and the State Water Board to implement more proactive drought planning and be better prepared for future water shortage events or dry years.

SB 552 Accomplishments

Counties

The counties are required to create a standing county drought and water shortage task force (or similar alternative) for state small water systems (see "Water System

Definitions" section) and domestic wells, and to develop a county drought resilience plan (including a drought risk assessment) for state small water systems and domestic wells in the county. DWR, in coordination with the State Water Board, California Office of Emergency Services (CalOES), and the Governor's Office of Planning and Research, has developed a guidebook for counties on how to develop a task force and implement the planning elements of SB 552. DWR has also developed a funding program to assist counties through non-competitive planning grants and direct planning assistance with their task forces and plan development.

Small Water Suppliers

The small water suppliers are required to develop abridged water shortage contingency plans (WSCP) or a drought element of an emergency plan, comply with new drought resilience standards, and report more information to the State Water Board. To support these suppliers, DWR and the State Water Board developed templates for the WSCP, one for the suppliers serving more than 1,000 connections, and a separate tailored version for schools. The first WSCPs were due July 1, 2023, for suppliers serving 1,000 to 2,999 connections. They must be updated every five years.

Water Shortage Vulnerability Explorer Tool

DWR developed an online tool to help counties, small water suppliers, and other interested parties explore the relative risks for drought and water shortage for domestic wells and state small water systems. The Water Shortage Vulnerability Scoring and Tool is designed to assist counties as they conduct the newly required drought risk assessments for domestic wells and state small water systems. This tool factors in physical and social vulnerabilities. The social vulnerability component includes a combination of income and socio-economic characteristics, household composition and language, housing, and transportation, thereby incorporating the equity goals of the State.

In a separate tool and analysis focused on public water systems, DWR provides an assessment of water shortage vulnerability of small community water systems and non-transient non-community water systems that serve schools. This tool is being updated regularly and is conducted in coordination with the State Water Board's Safe and Affordable Funding for Equity and Resilience (SAFER) needs assessment.

Emergency Relief Resources

SB 552 also requires the State Water Board to provide communication to counties about water hauling and other emergency relief resources. The State Water Board has been supporting this effort as part of its Countywide and Regional Assistance program.

Task Force

Additionally, SB 552 directs DWR to establish an interagency drought and water shortage task force to facilitate proactive State planning and coordination, for pre-drought planning and post-drought emergency response. The task force, Drought Resilience Interagency and Partners (DRIP) Collaborative was established in March 2023 and is composed of eight State agency leaders and 18 non-state agency members. The task force held its first meeting in April 2023 with a schedule of three meetings per year.

Water System Definitions

Public water system: A system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily for at least 60 days out of the year (Health and Safety Code Section 116275[h]).

Rural community: A community with fewer than 15 service connections or regularly serving fewer than 25 individuals daily at least 60 days out of the year, including domestic wells (Water Code Section10609.51[j]). In other words, rural community in this law covers all water systems or domestic wells for human consumption that are not a public water system.

Small water supplier: A community water system serving 15 to 2,999 service connections, and that provides less than 3,000 acre-feet of water annually (Water Code Section10609.51[k]). It considers several categories of small water suppliers: those suppliers with less than 1,000 connections; those with 1,000 to 2,999 connections; and non-transient, non-community water systems that service schools.

State small water system: A system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year as defined in Section 116275(n) of the Health and Safety Code (Water Code Section 10609.51[m]).

Urban water supplier: Water suppliers providing water to more than 3,000 connections, or delivering more than 3,000 acre-feet of water annually, are considered urban water suppliers and are subject to the Urban Water Management Planning Act (Water Code Section10610 et seq.) and other requirements. Water suppliers that comply with the Urban Water Management Planning Act, either as a requirement or voluntarily, are exempt from the previously stated requirements of SB 552.

5. Climate Change

Urban water suppliers and water users are particularly vulnerable to changes in climate because they require reliable water supplies to meet current and future demands from an increasing population. While some agricultural water users may be able to temporarily reduce water use by fallowing land or changing cropping patterns, urban water uses tend to have much less flexibility. Urban water use efficiency provides a key strategy for addressing these vulnerabilities.

Key impacts of climate change that relate to urban water supplies include:

- Warming temperatures leading to increases in water usage, particularly for outdoor irrigation.
- Decreasing snowfall and reduction in the natural water storage found in the Sierra Nevada snowpack.
- Precipitation shifting from snow to rain in a warmer climate, requiring a change in water supply management.
- Rising sea levels:
    - Increasing vulnerability of flooding and damage to water supply infrastructure in coastal communities.
    - Increasing seawater intrusion into coastal freshwater aquifers.
    - Reducing water exports from the Delta.
- Increasing frequency of floods, droughts, and wildfires damaging watersheds that provide water to urban communities.

To help address these climate-related challenges, State and federal agencies have developed several programs that provide guidance and information to urban water suppliers. In 2011, DWR, the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers, and the Resources Legacy Fund cooperatively developed the *Climate Change Handbook for Regional Water Planning* , which provides a comprehensive resource for regional water managers and includes information that will also be useful to urban water managers. The EPA also developed the Creating Resilient Water Utilities program which provides guidance and tools specifically for water utilities, such as urban water providers, to incorporate climate change into their planning and operations.

Adaptation

Water conservation and water use efficiency are considered primary climate change adaptation strategies – those that should be undertaken first because they are generally lower-cost and provide multiple benefits. By implementing practices that make the most of available water supplies, practices that reduce waste and increase efficiency, the urban water use sector will be better equipped to adapt to potential reductions in water supply.

Mitigation

Supplying and treating water for urban use requires a high amount of energy, which in turn contributes to greenhouse gas emissions and climate change. Reducing the amount of water used in the urban setting reduces the energy used, thus mitigating impacts of climate change. Urban water use efficiency is a mitigation measure and an adaptation measure for climate change.

Energy is used to transport, pump, heat, cool, treat, and recycle water. And water is used to generate hydroelectricity and to cool power plants.

According to the report, *California's Water-Energy Relationship* (California Energy Commission 2005), water-related energy use consumes approximately 19 percent of California's electricity, 88 billion gallons of diesel fuel, and 30 percent of non-power-plant natural gas, which together equate to approximately 12 percent of total statewide energy use. Urban and industrial water use, including conveyance, treatment, distribution, and end uses, account for approximately 11 percent of statewide energy use, the other 1 percent being related to agricultural water use.

When water is used efficiently, there is a corresponding savings in energy. Also, because most energy production creates greenhouse gases that contribute to climate change, water use efficiency is a method for mitigating climate change.

In 2004, California Urban Water Conservation Council members who implemented the council's best management practices reported saving 27 billion gallons of water. This significant water savings also saved more than 234 million kilowatt-hours of electricity and an estimated $200 million in energy costs.

6. Potential Costs and Implementation Challenges

Increasing the water supply has the same effect on water availability as decreasing the demand for water (through increased efficiency). But historically reliable methods for increasing supply, such as building new dams for surface storage, or increasing water exports from the Delta, are less certain as California moves into the future. Many water suppliers are turning to other strategies, such as improving efficiency, to meet increasing demand. And as the costs for increasing water supply go up, even the more expensive conservation strategies may become economically viable in the future.

Costs of Implementation

The cost of implementing the long-term water use efficiency and drought planning has not been quantified. After the State Water Board adopts its regulations and the water use efficiency standards, CII performance measures, and other requirements are finalized, this RMS will be updated and will include the costs of implementing the new requirements. It is expected that implementation of the 2018 legislation requirements will result in new costs for urban water suppliers with a potentially heavier burden on lower-income communities. There are also non-quantifiable costs associated with behavior changes needed to reduce water use by customers and the potential for non-monetary costs and indirect monetary costs (e.g., changes that can create new power usage or adverse public health impact).

Major Implementation Challenges

Rate Structures Limitations

Some of the limitations for public water suppliers include constraints in subsidizing assistance and passing on overall costs for compliance to ratepayers, as well as reduced revenue from reduced water use.

Public Awareness and Water User Behavior

Customer participation is the key to successful water use efficiency programs. A sustained statewide education campaign is needed to help educate water users and increase awareness of meaningful actions that will use water more efficiently and save

water; the State, in partnership with local agencies, can be more effective than local agencies alone.

Landscape Area Measurement for Water Budgets

Estimating the efficient outdoor water use budget can be used to assess whether landscapes are being watered efficiently. The outdoor standards in the urban water use objective will be used to determine the budget for efficient outdoor residential and CII landscapes with dedicated meters. A big challenge is knowing the landscape area, which is critical to developing the water budget.

While DWR has quantified the residential landscape areas for the urban retail water suppliers using aerial images from the period of 2017–2019, future landscape area measurement is still needed for long-term implementation of the outdoor residential water use standard and resulting outdoor residential water use budget. Additionally, many water suppliers have not measured the CII landscape area in their service area and, as a result, cannot adequately budget for these spaces. Landscape areas for CII landscapes with dedicated meters is needed for implementation of the CII long-term outdoor standard. Measured area for landscapes with mixed use meters remains important for calculating efficient water use budgets as a best management practice and is needed to determine if the landscape is subject to CII performance measures.

Impediments to measuring or estimating landscape area include insufficient financial, technical, and personnel resources. A high degree of financial and personnel resources would be required to physically measure sites or to purchase and analyze satellite imagery. Many water suppliers do not have technical expertise to analyze available satellite data, and, in some cases, satellite data are hard to interpret. Managing CII landscape irrigation efficiently using water budgets is further complicated by the difficulty in segregating areas served by multiple meters and linking the landscape areas and parcels with customer data.

Capacity of Qualified Landscape Professionals

Design, construction, and long-term maintenance of water efficient landscapes requires expertise. Currently, there is an insufficient number of landscape professionals who have the expertise to design, construct, and maintain water efficient landscape. Many landscapers hired by customers have limited training in managing landscapes with water efficient plant types and making sure the irrigation systems are maintained. Landscapers and customers are also often unaware of how to schedule irrigation or program irrigation controllers for efficient water use.

Inconsistent Implementation of the Model Water Efficient Landscape Ordinance

Compliance with the Model Water Efficient Landscape Ordinance (MWELO) is required on any new landscape project that exceeds 500 square feet or any rehabilitated landscape areas more than 2,500 square feet, which requires a permit, plan check, or design review. But, statewide, the local agency enforcement of the ordinance is inconsistent. DWR and the University of California, Davis, conducted a survey of local agencies to identify the barriers to MWELO implementation. The survey found that local agencies are challenged by the complexity of landscape and irrigation design requirements as well as lack of staff to review and inspect landscape. Additionally, MWELO implementation and enforcement is required of local agencies, but those agencies are often under the incorrect assumption that implementation is the responsibility of water suppliers.

Current Plumbing Code Enforcement on Sale and Resale

Current plumbing code requires efficient faucets and toilets in all residential and CII buildings. For new construction, this requirement is enforced by way of building inspections, but, for existing buildings, compliance enforcement is often limited to self-certification when a property is sold and may be inconsistently applied.

Inadequate Technical and Financial Resources

Local agencies and water suppliers are often faced with limited technical and financial resources to incentivize implementation of water use efficiency measures by their customers.

Costs If Not Implemented

Water conservation is imperative given continued climate change aridification and increasing population (California for All et al. 2022). As water supplies become more limited and water demands increase because of hotter and drier conditions, the cost of water will increase as will the risk to human health and safety because of diminished supplies and supply reliability. Recent droughts have made evident that some communities run out of water during drought conditions and are on the brink of running out of water long-term.

Water use efficiency and management planning stretches limited water resources that are only going to be more limited in the future. Already, water use efficiency, management, and planning has reduced per person water use by approximately

30 percent since 2010 (Figure 1). But, without implementation of recommendations in this RMS, more communities in California are likely to be vulnerable to water shortages requiring expensive water hauling or other emergency actions. Additionally, costs will likely rise and water affordability, especially for more vulnerable populations, will become unsupportable; customer water bills have increased by 42 to 47 percent in the past 20 years, particularly for those households served by smaller systems (Goddard, Ray, and Balazs 2021). Water rate increases cannot be eliminated with conservation because of the rising cost of operation and maintenance, and aging infrastructure, which must be addressed. Water use efficiency and water conservation are often cheaper solutions than developing new water supplies, and good planning and management can help mitigate water supply reliability vulnerabilities.

7. Recommendations

1. **Continue the Save Our Water Campaign**: DWR in partnership with the Governor's Office continue to lead efforts behind the statewide Save Our Water Campaign effort to further water conservation indoors and outdoors. As California prepares for a hotter and drier future, the Save Our Water Campaign is focused on engaging with the public through outreach activities and targeted marketing strategies to provide residents with conservation actions.
2. **Create Clearing Houses for Water Conservation Information and Assistance**: The State should consider creating clearing houses of water conservation information on water savings of conservation actions and benefits of the actions taken by the urban water suppliers, as well as a place for customers to identify what technical and financial assistance programs are available to them.
3. **Promote Technologies and Equipment that Support End-User Demand Management**: Readily accessible data and information about customer's real-time indoor and outdoor water use is powerful and important for increasing awareness and for modifying customer water use behavior. For example, efficiencies can be improved using short-interval water use measurements such as Advanced Metering Infrastructure data coupled with analytics, cell phone apps, or dashboards for water use patterns and trends analysis accessible to the customers. Also, use of rain sensors, EPA WaterSense-labeled irrigation controllers, good irrigation management practices, leak detection and repair, and other technologies, have been demonstrated to have significant potential to reduce inefficient water use.
4. **Support Studies and Demonstrations for Turfgrass Innovation**: Turfgrass remains a large component of many landscapes. In some cases, this turfgrass serves only for decoration (non-functional). In other cases, this turfgrass supports an important recreational function (functional turf). Water conservation and water use efficiency improvements can be made in reducing the amount of non-functional turf and improving the efficiency of functional turf through innovative technologies such as new turfgrass species and improved irrigation.
5. **Increase Landscape Water Management Skills**: Water use efficiency is most easily achieved on landscapes with properly designed and installed irrigation systems and managed with water budgets. To make this possible, the Contractors State License Board should continue the emphasis and testing requirements in the C-27 Landscape Contractor's exam in the subject areas of

irrigation design and installation and water budgeting to ensure landscape professionals have the needed skills. Colleges and universities should consider adding more instruction on efficient irrigation practices and plant water use requirements to their curriculum for landscape architects and horticulture majors. DWR, water suppliers, and the landscape industry should also consider increasing opportunities to improve water management skills of non-English-speaking landscapers and landscapers who do not hold a contractor's license with added benefit of expanding work opportunities for the landscape professionals.

6. **Encourage Innovation in Efficient Irrigation Equipment Design That Increases Durability, Reliability, and Ease of Use**: The irrigation manufacturing industry should consider working with the landscape industry, universities, and other industries to develop irrigation equipment, sensors, and controllers that are more durable and easier to install, maintain, and program.
7. **Assist Urban Water Suppliers in Providing more Accurate and Consistent Estimates of Water Savings Attainable through Various Demand Management Measures for Use in WSCPs**: The State should consider providing resources to conduct studies for the development of technical-based metrics and guidance necessary for urban water suppliers to realistically estimate the effectiveness of various drought response actions. More accurate estimates allow suppliers to activate effective demand management actions during water shortages. Currently, many urban water suppliers, with similar geographic, hydrologic, and climatic conditions, have inconsistent water reduction values for the same actions.
8. **Assist Utilities in Developing Sustainable Conservation Rate Structures**: Conduct studies to analyze and evaluate the effectiveness of the rate structures in conserving water and meeting water supplier revenue requirements. These studies should be done in collaboration with entities such as DWR, the U.S. Bureau of Reclamation, the California Public Utilities Commission, California Water Efficiency Partnership (CalWEP), the Association of California Water Agencies (ACWA), the California Water Association, California Urban Water Agencies, and water suppliers. DWR should consider disseminating the findings and recommendations from the study, as well as guidance to water agencies, throughout the state by way of regional workshops and on DWR website. Proposition 218 (1996) should be considered in these studies.
9. **Assist Water Suppliers in Landscape Area Measurement**: The State should consider continuing landscape area measurement programs by incorporating advances in remote sensing technologies to provide updated landscape area

measurement data to the urban retail water suppliers every five years. Additionally, landscape measurements of functional and non-functional turf would enable local agencies and the State to better implement programs designed to improve water efficiency and conservation.

10. **Support Increased Implementation of the Model Water Efficient Landscape Ordinance**: The State should collaborate with local agency advocacy groups such as California League of Cities, California Association of Counties, Strategic Growth Council, California Building Officials, and others, to improve coordination with local agencies about MWELO and MWELO implementation.

    The State should also consider collaborating with landscape industry groups, such as the California Landscape Contractors Association, Irrigation Association, American Society of Landscape Architects, Association of Professional Landscape Designers, and others, to improve coordination with landscape professionals about MWELO and MWELO implementation.

    The State should consider providing resources to conduct studies that demonstrate the effectiveness of MWELO in the design, installation, and management of water efficient landscapes. These studies should be done in collaboration with entities such as DWR, local agencies, local water suppliers, researchers, the landscape industry, and other interested parties.

8. References

American Water Works Association. 2014. M36: Water Audits and Loss Control Programs. Third Edition. Denver (CO).

Hanak E. and Davis M. 2006. "Lawns and Water Demand in California." California Economic Policy 2(2). Public Policy Institute of California.

California for All, California Natural Resources Agency, California Department of Water Resources, State Water Resources Control Board, California Environmental Protection Agency, California Department of Food and Agriculture, 2022. *California's Water Supply Strategy. Adapting to a Hotter, Drier Future*. 2022. Viewed online at: https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf. Accessed: July 14, 2023.

California Department of Water Resources. 2020. *California's Most Significant Droughts: Comparing Historical and Recent Conditions.* Sacramento (CA). Viewed online at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Drought-Mitigation/Files/Publications-And-Reports/CalSigDroughts19_v9_ay11.pdf. Accessed: September 28, 2023.

California Department of Water Resources. California Water Plan Update 2023 Sacramento (CA): California Department of Water Resources. Viewed online at: https://resources.ca.gov/Home/Programs/California-Water-Plan/Update-2023. Accessed: September 26, 2023.

City of Sacramento. Water Meters. City of Sacramento. Website. Viewed online at https://www.cityofsacramento.org/Utilities/Water/Conservation/Water-Wise-Tools/Water-Meters. Accessed: June 13, 2023.

Flume Inc. and Water DM 2021. *MWDOC 2020 Residential Water Use Study Revision 2. 71 Pages.* Prepared for Municipal Water District of Orange County (MWDOC). Viewed online at: https://www.mwdoc.com/wp-content/uploads/2021/10/MWDOC-2020-Water-Use-Study.pdf. Accessed: June 2, 2023.

Goddard, J. J., Ray, I., and Balazs, C. 2021. "Water affordability and human right to water implications in California." PLOS ONE: Section 6 Discussion and conclusion. [Website] Viewed online at: https://doi.org/10.1371/journal.pone.0245237. Accessed: July 13, 2023

Guerrero, Krista. Water Efficiency Team Metropolitan Water District of Southern California. Email communication June 18, 2023. With Gwen Huff, Senior Environmental Scientist, Department of Water Resources.

Leakage Emissions Initiative 2023. *Establishing a Standard Carbon Balance for Drinking Water Utilities*. Leakage Emissions Initiative Collaborative.12 pages. Viewed online at: https://www.leigroup.org/_files/ugd/997569_664e07b7afc84ab79a7f1561288f5ea8.pdf. Accessed: June 2, 2023.

Nordlie, Claire. Water Use Efficiency Coordinator, City of Santa Rosa. Email communication June 20, 2023, with Gwen Huff, Senior Environmental Scientist, Department of Water Resources.

San Francisco Public Utilities Commission 2021. 2020 Retail Water Conservation Plan. San Francisco, CA: 217 pages Viewed online at: https://www.cityofsacramento.org/Utilities/Water/Conservation/Water-Wise-Tools/Water-Meters. Accessed: June 13, 2023

Stricklin, Jennifer, Senior Engineer, Senior Environmental Scientist, Department of Water Resources. Email communication June 14, 2023, with Gwen Huff, Department of Water Resources.

9. Useful Web Links

American Water Works Association manual M36: Water Audits and Loss Control Programs guidebook
https://www.awwa.org/Portals/0/files/publications/documents/M36LookInside.pdf

California Irrigation Management System
https://cimis.water.ca.gov

California's Most Significant Droughts: Comparing Historical and Recent Conditions
https://water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Drought-Mitigation/Files/Publications-And-Reports/CalSigDroughts19_v9_ay11.pdf

California's Water-Energy Relationship
https://cawaterlibrary.net/document/californias-water-energy-relationship/

California Water Code Section 10608.34 (requires the State Water Board to develop water loss performance standards for urban retail water suppliers)
https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=WAT&sectionNum=10608.34

Climate Change Handbook for Regional Water Planning
https://www.epa.gov/sites/default/files/2021-03/documents/climate_change_handbook_regional_water_planning.pdf

Climate Resilient Water Program
https://www.epa.gov/crwu

DWR's Annual Water Supply and Demand Assessment webpage
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Water-Supply-and-Demand-Assessment

DWR's Countywide Drought and Water Shortage Contingency Plans webpage
https://water.ca.gov/Programs/Water-Use-And-Efficiency/2018-Water-Conservation-Legislation/County-Drought-Planning

DWR's Model Water Efficient Landscape Ordinance webpage
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance

DWR's Urban Water Loss webpage
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Validated-Water-Loss-Reporting

DWR's Urban Water Management Plans webpage
https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans

DWR's Water Use Efficiency webpage
https://water.ca.gov/Programs/Water-Use-And-Efficiency

DWR's Urban Water Use Efficiency Standards, Variances and Performance Measures webpage
https://water.ca.gov/Programs/Water-Use-And-Efficiency/2018-Water-Conservation-Legislation/Urban-Water-Use-Efficiency-Standards-Variances-and-Performance-Measures

Making Water Conservation a California Way of Life
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Make-Water-Conservation-A-California-Way-of-Life/Files/PDFs/Final-WCL-Primer.pdf?la=en&hash=B442FD7A34349FA91DA5CDEFC47134EA38ABF209

Recommendations for Urban Wholesale Distribution Systems Water-Loss Audit Reporting
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Validated-Water-Loss-Reporting/Final-of-Wholesale-Water-Loss-Legislative-Report_Feb-18-2020_a.pdf

Safe and Affordable Funding for Equity and Resilience
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/safer.html

Save Our Water
https://saveourwater.com/

Urban Water Management Plan Guidebook 2020
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans/Final-2020-UWMP-Guidebook/UWMP-Guidebook-2020---Final-032921.pdf

Water Shortage Vulnerability Scoring and Tool
https://water.ca.gov/Programs/Water-Use-And-Efficiency/SB-552/SB-552-Tool

Water Use Efficiency Data portal
https://wuedata.water.ca.gov


DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA