BAWSCA
Bay Area Water Supply & Conservation Agency

Bay Area Water Supply & Conservation Agency's Regional Water Demand and Conservation Projections

FINAL

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WESTERN POLICY RESEARCH

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ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS AND ACRONYMS

2014 Project	2014 BAWSCA Regional Water Demand and Conservation Projections
AB	Assembly Bill
ABAG	Association of Bay Area Governments
acct	Account
AF	acre-feet
AFY	acre-feet per year
AMI	Advanced Metering Infrastructure
AWWA	American Water Works Association
AWWARF	American Water Works Association Research Foundation
BAM	Bay Area Management
BAWSCA	Bay Area Water Supply and Conservation Agency
BC	Brown and Caldwell
CalWEP	California Water Efficiency Partnership
CEC	California Energy Commission
COM	Commercial
CI	Commercial Institutional
CII	Commercial, Industrial, and Institutional
CUWCC	California Urban Water Conservation Council
CWS	California Water Service
DOF	Department of Finance
DSS Model	Demand Side Management Least Cost Planning Decision Support System
DWR	California Department of Water Resources
EO	Executive Order
ETo	Evapotranspiration
GPCD	gallons per capita per day
gpd	gallons per day
gpf	gallons per flush
gpm	gallons per minute
GVMID	Guadalupe Valley Municipal Improvement District
HET	high efficiency toilet
HEU	high efficiency urinal
HEW	high efficiency commercial washer
ILI	Infrastructure Leakage Index
INS	institutional
IPCC	International Panel on Climate Change
IRR	irrigation
MAF	million acre-feet
MF	multifamily
MID	Municipal Improvement District
MUR	Multi-Unit Residential
MWELO	Model Water Efficient Landscape Ordinance
MWM	Maddaus Water Management
N/A	not applicable
NOAA	National Oceanic and Atmospheric Administration
NRW	non-revenue water
OTH	Other
PPIC	Public Policy Institute of California
psi	pounds per square inch
R-GPCD	Residential gallons per capita per day
R^2	R-Squared
RCP	Representative Concentration Pathways
SB	Senate Bill
SB X7-7	Water Conservation Act of 2009
SF	Single Family
SFPUC	San Francisco Public Utilities Commission
SFR	Single Family Residential
SWP	State Water Project
SWRCB	State Water Resources Control Board
TM	technical memorandum
ULFT	ultra-low flush toilet
UWMP	Urban Water Management Plan
Valley Water	Santa Clara Valley Water District
WCDB	Water Conservation Database
WCIP	Water Conservation Implementation Plan
WSA	Water Supply Assessment
WUE	Water Use Efficiency

EXECUTIVE SUMMARY

The Regional Water Demand and Conservation Projections Project (Demand Study) developed water demand and conservation projections through 2045 for each Bay Area Water Supply and Conservation Agency (BAWSCA) member agency and the region overall. The purpose of the Demand Study is to provide valuable insights on long-term water demand patterns and conservation savings potential for the BAWSCA agencies to support regional efforts, such as implementation of BAWSCA's Long-Term Reliable Water Supply Strategy. In addition, the intent of the Demand Study is to provide necessary information to support individual agency efforts, such as compliance with the new state water efficiency requirements and completion of Urban Water Management Plans (UWMPs). The results will support agencies in preparing to comply with new statewide water use efficiency requirements as required by Assembly Bill (AB) 1668 and Senate Bill (SB) 606 (herein collectively referred to as "legislation"[1]).

Background

BAWSCA actively works with its member agencies to develop comprehensive water demand projections for the region. Most recently, in 2014, BAWSCA completed the *BAWSCA Regional Water Demand and Conservation Projections* report (2014 Project) to support the development of its Long-Term Reliable Water Supply Strategy. The 2014 Project developed long-term demand projections through 2040 as well as short-term demand projections accounting for rebound in water demand associated with economic recovery from the 2008-2013 recession.

After the 2014 Project completion, the local Bay Area economy continued to recover. However, beginning in 2014, the state experienced a major drought that significantly decreased water demand for all BAWSCA member agencies. The impact of the drought reduced overall water use among the BAWSCA agencies by 27% below 2013 demand levels in 2015, the worst year of the drought. BAWSCA initiated the Demand Study in January 2019 to update water demand and conservation projections for each BAWSCA agency given the significant change in conditions following the 2014 Project. The results of the Demand Study will be used to support the 2020 Urban Water Management Plans through the 25-year planning horizon, considering the impacts of the recent drought on short-term and long-term water demand and BAWSCA's Long-Term Reliable Water Supply Strategy implementation.

The Demand Study was completed as a collaborative effort between the BAWSCA and its BAWSCA member agencies. Valley Water also provided input on assumptions associated with the conservation analysis, given its role as the wholesale water agency to eight of the BAWSCA member agencies in Santa Clara County. In addition, an external Stakeholder Workgroup consisting of representatives from 5 organizations and entities provided feedback on the conservation measure selection and analysis components of the Demand Study. Over the course of the Demand Study, input was solicited from the aforementioned groups through multiple forums, including workshops, stakeholder engagement, one-on-one communication, and web-based meetings.

Demand and Conservation Projections Development Process

The Demand Side Management Least Cost Planning Decision Support System (DSS Model), in combination with an Econometric Model, was used to determine short-term and long-term demand projections for each BAWSCA agency. The Econometric Model projected short-term demands (through 2025) based upon historical water use patterns and the projected future rebound in water demand associated with forecasts for drought recovery. The

[1] An AB 1668/SB 606 primer document explaining the legislation is available on the Department of Water Resources website: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Make-Water-Conservation-A-California-Way-of-Life/

DSS Model projected long-term demand (through 2045) based upon expected service area growth for both population and employment.

The data collection for this Demand Study was conducted through the use of a Data Collection and Verification File (Data Workbook), a quantitative data intensive multi-spreadsheet MS Excel file. This workbook was an update to the Data Collection and Verification File developed during the 2014 Project. The data collected included monthly water demand and water conservation from 1995 through 2018, unemployment, water rates, historical conservation and more items as described in Section 2.

Service Area Population and Employment Growth Projections

The total BAWSCA service area population and employment projections are presented in Table ES-1. These projections are based upon each member agency's population and employment projections, using Association of Bay Area Governments (ABAG) Plan Bay Area 2040 data, including projections released in 2017, or other adopted data sources.

Table ES-1. Total BAWSCA Service Area Population and Employment Projections

	2020	2025	2030	2035	2040	2045
Population	1,858,392	1,941,725	2,032,304	2,187,849	2,311,562	2,438,515
Employment	1,156,613	1,209,770	1,270,096	1,329,806	1,379,449	1,430,112

Demand Projections

Demand forecasts were developed for each agency to account for conservation from passive (i.e., from codes/standards) and active conservation programs. Based upon this analysis, water demands are projected to increase 25% from 2020 to 2045 after accounting for the effects of the existing plumbing code, future active conservation savings, and climate change. These results are shown in Table ES-2. By comparison, the population and employment projections noted in Table ES-1 above show growth rates of 31% and 24% respectively between 2020 and 2045.

Table ES-2. Total BAWSCA Demand Projections

Demand Forecast (MGD)	2020	2025	2030	2035	2040	2045
Total Demand without Plumbing Code Savings	210.8	240.3	251.1	266.7	280.0	293.6
Total Demand with Plumbing Code Savings	205.6	228.9	234.3	244.3	253.1	262.4
Total Demand with Active Measure Savings	204.3	225.1	229.2	238.8	247.0	256.3

Note: Total water demand accounts for the total projected demand in a service area water system regardless of source, which could be from San Francisco Public Utilities Commission (SFPUC), groundwater, surface water, recycled water, desalination, State Water Project (SWP), or Valley Water.

Potential New Conservation Measures

Through this analysis, 24 conservation measures with high water savings potential and/or member agency interest were identified. BAWSCA further evaluated these measures for potential future implementation and incorporated feedback from a Stakeholder Workgroup feedback, including ideas for measure implementation and co-benefits described in Section 4. Implementation of these conservation measures, along with passive conservation, is anticipated to yield an additional 37.3 MGD of water savings by 2045 beyond what has already been achieved.

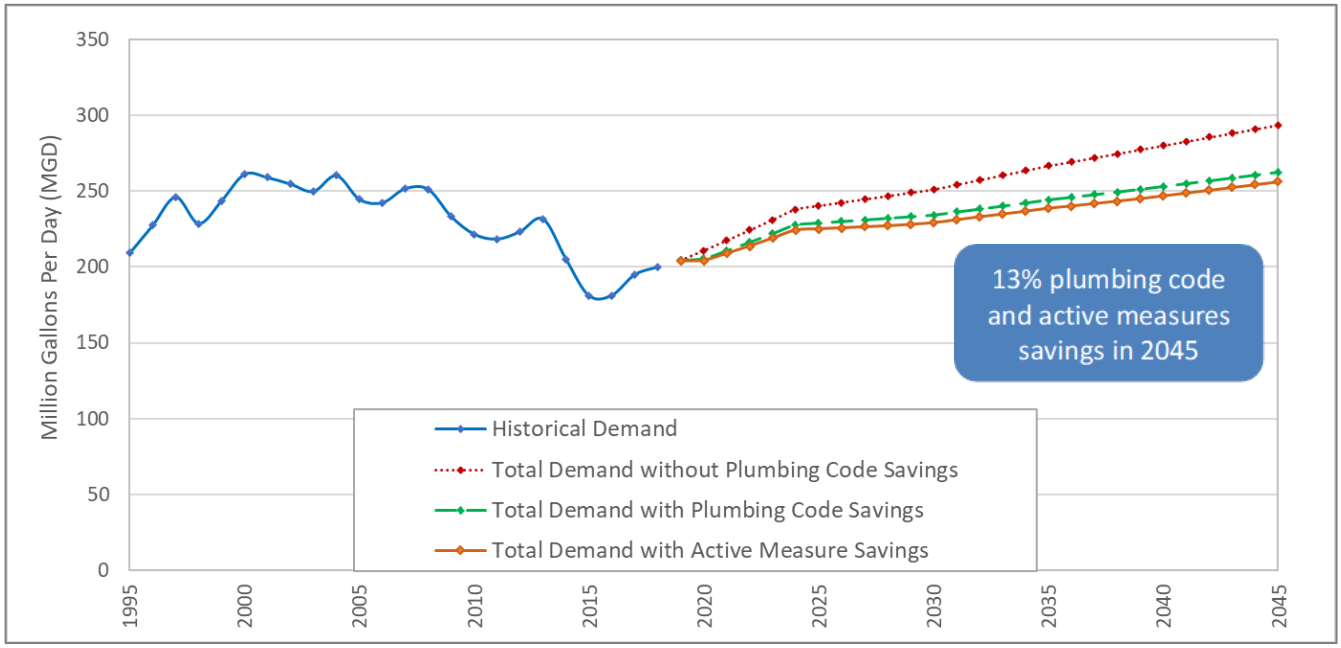
Figure ES-1. Potential Conservation Measures

BAWSCA Planned Conservation Measure Implementation

Measure Name	# of Agencies Planning to Implement
Commercial	
CII Water Survey	13
CII Water Efficient Technology (WET) Rebate	10
School Building Retrofit	6
Fixture Retrofit on Resale or Water Account Change (Commercial)	2
Irrigation	
Residential Outdoor Water Surveys	16
Large Landscape Outdoor Water Surveys	20
Large Landscape (Waterfluence) Program	14
Lawn Be Gone! and Rainwater Capture Rebates	19
Financial Incentives for Irrigation and Landscape Upgrades	14
Landscape Irrigation and Codes	10
Residential	
Residential Indoor Water Surveys	9
Residential Water-Savings Devices Giveaway	20
Flowmeter Rebate	7
Leak Repair and Plumbing Emergency Assistance	9
Multifamily HET Direct Install	2
Multifamily Submetering for Existing Accounts	5
New Development Submetering	8
New Development Hot Water On Demand	4
Low Impact New and Remodeled Development	3
Fixture Retrofit on Resale or Water Account Change (Residential)	2
Community & Education	
Public and School Education	22
Billing Report Educational Tool Non-AMI	10
AMI Customer Portal	14
System Water Loss	
Water Loss	20

Figure ES-2 presents the combined BAWSCA region-wide water demand projections with and without passive and active conservation. Total water demand is defined as total water consumption plus non-revenue water. Water consumption is defined as water delivered to individual customers for use. Figure ES-3 compares historical and projected water use and population. Figure ES-4 presents historical and projected gross per capita water use and residential per capita water use in the BAWSCA region through 2045.

Figure ES-2. BAWSCA Region-Wide Demands with Active Conservation Savings to 2045*



* *Water demands are based on data provided from 1995 through 2018. This analysis was completed before the COVID-19 pandemic and does not incorporate any of the new changes in water use profiles, population, employment, or vacancies as the data was not yet available and was outside the scope of the current project. However, it is recognized that the water demands may need review or modification depending on the impact of recent events.*

Figure ES-3. Historical and Projected Population and Demand

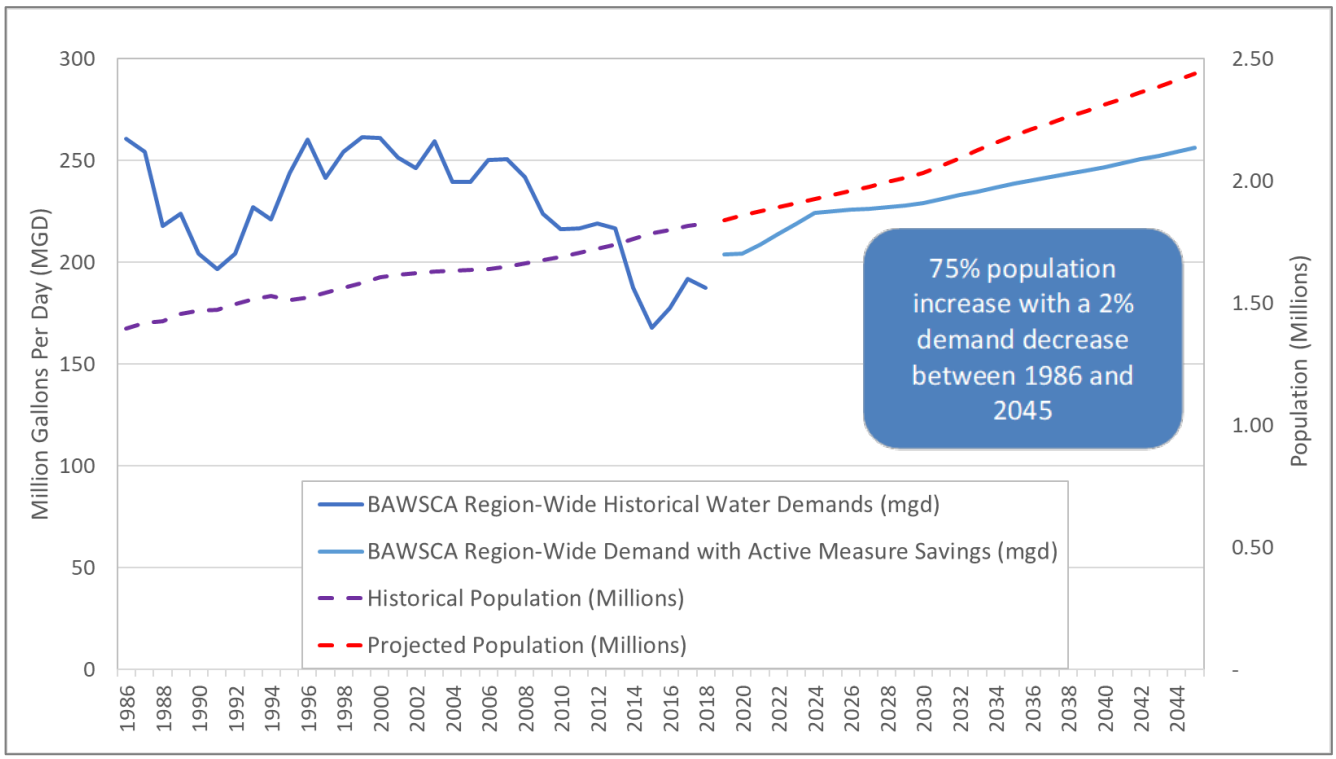
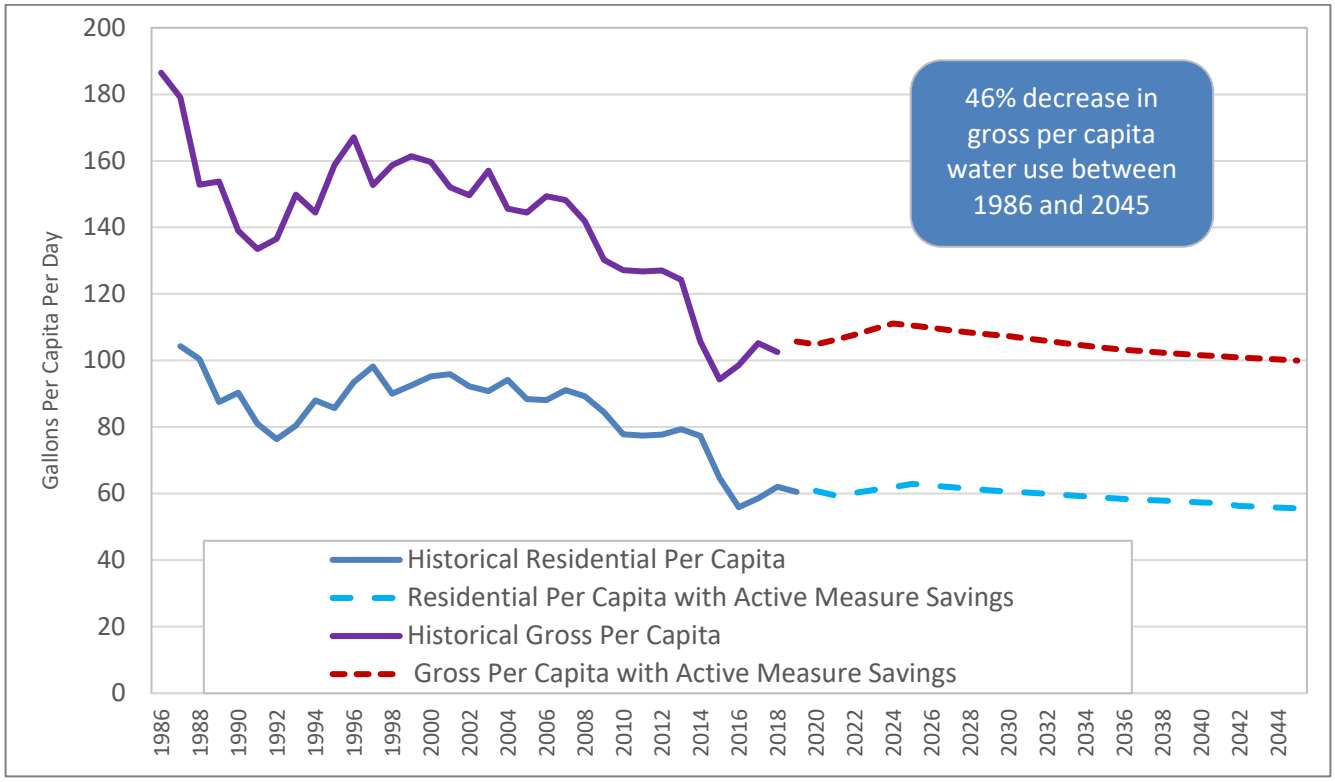


Figure ES-4. Gross and Residential Per Capita Water Use



Note: To be consistent with the BAWSCA methodology for the BAWSCA Annual Survey, recycled water has been removed from the per capita calculations. Therefore, the above information is a potable-only per capita value. Note that residential water use includes some irrigation as not all agencies have dedicated irrigation meters.

Recommendations and Next Steps

The majority of the BAWSCA member agencies meet the definition of an urban water supplier[2] and therefore are required to prepare 2020 UWMPs, which must be submitted to the California Department of Water Resources (DWR) by July 1, 2021. Member agencies may elect to utilize the demand and conservation savings projections developed through this Demand Study to support their UWMP development. Member agencies may also update the individual DSS Models for the upcoming UWMP submissions, if necessary, to incorporate new information for their respective service areas. It is anticipated that agencies will be formally adopting updated demand projections as part of the 2020 UWMP process.

California state laws, AB 1668 and SB 606, passed in May 2018, require each urban retail water supplier to calculate and report an urban water use objective no later than November 1, 2023, and by November 1 every year thereafter, and to compare its actual urban water use to the objective. The urban water use objectives will be calculated using individual efficiency standards set by the state for indoor residential water use, outdoor residential water use, dedicated irrigation, and water loss. In addition, the urban water suppliers may be required to implement specific performance measures for commercial, industrial and institutional (CII) water use. When more information on the state standards becomes available, BAWSCA and the member agencies may

[2] The requirements for UWMPs and definition of urban water supplier are found in two sections of the California Water Code, §10610-10656 and §10608. "Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually.

need to review demand projections and conservation targets to prepare for compliance with the urban water use objectives.

In addition, BAWSCA will work with the member agencies to further evaluate for regional implementation the identified conservation programs that have high water savings potential and agency interest. BAWSCA recognizes that actual implementation of water conservation is needed to achieve the identified water savings goals in support of member agencies meeting their future water use objectives. BAWSCA and its member agencies' conservation programs must be managed in concert with one another and in a very adaptive fashion. Small and large program changes will need to be made over time and, where applicable, to align with pending state regulations currently being developed in connection with AB 1668 and SB 606.

The Demand Study was initiated in January 2019 and was completed through June 2020. Given the project timeline, recent changes to water consumption patterns, population, employment, and vacancies due to the COVID-19 pandemic have not been incorporated into the analysis or demand projections. BAWSCA will continue to monitor the effects of COVID-19 response actions on water use within the region and may consider future updates to this study to reflect these changes.

1 INTRODUCTION

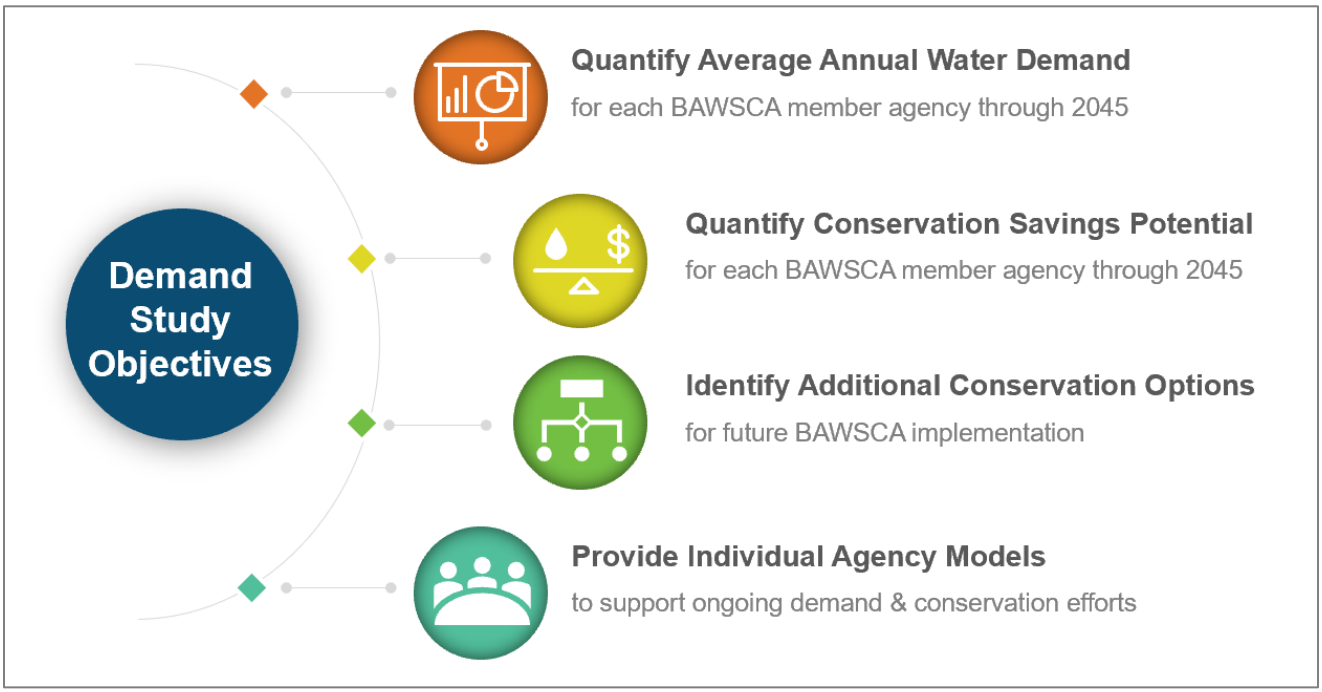
This Regional Water Demand and Conservation Projections Project (Demand Study) Final Report summarizes the water demand and conservation savings projections for each individual BAWSCA member agency and for the BAWSCA region as a whole.

1.1 Goals and Objectives

Recently, a substantial shift in the challenges and drivers for water management has occurred – in part because of the recent drought, water supply conditions, and the need to comply with pending water conservation regulations. This Demand Study will allow BAWSCA to implement additional water use conservation measures in line with current conditions regarding water sustainability and reliability. The Demand Study considers best management practices consistent with current regulations and best practices in the industry. It also considers the capabilities and practices of the BAWSCA agencies and how they may need to be further developed in relation to the new legislation.

The overall goal of the Demand Study was to develop transparent, defensible, and uniform demand and conservation projections for each BAWSCA member agency, using a common methodology that could be implemented to support regional planning efforts as well as individual agency work. Pursuant to this goal, specific objectives were developed as detailed in the following figure.

Figure 1-1. BAWSCA Demand Study Objectives



1.2 Approach and Methodology

To accomplish the above goal and objectives, each BAWSCA member agency's water demands and conservation savings were forecasted through 2045 using a combination of two different models – an Econometric Model and the DSS Model developed by Maddaus Water Management (MWM). The purpose of using two tools is to leverage the strengths of each tool to obtain the best forecast through 2045. The Econometric Modeling was initially done outside of the DSS Model then incorporated as a feature in each member agency's individual DSS Model.

Econometric Modeling is a statistical approach used to determine the impact of factors such as economic conditions, weather, rates, and conservation on water demands. The Econometric Model is used to project, based upon historical patterns, the future rebound in water demand associated with short term effects (i.e. economic recovery, drought conditions, etc.) while also taking into account other factors such as water rate increases and weather. The Econometric Model was used to forecast each agency's baseline demand through 2023.

The DSS Model prepares long-range, detailed water demand and conservation savings projections to enable a more accurate assessment of the impact of water efficiency programs on demand. The DSS Model can use either a statistical approach to forecast demands (e.g., an Econometric Model), or it can use forecasted increases in population and employment to evaluate future demands. Furthermore, the DSS Model evaluates conservation measures using benefit-cost analysis with the present value of the cost of water saved and benefit-to-cost ratio as economic indicators. The analysis is performed from various perspectives including the utility and community. The DSS Model also was used to forecast demands for the BAWSCA member agencies in prior planning efforts in 2004, 2009, and 2014.

1.3 Project Partners

The Demand Study was completed as a collaborative effort between BAWSCA staff, BAWSCA member agencies, and the Project Team, which was led by Maddaus Water Management in association with Brown and Caldwell and Western Policy Research. Over the course of the Demand Study, input was solicited from the aforementioned groups through multiple forums, including workshops, online surveys using SurveyMonkey, one-on-one communication, and web-based meetings.

Maddaus Water Management, BAWSCA staff, Valley Water, San Francisco Public Utilities Commission, and individual agencies collaborated to compile and review information, which led to the development of design parameters. Valley Water also provided input on assumptions associated with the conservation analysis, given its role as the wholesale water agency to eight of the BAWSCA member agencies located in Santa Clara County.

Each BAWSCA member agency held a critical role in the development of its individual demand and conservation projections. BAWSCA member agencies' roles in the Demand Study included the submission of technical information for use in individual agency DSS Models and the review and sign-off of interim work products. More details on the involvement of the member agencies in the completion of each Demand Study task are included in this report.

Stakeholder Workgroup

In addition to coordination with the BAWSCA agencies, BAWSCA formed a Stakeholder Workgroup to seek input from external stakeholders. Based on suggestions provided by the BAWSCA agencies, a total of twelve organizations were invited to participate in the Stakeholder Workgroup. Five organizations accepted the invitation to participate, including the Pacific Institute, San Mateo County Office of Sustainability, San Mateo Countywide Water Coordination Committee, Sustainable Silicon Valley, and the Tuolumne River Trust.

The Stakeholder Workgroup held two meetings in January and May 2020 to provide input on the conservation projections portion of the Demand Study. In particular, the Stakeholder Workgroup shared insights and perspectives on topics such as:

- Types of conservation measures BAWSCA should be considering for future implementation in the region;
- Co-benefits or secondary impacts some conservation measures have that should be considered in BAWSCA's implementation decisions;
- Opportunities for partnership and collaboration on water conservation initiatives;
- Ways to support social equity in the water conservation measure implementation; and
- New or innovative technologies to explore for conservation savings potential.

The stakeholder comments on multiple co-benefits of the conservation measures were considered during measure selection as described in Section 4.

1.4 Relationship to Other Planning Efforts

In September 2018, the BAWSCA Board unanimously approved the Strategic Plan Phase 1[3] recommendations, including the recommendation to update the water demand and conservation projections for the BAWSCA member agencies using a common methodology.

In addition to providing a critical input for the strategy, the updated demand estimates may be used by individual BAWSCA member agencies in the development of their 2020 Urban Water Management Plans.

Prior efforts have developed regional demand and conservation projections for the BAWSCA region using the DSS Model, including:

- San Francisco Public Utilities Commission *Wholesale Customer Water Demand Projections* (URS Corp. and MWM, 2004);
- San Francisco Public Utilities Commission *Wholesale Customer Water Conservation Potential* (URS Corp., MWM, Jordan Jones & Goulding, 2004);
- *Projected Water Usage for BAWSCA Agencies* (Brown and Caldwell [BC], MWM, 2006);
- *BAWSCA Water Conservation Implementation Plan* (MWM, BC, 2009); and
- *BAWSCA Regional Water Demand and Conservation Projections* (MWM, Western Policy Research, 2014).

These prior efforts proved to be a robust means to support environmental documents like the Water System Improvement Program – Program Environmental Impact Report [SFPUC, 2006]); member agency UWMPs; conservation planning (e.g., the BAWSCA Regional Water Conservation Program and development of the BAWSCA Water Conservation Database [WCDB]); and development and implementation of BAWSCA's Long-Term Reliable Water Supply Strategy.

[3] Maddaus Water Management et al. (2018). *Bay Area Water Supply and Conservation Agency's "Making Conservation A Way of Life" Strategic Plan – Phase 1*.

2 DATA COLLECTION AND VERIFICATION PROCESS

This section documents the data collection and verification process for the Demand Study, which was critical to the modeling process to ensure that the best available information was used to develop each member agency's water demand and conservation savings projections. Described herein are the types of data that were collected for the Demand Study and the steps taken to obtain and verify the data.

2.1 Preliminary Survey

In April 2019, the member agencies participated in a survey as part of their Data Workbook completion tasks. The survey provided initial service-area background information, perspectives on future water demand trends, agency feedback on the desired project outcomes, and initial interest in different types of conservation measures. The survey responses also were used to identify data items to include in the Data Workbook. The following information was collected in the Data Workbook survey:

- Key contact information for each agency
- Each agency's desired objectives or results for the Demand Study
- Description of water use trends within the agency's service area in recent years
- Source of most recent water demand projections and methodology description
- Perspective on future growth and water demand trends
- Billing system components and capabilities, including any recent changes or upgrades
- Availability of water and sewer rate history by customer class
- Potable and non-potable water reuse planning
- Source and accuracy of service area water audit data in recent years
- Current and projected usage of mixed-use meters
- Plans for water source adjustment when water conservation is active
- Additional comments or questions on the project or planning process

See Appendix A for a complete list of the Data Workbook survey questions.

2.2 Types of Data Collected

The impetus for the types of data collected was the specific data needs for the Econometric Modeling and the DSS Model. The data collected can be classified into a few major categories as discussed below and listed in Figure 2-1.

Service Area Data
Data including water production by source as well as water and sewer rates were collected to show the impact of prices on historical water demands. The service area data were used for the econometric historical analysis, the demand forecast in the DSS Model, and the conservation analysis.

Service Area Demographics
Service area demographic data were collected regarding historical and projected population using previous DSS Models, 2015 UMWPs, and the ABAG 2040 Bay Area Plan Projections. These demographics were used for the econometric analysis of historical demand and for future demand forecasting.

Economy
Data from the U.S. Bureau of Labor Statistics[4] on historical employment and unemployment were collected for the individual service areas (at the city level) to attempt to capture the change in work force during the period from 1995 to 2018 to show historical and future growth in the service area. The economic data were used for the econometric analysis of historical water demand.

[4] U.S. Bureau of Labor Statistics. Local Area Unemployment Statistics web page: https://data.bls.gov/PDQWeb/la

Weather

Data from the local National Oceanic and Atmospheric Administration (NOAA) weather stations closest to each individual agency were collected.[5] Data types included temperature maximum, temperature minimum, temperature average, and precipitation for the years 1995 to 2018. The weather data were used for the econometric analysis of historical water demand.

Conservation

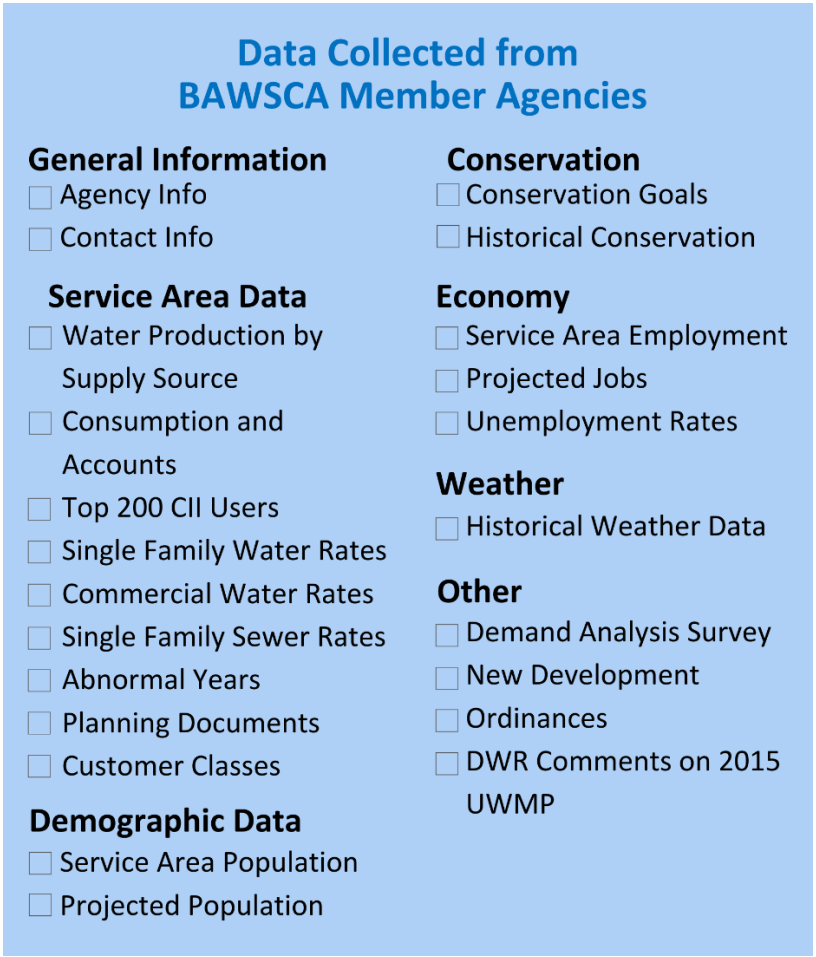
Select conservation data from the WCDB back to 2004 were incorporated into the Econometric Models. The conservation data were used for the historical demand analysis, for a review of future conservation program levels of saturation, and as a benchmark of reasonable levels of implementation for future conservation programs. Fiscal Year 2016-2017 and Fiscal Year 2017-2018 conservation programs participation data for CII Survey, Residential High Efficiency Fixture Giveaway, Residential Indoor Water Surveys, Landscape Water Budget/Monitoring, and Lawn Be Gone! Turf Removal were utilized to calculate levels of saturation.

Other

Each agency was asked to provide any new information, such as new development ordinances or comments received from DWR regarding the agency's 2015 UWMP (if one was filed). These data were used for background information when analyzing each individual water agency's service area.

The individual data elements that were collected are listed categorically in the following figure.

Figure 2-1. Data Collected from Member Agencies



[5] National Oceanic and Atmospheric Administration Climate Data Online Search web page: https://www.ncdc.noaa.gov/cdo-web/search

2.3 Data Collection Process Overview

The data collection for this Demand Study was done using the Data Workbook, which was an update to the one developed during the 2014 Project. Previously, parts of the 2014 workbook were refined for the 2017 BAWSCA "Making Conservation a Way of Life" Strategic Plan. This most recent effort initiated in 2019 was the next iteration in conservation program planning at the regional level to support the 2020 UWMPs and to guide BAWSCA and its member agencies for the next several years.

The Data Workbook was used to collect, organize, and verify the necessary input data for the econometric analysis and DSS model. The data required for the demand and conservation projections continues to be organized into individual Data Workbooks (one per BAWSCA member agency). This task was streamlined by populating the Data Workbook using a variety of existing data sources (as shown in Figure 2-1) prior to distributing the files to the individual agencies. The member agencies were then asked to verify that the information in the Data Workbook was accurate. A key source for existing data was the BAWSCA WCDB, which was specifically designed as a recommendation of the 2009 BAWSCA Water Conservation Implementation Plan (WCIP) to capture much of the required data. Other significant data sources included BAWSCA Annual Surveys, 2015 UWMPs, and the Association of Bay Area Governments (ABAG) Projections[6] (population and employment forecasts).

The Data Workbook was completed and verified by the member agencies through the following steps:

1. **Distribution of Data Workbook Files to Individual Agencies:** The files were distributed to the individual agencies in April 2019 via the BAWSCA WCDB.
2. **Instructional Webinar:** A webinar was held in April 2019 to disseminate information related to the data collection process to the member agencies. During the webinar, the Project Team reviewed the Data Workbook contents with the member agencies and provided instructions for completing the files.
3. **Data Workbook Completion by Agencies:** Each member agency reviewed and completed its individual Data Workbook, which required the following:
    - Verification of existing data that was remaining from the previous efforts as well as what was pre-populated in the file by the Project Team before distribution to the agencies
    - Data entry of missing information into the Data Workbook as needed
4. **Data Workbook Submission by Agencies:** Agencies submitted the files via the WCDB between April and mid-May 2019 after completing Step 3.
5. **Data Workbook Review and Refinement**: The Project Team reviewed the submitted individual Data Workbooks in the order submitted. If further data and refinement were required, the Project Team contacted the individual member agencies to obtain the necessary information.
6. **Data Workbook Validation through Technical Memorandum 1 (TM-1):** Each member agency reviewed and signed a confirmation letter attached to TM-1 that all the information in the data workbook was accurate and approved for use in the project analysis.

2.4 Agency Verification

The last step in the data collection process was the final agency verification of the data. Once all data had been collected and compiled, each agency received a copy of its Final Data Workbook, and the representative for that agency was asked to complete the BAWSCA Agency Population Projection Selection/Data Verification Signature Form. As part of this step, each member agency also was asked to identify an appropriate source for population and employment projections to use in the demand and conservation modeling.

[6] ABAG. Plan Bay Area 2040: http://2040.planbayarea.org/reports.

3 DEMAND PROJECTIONS

This section documents the demand projections developed for the Demand Study. This section describes: 1) the demand projection analysis methodology; 2) the demand analysis results including each BAWSCA member agency demand projections through 2045; and 3) the projections verification process to be completed and signed by each member agency.

3.1 Demand Methodology Overview

The demand projection update for each BAWSCA member agency used a combination of two different analytic models – the Econometric Model and the Demand Side Management Least Cost Planning Decision Support System (DSS Model). The purpose of using two tools was to leverage the strengths of each tool to obtain a suite of demand recovery scenarios through the year 2045.

The Econometric Model estimated the impact of various conditions on service area water demand. The model used historical patterns to project the future rebound in demand associated with post-drought recovery, while considering other factors such as economy, rate increases, conservation activity, and weather. Since the Econometric Model was calibrated using historical data, its reliability depended on the historical relationship between water demand and its influencing factors remaining constant from the calibration period to the forecasting period. Further into the future, changes in demographics, living patterns, housing stock, and industrial structure can alter the historical relationship with water demand.

The data collected for the Demand Study was used to forecast each agency's water demands and conservation savings through 2045, using the DSS Model. The model prepares long-range, detailed water demand and conservation savings projections to enable a more accurate assessment of the impact of water efficiency programs on demand. It also evaluates potential conservation measures using benefit-cost analysis with the present value of the cost of water saved ($/Million Gallons) and benefit-to-cost ratio as economic indicators. The analysis is performed from various perspectives including the utility and community (utility plus customer). This rigorous modeling approach is especially important if the projections are to be included in a document that will undergo regulatory or environmental review.

Previously, the DSS Model was used to forecast demands in the 2004 SFPUC Wholesale Demand and Conservation Analysis (URS, MWM 2004), the 2009 *BAWSCA Water Conservation Implementation Plan*, and the 2014 BAWSCA Regional Water Demand and Conservation Projections Project (2014 Project). The DSS Model has been peer reviewed by the California Urban Water Conservation Council (now known as the California Water Efficiency Partnership) and endorsed by the organization since 2006.

The DSS Model can accommodate historic service agency data and projected information; this information reflects how future service area and water use characteristics may differ from the past in each BAWSCA member service area. To accommodate all these considerations, several scenarios were generated to model the post-drought demand recovery, including a scenario generated by each agency's respective Econometric Model.

The DSS Model also has a conservation component that quantifies savings from plumbing codes and active conservation programs. In this Demand Study, only the DSS Model's estimates of future savings from plumbing codes were incorporated into the demand projections. The intent of this was to facilitate each agency's evaluation of its future water demand before implementation of active conservation programs between 2019 and 2045. Quantification of savings from active conservation programs is discussed in Section 5.

The demand analysis for each agency had three distinct parts (Figure 3-1):

1. **Historical Analysis** – This was an analysis of updated historical data between 1995 and 2018 (or a shorter window if an agency could not provide complete data back to 1995). The purpose of this analysis was to identify the impacts of factors such as water rates, economic conditions, weather, water conservation, and drought reductions on water demands. Data analyzed included historical system production,

population, water rates, weather (rainfall and temperature), unemployment rate, and drought restrictions. See Figure 2-1 for a list of the data used for this analysis.

2. **Short-Term Forecast (Post-Drought Demand Recovery)** – Forecast of demands from 2019 through 2023 was weather normalized, assumed normal economic conditions, and incorporated climate change predictions as well as population growth. Normal weather is defined as the average temperature and rainfall between 1995 and 2006. At the time the analysis was conducted in November 2019, the U.S. economy was operating at an unemployment rate that was below the historical norm. The model assumes there will be a return to the historical norm while developing a model-generated drought recovery estimate. The unemployment rate differs considerably across member agencies at any given point in time. However, movements in this metric for an agency over time parallels movement in the national unemployment rate quite well. To account for the unique conditions that exist within each member agency, it is assumed that each member agency will reach an unemployment rate that reflects the average during the 1993-2000 period, a time period that best captures normal economic conditions. Projections of population and employment growth that fed into these short-term forecasts came from the same sources as those used for the long-term forecasts. These data sources were discussed previously in Section 2.
3. **Long-Term Future** – Long-term water demand (2024-2045) was forecasted using the DSS Model, which estimated increases in each agency's demand by customer category based upon forecasted changes in population and employment. In addition, the long-term forecast incorporated climate change predictions as further detailed in Section 3.6.

Figure 3-1. Demand Forecasting

3.2 Econometric Analysis Methodology

As noted above, the Demand Study used Econometric Models to project post-drought demand recovery in the Partial Rebound – Normal Economy, Weather Normalized scenario (as described in Section 3.7). This tool was incorporated into the demand analysis to estimate the relationship between per capita water demand and factors that cause it to vary over time. Some factors are cyclical in nature and can cause per capita demand to increase or decrease over a period of time. Such factors include weather, economic conditions, and temporary drought restrictions. Other factors put one-way downward pressure on per capita demand over time. The

intensity of pressure may vary from year to year, but the effects are not cyclical. Examples of such factors include water rate increases, plumbing codes, appliance efficiency standards, and active conservation programs. Relying on knowledge of past historical relationships and assuming that they continue in the near-term, this analysis provided insights into questions associated with demand such as:

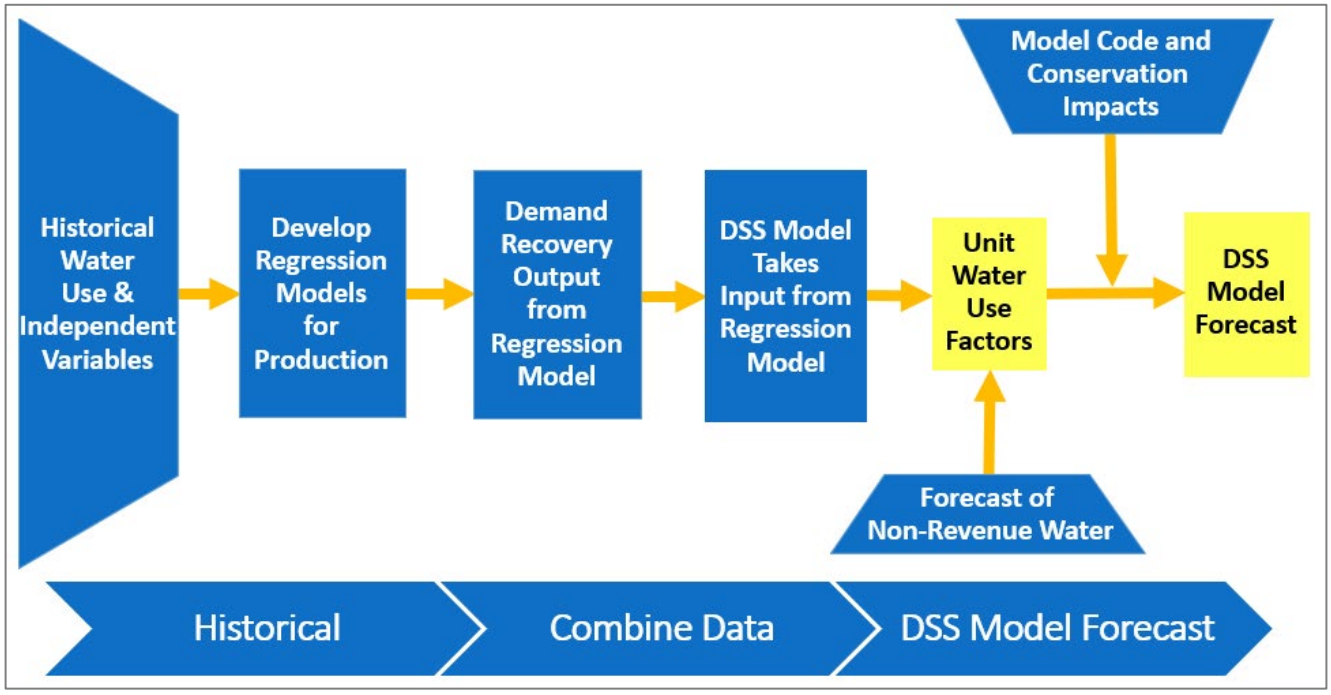
- What was the effect of drought restrictions on demand during the time period for which they were in effect (2014-2017)? Since the removal of these restrictions, demand started to increase – how much more will it rise in the future?
- How have economic conditions impacted demand in the past? Under normal economic conditions, what would fully recovered demand be?
- How has weather impacted demand in the past? Under normal weather conditions, what would fully recovered demand be? Or, under future climate conditions when the average temperature is, for example, two degrees hotter than normal, what would future demand be?

An Econometric Model of water demand was developed for each BAWSCA member agency using up to 24 years of monthly production data (where available, data from 1995 through 2018 were used). Each BAWSCA member agency's Econometric Model utilized agency-specific data to depict economic conditions, retail water rates, population, and impact of drought restrictions implemented during the 2014-2017 period. The models also included a trend variable, if necessary, to capture the long-term decline in per capita demand as a result of historical active and passive conservation. Weather data were assigned to each agency from the closest of the NOAA stations located throughout the San Francisco Bay Area. These data were submitted and verified by each BAWSCA member agency through the data collection process described in Section 2.

After development, the Econometric Model for each BAWSCA member agency was used to generate water demand forecasts to 2023. The Econometric Model assumed that temporary behavioral changes encouraged during the drought returned close to pre-drought norms. The post-drought recovery behaviors were further documented in the Alliance for Water Efficiency 2020 study titled Use and Effectiveness of Municipal Irrigation Restrictions.[7] BAWSCA helped to fund the project and was a contributing project participant which included an in-depth analysis of drought behavior changes. However, the water savings emanating from historical water rate increases and active conservation programs (e.g., non-behavior-based programs such as rebates) achieved through 2018 were assumed to be permanent and therefore did not rebound. The model assumed that the predicted demand recovery would occur gradually over an additional five years (2019-2023), based on BAWSCA's historical experience of the 1987-1992 drought. The estimated gallons per capita per day (GPCD) drought recovery was incorporated into the 27 member agency DSS Models and is further described in Appendix B. This information was reviewed and calibrated with the DSS Model to capture and reflect previous knowledge of the service area from the 2004, 2008, and 2014 BAWSCA forecasting projects. This process generated one complete model for each agency with data between 2020 and 2045 as shown in the following figure.

[7] Alliance for Water Efficiency. (2016). *The Status of Legislation, Regulation, Codes & Standards on Indoor Plumbing Water Efficiency*. http://www.allianceforwaterefficiency.org/Codes-Standards-White-Paper.aspx

Figure 3-2. BAWSCA Demand Model Flow Diagram



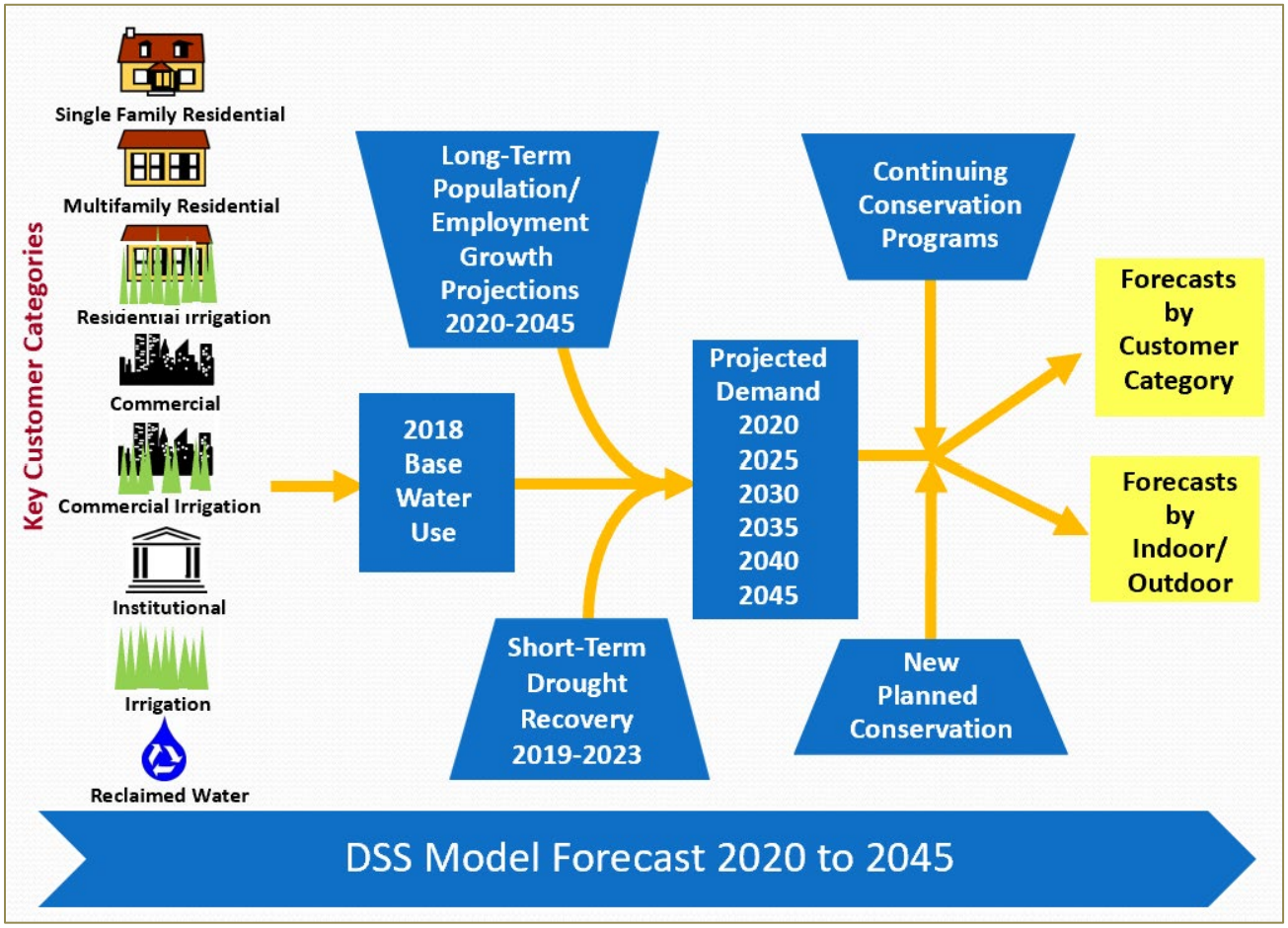
For each BAWSCA member agency, the econometric analysis estimated the relative impact of various factors on water demand. These results have been provided in Appendix C (In Table C-1 and in Figure C-1 the BAWSCA region-wide demand projections are shown with passive savings. Active conservation has not been incorporated into any of the four scenarios. These values are intended to be used for general comparison of ranges in potential future water demands if no active conservation was implemented.

Table C-1). A more detailed description of the Econometric Modeling framework can be found in Appendix B.

3.3 DSS Model Methodology

For the long-term projections (2019-2045), the DSS Model was used to generate demand forecasts for each BAWSCA member agency. The DSS Model also included a conservation component that quantified savings from passive conservation (e.g., plumbing codes) and active conservation programs. The DSS Model's conservation component covers the entire forecast period of 2019-2045. Quantification of savings from active conservation programs is covered in Section 5. Only the DSS Model's estimates of savings from plumbing codes were provided to enable each agency to evaluate what its future demand likely would be absent any active conservation programs from 2020 to 2045.

Figure 3-3. BAWSCA Demand and Conservation DSS Model Flow Diagram



As illustrated above in Figure 3-3, the first step for forecasting water demands using the DSS Model was to gather customer category billing data (e.g., single family residential, multifamily residential, commercial, institutional, etc.) from each BAWSCA member agency. The next step was to calibrate the model by comparing water use data with available demographic data to characterize water usage for each customer category in terms of number of users per account and per capita water use. During the model calibration process, data were further analyzed to approximate the indoor/outdoor split by customer category. The indoor/outdoor water usage was further divided into typical end uses for each customer category. Published data on average per capita indoor water use and average per capita end use were combined with the number of water users to calibrate the volume of water allocated to specific end uses in each customer category. In other words, the DSS Model reflects social norms from end-use studies on water use behavior (e.g., flushes per person per day).

Following the model calibration, the future population and employment projections were incorporated. Each BAWSCA member agency selected its own projection forecasts. These growth projections were used to develop a projected demand for 2019-2045.

As shown in Figure 4-2, the analyzed conservation measures were input into the DSS Model. These conservation measures were a combination of existing and new conservation measures selected by polling the BAWSCA member agencies via SurveyMonkey (an internet-based electronic survey platform). A list of the measures selected for the cost-effectiveness analysis based on this survey can be found in Appendix D.

3.4 Demand Projection – Agency Input and Review

As part of this Demand Study's collaborative approach, one instructional webinar conference call and one workshop were held to facilitate BAWSCA member agency understanding of, and involvement in, the development of the forecasting methodology and analysis. In addition, each member agency was provided with its individual results in written form and was asked to provide written approval of the results.

- **Instructional Webinar –** A webinar with the member agencies was held on April 18, 2019 to give an overview of the project, review the data collection workbook, and provide an overview of the DSS Modeling methodology. The webinar was recorded and offered to those who could not attend to maximize participation by the agencies.
- **Demand Workshop –** On November 18, 2019 a workshop was held for BAWSCA agencies to review the demand modeling approach and results and to answer agency questions. During the workshop, the methodology was reviewed using a real example with preliminary results from one of the BAWSCA agencies.
- **Agency Communication and Technical Memorandum 2 (TM-2) –** In December 2019, agencies were provided a copy of their individual results via TM-2. Agencies were able to email questions or set up virtual calls to review the demand analysis results and make any necessary modifications.
- **Written Approval of Demand Values –** In January 2020, individual agencies were asked to submit written approval that their demand values appeared reasonable. The active conservation analysis in the DSS Model did not proceed until all agencies approved their demand values in TM-2.

3.5 Future Population and Employment

Population and employment projections through 2045 were confirmed by each BAWSCA member agency through the data collection process described in Section 2. Population projections were obtained from one of the following sources:

- Association of Bay Area Governments 2040 Plan Bay Area
- 2015 Urban Water Management Plans
- Other publicly adopted sources as provided by each BAWSCA member agency

3.6 Weather and Climate Change Data

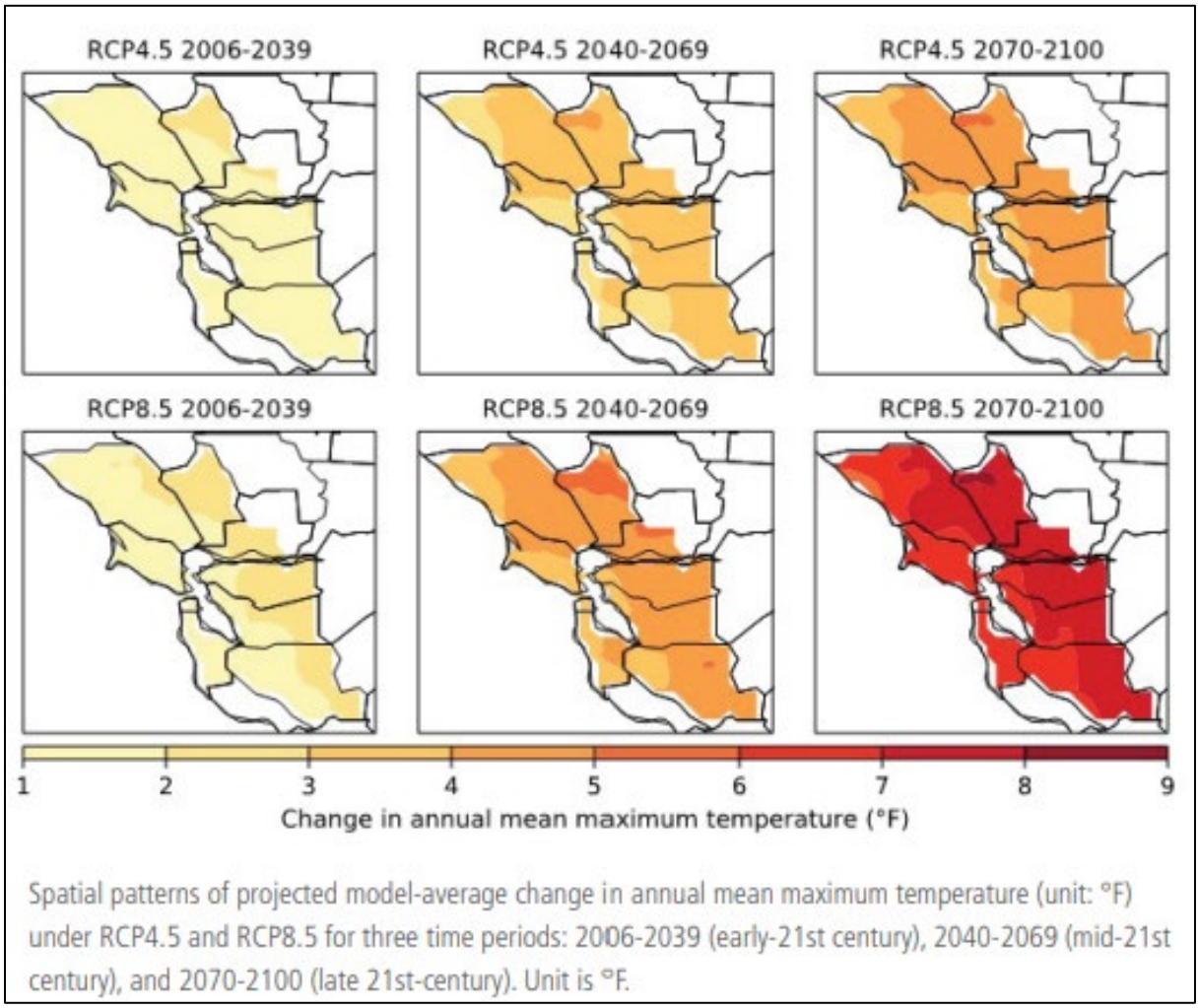
The Public Policy Institute of California has predicted that five climate pressures will impact the future of California's water management: warming temperatures, shrinking snowpack, shorter and more intense wet seasons, more variable precipitation, and rising seas.[8] As of 2019, some of these pressures are already apparent. The climate impact on water supply is predicted to significantly exceed the impact on water demand.

Precipitation in the Bay Area will continue to have high variability year to year, leading to very wet years sometimes and very dry years at other times. The largest winter storms in the Bay Area will likely become more powerful and potentially more damaging. Due to a predicted increase in temperature in the future, it is assumed that California and the Bay Area will experience longer and deeper droughts, which could impact the water supply.

The International Panel on Climate Change (IPCC) develops several future climate change scenarios referred to as Representative Concentration Pathways (RCP). RCP 4.5 represents a mitigation scenario where global CO2 emissions peak by the year 2040. RCP 8.5 represents the business-as-usual scenario where CO2 emissions continue to rise throughout the 21st century. The following figure shows the spatial changes in annual mean of maximum daily temperatures across nine Bay Area counties under RCP 4.5 and RCP 8.5.

[8] Public Policy Institute of California (PPIC). (2019). Priorities for California's Water, accessed online December 2019: https://www.ppic.org/publication/priorities-for-californias-water/

Figure 3-4. Bay Area Historical and Projected Mean Maximum Temperatures



Source: Ackerly, David, Andrew Jones, Mark Stacey, Bruce Riordan. (University of California, Berkeley), 2018.

According to California's Fourth Climate Change Assessment San Francisco Bay Area Summary Report,[9] the Bay Area's historical temperature increased 1.7 degrees Fahrenheit from 1950 to 2005. It is predicted that annual mean maximum temperatures will increase by 1 to 2 degrees Fahrenheit in the early 21st century from the years 2006 to 2039, then will increase by an additional 3.3 degrees Fahrenheit in the mid-21st century from 2040 to 2069. This increment for the mid-21st century rises to 4.4 degrees Fahrenheit if the Bay Area remains under the high emissions scenario of "business-as-usual."

The above IPCC report temperature change is broken over two time periods (early-21st century and mid-21st century). For the BAWSCA Demand Study, the time period of focus was 2019-2045. Therefore, it was necessary to combine the two time periods to get an overall temperature change for the length of the BAWSCA Demand Study.

[9] Ackerly, David, Andrew Jones, Mark Stacey, Bruce Riordan (University of California, Berkeley). (2018.) *San Francisco Bay Area Summary Report.* California's Fourth Climate Change Assessment. Publication number: CCCA4-SUM-2018-005. Accessed online December 2019: https://www.energy.ca.gov/sites/default/files/2019-07/Reg%20Report-%20SUM-CCCA4-2018-005%20SanFranciscoBayArea.pdf

Following are the considerations and methodology used to calculate the average annual temperature change for each of the IPCC report time periods:

- Early 21st Century (2006-2039) had an estimated temperature increase of 1 to 2 degrees Fahrenheit that was averaged to 1.5 degrees Fahrenheit. For the 33-year time period, this equates to an average annual temperature increase of 0.045 degrees Fahrenheit.
- Mid-Century (2040-2069) was estimated to have a temperature increase of 3.3 degrees Fahrenheit. For the 29-year time period, this equates to an average annual temperature increase of 0.114 degrees Fahrenheit.

Calculating the increase within each time period for the BAWSCA Demand Study required three steps:

- Step 1: Calculate a value for the 20 years from 2019 to 2039, which equates to an estimated temperature change of 0.95 degrees Fahrenheit.
- Step 2: Calculate a value for the five years from 2040 to 2045, which equates to an estimated temperature change of 0.68 degrees Fahrenheit.
- Step 3: Finally, the two values from Step 1 and Step 2 were added together to get a total temperature increase of 1.7 degrees Fahrenheit (rounded) for 2019-2045.

In summary, for the BAWSCA Demand Study, the previously mentioned predicted annual mean temperature increase in the early 21st century of 1.7 degrees Fahrenheit[10] was incorporated into the demand forecast for all scenarios for the time period of 2019 to 2045.

3.7 Demand Projections Scenarios

The Econometric Model and DSS Model were used in conjunction to generate water demand projection scenarios for each BAWSCA member agency for four scenarios as noted in the table below.

Table 3-1. Water Demand Recovery Scenarios

Scenario	Water Data Years	Normal Economy	Weather Normalized	Water Rates	Active Conservation	Passive Conservation Savings (Plumbing Codes)	Future Service Area Changes/ Growth Forecast
Pre-Recession and Pre-Drought Demand Level Recovery	**2000-2007**					✓	✓
Pre-Drought Demand Level Recovery	**2004-2013**					✓	✓
Partial Rebound – Normal Economy, Weather Normalized	**1995-2018**	✓	✓	✓	✓	✓	✓
Current Water Demand Profile – Normal Economy, Weather Normalized	**2018**	✓	✓			✓	✓

[10] Ibid.

Each individual member agency's historical and projected water demands are shown in Appendix A (Figure A-1) of their respective TM-2s. Those TM-2 Appendix A figures, along with Table 3-1 and Figure 3-5 in this section, contain the following curves:

- Pre-Recession and Pre-Drought Demand Level Recovery – Demand projections based on years 2000-2007 water use profile, starting with 2018 demand levels and recovering from the drought in five years.
- Pre-Drought Demand Level Recovery – Demand projections based on years 2004-2013 water use profile, starting with 2018 demand levels and recovering from the drought in five years.
- Partial Rebound – Projections developed by the Econometric Model assuming: 1) normal weather, 2) normal economy, 3) price escalation projections that vary by agency, 4) historical active conservation efforts, 5) passive conservation plumbing codes, and 6) recovery from the drought in five years.
- Current Water Demand Profile – Assuming: 1) normal economy, and 2) weather normalized. This is water demand calculated from historical 2018 water production data submitted by each BAWSCA member agency. The 2018 data were weather normalized and assumed a normal economy. This scenario does not include any additional post-drought demand recovery.

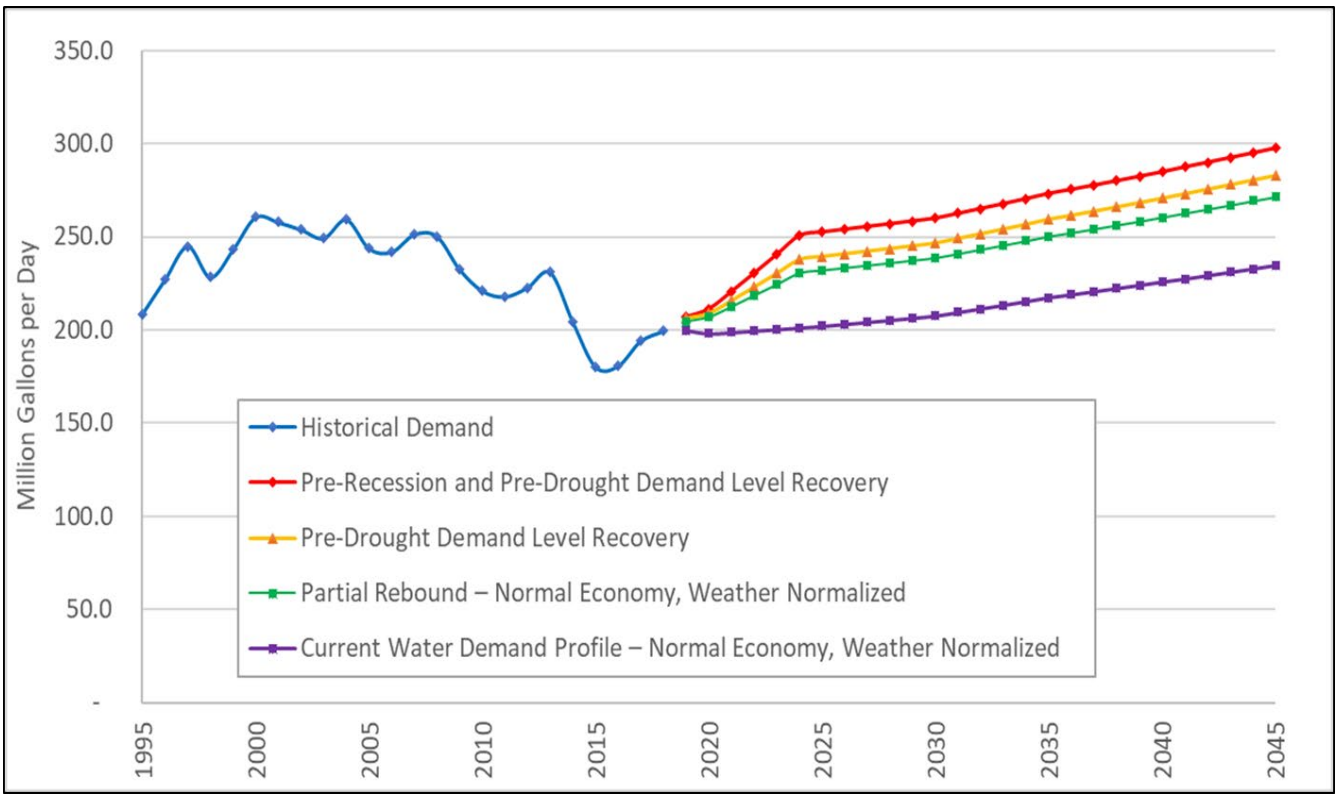
Savings from plumbing codes (also known as "passive conservation") is based on federal and state legislated efficiency standards pertaining to plumbing fixtures and appliances. The impact of codes quantified here include the Energy Policy Act of 1992, CALGreen Building Code, AB 715, and SB 407 (governs the types of fixtures available on the market for toilets, showers, washers, etc.). The plumbing code has been added into all four scenarios. Figure 3-5 presents a summary of the BAWSCA service area total demand projections through 2045 including passive conservation. These projections encompass all demands regardless of source, including non-potable water demands.

The Partial Rebound – Normal Economy, Weather Normalized scenario was used for the conservation analysis in the next phase of the BAWSCA project because it incorporated the longest time period of data (1995-2018), included weather normalization, and was adjusted for the change in water rates. The inclusion of these variables over a long time period using regression analysis was deemed by BAWSCA to be the most representative for a long-term forecast. In addition, analysis of BAWSCA data from prior droughts demonstrated that there was a significant rebound in per capita water use within seven years following the end of a drought.[11] Therefore, an assumption of a partial rebound to pre-drought demands is consistent with past experience. Taking a long-term viewpoint was found to be especially important since recent data included both recession and severe drought, as mentioned previously.

Furthermore, beginning in 2023, each urban water supplier in California, including 24 of the 27 BAWSCA member agencies, will be required to calculate and report to the State Water Resources Control Board (SWRCB) on an annual water use objective. The urban water use objective will be based upon standards of efficient water use for indoor residential, outdoor residential, and dedicated irrigation. The water efficiency standards have not been established yet by the SWRCB; however, it is anticipated that these standards, and resulting urban water use objectives, will become a key driver for water conservation planning for the BAWSCA region. Each agency's water conservation program will be designed to reduce its projected water use by, at a minimum, the amount needed to stay within its urban water use objective. To ensure that sufficient water conservation programming is planned and budgeted, it is prudent to plan and budget under the assumption that drought rebound will occur and to develop a robust water conservation program to enable agencies to meet their urban water use objectives in spite of that rebound.

[11] Analysis of residential per capita water use data from the BAWSCA *Annual Survey Fiscal Year 2018-19* (BAWSCA, 2020) for the 4 years prior to the 1987-1992 drought (1984-1988) and years 4-7 following the drought (1995-1998) showed a 23% increase in residential per capita water from the lowest drought year to the 4-year average from years 4-7 of the recovery period.

Figure 3-5. BAWSCA Region-Wide Demands to 2045 with Passive Conservation*



* *Savings from plumbing codes (also known as "passive conservation") is based on federal and state legislated efficiency standards pertaining to plumbing fixtures and appliances.*

4 WATER CONSERVATION SAVINGS PROJECTIONS

This section documents the conservation savings projections for each BAWSCA member agency and for the BAWSCA region. In addition, the conservation analysis methodology and results are detailed.

4.1 Conservation Analysis Goals and Objectives

The Demand Study included two goals related to water conservation: 1) to define how much conservation can reasonably contribute to more supply reliability for all BAWSCA member agencies and 2) to incorporate projected conservation savings into the demand projections for each agency. Pursuant to this goal, the specific objectives of the conservation analysis for the Demand Study were:

- Assist BAWSCA member agencies in evaluating the potential water savings and cost-effectiveness associated with implementing a variety of existing and potential new water conservation measures;
- Determine the projected water savings from 2020 through 2045 associated with implementing a selected suite of new conservation measures; and
- Determine which entity (i.e., BAWSCA, the member agencies, or Valley Water) should implement each conservation measure or program and when the program should be implemented in order to achieve the specified water savings goals.

To develop demand forecasts for each agency that account for conservation from both passive (plumbing code and standards) and active conservation programs, the individual agency DSS Models were designed to achieve the following two objectives:

1. Account for passive conservation savings projected through 2045
2. Analyze potential savings from a variety of water use efficiency measures to facilitate the development of individual agency conservation savings estimates through 2045

Each BAWSCA member agency's individual conservation water savings goal, where applicable, was provided by the agency during the data collection process described in Section 2 and was used in the conservation analysis.

4.2 Conservation Analysis Methodology Overview

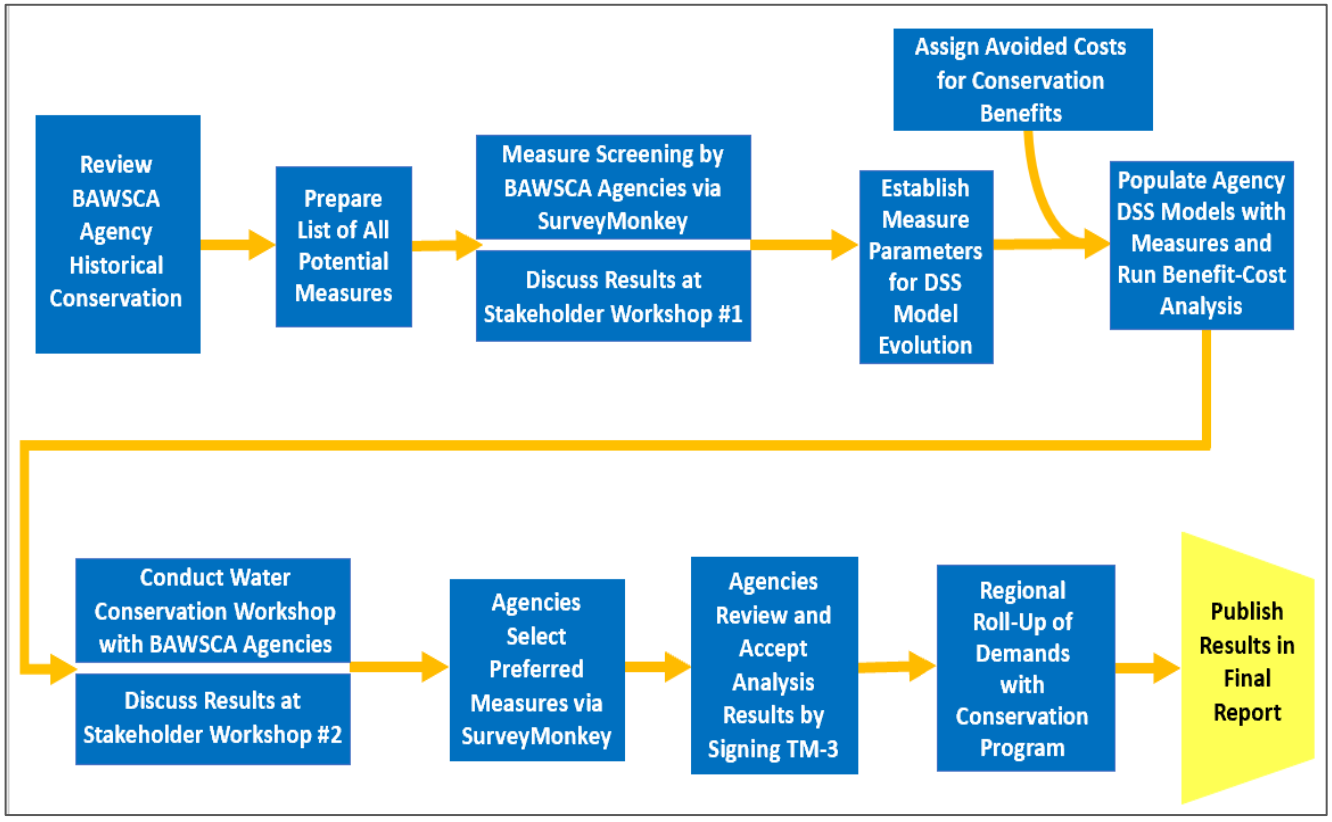
The conservation savings projections were developed through a 10-step process.

Review of Historical BAWSCA Member Agency Conservation Programs and Savings

The first step in the conservation analysis was to review historical BAWSCA member agency water conservation and savings. The purpose of this review was to look at historically successful programs, past penetration rates (activity levels) for individual measures, and the types of programs that were implemented (and for which customers – single family, multifamily, commercial, etc.) by each of the agencies since the 2014 Project. This information was reviewed on a regional and individual agency level. The participation rates were incorporated into the design of the activity levels for each of the conservation measures in the DSS Model analysis.

Figure 4-1 illustrates the 10-step conservation analysis process.

Figure 4-1. BAWSCA 10-Step Conservation Analysis Process



Selection of Conservation Measures for Analysis

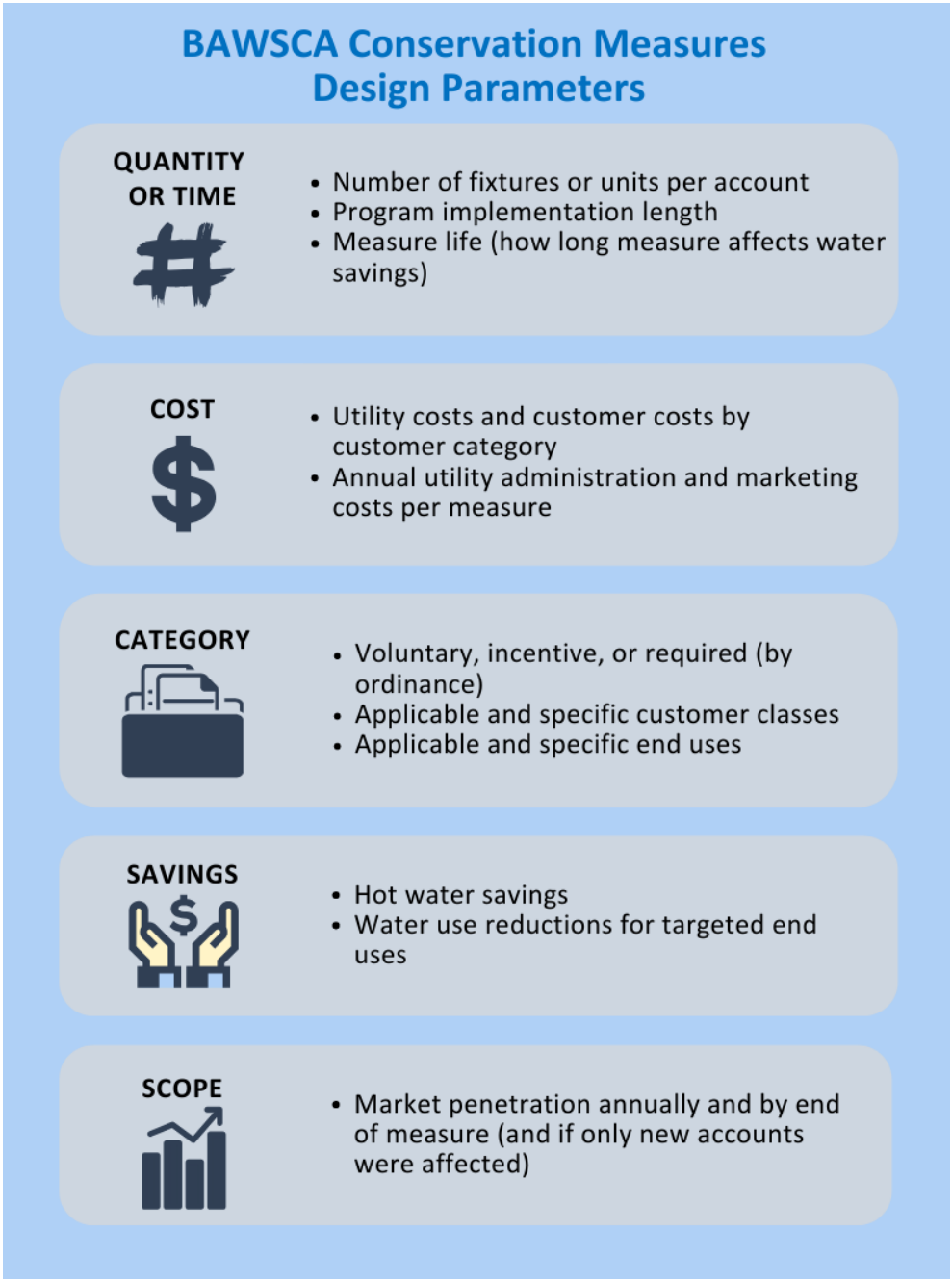
Following the review of the historical conservation efforts, a list of 40 potential conservation measures was selected by BAWSCA staff. Member agencies were then asked to complete an online survey through SurveyMonkey to assist in choosing 20-25 of the 40 potential conservation measures that should be considered for further evaluation in the DSS Model. This list of measures was screened by BAWSCA and the member agencies to identify those measures with the highest level of interest, importance, and potential for implementation within the BAWSCA service area independent of which entity (BAWSCA, Valley Water, or the individual agencies) would be best suited to implement each measure. The list was also reviewed by the Stakeholder Workgroup, who provided suggestions on measure ideas and design. Through this process, a total of 24 measures were selected for analysis in the individual agency DSS models. The 24 measures that were incorporated into the DSS Models are presented in Figure 4-2, with the screening process results and further details on each measure in Appendix D.

Figure 4-2. BAWSCA Agency-Selected Water Use Efficiency Measures

Conservation Measure Design

Following the selection of the 24 conservation measures for the DSS Model, design parameters for each measure were developed for inclusion in the model (see Figure 4-3). The design parameters were developed through a collaborative effort in which information was compiled and reviewed by participants from MWM, BAWSCA staff, Valley Water, SFPUC, and the individual agencies.

Figure 4-3. Conservation Measures Design Parameters



The following assumptions were used in designing the model parameters for each conservation measure:

- Historical BAWSCA data were used in cases when the measure was already in existence.
- Valley Water data were used to design BAWSCA-led measures in cases where Valley Water was running a comparable measure at the time of the analysis.
- Design of individual "agency measures" and their parameter values came from BAWSCA member agencies.
- Other industry data and knowledge was incorporated when local data was not available.
- New measures were designed with an implementation schedule reflecting dates sometime in the future when BAWSCA or its member agencies might begin such programs.

Measure Analysis and Conservation Program Selection

The 24 conservation measures were incorporated into each agency's DSS Model for benefit-cost analysis (described below) and selection of a conservation program to meet the agency's goals. Included in each agency's DSS Model was a list of measures selected by the individual member agency. The following four key items were taken into consideration during measure selection:

- Existing agency water use efficiency measures
- Programs run by BAWSCA (with consideration for Valley Water programs)
- Measures focused on the topic areas of new state regulations (residential indoor per capita use, water loss, landscape, commercial
- New and innovative measures

Each BAWSCA member agency's DSS Model presented estimated average per capita per day savings with the plumbing codes only. Plumbing code includes current state and federal standards (including CALGreen, Senate Bill 407 and Assembly Bill 715) for items such as toilets, showerheads, faucets, pre-rinse spray valves. SB 407 and AB 715 require the replacement of non-water conserving plumbing fixtures with water-conserving fixtures as described in Appendix E.

Each BAWSCA member agency was allowed to review the conservation program options, tailor the programs to meet its needs, and select the program that fit its individual water savings goals and budgets. The reasons that each member agency selected a particular suite of measures varied but included:

- Measure cost effectiveness
- Applicability to service area
- Amount of water savings generated
- Cost
- Ease of implementation and staffing requirements
- Which agency was running the measure (BAWSCA or Valley Water)
- Local preferences

Perspectives on Benefits and Costs

The determination of the economic feasibility of water conservation programs involves comparing the costs of the programs to the benefits provided. This analysis was performed using the DSS Model developed by MWM, which calculates the cost effectiveness of conservation measure savings at the end-use level. For example, the model determines the amount of water a toilet rebate program saves in daily toilet usage for each single family account. Additional detail on the DSS Model and assumptions can be found in Appendix E.

Appendix F presents generic starting value measure assumptions used as a means for each BAWSCA member agency to tailor its DSS Model to evaluate the potential water use efficiency measures. The agencies had the option to select or unselect any measure for implementation. Assumptions were made for the following variables incorporated into the DSS Model:

- **Targeted Water User Group End Use –** Water user group (e.g., single family residential) and end use (e.g., indoor or outdoor water use)
- **Utility Unit Cost –** Cost of rebates, incentives, and contractors hired by BAWSCA and BAWSCA member agencies to implement measures
- **Retail Customer Unit Cost –** Cost for implementing measures that is paid by retail customers (i.e., remainder of a measure's cost that is not covered by a rebate or incentive)
- **Utility Administration and Marketing Cost –** The cost to the utility for staff time, general expenses, and overhead needed to implement and administer the measure, including consultant contract administration, marketing, and participant tracking. The unit costs vary greatly according to the type of customer and implementation method. For example, a measure might cost a different amount for a single family account than a multifamily account. Rebate program costs are different than costs to develop and enforce an ordinance requirement or a direct installation program. Typically, water utilities incur increased costs with achieving higher market saturation, such as more surveys per year. The model calculates the annual costs based on the number of participants each year.

  The general formula for calculating annual utility costs is:

  Annual Utility Cost = Annual market penetration rate x total accounts in category x unit cost per account x (1+administration and marketing markup percentage)

  Annual Customer Cost = Annual number of participants x unit customer cost

  Annual Community Cost = Annual utility cost + annual customer cost

Considering Co-Benefits of Water Conservation Measures

The DSS Model considers the costs and benefits of water conservation programs from a water utility perspective to determine economic feasibility. However, many of the water conservation programs evaluated through this study include additional benefits distinctly different from what a water utility would track. The value of those distinctly different impacts is not fully captured in this quantitative analysis. Examples of these co-benefits include the following items shown in Table 4-1.

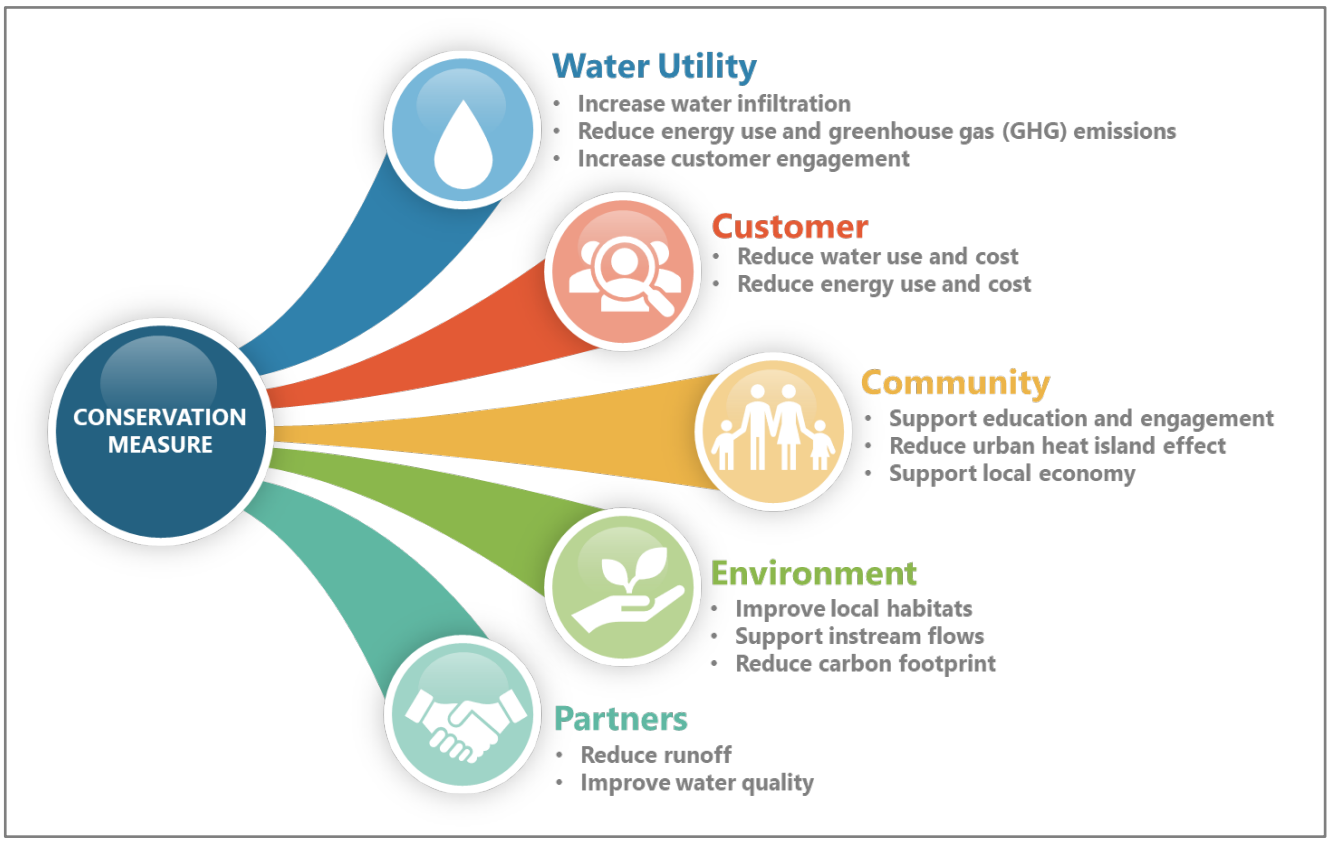
Table 4-1. Co-Benefits from Conservation Measure Implementation*

Beneficiary	Benefit
Utility	Reduce energy and GHG for pumping and treating water
Utility	Increase water infiltration (if groundwater basin)
Utility	Increase customer engagement
Partner	Reduce runoff and improve local water quality
Customer	Reduce water cost for customer
Customer	Reduce energy cost on-site
Environment	Improve local habitats
Environment	Reduce carbon footprint
Community	Reduce urban heat island effect
Community	Support education
Community	Build community cohesion and resilience
Community	Support local economy (local jobs and/or property values)

** Adapted in collaboration with Pacific Institute from Diringer et al. (2020). Incorporating Multiple Benefits into Water Projects: A Guide for Water Managers. Pacific Institute. www.pacinst.org/multiplebenefits.*

Figure 4-4 presents key co-benefits that can be achieved from various conservation measure implementation. This information may support the development of partnerships and cost sharing opportunities for measure implementation to optimize the investment of time and resources. Potential partnership opportunities may include local municipalities with stormwater permit requirements, cities implementing Climate Action Plans, energy utilities, and regenerative landscaping organizations such as ReScape.

Figure 4-4. Co-Benefits of Identified Conservation Measures



Note: Adapted in collaboration with Pacific Institute – Diringer et al. (2020). Incorporating Multiple Benefits into Water Projects: A Guide for Water Managers. Pacific Institute. www.pacinst.org/multiplebenefits.

4.3 Conservation Measures – Agency Input and Review

As part of this Demand Study's collaborative approach, two instructional webinar conference calls were held to facilitate BAWSCA member agency understanding of and involvement in the review and selection of the conservation measures and savings analysis.

- **Instructional Webinar and Conservation Survey #1 –** A webinar with the member agencies was held on an initial webinar was held on December 19, 2019, to facilitate the selection of conservation measures for analysis in the DSS Model. The webinar was recorded and offered to those who could not attend to maximize participation by the agencies. This was followed by a survey conducted in January 2020 to solicit feedback on which conservation measures BAWSCA member agencies wanted to consider as part of the conservation analysis. Results from the January 2020 survey can be found in Appendix D.
- **Conservation Workshop (virtual) and Conservation Survey #2 –** A virtual workshop was held on April 1, 2020 to facilitate BAWSCA member agency understanding of and involvement in the conservation program analysis in the DSS Model**.** The originally planned in-person workshop was changed to a virtual workshop in response to the COVID 19 pandemic. This was followed by a survey conducted in April 2020 to solicit feedback on which conservation measures BAWSCA member agencies wanted to consider as part of the conservation analysis.
- **Agency Communication and Technical Memorandum 3 (TM-3) –** In April 2020, individual agencies were provided a copy of their individual conservation saving results via a Technical Memorandum (TM-3). Following the release of the TM-3 individual agencies were able send questions via email or set up virtual calls to review the conservation savings analysis results and make any necessary modifications.

- **Written Approval of Demand Values –** In May 2020, individual agencies were requested to submit a written approval that their demand values including passive and active conservation appeared reasonable. The report includes all the values that were signed off by the individual agencies.

4.4 Comparison of Individual Conservation Measures

MWM conducted an economic evaluation of each selected water conservation measure using the DSS Model. Appendix F presents detailed results with regard to how much water each measure will save through 2045; how much each will cost; and the cost of saved water per unit volume if the measure were to be implemented on a stand-alone basis (i.e., without interaction or overlap from other measures that might address the same end use or uses). Dollar savings from reduced water demand was quantified annually and based on avoided costs. Actual measure design parameter inputs can be found in Appendix F. While each measure was analyzed independently, it is important to note that very few measures operate independently. Savings from measures which address the same end use(s) are not directly additive. The model uses impact factors to avoid double counting in estimating the water savings from programs of measures (further details in Appendix E, Section E.4).

One of the objectives of the Demand Study was to identify conservation measures for further consideration for BAWSCA region-wide implementation. Figure 4-5 presents the number of BAWSCA member agencies that selected each measure as part of their planned conservation programs.

Figure 4-5. Potential Conservation Measures

BAWSCA Planned Conservation Measure Implementation

Measure Name	# of Agencies Planning to Implement
Commercial	
CII Water Survey	13
CII Water Efficient Technology (WET) Rebate	10
School Building Retrofit	6
Fixture Retrofit on Resale or Water Account Change (Commercial)	2
Irrigation	
Residential Outdoor Water Surveys	16
Large Landscape Outdoor Water Surveys	20
Large Landscape (Waterfluence) Program	14
Lawn Be Gone! and Rainwater Capture Rebates	19
Financial Incentives for Irrigation and Landscape Upgrades	14
Landscape Irrigation and Codes	10
Residential	
Residential Indoor Water Surveys	9
Residential Water-Savings Devices Giveaway	20
Flowmeter Rebate	7
Leak Repair and Plumbing Emergency Assistance	9
Multifamily HET Direct Install	2
Multifamily Submetering for Existing Accounts	5
New Development Submetering	8
New Development Hot Water On Demand	4
Low Impact New and Remodeled Development	3
Fixture Retrofit on Resale or Water Account Change (Residential)	2
Community & Education	
Public and School Education	22
Billing Report Educational Tool Non-AMI	10
AMI Customer Portal	14
System Water Loss	
Water Loss	20

5 PROJECTED WATER DEMAND AND CONSERVATION SAVINGS RESULTS

This section presents the results of the water demand and conservation analysis for each individual BAWSCA member agency and for the BAWSCA region.

5.1 BAWSCA Regional Demand Projections

For the purposes of these regional projections, the demand projections for future planning are presented in Table 5-1. These demand projections were developed using the Partial Rebound demand scenario developed utilizing an Econometric Modeling approach, both of which are further described in Section 3. The Econometric Modeling approach assumed: 1) normal weather, 2) normal economy, 3) price escalation projections that vary by agency, 4) historical active conservation efforts, and 5) passive conservation plumbing codes.

Demand projections are based on data provided from 1995 through 2018. This analysis was completed before the COVID-19 pandemic Shelter in Place orders began in March 2020. Therefore, none of the new changes in water use profiles, population, employment, or vacancies resulting from the pandemic have been incorporated because the data was not yet available and was outside the scope of this project. It is recognized that, depending on the impact of recent events, the water demands may need to be reviewed and/or modified.

Table 5-1 presents the following:

- **Demand projections with no plumbing code savings** – previously verified by each member agency through the Technical Memorandum 2 signature form.
- **Demand projections with plumbing code savings** – previously verified by each member agency through the TM-2 signature form.
- **Demand projections with the plumbing code savings and active conservation program savings** – incorporates the member agency-selected active conservation program from the agency's DSS Model. The SurveyMonkey with the selected conservation program was returned to BAWSCA on April 30, 2020.

Table 5-1. Demand Projections for Partial Rebound Scenario

Demand Forecast (MGD)	2023	2025	2030	2035	2040	2045
Total Demand with No Plumbing Code Savings	231.1	240.3	251.1	266.7	280.0	293.6
Total Demand with Plumbing Code Savings	222.0	228.9	234.3	244.3	253.1	262.4
Total Demand with Active Measure Savings	219.0	225.1	229.2	238.8	247.0	256.3

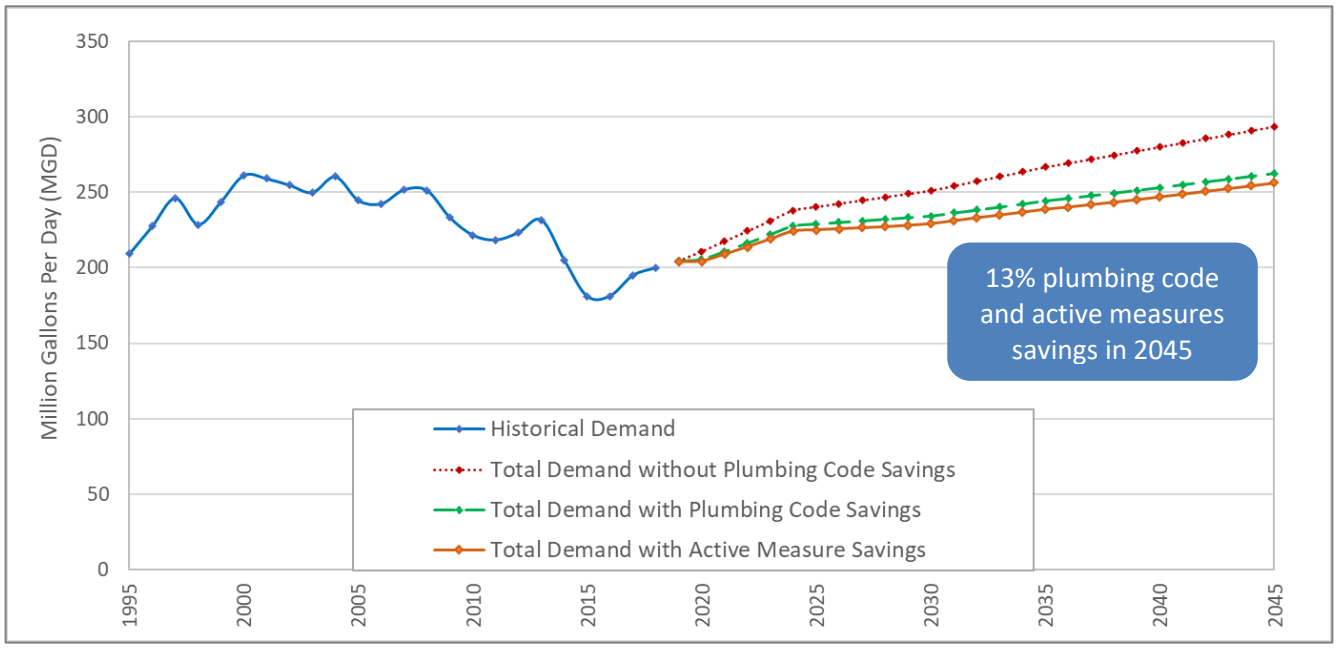
Note: Total water demand accounts for the total projected demand in a service area water system regardless of source, which could be from SFPUC, groundwater, surface water, recycled water, desalination, SWP, or Valley Water. The basis for this demand scenario was discussed previously in Section 3. AB 1668 (Friedman) and SB 606 (Hertzberg) will begin to be enforced in 2023. Therefore, projections for that particular year are included since that is when the new conservation requirements begin to take effect.

Figure 5-1 presents the combined BAWSCA region-wide water demand projections with and without passive conservation. Total water demand is defined as total water consumption plus non-revenue water. Water consumption is defined as water delivered to individual customers for use. As noted earlier in Section 3, the conservation analysis was based upon the Partial Rebound – Normal Economy, Weather Normalized scenario.

Figure 5-2 illustrates the projected 75% population increase with a 2% demand decrease between 1986 and 2045. The demand shown in this chart includes both plumbing code and active conservation measure savings.

Figure 5-3 represents the gross and residential per capita water use for BAWSCA. The gross per capita value is the total production including non-revenue water. Both the gross and residential per capita water use exclude recycled water.

Figure 5-1. BAWSCA Region-Wide Demands with Active Conservation Savings to 2045*



* *Water demands are based on data provided from 1995 through 2018. This analysis was completed before the COVID-19 pandemic and does not incorporate any of the new changes in water use profiles, population, employment, or vacancies as the data was not yet available and was outside the scope of the current project. However, it is recognized that the water demands may need review or modification depending on the impact of recent events.*

Figure 5-2. Historical and Projected Population and Demand

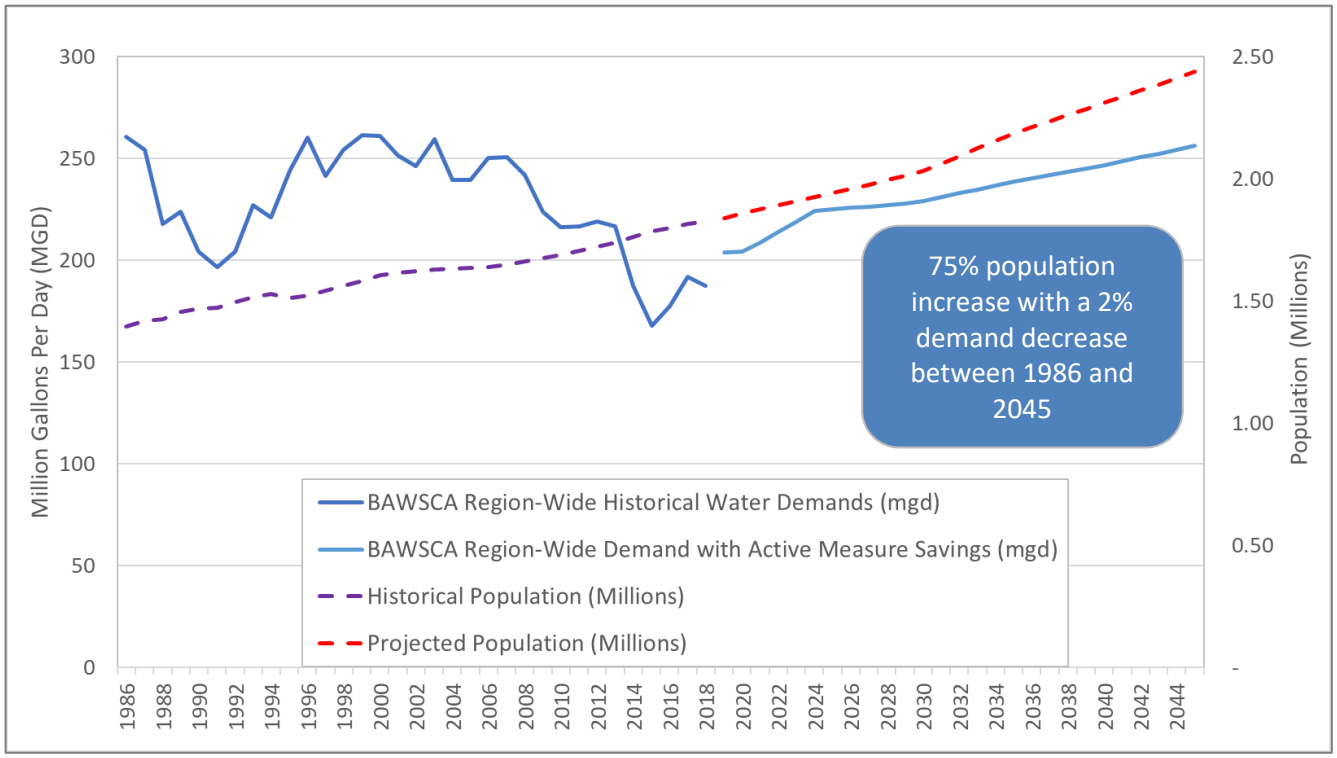
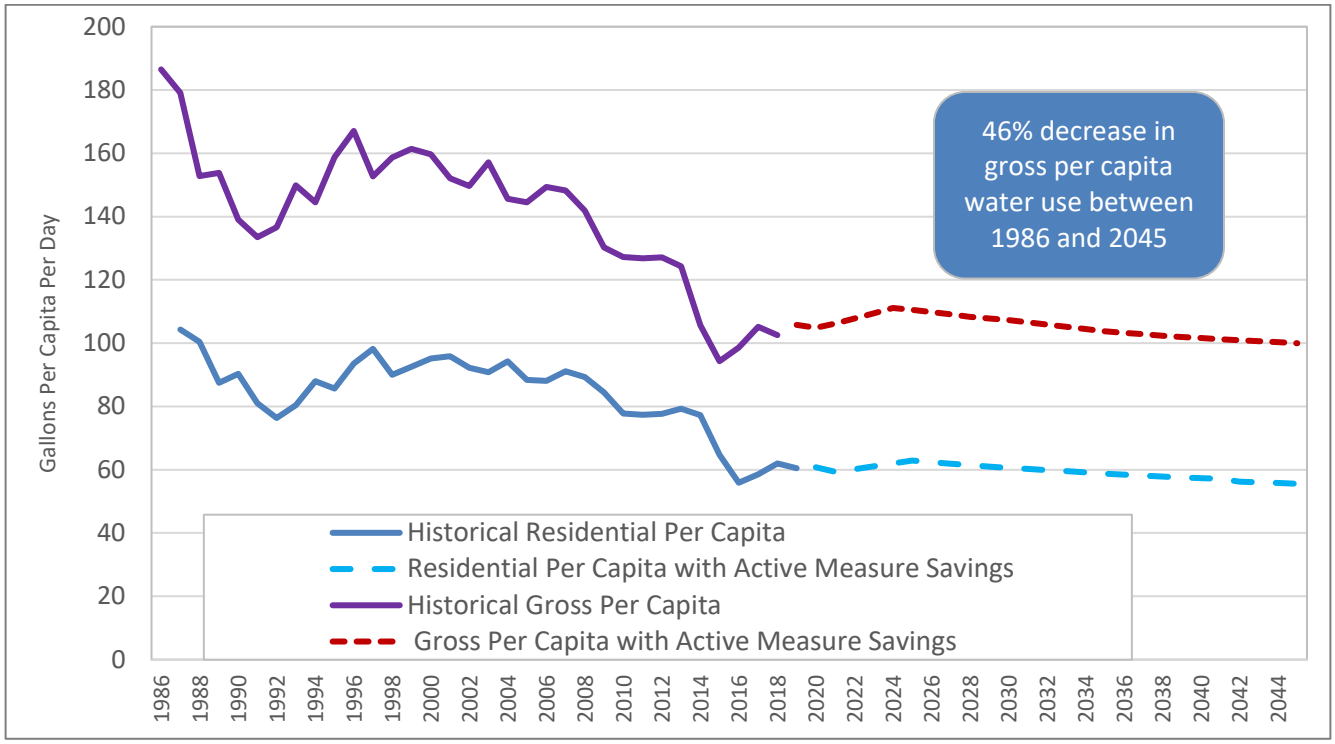


Figure 5-3. Total BAWSCA Gross Per Capita Demands



Note: To be consistent with the BAWSCA methodology for the BAWSCA Annual Survey, recycled water has been removed from the per capita calculations. Therefore, the above information is a potable-only per capita value.

5.2 Population and Employment Projections Summary

Table 5-2 presents the BAWSCA region-wide historical and projected population and employment.

Table 5-2. BAWSCA Region-Wide Historical and Projected Population and Employment

Year	Population	Employment (Jobs)
1995*	1,511,254	1,044,179
2000*	1,604,927	1,129,881
2005*	1,636,600	1,064,347
2010*	1,688,378	1,033,325
2015*	1,785,787	1,072,024
2020	1,858,392	1,156,613
2025	1,941,725	1,209,770
2030	2,032,304	1,270,096
2035	2,187,849	1,329,806
2040	2,311,562	1,379,449
2045	2,438,515	1,430,112

** Historical population and employment based on BAWSCA records as reported by individual member agencies.*

Figure 5-4 presents the BAWSCA service area population and employment projections.

Figure 5-4. Historical and Projected Population and Employment

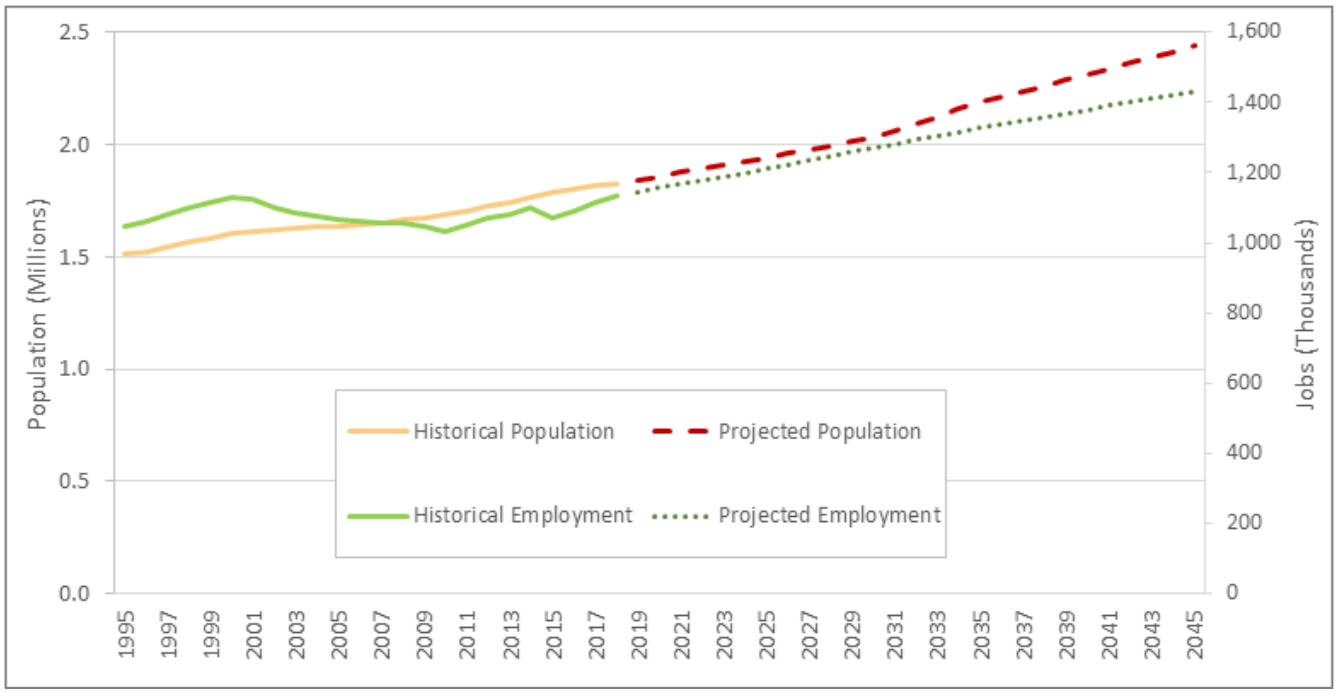


Table 5-3 presents individual BAWSCA member agency population projections. Each agency was given the ability to select the source they felt best represented their service area and other planning documents.

Table 5-3. BAWSCA Member Agency Population Projections

Service Areas	Projection Source	2023	2025	2030	2035	2040	2045
Alameda County Water District	ACWD Forecast – California Department of Finance (DOF), ABAG, BAM[1]	358,902	360,273	363,700	381,190	403,005	424,820
Brisbane/GVMID	Previous DSS Model; model updated in 2018 for WSA	4,583	4,632	4,761	4,906	5,056	5,206
Burlingame, City of	2015 UWMP	33,804	34,477	36,162	37,846	39,530	41,214
CWS – Bear Gulch District	CalWater Draft Demand Model	61,257	61,329	61,697	62,243	62,780	63,327
CWS – Mid Peninsula District	CalWater Draft Demand Model	137,332	137,623	138,350	139,077	139,804	140,531
CWS – South San Francisco District	CalWater Draft Demand Model	63,225	63,381	63,890	64,633	66,990	69,458
Coastside County Water District	Preliminary 2019 ABAG	18,890	18,991	19,238	19,371	19,472	19,573
Daly City, City of	Previous effort's DSS Model; based on ABAG 2013 subregional data; 1995 data from 2000 ABAG	114,352	115,671	119,147	123,020	127,028	131,037
East Palo Alto, City of	2015 UWMP	26,703	27,215	28,589	30,062	31,646	33,230
Estero MID/ Foster City	Updated DSS Model in 2017 for WSA effort	37,560	37,800	38,400	39,000	39,600	40,200
Hayward, City of	DOF 2019 Population; growth based on flow projections in Hayward's Sewer Master Plan	173,933	181,670	202,553	225,836	251,795	280,738
Hillsborough, Town of	2015 UWMP	10,939	10,956	11,000	11,000	11,000	11,000
Menlo Park, City of[2]	2015 UWMP	20,018	21,214	24,204	27,194	30,184	33,174
Mid-Peninsula Water District	2019 Preliminary ABAG	28,851	29,711	30,008	31,010	31,961	32,912
Millbrae, City of	2019 Preliminary ABAG	22,734	22,846	26,774	26,657	27,081	27,505

Service Areas	Projection Source	2023	2025	2030	2035	2040	2045
Milpitas, City of	2015 UWMP and 2019 Preliminary ABAG	87,160	90,400	98,100	106,000	109,100	112,200
Mountain View, City of	Provided by E. Anderson – General Plan Buildout	85,247	88,125	95,318	102,512	109,706	116,900
North Coast County Water District	Previous DSS Model	41,080	41,400	42,000	42,400	42,800	43,200
Palo Alto, City of	2015 UWMP	72,420	73,700	77,100	80,800	84,600	88,400
Purissima Hills Water District	Preliminary 2019 ABAG	6,827	6,833	6,898	7,025	7,112	7,199
Redwood City, City of	2015 UWMP	92,466	93,765	97,128	100,614	104,247	107,947
San Bruno, City of	Preliminary 2019 ABAG	42,619	43,100	44,328	47,080	51,922	56,764
San Jose, City of[3]	Preliminary 2019 ABAG	32,139	35,530	49,100	72,283	80,111	87,939
Santa Clara, City of	City of Santa Clara Community Development Department ABAG projections	134,991	137,215	142,425	151,715	159,500	167,285
Stanford University	Office of Institutional Research and Decision Support	33,912	34,748	36,922	39,226	41,342	43,525
Sunnyvale, City of	Preliminary 2019 ABAG	153,134	156,020	161,100	201,428	220,169	238,910
Westborough Water District	2015 UWMP	12,977	13,101	13,411	13,721	14,020	14,319
TOTAL		**1,908,054**	**1,941,725**	**2,032,304**	**2,187,849**	**2,311,562**	**2,438,515**

[1] California Department of Finance 2019 Population; 2020-2029 interpolation from 2019 DOF with 2017 ABAG/BAM 2030 projections; 2030-2040 from 2017 ABAG/BAM.

[2] Service area population was further reviewed and refined at the request of Menlo Park staff. Population minor update was made with support from the Project Team's analysis of census data with input from ABAG, which was then reviewed and approved by Menlo Park staff.

[3] Service area population estimates for San Jose represent San Jose Municipal Water System's northern San Jose service area, not the entire service area of the City of San Jose.

5.3 Individual Agency Water Demands with and without Conservation

Table 5-5, and Table 5-6 present BAWSCA individual member agency water demand projections through 2045, including the following for the Partial Rebound – Normal Economy, Weather Normalized scenario:

- Demands before incorporating future passive conservation savings
- Demands including projected passive conservation savings
- Demands including projected passive and active conservation savings

Table 5-4. Demand Projections Before Passive Conservation Savings (MGD)

Service Areas	2023	2025	2030	2035	2040	2045
Alameda County Water District	44.0	45.8	46.7	48.6	50.6	52.8
Brisbane/GVMID	0.9	0.9	0.9	1.0	1.0	1.0
Burlingame, City of	4.6	4.7	4.9	5.2	5.4	5.6
CWS - Bear Gulch District	12.8	13.3	13.4	13.7	13.8	13.9
CWS - Mid Peninsula District	13.4	13.6	13.7	13.8	13.9	14.0
CWS - South San Francisco District	7.1	7.4	7.5	7.6	8.4	9.1
Coastside County Water District	2.1	2.1	2.1	2.1	2.1	2.1
Daly City, City of	6.8	6.9	7.1	7.4	7.6	7.8
East Palo Alto, City of	1.9	2.1	2.2	2.4	2.9	3.4
Estero MID/Foster City	4.4	4.4	4.7	4.8	5.0	5.1
Hayward, City of	18.2	19.3	21.0	22.7	24.4	26.3
Hillsborough, Town of	3.2	3.4	3.4	3.4	3.4	3.4
Menlo Park, City of	3.9	4.2	4.7	5.2	5.6	6.1
Mid-Peninsula Water District	2.9	3.1	3.2	3.3	3.4	3.4
Millbrae, City of	2.4	2.4	2.7	2.7	3.2	3.6
Milpitas, City of	11.8	12.5	13.3	14.2	14.9	15.7
Mountain View, City of	10.6	11.3	12.0	12.7	13.5	14.2
North Coast County Water District	2.6	2.6	2.7	2.7	2.7	2.7
Palo Alto, City of	12.1	12.5	12.9	13.5	14.0	14.6
Purissima Hills Water District	2.0	2.1	2.1	2.2	2.2	2.2
Redwood City, City of	9.7	10.0	10.5	11.0	11.4	11.7
San Bruno, City of	3.5	3.6	3.7	3.9	4.2	4.5
San Jose, City of	6.0	6.3	7.2	9.0	10.0	11.0
Santa Clara, City of	21.9	22.5	24.1	25.2	25.9	26.6
Stanford University	3.0	3.2	3.4	3.6	3.9	4.1
Sunnyvale, City of	18.6	19.1	19.9	23.8	25.7	27.7
Westborough Water District	0.9	0.9	0.9	1.0	1.0	1.0
TOTAL*	231.1	240.3	251.1	266.7	280.0	293.6

** Total projections account for the total projected water demand in a service area water system regardless of source. Sources include purchases from SFPUC, groundwater, surface water, recycled water, desalination, SWP, or Valley Water.*

Table 5-5. Demand Projections with Passive Conservation Savings (MGD)

Service Areas	2023	2025	2030	2035	2040	2045
Alameda County Water District	42.4	43.7	43.7	44.6	45.8	47.3
Brisbane/GVMID	0.8	0.9	0.9	0.9	0.9	0.9
Burlingame, City of	4.4	4.5	4.6	4.7	4.8	4.9
CWS - Bear Gulch District	12.5	12.9	12.8	12.9	12.9	12.9
CWS - Mid Peninsula District	12.7	12.8	12.6	12.5	12.3	12.2
CWS - South San Francisco District	6.9	7.1	7.1	7.1	7.8	8.4
Coastside County Water District	1.9	1.9	1.9	1.9	1.8	1.8
Daly City, City of	6.4	6.4	6.3	6.4	6.4	6.5
East Palo Alto, City of	1.8	1.9	2.0	2.1	2.5	3.0
Estero MID/Foster City	4.2	4.2	4.4	4.4	4.5	4.6
Hayward, City of	17.2	18.1	19.1	20.2	21.3	22.6
Hillsborough, Town of	3.1	3.3	3.3	3.3	3.3	3.3
Menlo Park, City of	3.7	4.0	4.4	4.8	5.1	5.5
Mid-Peninsula Water District	2.8	2.9	2.9	3.0	3.0	3.0
Millbrae, City of	2.3	2.3	2.6	2.5	2.9	3.3
Milpitas, City of	11.3	11.9	12.4	13.0	13.5	14.0
Mountain View, City of	10.2	10.8	11.2	11.7	12.1	12.6
North Coast County Water District	2.4	2.4	2.4	2.3	2.3	2.3
Palo Alto, City of	11.7	12.0	12.3	12.6	13.0	13.4
Purissima Hills Water District	2.0	2.1	2.1	2.1	2.2	2.2
Redwood City, City of	9.3	9.4	9.7	9.9	10.0	10.2
San Bruno, City of	3.3	3.4	3.4	3.5	3.7	3.9
San Jose, City of	5.7	5.9	6.6	7.9	8.7	9.4
Santa Clara, City of	21.3	21.8	23.0	23.8	24.2	24.6
Stanford University	2.9	3.1	3.3	3.5	3.7	4.0
Sunnyvale, City of	17.9	18.3	18.6	21.8	23.3	24.8
Westborough Water District	0.9	0.9	0.9	0.8	0.8	0.8
TOTAL*	222.0	228.9	234.3	244.3	253.1	262.4

** Total projections account for the total projected water demand in a service area water system regardless of source. Sources include purchases from SFPUC, groundwater, surface water, recycled water, desalination, SWP, or Valley Water.*

Table 5-6. Demand Projections with Passive and Active Conservation Savings (MGD)

Service Areas	2023	2025	2030	2035	2040	2045
Alameda County Water District	41.6	42.7	42.5	43.3	44.5	46.0
Brisbane/GVMID	0.8	0.9	0.9	0.9	0.9	0.9
Burlingame, City of	4.3	4.4	4.5	4.6	4.7	4.8
CWS - Bear Gulch District	12.3	12.7	12.6	12.8	12.7	12.7
CWS - Mid Peninsula District	12.5	12.5	12.4	12.2	12.0	11.9
CWS - South San Francisco District	6.8	7.0	7.0	7.0	7.6	8.2
Coastside County Water District	1.9	1.9	1.9	1.9	1.8	1.8
Daly City, City of	6.4	6.3	6.2	6.3	6.3	6.4
East Palo Alto, City of	1.8	1.9	1.9	2.1	2.5	2.9
Estero MID/Foster City	4.1	4.1	4.1	4.2	4.2	4.4
Hayward, City of	17.0	17.9	18.7	19.8	20.8	22.1
Hillsborough, Town of	3.1	3.3	3.3	3.2	3.2	3.2
Menlo Park, City of	3.7	4.0	4.3	4.7	5.1	5.5
Mid-Peninsula Water District	2.8	2.9	2.8	2.9	2.9	2.9
Millbrae, City of	2.3	2.3	2.5	2.5	2.9	3.2
Milpitas, City of	11.1	11.6	12.0	12.6	13.0	13.6
Mountain View, City of	10.0	10.5	10.9	11.2	11.5	11.9
North Coast County Water District	2.3	2.3	2.3	2.3	2.2	2.2
Palo Alto, City of	11.5	11.8	12.0	12.3	12.6	13.0
Purissima Hills Water District	2.0	2.1	2.1	2.1	2.1	2.2
Redwood City, City of	9.1	9.2	9.3	9.5	9.6	9.8
San Bruno, City of	3.3	3.4	3.4	3.4	3.6	3.9
San Jose, City of	5.7	5.9	6.5	7.9	8.7	9.4
Santa Clara, City of	21.1	21.5	22.6	23.3	23.7	24.1
Stanford University	2.9	3.1	3.3	3.5	3.7	3.9
Sunnyvale, City of	17.9	18.2	18.5	21.6	23.0	24.5
Westborough Water District	0.8	0.9	0.9	0.8	0.8	0.8
TOTAL*	219.0	225.1	229.2	238.8	247.0	256.3

**Total projections account for the total projected water demand in a service area water system regardless of source. Sources include purchases from SFPUC, groundwater, surface water, recycled water, desalination, SWP, or Valley Water.*

6 RECOMMENDATIONS AND NEXT STEPS

BAWSCA will utilize the results of the Demand Study to support implementation of its Long-Term Reliable Water Supply Strategy. In particular, the Demand Study results will support decisions as to which new conservation measures to incorporate in BAWSCA's Regional Water Conservation Program.

This section also offers details on the California legislation regarding new water conservation requirements, the implementation schedule for the legislation, and how that relates to the recommended next steps for BAWSCA and its member agencies.

6.1 Recommendations

Recommendations to assist with future conservation program development and implementation include the following:

- Engage in the state processes to establish the requirements associated with implementation of the AB 1668 and SB 606 legislation.
- Prioritize measures for implementation with the highest priority given to those that contribute the most to meeting water saving targets, fulfill regulatory requirements, or provide opportunities for partnership. To launch implementation of a conservation program, BAWSCA may consider answering a series of key questions to determine the measures, budget and schedule. These questions include:
    - What level of support will be required from conservation staff to run the selected measures?
    - What other support (e.g., outsourced support or other sources of funding) is needed or wanted to run these programs?
- Form partnerships for cost-sharing and outreach. To identify partnership opportunities, consider co-benefits of measures prioritized for implementation and connect with organizations whose objectives are in alignment. Engage potential partners early in the design of measures. Apply for grants where appropriate.
- Consider opportunities for customer engagement to increase participation in conservation measures. Early partnership with community organizations may be beneficial in implementing measures in a manner that is accessible to customers and in effectively communicating the benefits of participation to attract customer interest.
- Continue to track and manage measure participation, cost, and other data to gauge successes and areas for improvement.
- Support BAWSCA agencies in taking steps to differentiate between residential and non-residential dedicated irrigation use in their billing systems in order to: 1) support compliance with the state requirements; and 2) improve future per capita water use forecasting.
- Continue to track the impact of the COVID-19 pandemic on employment and total water production. Revisit water demands as appropriate to incorporate recent events into planning efforts.

At this point, no formal commitment has been made at the BAWSCA region-wide or individual agency level to implement the new water conservation measures that were evaluated as part of the Demand Study. BAWSCA will work with the member agencies to further evaluate these programs and to implement new regional programs as appropriate. BAWSCA recognizes that actual implementation of water conservation to achieve the identified water savings goals must be managed in an adaptive fashion, making both small and large program changes as needed over time.

6.2 Adapting to the California Legislation and the Pending Regulations

On April 7, 2017, the California Department of Water Resources (DWR) released the "Making Water Conservation a California Way of Life, Implementing Executive Order B-37-16" Final Framework Report (California Department of Water Resources et al, 2017). The State Framework Report, which builds upon Governor Brown's call for new long-term water use efficiency requirements in Executive Order (EOs) B-37-16, provided the state's proposed approach for implementing new long-term water conservation requirements. A key element of the report was proposed new water use targets for urban water suppliers that go beyond existing Senate Bill X7-7 (SB X7-7; Steinberg)[12] requirements and are based on strengthened standards for indoor residential per capita use, outdoor irrigation, commercial, industrial and institutional water use (CII), and water loss.

On May 17, 2018, the California Legislature adopted AB 1668 (Friedman) and SB 606 (Hertzberg) to implement new long-term water use efficiency requirements, including new urban water use objectives for urban water suppliers. This legislation incorporated some key components of the State Framework Report, although some specific elements of the approach for implementing the new water use objectives were changed during the legislative process.

Adopted Legislation and Regulatory Schedule

The California legislation accomplishes the following:

- Requires the SWRCB, in coordination with DWR, to adopt long-term standards for the efficient use of water.
- Establishes specified standards for per capita daily indoor residential use; in addition to performance measures for CII water use, and with stakeholder input, the SWRCB will adopt long-term efficiency standards for outdoor water use and water loss through leaks.
- Provides SWRCB with the option to adopt long-term efficiency standards for outdoor water use and water loss through leaks, in addition to performance measures for CII water use and with stakeholder input.
- Requires each urban retail water supplier to calculate and report an urban water use objective (which is an estimate of aggregate efficient water use for the previous year based on the adopted water use efficiency standards) and compare that objective to actual water use; to be reported initially by November 1, 2023, then by November 1st every year thereafter.
- Grants SWRCB the authority to enforce compliance with the urban water use objectives, with enforcement actions increasing over the first three years of implementation.
- Establishes a schedule for state agencies to develop the methodology for implementing the requirements, as presented in the following table.

As of June 2020, current regulatory implementation schedule and details of each element of the legislation is provide in Table 6-1.

[12] SB X7-7, also known as the Water Conservation Act of 2009, was a significant amendment introduced after the drought of 2007-2009 and because of the California governor's call for a statewide 20% reduction in urban water use by the year 2020. See the California Department of Water Resources website for more information: https://water.ca.gov/Programs/Water-Use-And-Efficiency/SB-X7-7

Table 6-1. Implementation Schedule for AB 1668 and SB 606 Key Requirements

Date	AB 1668/SB 606 Key Requirement
January 1, 2021	1. DWR to recommend to CA Legislature standards for indoor residential water use. Defaults are: • 55 GPCD until 2025 • 52.5 GPCD from 2025 until January 2030 • 50 GPCD beginning in 2030 2. DWR to provide each urban retail water supplier with data regarding irrigable lands at level of detail sufficient to verify accuracy at the parcel level
October 1, 2021	1. DWR to recommend standards for outdoor residential use for adoption by SWRCB: • Incorporate Model Water Efficient Landscape Ordinance (MWELO) principles • Applies to irrigable lands • Include provisions for swimming pools, spas, etc. 2. DWR to recommend performance measures for CII water use including: • CII classification system • Minimum size thresholds for converting mixed CII meters to dedicated irrigation meters • Recommendations for CII best management practices 3. DWR to recommend variance provisions for: • Evaporative coolers • Horses and livestock • Seasonal populations • Soil compaction/dust control • Water to sustain wildlife • Water for fire protection 4. DWR to recommend standards for outdoor irrigation of landscape areas with dedicated irrigation meters: • Incorporate MWELO principles
June 30, 2022	1. SWRCB to adopt long-term standards for efficient water use: • Outdoor residential • Outdoor irrigation of landscape with dedicated irrigation meters at CII customer sites • Water loss (consistent with Senate Bill 555) 2. SWRCB to adopt performance measures for CII water use
November 1, 2023	1. Urban water supplier shall calculate its urban water use objective and its actual water use for previous calendar or fiscal year: • Efficient indoor residential water use, plus • Efficient outdoor residential water use, plus • Efficient outdoor water use through dedicated irrigation meters at CII customer sites, plus • Efficient water loss, plus • Variances as appropriate

6.3 Next Steps

Most of the BAWSCA member agencies are required to prepare 2020 UWMPs, which are due to DWR by July 2021. Member agencies may elect to utilize the demand and conservation savings projections developed through this Demand Study in completion of their respective UWMPs. Member agencies may also update these demands for the 2020 UWMPs, if necessary, to incorporate new information for their respective service areas.

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APPENDIX A. BAWSCA DEMAND ANALYSIS SURVEY QUESTIONS

Following are the April 2019 BAWSCA Demand Analysis Survey questions that were included in the Data Workbook. These are provided here for reference only. Individual agency responses are in each agency's Data Workbook file.

1.	**Please provide the name and contact information for any individuals completing this survey (including outside consultants).**
2.	What is your agency's main objective or what results would your agency like to achieve as part of this project?
3.	Does your planning department have any projected growth by land use type and/or associated land use water demands that you would like considered as part of this effort?
4.	Would you like to provide building activity from any relevant Building Departments (number of permits, value of construction, etc.) to be considered in this analysis?
5.	Does your agency's 2015 Urban Water Management Plan (UWMP) include the most recent water demand projections prepared by or for your agency? Please identify any documents (other than your agency's 2015 UWMP) that describe your service area's existing demand projection methodology on the Planning Documents tab in this workbook.
6.	Does your agency intend to update demand projections independent of this project between now and 2020 for the 2020 UWMP or any other project (e.g., Water Supply Assessment)? If yes, when and for which projects?
7.	Please describe any notable water use trends within your service area over the last five years (i.e., a decline or increase). Does your agency have any specific knowledge of why the trend occurred (e.g., a large business closed or moved into service area, significant foreclosures or large development, recent economic recovery)?
8.	What is your agency's perspective on what future trends in water demands might be? Is your agency aware of any large developments or planned changes in the service area that would increase or decrease demands in the near or long-term future that are not reflected in the current demand forecast (i.e., published in your agency's 2015 UWMP)?
9.	Please describe any major account re-classifications or billing system upgrades that took place in your service area (i.e., multifamily accounts were reclassified from CII into a class of their own). Please include the specific type of change and when the change took place.
10.	Do sewer charges appear on your agency's customers' water bills? If "Yes," please provide sewer rate histories by customer class corresponding chronologically to the water rate histories. If "No," which sanitation district serves your agency's water service area (if separate agency)? Can you assist us in obtaining sewer rate data from that agency?
11.	Do you plan to expand potable water reuse before 2045? What volume do you plan to add? Will this volume offset current potable water use?
12.	Are you planning any non-potable reuse projects that might offset potable demand?
13.	Please confirm the service area's most recent water audit data can be found on DWR's WUE site here: https://wuedata.water.ca.gov/awwa_plans. Is this accurate and representative of your system's current water loss?
14.	Do you currently have combined mixed use meters/buildings? Do you project having mixed use meters/buildings in any future development? Can you provide us with any data for this?
15.	If you save water through conservation (or your demand is lower in a year), would the water source you would cut back on be SFPUC water supplies?
16.	Do you have any additional comments, questions or concerns about this project or planning process you would like to share?

APPENDIX B. ECONOMETRIC MODEL DESCRIPTION AND FRAMEWORK

This appendix describes the Econometric Modeling process, framework, and results.

B.1 Introduction

In the past, BAWSCA has relied on projections of population and jobs to predict future baseline water demand. Residential demand was projected by multiplying per household use by population growth; Commercial, Institutional, and Industrial (CII) demand was prepared by multiplying per employee use by projected job growth. Then, these estimates of baseline demand were converted into estimates of net demand by subtracting likely savings from various plumbing codes and active conservation programs. While the simplicity of this methodology makes it appealing and easy to understand, econometric analysis studying historical data (assuming historical relationships remain valid) can provide helpful information for answering questions about changing demand patterns (i.e., How much will demand rebound as drought impacts recede and as economic and weather conditions return to normal?). To address such questions, econometric demand models have been developed for each agency to estimate the relationship between water demand and its key drivers, such as price, economic conditions, and weather (Equation 1).

Based on this analysis, the following best-fit equation was developed:

$$Ln(monthly\ GPCD) = \alpha + \beta Trend + \theta Ln(unemployment\ rate) + \delta Ln(marginal\ price) + \vartheta Temperature\ Deviation + \psi Rainfall\ Deviation + \pi monthly\ indicators + \phi drought\ restriction\ indicators + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Eq.\ 1$$

Where,

Monthly production is measured in gallons per capita per day (GPCD)

α is a scaling constant. Trend is a variable that takes on a value of 0 in the first year, 1 in the second year, and so on

Unemployment rate is captured as an annual percent (for example, 7%)

Marginal price for single family customers is measured in dollars per hundred cubic feet deflated by the consumer price index

Temperature deviation is measured in degrees Fahrenheit (average maximum daily temperature in a given month minus average for the same month between 1995 and 2006)

Rainfall deviation is measured in total inches (total rainfall in a given month minus average total rainfall for same month between 1995 and 2006)

Monthly indicators are binary 0-1 variables, taking on a value of 1 for a given month in question, 0 otherwise

Drought restriction indicator variables for affected months during the 2014-2017 period

ε denotes random statistical error

Sources for these data are indicated below:

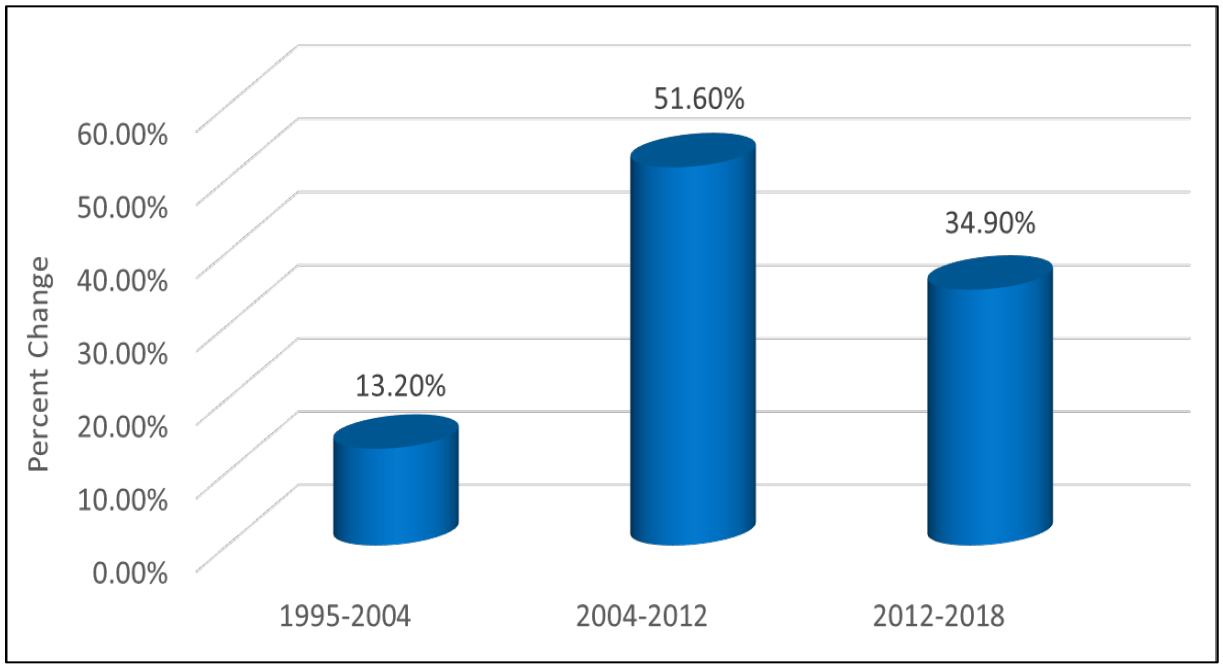
Each variable on the right-hand side of the equation (independent variable) is preceded by a coefficient (e.g., β, etc.) that measures the strength of the impact of an independent variable on monthly demand. (The variable on the left-hand side of the equation is also known as the dependent variable.) A positive coefficient implies that increases in an independent variable will cause an increase in the dependent variable; a negative coefficient implies the opposite. The purpose of model development is both to select the elements of the equation and to estimate each independent variable's coefficient. Continuous variables, such as the marginal price and the unemployment rate, are logarithmically transformed so that their respective coefficients can be given a

proportional interpretation. For example, the coefficient on logarithmically transformed marginal price becomes the price elasticity. The trend variable captures changes in GPCD over time not accounted for by price, unemployment rate, or weather.

Our basic model specification (Eq. 1) includes several features. First, agency-specific production data are modeled at a monthly, not annual, level. Estimating monthly level models allows for the impact of weather to vary by time of year. Prior research strongly indicates that abnormal temperature and abnormal rainfall do not have the same effect in January as, say, in May.[13] Working with monthly production data allows one to incorporate time-varying weather effects. Second, temperature and rainfall enter the model as deviations from their respective monthly averages, capturing directly how demand reacts to weather as it deviates from the average. Normal seasonality in monthly demand (i.e., July demand being much higher than January demand) is captured by the monthly indicator variables. Temperature and rainfall data were obtained from the closest NOAA stations throughout the San Francisco Bay Area. Third, economic conditions are captured by the unemployment rate obtained from the Bureau of Labor Statistics. This metric is available at a granular level and is useful for capturing economic cycles impacting water demand.

Finally, the models also include a measure of the marginal price of water in real terms (i.e., price deflated by the consumer price index published by the Bureau of Labor Statistics). Marginal price of water faced by the average single family customer in an agency has been used to depict price variation over time. By and large, CII and Single Family Residential (SFR) price trends appear similar. Figure B-1 shows price escalation faced by single family customers in the BAWSCA service area overall, calculated as a weighted average of each BAWSCA member agency's price data. The price and unemployment rate data are available at a water supplier level (the latter by town or city) so that these metrics can be tailored to each member agency's service area. In other words, each BAWSCA member agency has its own marginal price and unemployment rate metric, including a weather metric from the closest NOAA station.

Figure B-1. BAWSCA Region-Wide Trends in Single Family Real Price of Water



Note: The increase in price represents the BAWSCA member agency share for funding the $4.6 billion Water System Improvement Program.

[13] Bamezai, A. (2011). *GPCD Weather Normalization Methodology*, final report submitted to the California Urban Water Conservation Council.

B.2 Model Results

As shown in Equation 1, a model was developed for each agency using its unique data. To illustrate the method in general, a monthly GPCD model also was developed for all BAWSCA agencies combined; results for this "rolled-up" region-wide model are shown in Table B-1. This type of model is known as a time-series, cross-sectional model. This region-wide model incorporates agency-level fixed effects, a correction for autocorrelation in the error term, and population weighting to account for different agency sizes. Agency-specific fixed effects capture the impact of agency characteristics that do not vary much over time, such as average household income and lot size, leading to a much more robust model specification than one without these fixed effects. In other words, the model captures the impact on GPCD of income, lot size, and other unobservable time-invariant differences across agencies implicitly through these fixed effects.

In addition to the fixed effects, each agency is allowed to have its own time trend, if necessary, to capture the impact of service area dynamics that influence water use but are not fully captured by price, unemployment rate, or weather. The normal seasonality in water use also is allowed to vary across agencies. The impact of weather deviations from normal weather is allowed to vary by season and across agencies by interacting these deviation variables with an agency's transformed seasonal peaking factor[14]. A greater summer-winter differential indicates a greater prevalence of weather-sensitive end uses, making the impact of non-normal weather correspondingly greater. The feasibility of using peaking factors to scale the impact of non-normal weather across agencies was demonstrated by the study cited earlier that was completed for the California Urban Water Conservation Council (Bamezai, 2011). Those concepts have been applied here as well.

An important goal of the Econometric Modeling is to forecast what water demand would have been in 2018 had the drought of 2014-2017 not occurred. The gap between actual 2018 demand and model-predicted demand then provides an estimate of potential rise in demand over the next several years (assumed to be 5 years: 2019-2023). This potential rise is down-corrected to account for the effect of plumbing codes and expected rate increases between 2018 and 2023 that will continue to place downward pressure on demand. The potential rise also is corrected to reflect normal weather and normal economic conditions, which then yields the expected demand for 2023 under these conditions.

It is important to test the stability of Eq. 1 by estimating it using only pre-drought data (1995-2013) excluding the drought restriction indicators; then doing so again using all the available data (1995-2018) including the drought restriction indicators. The estimated coefficients on the metrics used to capture variation in price, economic conditions, and weather should not change significantly between these two model specifications, implying that the pre-drought historical relationships are holding during the drought period. The models used here meet this stability condition. The effect of active conservation programs undertaken between 2019 and 2023 is yet to be layered into these forecasts because such layering will cause the demand forecast for the years 2019-2023 to decrease further. In addition, it will affect the post-2023 forecasts.

The estimated pre-drought region-wide model (Table B-1) has three columns: 1) the estimated coefficient, 2) the likely band of error surrounding this coefficient (referred to as standard error), and 3) the t-statistic. An independent variable's t-statistic is the ratio of the coefficient over its standard error. A t-statistic higher than 1.96 or lower than -1.96 indicates a statistically significant relationship at 5% level of significance between the dependent and independent variable; a t-statistic between -1.96 and 1.96 indicates that the data are not able to conclusively demonstrate a relationship. The latter finding may reflect the lack of any relationship, data errors, or other problems (e.g., two or more independent variables being highly correlated with one another). The model's R-Square value (R^2), which is indicative of the explanatory power of a statistical model, is shown at the

[14] Peaking factor is calculated by dividing maximum monthly summer demand by minimum winter monthly demand in any given year, then averaging these ratios across all years included during the baseline period. Transformed peaking factor is calculated as 1-(1/Peaking Factor).

bottom of Table B-1. It can vary between zero and a maximum of 1, with higher numbers indicating greater explanatory power.

The coefficients in Table B-1 have the following interpretations:

- A price elasticity of -0.2 indicates that a 10% real increase in the marginal price of water can be expected to reduce demand by 2%. BAWSCA's region-wide estimate of price elasticity compares well with the published literature on this topic.
- A 10% increase in the annual unemployment rate is likely to depress water demand by 0.05%, a statistically significant effect, but one weaker than price.
- All weather coefficients are significant and behave in expected ways. For an agency with a peaking factor of 2, or a transformed peaking factor of 0.5 (a typical agency peaking factor), an extra inch of rainfall per month during the spring reduces monthly demand by about 6.6%, while the same extra inch during the winter only depresses monthly demand by 0.5%.
- On the temperature dimension, if daily maximum temperature is 1 degree higher on average in a given month, monthly water demand is likely to increase by 1.0% during the spring, 0.5% during the summer, and 1.1% during late fall and winter. Lower than average temperatures would have the opposite effect.

The monthly dummy variables also exhibit the expected pattern with July showing the largest coefficient, indicating that July demand is greatest during the year. The coefficient reaches a minimum during January.

Table B-1. BAWSCA Region-Wide Pre-Drought Model Results

Dependent Variable: Ln(Monthly Baseline GPCD)

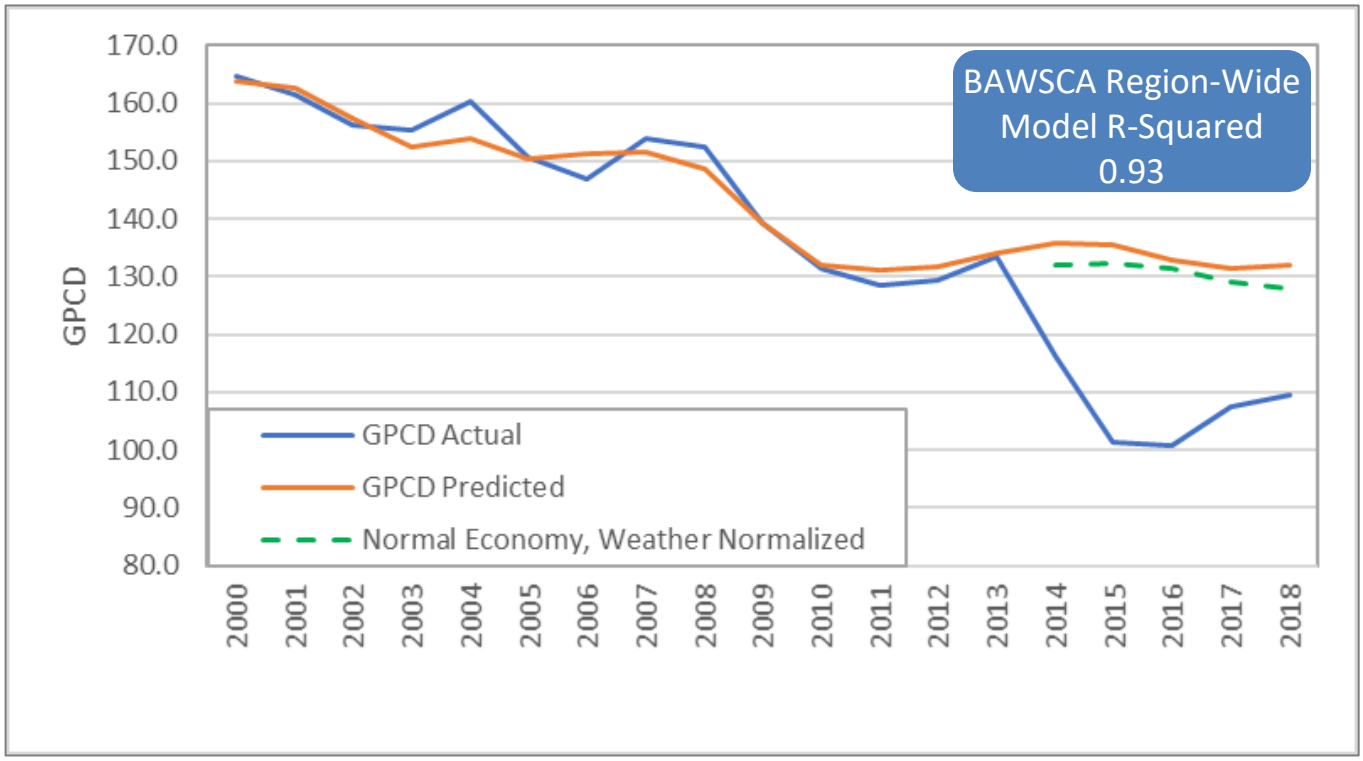
Independent Variable	Coefficient	Standard Error	t-statistic
Ln(Marginal Price)	-0.200	0.015	-13.1
Ln(Unemployment Rate)	-0.052	0.007	-7.8
Temperature Deviation (Apr-Jun) x TPF[1]	0.019	0.002	8.3
Temperature Deviation (Jul-Oct) x TPF	0.013	0.002	5.6
Temperature Deviation (Nov-Mar) x TPF	0.023	0.002	12.2
Rain Deviation (Apr-Jun) x TPF	-0.137	0.008	-17.6
Rain Deviation (Jul-Oct) x TPF	-0.054	0.009	-6.0
Rain Deviation (Nov-Mar) x TPF	-0.01	0.002	-5.7
Feb Indicator	0.017	0.014	1.2
Mar	0.104	0.016	6.5
Apr	0.271	0.017	16.0
May	0.478	0.017	27.7
Jun	0.641	0.017	36.8
Jul	0.690	0.017	39.5
Aug	0.680	0.017	39.1
Sep	0.612	0.017	35.4
Oct	0.436	0.017	25.7
Nov	0.169	0.016	10.5
Dec	0.035	0.014	2.5
Constant	4.899	0.016	311.6
Agency-Specific Fixed Effects[2]	Included		
Agency-Specific Trend Terms[2]	Included		
Agency Interactions with Monthly Dummies[2]	Included		
R-Square	0.93		

[1] *TPF denotes transformed peaking factor.*

[2] *For the sake of brevity, the large number of coefficients associated with the agency-specific fixed effects, agency-specific trend terms, and agency interactions with monthly dummies are not shown.*

Figure B-2 shows how the model prediction compares with BAWSCA's region-wide GPCD trend during the pre-drought period since that is the period from which the model is estimated. The resulting R^2 value of 0.93 shows that there is a high correlation between actual and predicted values. The model quite accurately captures the downturn in demand experienced during the Great Recession of 2008-2010 and subsequent recovery until 2013. Beyond 2013, the model is used to forecast what demand would have been without the drought, taking into account a strengthening economy tempered by ongoing rate increases and conservation. The dotted green line in Figure B-2 shows the Normal Economy, Weather Normalized model forecast. The gap between actual 2018 demand and the dotted green line provides an initial estimate of what fully rebounded demand should be. It is not logical to assume that actual demand will jump to the dotted green line within a shorter period of time (i.e., a year). Instead, it is assumed that actual demand will meet the declining dotted green line in 2023. The dotted green line's position in 2023 is calculated by factoring in the effect of plumbing codes and rate increases between 2018 and 2023.

Figure B-2. BAWSCA Region-Wide Econometric Model Fit and Forecast



APPENDIX C. BAWSCA-WIDE DEMAND PROJECTIONS

In Table C-1 and in Figure C-1 the BAWSCA region-wide demand projections are shown with passive savings. Active conservation has not been incorporated into any of the four scenarios. These values are intended to be used for general comparison of ranges in potential future water demands if no active conservation was implemented.

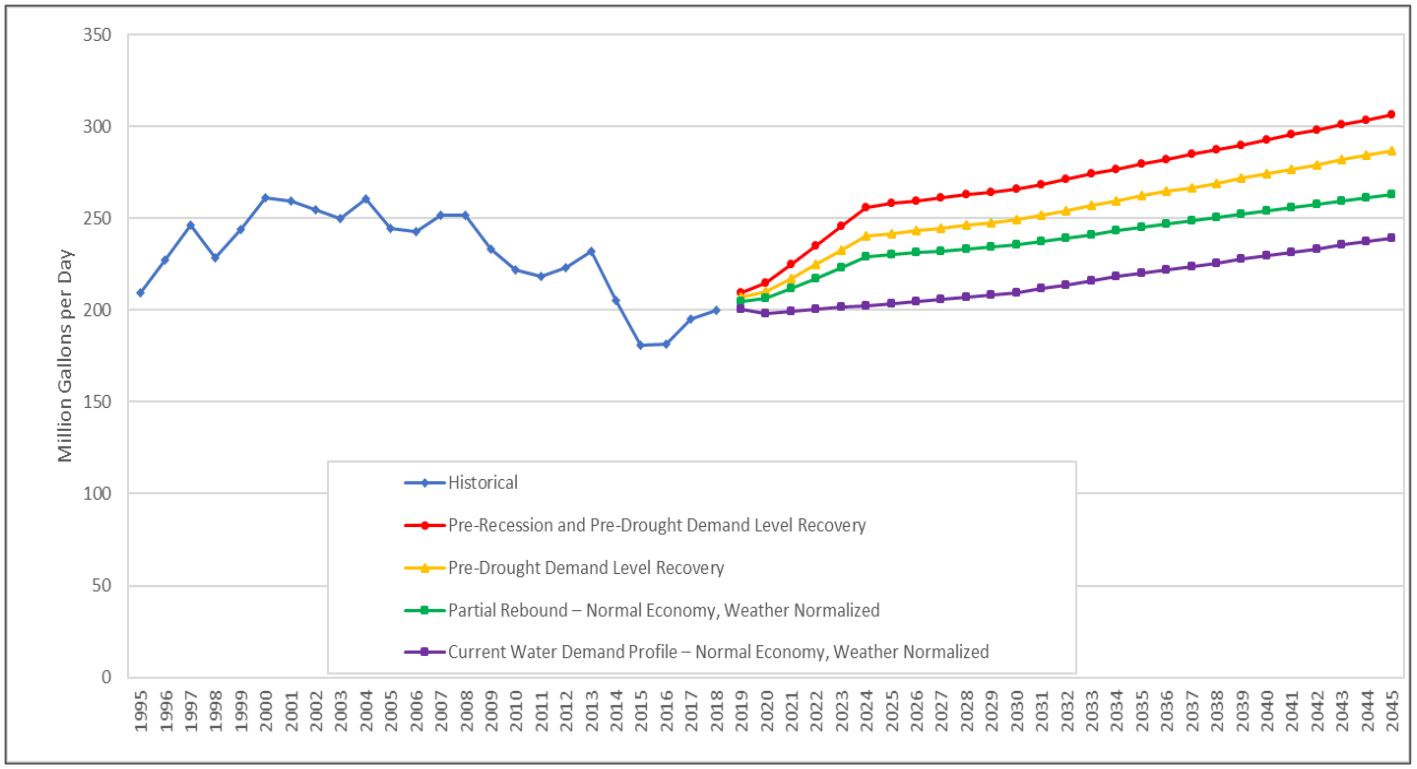
Table C-1. BAWSCA Region-Wide Demand Projections Including Passive Savings[1] in MGD

Demand Forecast Scenarios	2023	2025	2030	2035	2040	2045
Pre-Recession and Pre-Drought Demand Level Recovery	245.4	257.9	265.8	279.7	292.5	306.3
Pre-Drought Demand Level Recovery	232.3	241.8	249.1	262.2	274.0	286.8
Partial Rebound – Normal Economy, Weather Normalized[2]	222.0	229.0	234.3	244.3	253.1	262.5
Current Water Demand Profile – Normal Economy, Weather Normalized	201.4	203.5	209.7	220.3	229.6	239.3

[1] Total water demand accounts for the total projected demand in a service area water system regardless of source, which can be from SFPUC, groundwater, surface water, recycled water, desalination, SWP, or Valley Water.

[2] The Partial Rebound scenario was used for the active conservation analysis portion of the project, which was provided to all individual BAWSCA agencies for review in Technical Memorandum 3.

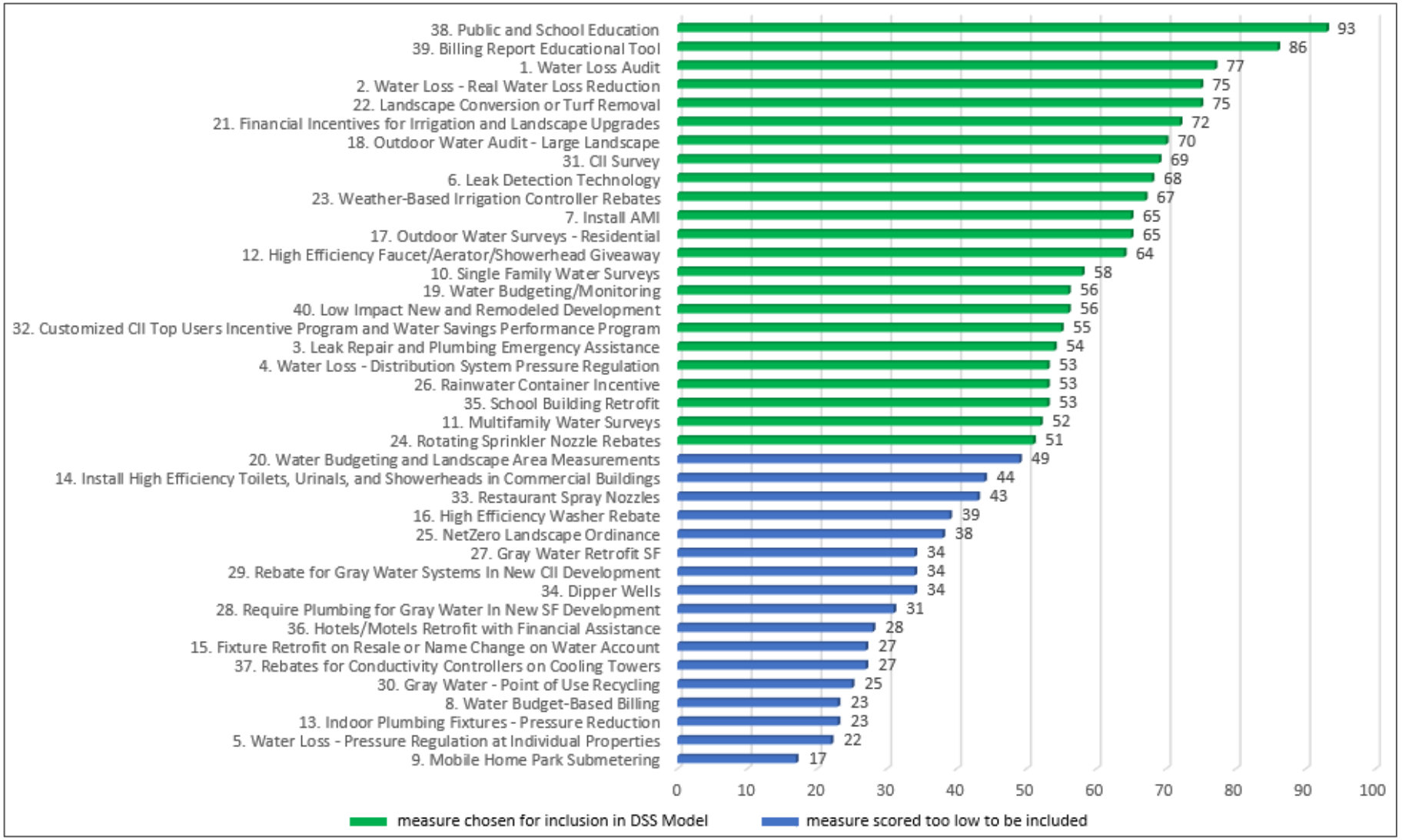
Figure C-1. BAWSCA Region-Wide Demand Projection



APPENDIX D. CONSERVATION MEASURES SCREENING RESULTS

The following figure and table present the results of the January 2020 online survey conducted through SurveyMonkey that solicited BAWSCA member agency feedback on conservation measures that would be considered in the DSS Model analysis.

Figure D-1. Summary of Online Survey Ranking of Water Use Efficiency Measures



Note: The number to the right of each measure color block is that particular measure's score based on BAWSCA member agency rankings where 5 points were given for "High Interest", 3 points were given for "Medium Interest", 1 point was given for "Low Interest", and no points were given for "No Interest" or "Not Applicable."

Table D-1. Water Use Efficiency Measure Descriptions

No.	Measure Name	Description
1	Water Loss Audit	Maintain a thorough annual accounting of water production, sales by customer class, and quantity of water produced but not sold (non-revenue water). This provides a picture of your system, including water usage patterns and trends needed to identify appropriate conservation activities. In conjunction with system accounting, include audits that identify and quantify known legitimate uses of non-revenue water in order to determine remaining non-revenue water losses. Goal would be to lower the Infrastructure Leakage Index (ILI) and non-revenue water every year by a pre-determined amount based on cost effectiveness. These programs typically pay for themselves based on savings in operational costs (and saved rate revenue can be directed more to system repairs/replacement and other costs). Continuously analyze billing data for system errors and mis-registering meters. Identify and quickly notify customers of apparent leaks. Address meter testing and repair/replacement to insure more accurate meter reads and revenue collection. Actions could include meter calibration and accelerated meter replacement.
2	Water Loss – Real Water Loss Reduction	Measure covers efforts to find and repair leaks in distribution system to reduce real water loss. Actions could include installation of data loggers and proactive leak detection. Leak repairs would be handled by existing crews at no extra cost. A ten-year program to reduce non-revenue water to a lower target level such as 10% of production or less could be proposed for a combination of this measure and actions to reduce apparent water losses. Specific goals and methods to be developed by the utility.
3	Leak Repair and Plumbing Emergency Assistance	Customer leaks can go uncorrected at properties where owners are least able to pay costs of repair. These programs may require that customer leaks be repaired, but either subsidize part of the repair and/or pay the cost with revolving funds that are paid back through water bills over time. May also include an option to replace inefficient plumbing fixtures at low-income residences.
4	Water Loss – Distribution System Pressure Regulation	Install additional pressure regulators in portions of distribution system to maintain pressure within limits so accounts do not receive excessive pressure. High correlation between high water usage and high pressure, due to higher leakage, atomization of sprinklers, and ease of using excessive water.
5	Water Loss – Pressure Regulation at Individual Properties	Install pressure regulators at properties where pressure is above a certain level and pressure regulation is found to be lacking or inadequate. Plumbing codes require installation of pressure regulation when pressure exceeds 80 psi. However, this does not always occur and/or regulators are installed improperly or in locations where they do not serve the irrigation system, resulting in significant waste. Utility could fund and facilitate appropriate installation of regulators, first targeting neighborhoods with the highest pressure. Utility may need to impose regulations to require that such installations are made and maintained thereafter.

No.	Measure Name	Description
6	Leak Detection Technology	Leak detection technology system that allows for remote shutoff with a smart phone interface. Might target second homes that are often vacant, which could leak for extensive periods while left unattended. Might require for new homes. Customer instant access to water use data by installing a flow sensor. Primarily residential. Can monitor indoor only, whole site meter use, and/or irrigation only use. Example products are listed online: www.gearbrain.com/smart-leak-and-flood-detectors-2563785823.html and www.robeau.tech/en/.
7	Install AMI	Retrofit system with AMI meters and associated network capable of providing continuous consumption data to the utility offices. Improved identification of system and customer leaks is major conservation benefit. Some costs for these systems are offset by operational efficiencies and reduced staffing, as regular meter reading and those for opening and closing accounts are accomplished without need for physical or drive-by meter reading. Also enables enhanced billing options and ability to monitor unauthorized usage (such as use/tampering with closed accounts or irrigation if time of day or days per week are regulated). Customer service is improved as staff can quickly access continuous usage records to address customer inquiries. Optional features include online customer access to usage which has been shown to improve accountability and reduce water use. A ten year change-out would be a reasonable objective.
8	Water Budget-Based Billing	Develop individualized monthly water budgets for all or selected category of customers. Water budgets are linked to a rate schedule where rates per unit of water increase when a customer goes above their budget or decreases if they are below their budget. Budgets typically are based on such factors as the size of the irrigated area and often vary seasonally to reflect weather during the billing period. These rates have been shown to be effective in reducing landscape irrigation demand (AWWARF reports). Would require rate study and capable billing software. Assume 10% of accounts receive new budgets per year and would be reviewed periodically to remain current.
9	Mobile Home Park Submetering	Require or provide a partial cost rebate to meter all sites within a mobile home park that is currently master metered. Pattern after Valley Water (Santa Clara Valley Water District) program.
10	Single Family Water Surveys	Indoor water surveys for existing single family residential customers. Target those with high water use and provide a customized report to owner. May include give away of efficient showerheads, aerators, toilet devices. Usually combined with outdoor surveys (See Irrigation Measures).
11	Multifamily Water Surveys	Indoor water surveys for existing multifamily residential customers (2 units or more). Target those with high water use and provide a customized report to owner. Usually combined with outdoor surveys (see Irrigation Measures) and sometimes with single family surveys.
12	High Efficiency Faucet/ Aerator/ Showerhead Giveaway	Utility would buy high efficiency showerheads and faucet aerators in bulk and give them away at the utility office or community events.

No.	Measure Name	Description
13	Indoor Plumbing Fixtures – Pressure Reduction	Provide incentive to install pressure regulating valve on existing properties with pressure exceeding 80 psi.
14	Install High Efficiency Toilets, Urinals, and Showerheads in Commercial Buildings	Consider direct install program, rebates, or grants for installation of high efficiency fixtures in all or selected commercial or institutional buildings. Replacements would include high efficiency toilets, showerhead, and waterless or high efficiency urinals.
15	Fixture Retrofit on Resale or Name Change on Water Account	Work with the real estate industry to require submission of a certificate of compliance to the utility verifying that a plumber has inspected the property and efficient fixtures were either already there or were installed before close of escrow. This is an upgraded enforcement approach for implementing the existing code: Require Fixture Retrofit on Resale or Name Change on Water Account or Renovation. Pattern after Los Angeles, San Diego or Santa Cruz programs.
16	High Efficiency Washer Rebate	Provide a rebate for the installation of a high efficiency commercial washer (HEW). Rebate amounts would reflect the incremental purchase cost. Program would shorter-lived as it is intended to be a market transformation measure that eventually would be stopped as efficient units reach saturation.
17	Outdoor Water Surveys – Residential	Outdoor water surveys offered for existing customers. Normally those with high water use are targeted and provided a customized report on how to save water. Can be combined with indoor surveys or focused on certain customer classes. All single family and multifamily residential would be eligible for free landscape water surveys upon request.
18	Outdoor Water Audit - Large Landscape	Outdoor water audits offered for existing large landscape customers. Normally those with high water use are targeted and provided a customized report on how to save water. All large multifamily residential, CII, and public irrigators of large landscapes would be eligible for free landscape water audits upon request. Tied to the Water Budget Program.
19	Water Budgeting/ Monitoring	Website that provides feedback on irrigation water use (budget vs. actual). Model after Municipal Water District of Orange County's Landscape Certification Program. Could be created by a consultant, agency, or customer on website.
20	Water Budgeting and Landscape Area Measurements	Require water budgets for targeted customer categories. Might tie water budgets to weather and/or rates. Conduct detailed landscape area measurements for targeted customer categories. Can use aerial imagery including Google Earth. Might conduct field verification. Might measure non-irrigated area that can potentially be irrigated (e.g., for water budgets or for planning and design of stormwater projects).
21	Financial Incentives for Irrigation and Landscape Upgrades	For SF, MF, CII, and IRR customers with landscape, provide a Smart Landscape Rebate Program with rebates for substantive landscape retrofits or installation of water efficient equipment upgrades. Rebates contribute towards the purchase and installation of water-wise plants, compost, mulch, and selected types of irrigation equipment upgrades. Rebate for residential accounts and up to 50% more for commercial customers. Landscape upgrades might include conversion of turf to lower-water-using turf varieties.

No.	Measure Name	Description
22	Landscape Conversion or Turf Removal	Provide a per-square-foot incentive to remove turf and replace with low-water-use plants or permeable hardscape. Landscape conversion could include conversion of turf to lower-water-use turf varieties. Rebate based on dollars per square foot removed and capped at an upper limit for single family residence, multifamily residence, and/or commercial account.
23	Weather-Based Irrigation Controller Rebates	Provide a per-station rebate for the purchase of a weather-based irrigation controller. These controllers have onsite weather sensors or rely on a signal from a central weather station that modifies irrigation times at least weekly. Requires local irrigation contractors who are competent with these products, so may require sponsoring a training program in association with this measure.
24	Rotating Sprinkler Nozzle Rebates	Provide rebates to replace standard spray sprinkler nozzles with rotating nozzles that have lower application rates. Nozzles cost about $6 each, and rebates have been about $4 each with a minimum purchase of around 20 nozzles.
25	NetZero Landscape Ordinance	This measure is an aggressive local landscape ordinance that could be a step-up from California's Model Water Efficient Landscape Ordinance. Targeting new development only, this measure aims to achieve "net-zero" outdoor water use by any method including the use of native plants, weather-based irrigation controllers, gray water systems, cisterns, and rain barrels. Could design like AWE's Net Blue Supporting Water-Neutral Community Growth. More information is available online: www.allianceforwaterefficiency.org/net-blue.aspx.
26	Rainwater Container Incentive	Provide incentive for installation of rain barrels or large rainwater catchment systems. This could involve rebates, grants, bulk purchase and giveaways of rain barrels, and/or other cost-share methods. This may include workshops on proper installation and use of captured rainwater for landscape irrigation. Might require simultaneous installation of water efficient landscaping to assure that amount of water collected is capable of lasting into the peak irrigation season.
27	Gray Water Retrofit SF	Provide a rebate to assist a certain percentage of single family homeowners per year to install gray water systems.
28	Require Plumbing for Gray Water in New SF Development	Provide a rebate or require builders of single family homes to provide plumbing for and/or install a gray water system in new homes.
29	Rebate for Gray Water Systems in New CII Development	Provide a rebate for gray water systems in new CII development.
30	Gray Water – Point of Use Recycling	Point of use water recycling will allow for toilet flushing and other possible uses with locally treated gray water. It could be considered for new homes to help shape the demand forecast curve down. Establish an ongoing maintenance and monitoring/follow-up program (back-flow device inspection). Ordinance or rebate.

No.	Measure Name	Description
31	CII Survey	CII water customers would be offered a free water survey that would evaluate ways for the business to save water and money. The surveys may target large accounts only (e.g., accounts that use more than 5,000 gallons of water per day), such as hotels, restaurants, stores, and schools. Emphasis may be on supporting the top 25 users for each individual water agency.
32	Customized CII Top Users Incentive Program and Water Savings Performance Program	After a free water use survey has been completed at the site, the utility will analyze recommendations on the findings report that is provided and determine if site qualifies for a financial incentive. Financial incentives will be provided after analyzing the benefit-cost ratio of each proposed project. Incentives are tailored to each individual site as each site has varying water savings potentials. Incentives will be granted at the sole discretion of the Utility while funding lasts. Water districts, such as the Metropolitan Water District of Southern California, provide about $3 per 1,000 gallons saved to sites within their service area. Incentive is based on the potential for savings over 5 years. Eligible project costs include labor, hardware, and up to 1 year of water management fees.
33	Restaurant Spray Nozzles	Provide free 1.15 gpm (or lower) spray nozzles and possibly free installation for the rinse and clean operation in restaurants and other commercial kitchens. Thousands have been replaced in California going door to door; very cost-effective because it saves hot water. U.S. Department of Energy requires nozzles to be less than 1.28 gpm. Fishnick recommends 1.15 gpm.
34	Dipper Wells	Provide a dipper well device incentive for relevant food service accounts. Devices save water and money using less than 600 gallons of water per year; they reduce bacteria using heated water held above 140^{o}F. There is a programmable timer option to ensure scheduled water changeouts. A rebate may cover the $500-$600 device, installation, and any permitting. Electricity access is needed. A ConserveWell drop-in model is estimated to use ~320 gal/well/restaurant/year: https://server-products.com/ConserveWell-notdipperwell. As reported in the *Dipper Well Replacement Field Evaluation Report,* Frontier Energy Report #50115-R0 (Frontier Energy, 2017), a Los Banos site saved 176,000 gal/year and a Madera site saved 116,000 gal/year: http://www.bewaterwise.com/assets/2015icp-dipperwellfrontierenergy.pdf.
35	School Building Retrofit	School retrofit program wherein school receives a grant to replace fixtures and upgrade irrigation systems. Might target university/college campuses. Pattern after Metropolitan Water District of Southern California program.
36	Hotels/Motels Retrofit with Financial Assistance	Following a free water audit, offer hotels/motels a rebate for equipment identified that would save water. Or, provide a rebate schedule for certain efficient equipment, such as air-cooled ice machines, that hotels/motels could apply for without an audit. Pattern after San Antonio, Texas program.
37	Rebates for Conductivity Controllers on Cooling Towers	Offer a rebate ($900-$1,200 depending on type) to buildings that install conductivity controllers to reduce bleed-off water of the facility cooling towers. Provide educational brochures and a phone contact of a knowledgeable person to provide conservation information.

No.	Measure Name	Description
38	Public and School Education	Use a range of printed materials to raise awareness of conservation measures available to customers, including incentive programs offered by utility, newsletters, bill stuffers, brochures (self-developed or purchased), working with local newspapers, signage at retailers, signs on public buses. Regional participation and development can help assure consistent message. Such programs would continue indefinitely. Provide variety of conservation information on city or utility website, distribution of "videos." Also consider social media options such as cell phone apps, Facebook, interactive kiosk with view screen, etc. Conduct presentations at various venues, from radio and TV to service organizations and focused groups. Have booths at relevant community events, participate in parades, etc. Suggest a general "Use Only What You Need" message like Denver Water's program or a "Beat the Peak" message media campaign like Cary, North Carolina or Tucson, Arizona: https://www.tucsonaz.gov/water/pete-the-beak. Also consider a program like the "Take Control of your Controller" campaign for a focused, social media-based campaign. Consider determining appropriate usage and media campaign message with marketing study/focus groups. Example: Water Smart Software with online and print billing consumptions to customers. Work with local school districts to develop classroom programs that they would embrace. Consider poster contests, etc. Some programs would require dedicated utility staff to assist and present. Utility would also offer, organize, and sponsor a series of educational workshops or other means for educating homeowners, landscapers, and contractors in efficient landscaping and irrigation principals. Utilize guest speakers, native demonstration gardens, and incentives (e.g., a nursery plant coupon). Utility would sponsor bilingual training for managers and workers in landscape maintenance methods that will save irrigation water. With some of these programs, names of businesses that have obtained training are included in utility publications and/or websites as an incentive to participate. Utility would also develop or support development of a Landscape Watering Calculator and Watering Index, and actively market these. Consider cell phone app with Watering Index, following up in-person with large landscape customers on a frequent basis to encourage use of Watering Index.
39	Billing Report Educational Tool	Have a customer portal available to show customer their individualized current and historical water use pattern to help customer see their data thereby encouraging them to be more efficient with their water use. Example: Water Smart Software with online and print billing consumptions to customers.
40	Low Impact New and Remodeled Development	Utility would require developers of new/remodeled sites to follow Low Impact Development concepts/standards/best management practices for stormwater and water conservation benefits. Encourage or require use of bio-retention facilities, rainwater cisterns, gray water plumbing, etc.

APPENDIX E. KEY ASSUMPTIONS FOR THE DSS MODEL

This section presents the methodology used to determine passive water savings, information regarding national and state plumbing codes, and key inputs and assumptions used in the DSS Model including fixture replacement and estimates.

E.1 National Plumbing Code

The Energy Policy Act of 1992, as amended in 2005, mandates that only fixtures meeting the following standards can be installed in new buildings:

- Toilet – 1.6 gal/flush maximum
- Urinals – 1.0 gal/flush maximum
- Showerhead – 2.5 gal/min at 80 pounds per square inch (psi)
- Residential faucets – 2.2 gal/min at 60 psi
- Public restroom faucets – 0.5 gal/min at 60 psi
- Dishwashing pre-rinse spray valves – 1.6 gal/min at 60 psi

Replacement of fixtures in existing buildings is also governed by the Federal Energy Policy Act, which mandates that only devices with the specified level of efficiency (as shown above) can be sold as of 2006. The net result of the plumbing code is that new buildings will have more efficient fixtures and old inefficient fixtures will slowly be replaced with new, more efficient models. The national plumbing code is an important piece of legislation and must be carefully taken into consideration when analyzing the overall water efficiency of a service area.

In addition to the plumbing code, the U.S. Department of Energy regulates appliances, such as residential clothes washers, further reducing indoor water demands. Regulations to make these appliances more energy efficient have driven manufactures to dramatically reduce the amount of water these machines use. Generally, front loading washing machines use 30 to 50% less water than conventional models (which are still available).

In this analysis, the DSS Model forecasts a gradual transition to high efficiency clothes washers (using 12 gallons or less) so that by the year 2025 that will be the only type of machine available for purchase. In addition to the industry becoming more efficient, rebate programs for washers have been successful in encouraging customers to buy more water efficient models. Given that machines last about 10 years, eventually all machines on the market will be the more water efficient models. Energy Star washing machines have a water factor of 6.0 or less – the equivalent of using 3.1 cubic feet (or 23.2 gallons) of water per load. The maximum water factor for residential clothes washers under current federal standards is 9.5. The water factor equals the number of gallons used per cycle per cubic foot of capacity. Prior to the year 2000, the water factor for a typical new residential clothes washer was about 12. In March 2015, the federal standard reduced the maximum water factor for top- and front-loading machines to 8.4 and 4.7, respectively. In 2018, the maximum water factor for top-loading machines was further reduced to 6.5. For commercial washers, the maximum water factors were reduced in 2010 to 8.5 and 5.5 for top- and front-loading machines, respectively. Beginning in 2015, the maximum water factor for Energy Star certified washers was 3.7 for front-loading and 4.3 for top-loading machines. In 2011, the U.S. Environmental Protection Agency estimated that Energy Star washers comprised more that 60% of the residential market and 30% of the commercial market (Energy Star, 2011). A new Energy Star compliant washer uses about two-thirds less water per cycle than washers manufactured in the 1990s.

E.2 State Plumbing Code

This section describes California state codes applicable to each member agency service area water use.

California State Law – AB 715

Plumbing codes for toilets, urinals, showerheads, and faucets were initially adopted by California in 1991, mandating the sale and use of ultra-low flush toilets (ULFTs) using 1.6 gpf, urinals using 1 gpf, and low-flow showerheads and faucets. AB 715 led to an update to California Code of Regulations Title 20 (see below) mandating that all toilets and urinals sold and installed in California as of January 1, 2014 must be high efficiency versions having flush ratings that do not exceed 1.28 gpf (toilets) and 0.5 gpf (urinals).

California State Laws – SB 407 and SB 837

SB 407 addresses plumbing fixture retrofits on resale or remodel. The DSS Model carefully considers the overlap with SB 407, the plumbing code (natural replacement), CALGreen, AB 715 and rebate programs (such as toilet rebates). SB 407 (enacted in 2009) requires that properties built prior to 1994 be fully retrofitted with water conserving fixtures by the year 2017 for single family residential houses and 2019 for multifamily and commercial properties. SB 407 program length is variable and continues until all the older high flush toilets have been replaced in the service area. The number of accounts with high flow fixtures is tracked to make sure that the situation of replacing more high flow fixtures than actually exist does not occur. Additionally, SB 407 conditions issuance of building permits for major improvements and renovations upon retrofit of non-compliant plumbing fixtures. SB 837 (enacted in 2011) requires that sellers of real estate property disclose on their Real Estate Transfer Disclosure Statement whether their property complies with these requirements. Both laws are intended to accelerate the replacement of older, low efficiency plumbing fixtures, and ensure that only high efficiency fixtures are installed in new residential and commercial buildings.

2019 CALGreen and 2015 CA Code of Regulations Title 20 Appliance Efficiency Regulations

Fixture characteristics in the DSS Model are tracked in new accounts, which are subject to the requirements of the 2019 California Green Building Code and 2015 California Code of Regulations Title 20 Appliance Efficiency Regulations adopted by the California Energy Commission (CEC) on September 1, 2015. The CEC 2015 appliance efficiency standards apply to the following new appliances, if they are sold in California: showerheads, lavatory faucets, kitchen faucets, metering faucets, replacement aerators, wash fountains, tub spout diverters, public lavatory faucets, commercial pre-rinse spray valves, urinals, and toilets. The DSS Model accounts for plumbing code savings due to the effects these standards have on showerheads, faucets, aerators, urinals, and toilets.

- Showerheads – July 2016: 2.0 gpm; July 2018: 1.8 gpm
- Wall Mounted Urinals – January 2016: 0.125 gpf (pint)
- Lavatory Faucets and Aerator – July 2016: 1.2 gpm at 60 psi
- Kitchen Faucets and Aerator – July 2016: 1.8 gpm with optional temporary flow of 2.2 gpm at 60 psi
- Public Lavatory Faucets – July 2016: 0.5 gpm at 60 psi

In summary, the controlling law for **toilets** is Assembly Bill 715. This bill requires high efficiency toilets (1.28 gpf) to be exclusively sold in California beginning January 1, 2014. The controlling law for wall-mounted urinals is the 2015 CEC efficiency regulations requiring that ultra-high efficiency pint **urinals** (0.125 gpf) be exclusively sold in California beginning January 1, 2016. This is an efficiency progression for urinals from AB 715's requirement of high efficiency (0.5 gpf) urinals starting in 2014.

Standards for **residential clothes washers** fall under the regulations of the U.S. Department of Energy. In 2018, the maximum water factor for standard top-loading machines was reduced to 6.5.

Showerhead flow rates are regulated under the 2015 California Code of Regulations Title 20 Appliance Efficiency Regulations adopted by the CEC, which requires the exclusive sale in California of 2.0 gpm showerheads at 80 psi as of July 1, 2016 and 1.8 gpm showerheads at 80 psi as of July 1, 2018. The WaterSense specification applies to showerheads that have a maximum flow rate of 2.0 gpm or less. This represents a 20% reduction in showerhead flow rate over the current federal standard of 2.5 gpm, as specified by the Energy Policy Act of 1992.

Faucet flow rates have likewise been recently regulated by the 2015 CEC Title 20 regulations. This standard requires that the residential faucets and aerators manufactured on or after July 1, 2016 be exclusively sold in California at 1.2 gpm at 60 psi; and public lavatory and kitchen faucets/aerators sold or offered for sale on or after July 1, 2016 be 0.5 gpm at 60 psi and 1.8 gpm at 60 psi (with optional temporary flow of 2.2 gpm), respectively. Previously, all faucets had been regulated by the 2010 California Green Building Code at 2.2 gpm at 60 psi.

E.3 Key Baseline Potable Demand Inputs, Passive Savings Assumptions, and Resources

The following table presents the key assumptions and references that are used in the DSS Model in determining projected demands with plumbing code savings. The assumptions having the most dramatic effect on future demands are the natural replacement rate of fixtures; how residential or commercial future use is projected; and the percent of estimated real water losses.

Table E-1. List of Key Assumptions

Parameter	Model Input Value, Assumptions, and Key References
Model Start Year for Analysis	2019
Model End Year	2045
Non-Revenue Water	Based on individual billing
Population Projection Source	Provided by and verified by individual agencies
Employment Projection Source	Provided by and verified by individual agencies
Number of Water Accounts for Start Year	Provided by and verified by individual agencies
Avoided Cost of Water $/AF	Provided by and verified by individual agencies

Table E-2. Key Assumptions Resources

Parameter	Resource
Residential End Uses	Key Reference: CA DWR Report "California Single Family Water Use Efficiency Study," (DeOreo, 2011 – Page 28, Figure 3: Comparison of household end-uses) and AWWA Research Foundation (AWWARF) Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016). Table 2-A. Water Consumption by Water-Using Plumbing Products and Appliances - 1980-2012. PERC Phase 1 Report. Plumbing Efficiency Research Coalition. 2013. http://www.map-testing.com/content/info/menu/perc.html Model Input Values are found in the "End Uses" section of the DSS Model on the "Breakdown" worksheet.
Non-Residential End Uses, percent	Key Reference: AWWARF Report "Commercial and Institutional End Uses of Water" (Dziegielewski, 2000 – Appendix D: Details of Commercial and Industrial Assumptions, by End Use). Santa Clara Valley Water District Water Use Efficiency Unit. "SCVWD CII Water Use and Baseline Study." February 2008. Model Input Values are found in the "End Uses" section of the DSS Model on the "Breakdown" worksheet.
Efficiency Residential Fixture Current Installation Rates	U.S. Census, Housing age by type of dwelling plus natural replacement plus rebate program (if any). Key Reference: GMP Research, Inc. (2019). 2019 U.S. WaterSense Market Penetration Industry Report Key Reference: Consortium for Efficient Energy (www.cee1.org). Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.
Water Savings for Fixtures, gal/capita/day	Key Reference: AWWARF Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016). Key Reference: CA DWR Report "California Single Family Water Use Efficiency Study" (DeOreo, 2011 – Page 28, Figure 3: Comparison of household end-uses). WCWCD supplied data on costs and savings; professional judgment was made where no published data was available. Key Reference: California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model.
Non-Residential Fixture Efficiency Current Installation Rates	Key Reference: 2010 U.S. Census, Housing age by type of dwelling plus natural replacement plus rebate program (if any). Assume commercial establishments built at same rate as housing, plus natural replacement. California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Santa Clara Valley Water District Water Use Efficiency Unit. "SCVWD CII Water Use and Baseline Study." February 2008. Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.

Parameter	Resource
Residential Frequency of Use Data, Toilets, Showers, Faucets, Washers, Uses/user/day	Key Reference: AWWARF Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016). Summary values can be found in the full report: http://www.waterrf.org/Pages/Projects.aspx?PID=4309 Key Reference: California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Key Reference: Alliance for Water Efficiency, The Status of Legislation, Regulation, Codes & Standards on Indoor Plumbing Water Efficiency, January 2016. Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model and confirmed in each "Service Area Calibration End Use" worksheet by customer category.
Non-Residential Frequency of Use Data, Toilets, Urinals, and Faucets, Uses/user/day	Key References: Estimated based on AWWARF Report "Commercial and Institutional End Uses of Water" (Dziegielewski, 2000 – Appendix D: Details of Commercial and Industrial Assumptions, by End Use). Key Reference: California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Fixture uses over a 5-day work week are prorated to 7 days. Non-residential 0.5gpm faucet standards per Table 2-A. Water Consumption by Water-Using Plumbing Products and Appliances - 1980-2012. PERC Phase 1 Report. Plumbing Efficiency Research Coalition, 2012. http://www.map-testing.com/content/info/menu/perc.html Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model and confirmed in each "Service Area Calibration End Use" worksheet by customer category.
Natural Replacement Rate of Fixtures (percent per year)	Residential Toilets 2%-4%
	Non-Residential Toilets 2%-3%
	Residential Showers 4% (corresponds to 25-year life of a new fixture)
	Residential Clothes Washers 10% (based on 10-year washer life). Key References: "Residential End Uses of Water" (DeOreo, 2016) and "Bern Clothes Washer Study, Final Report" (Oak Ridge National Laboratory, 1998).
	Residential Faucets 10% and Non-Residential Faucets 6.7% (every 15 years). CEC uses an average life of 10 years for faucet accessories (aerators). A similar assumption can be made for public lavatories, though no hard data exists and since CII fixtures are typically replaced less frequently than residential, 15 years is assumed. CEC, Analysis of Standards Proposal for Residential Faucets and Faucet Accessories, a report prepared under CEC's Codes and Standards Enhancement Initiative, Docket #12-AAER-2C, August 2013.
	Model Input Value is found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model.
Residential Future Water Use	Increases Based on Population Growth and Demographic Forecast
Non-Residential Future Water Use	Increases Based on Employment Growth and Demographic Forecast

Fixture Estimates

Determining the current level of efficient fixtures in a service area while evaluating the passive savings in the DSS Model is part of the standard process and is called "initial fixture proportions." As described earlier in Section 2.2, MWM reconciled water efficient fixtures and devices installed within the BAWSCA service area and estimated the number of outstanding inefficient fixtures.

MWM used the DSS Model to perform a saturation analysis for toilets, urinals, showerheads, faucets, and clothes washers. The process included a review of age of buildings from census data, number of rebates per device, and assumed natural replacement rates. MWM presumed the fixtures that were nearing saturation and worth analysis would include residential toilets and residential clothes washers as both have been included in recommended conservation practices for over two decades.

In 2014, the Water Research Foundation updated its 1999 Residential End Uses of Water Study (DeOreo, 2016). Water utilities, industry regulators, and government planning agencies consider it the industry benchmark for single family home indoor water use. This Demand Study incorporates recent study results which reflect the change to the profile of water use in residential homes including adoption of more water efficient fixtures over the past 20 years (1999-2019). Residential End Uses of Water Study results were combined with BAWSCA historical rebate and billing data to enhance and verify assumptions made for all customer accounts, including saturation levels on the above-mentioned plumbing fixtures.

The DSS Model presents the estimated current and projected proportions of these fixtures by efficiency level within each member agency service area. These proportions were calculated by:

- Using standards in place at the time of building construction;
- Taking the initial proportions of homes by age (corresponding to fixture efficiency levels);
- Adding the net change due to natural replacement; and
- Adding the change due to rebate measure minus the "free rider effect[15]."

Further adjustments were made to initial proportions to account for the reduction in fixture use due to lower occupancy and based on field observations. The projected fixture proportions do **not** include any future active conservation measures implemented by member agencies. More information about the development of initial and projected fixture proportions can be found in the DSS Model "Codes and Standards" section.

The DSS Model is capable of modeling multiple types of fixtures, including fixtures with different designs. For example, currently toilets can be purchased that flush at a rate of 0.8 gallons per flush (gpf), 1.0 gpf or 1.28 gpf. The 1.6 gpf and higher toilets still exist but can no longer be purchased in California. Therefore, they cannot be used for replacement or new installation of a toilet. So, the DSS Model utilizes fixture replacement rates to determine what type of fixture should be used for a new construction installation or replacement. The replacement of the fixtures is listed as a percentage within the DSS Model. A value of 100% would indicate that all the toilets installed would be of one particular flush volume. A value of 75% means that three out of every four toilets installed would be of that particular flush volume. All the Fixture Model information and assumptions were carefully reviewed and accepted by BAWSCA staff.

The DSS Model provides inputs and analysis of the number, type and replacement rates of fixtures for each customer category (e.g., single family toilets, commercial toilets, residential clothes washing machines). For example, the DSS Model incorporates the effects of the 1992 Federal Energy Policy Act and AB 715 on toilet fixtures. A DSS Model feature determines the "saturation" of 1.6 gpf toilets as the 1992 Federal Energy Policy Act was in effect from 1992 to 2014 for 1.6 gpf toilet replacements. AB 715 now applies for the replacement of

[15] It is important to note that in water conservation program management the "free rider effect" occurs when a customer applies for and receives a rebate on a targeted high efficiency fixture that they would have purchased even without a rebate. In this case, the rebate was not the incentive for their purchase but a "bonus." Rebate measures are designed to target those customers needing financial incentive to install the more efficient fixture.

toilets at 1.28 gpf. Further consideration and adjustments were made to replacement rates to account for the reduction in fixture use and wear due to lower occupancy and based on field observations.

E.4 Present Value Analysis and the Utility and Community Perspective

Present value analysis using present day dollars and a real discount rate of 3% is used to discount costs and benefits to the base year. From this analysis, benefit-cost ratios of each measure are computed. When measures are put together in programs, the model is set up to avoid double counting savings from multiple measures that act on the same end use of water. For example, multiple measures in a program may target toilet replacements. The model includes assumptions to apportion water savings between the multiple measures.

Economic analysis can be performed from several different perspectives, based on which party is affected. For planning water use efficiency programs for utilities, perspectives most commonly used for benefit-cost analyses are the "utility" perspective and the "community" perspective. The "utility" benefit-cost analysis is based on the benefits and costs to the water provider. The "community" benefit-cost analysis includes the utility benefit and costs together with account owner/customer benefits and costs. These include customer energy and other capital or operating cost benefits plus costs of implementing the measure, beyond what the utility pays.

The utility perspective offers two advantages. First, it considers only the program costs that will be directly borne by the utility. This enables the utility to fairly compare potential investments for saving versus supplying increased quantities of water. Second, revenue shifts are treated as transfer payments, which means program participants will have lower water bills and non-participants will have slightly higher water bills so that the utility's revenue needs continue to be met. Therefore, the analysis is not complicated with uncertainties associated with long-term rate projections and retail rate design assumptions. It should be noted that there is a significant difference between the utility's savings from the avoided cost of procurement and delivery of water and the reduction in retail revenue that results from reduced water sales due to water use efficiency. This budget impact occurs slowly and can be accounted for in water rate planning. Because it is the water provider's role in developing a water use efficiency plan that is vital in this study, the utility perspective was primarily used to evaluate elements of this report.

The community perspective is defined to include the utility and the customer costs and benefits. Costs incurred by customers striving to save water while participating in water use efficiency programs are considered, as well as benefits received in terms of reduced energy bills (from water heating costs) and wastewater savings, among others. Water bill savings are not a customer benefit in aggregate for reasons described previously. Other factors external to the utility, such as environmental effects, are often difficult to quantify or are not necessarily under the control of the utility. They are therefore frequently excluded from economic analyses, including this one.

E.5 Present Value Parameters

The time value of money is explicitly considered. Typically, the costs to save water occur early in the planning period whereas the benefits usually extend to the end of the planning period. A long planning period of over 30 years is often used because costs and benefits that occur beyond 50 years have very little influence on the total present value of the costs and benefits. The value of all future costs and benefits is discounted to the first year in the DSS Model (the base year), at the real interest rate of 3.01%. The DSS Model calculates this real interest rate, adjusting the current nominal interest rate (assumed to be approximately 6.1%) by the assumed rate of inflation (3.0%). The formula to calculate the real interest rate is: (nominal interest rate – assumed rate of inflation)/ (1 + assumed rate of inflation). Cash flows discounted in this manner are herein referred to as "Present Value" sums.

E.6 Assumptions About Measure Costs

Appendix F presents the assumptions and inputs used in the DSS Model to evaluate each water conservation measure. Assumptions regarding the following variables were made for each measure:

- **Targeted Water User Group End Use –** Water user group (e.g., single family residential) and end use (e.g., indoor or outdoor water use)
- **Utility Unit Cost –** Cost of rebates, incentives, and contractors hired by BAWSCA and BAWSCA member agencies to implement measures
- **Retail Customer Unit Cost –** Cost for implementing measures that is paid by retail customers (i.e., remainder of a measure's cost that is not covered by a rebate or incentive)
- **Utility Administration and Marketing Cost –** The cost to the utility for staff time, general expenses, and overhead needed to implement and administer the measure, including consultant contract administration, marketing, and participant tracking. The unit costs vary greatly according to the type of customer and implementation method. For example, a measure might cost a different amount for a single family account than a multifamily account. Rebate program costs are different than costs to develop and enforce an ordinance requirement or a direct installation program. Typically, water utilities incur increased costs with achieving higher market saturation, such as more surveys per year. The model calculates the annual costs based on the number of participants each year.

Costs are determined for each of the measures based on industry knowledge, past experience and data provided by BAWSCA staff, Valley Water, SFPUC staff and the member agencies. Costs may include incentive costs, usually determined on a per-participant basis; fixed costs, such as marketing; variable costs, such as the costs to staff the measures and to obtain and maintain equipment; and a one-time set-up cost. The set-up cost is for measure design by staff or consultants, any required pilot testing, and preparation of materials that are used in marketing the measure. Measure costs are estimated each year through 2045. Costs are spread over the time period depending on the length of the implementation period for the measure and estimated voluntary customer participation levels.

Lost revenue due to reduced water sales is not included as a cost because the water use conservation measures evaluated herein generally take effect over a long span of time that is sufficient to enable timely rate adjustments, if necessary, to meet fixed cost obligations and savings on variable costs such as energy and chemicals.

E.7 Assumptions about Measure Savings

Data necessary to forecast water savings of measures include specific data on water use, demographics, market penetration, and unit water savings. Savings normally develop at a measured and predetermined pace, reaching full maturity after full market penetration is achieved. This may occur three to seven years after the start of implementation, depending upon the implementation schedule. For every water use efficiency activity or replacement with more efficient devices, there is a useful life. The useful life is called the "Measure Life" and is defined to be how long water use conservation measures stay in place and continue to save water. It is assumed that measures implemented because of codes, standards, or ordinances (e.g., toilets) would be "permanent" and not revert to an old inefficient level of water use if the device needed to be replaced. However, some measures that are primarily behavior-based, such as residential surveys, are assumed to need to be repeated on an ongoing basis to retain the water savings (e.g., homeowners move away, and the new homeowners may have less efficient water using practices). Surveys typically have a measure life on the order of five years.

E.8 Assumptions about Avoided Costs

The estimated avoided cost of water was provided by BAWSCA staff and can be found in each BAWSCA member agency's specific DSS Model. The avoided cost of water or water production operational cost is $7.75/ccf as per information from Andree Johnson at BAWSCA on April 2, 2020 based on FY 2030-31 rates from SFPUC's Wholesale Rate Projections for the 10-year horizon. Given that there are no projections beyond the 2031 mark, the 2031 data value was selected.

APPENDIX F. INDIVIDUAL CONSERVATION MEASURE DESIGN INPUTS AND RESULTS

The following figures present the DSS Model starting values for the conservation measures that were analyzed for possible inclusion into each BAWSCA member agency's conservation program.

Measure 1: CII Water Survey

Overview	
Name	CII Water Survey
Abbr	1
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
COM	$1,000.00	$500.00	1

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Program provides free water surveys to CII customers to evaluate ways for the business to save water and money. The surveys may target large accounts (e.g., accounts that use more than 5,000 gallons of water per day) only such as hotels, restaurants, stores and schools. Emphasis may be on supporting the top 25 users for each individual water agency.

Customer Classes

SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
☐	☐	☑	☐	☐	☐	☐	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets			☑						
Urinals			☑						
Lavatory Faucets			☑						
Showers			☑						
Dishwashers			☑						
Clothes Washers			☑						
Process			☑						
Kitchen Spray Rinse			☑						
Internal Leakage			☑						
Baths									
Other			☑						
Irrigation			☐						
Pools									
Wash Down									
Car Washing									
External Leakage			☐						
Outdoor									
atory/Kitchen Faucets			☑						
Cooling			☑						

Comments

> **Utility Costs** - Survey cost is ~$500-$1,500 in-house staff or $2,000-$10,000 if contracted out. Utility cost is $60 for fixtures + 2-3 hours staff time for survey. ~$500 per survey for Utility cost. Utility costs represent fixture giveaway number distributed and costs (1.5 spray valves $50/ea., 5 aerators @ $2/ea.). Approx. 1.5 nozzles can be found per CII account per Tso & Koeller 2005 report "Pre-rinse Spray Valve Programs: How are they really doing?"

> **Customer Costs** - reflects cost/time to install fixtures and address survey recommendations.

> **End Use Water Saving** - BAWSCA Phase 1 study on Making Conservation a California Way of Life found savings of 10-15% per site. Assume 15% per site and include giveaways. Giveaways assume 1.15 gpm pre-rinse spray valve replace 2.5 gpm, 0.5 gpm aerators replace 2.2 gpm in lavatories, and 1.8 gpm replace aerators replace 2.2 gpm in non-lavatory settings (kitchens, utility rooms, etc.). This is an indoor survey only. Irrigation and landscaping will not be evaluated as part of the survey. Cooling systems will be evaluated in surveys.

> **Targets** - WCWDB FY16/17 & FY17/18 average measure participation rate of: 0.11%. ~7 BAWSCA agencies reported. Per 2018 BAWSCA Phase 1 Making Conservation a California Way of Life Strategic Plan study < 1% of CII accounts are audited per year.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
COM Toilets	15.0%	agency-specific
COM Urinals	15.0%	agency-specific
COM Lavatory Faucets	15.0%	agency-specific
COM Showers	15.0%	agency-specific
COM Dishwashers	15.0%	agency-specific
COM Clothes Washers	15.0%	agency-specific
COM Process	15.0%	agency-specific
COM Kitchen Spray Rinse	15.0%	agency-specific
COM Internal Leakage	15.0%	agency-specific
COM Other	15.0%	agency-specific
COM Non-Lavatory/Kitchen Faucets	15.0%	agency-specific
COM Cooling	15.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	0.110%
Only Effects New Accts	☐

Measure 2: CII Water Efficient Technology (WET) Rebate

Overview	
Name	CII Water Efficient Technology (WET) Rebate
Abbr	2
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2045
Measure Length	24

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
COM	$5,000.00	$5,000.00	1
IND	$5,000.00	$5,000.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Program modeled after the Valley Water program to provides rebates to commercial, industrial and institutional sites to help implement equipment changes that reduce water use. Rebate amount is $4 per ccf saved annually up to 50% of the cost of the equipment.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☐	☐	☑	☐	☑	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets			☑		☑				
Urinals			☑		☑				
Lavatory Faucets			☑		☑				
Showers			☑		☑				
Dishwashers			☑		☑				
Clothes Washers			☑		☑				
Process			☑		☑				
Kitchen Spray Rinse			☑						
Internal Leakage			☑		☑				
Baths									
Other			☑		☑				
Irrigation			☐		☐				
Pools									
Wash Down									
Car Washing									
External Leakage			☑		☑				
Outdoor									
vatory/Kitchen Faucets			☑		☑				
Cooling			☑		☑				

Comments

> **Utility Costs** - Program modeled after Valley Water. Incentive value for BAWSCA program based on cost effectiveness. Pre-rinse spray valves can cost $60/ea. These are also distributed during CII surveys. https://fishnick.com/equipment/sprayvalves/ Dipper wells: Installation of electricity access can cost ~$350/ea. A health dept. permit might be ~$400/ea. A permit for electricity installation might be ~$200, though not apply to all. ConserveWell Drop-in model costs ~ $510/well. ConserveWell Wall-mount model costs ~$565/well.

> **Customer Costs** - Customer costs reflect installation.

> **End Use Water Savings** - Eligible fixtures will change based on changes in plumbing codes that would negate the need for the fixture to be rebated. Ending eligibility of certain fixtures avoids free-ridership. Savings and both utility and customer costs will vary depending on rebated fixtures. Averaged overall estimates for costs and savings are assumed to account for the variance in devices. Water savings data is provided for dipper wells as an example of one possible newer device to increase water savings indoors for businesses: https://server-products.com/ConserveWell-notdipperwell. Dipper Well Replacement Field Evaluation Report. Frontier Energy Report # 50115-R0. Nov 2017. Los Banos site saved 176,000 gal/yr & Madera site saved 116,000 gal/yr. https://fishnick.com/publications/fieldstudies/Dipper_Well_Replacement_Field_Evaluation_ICP.pdf.

> **Targets** - Assumes 0.5% of CII accounts are targeted each year.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
COM Toilets	20.0%	agency-specific
IND Toilets	20.0%	agency-specific
COM Urinals	20.0%	agency-specific
IND Urinals	20.0%	agency-specific
COM Lavatory Faucets	20.0%	agency-specific
IND Lavatory Faucets	20.0%	agency-specific
COM Showers	20.0%	agency-specific
IND Showers	20.0%	agency-specific
COM Dishwashers	20.0%	agency-specific
IND Dishwashers	20.0%	agency-specific
COM Clothes Washers	20.0%	agency-specific
IND Clothes Washers	20.0%	agency-specific
COM Process	20.0%	agency-specific
IND Process	20.0%	agency-specific
COM Kitchen Spray Rinse	20.0%	agency-specific
COM Internal Leakage	20.0%	agency-specific
IND Internal Leakage	20.0%	agency-specific
COM Other	20.0%	agency-specific
IND Other	20.0%	agency-specific
COM External Leakage	20.0%	agency-specific
IND External Leakage	20.0%	agency-specific
COM Non-Lavatory/Kitchen Faucets	20.0%	agency-specific
IND Non-Lavatory/Kitchen Faucets	20.0%	agency-specific
COM Cooling	20.0%	agency-specific
IND Cooling	20.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	0.500%
Only Effects New Accts	☐

Measure 3: School Building Retrofit

Overview	
Name	School Building Retrofit
Abbr	3
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2028
Measure Length	10

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
COM	$5,000.00	$5,000.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Program provides site audits and customized rebates for fixture replacements and irrigation upgrades at school sites. Eligible sites may include K-12 schools as well as colleges and universities.

Customer Classes

SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
☐	☐	☑	☐	☐	☐	☐	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets			☑						
Urinals			☑						
Lavatory Faucets			☑						
Showers			☑						
Dishwashers			☑						
Clothes Washers			☑						
Process			☑						
Kitchen Spray Rinse			☑						
Internal Leakage			☑						
Baths									
Other			☑						
Irrigation			☑						
Pools									
Wash Down									
Car Washing									
External Leakage			☑						
Outdoor									
atory/Kitchen Faucets			☑						
Cooling			☑						

Comments

> **Utility Costs** - $5,000 utility cost assumes replacement of high use toilets and some irrigation system improvement (where applicable).
> **Customer Costs** - Assumes cost of installation and remainder of devices.
> **End Use Water Savings** - Savings similar to CII survey and incentive measures combined.
> **Targets** - Assumes 0.1% of institutional accounts targeted each year

Results

Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
COM Toilets	15.0%	agency-specific
COM Urinals	15.0%	agency-specific
COM Lavatory Faucets	15.0%	agency-specific
COM Showers	15.0%	agency-specific
COM Dishwashers	15.0%	agency-specific
COM Clothes Washers	15.0%	agency-specific
COM Process	15.0%	agency-specific
COM Kitchen Spray Rinse	15.0%	agency-specific
COM Internal Leakage	15.0%	agency-specific
COM Other	15.0%	agency-specific
COM Irrigation	15.0%	agency-specific
COM External Leakage	15.0%	agency-specific
COM Non-Lavatory/Kitchen Faucets	15.0%	agency-specific
COM Cooling	15.0%	agency-specific

Targets

Target Method:	Percentage
% of Accts Targeted / yr	0.100%
Only Effects New Accts	☐

Measure 4: Residential Outdoor Water Surveys

Overview	
Name	Residential Outdoor Water Surveys
Abbr	4
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2023
Last Year	2045
Measure Length	23

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
SF	$383.00	$50.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Outdoor water surveys offered for existing customers. Normally those with high water use are targeted and provided a customized report on how to save water. Can be combined with indoor surveys or focused on certain customer classes. Residential customers would be eligible for free landscape water surveys upon request. Typically during the surveys, the surveyor will checks for leaks, provide direction on appropriate irrigation scheduling, demonstrate how to set irrigation controllers, provide guidance on plant selection and offer additional ways to increase outdoor efficiencies (car washing, pool covers, mulch etc.). Low-cost, general-use, outdoor efficiency fixtures assumed to be handed out during the survey as needed.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☑	☐	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐								
Urinals									
Lavatory Faucets	☐								
Showers	☐								
Dishwashers	☐								
Clothes Washers	☐								
Process									
Kitchen Spray Rinse									
Internal Leakage	☐								
Baths	☐								
Other	☐								
Irrigation	☑								
Pools	☐								
Wash Down	☑								
Car Washing	☑								
External Leakage	☑								
Outdoor									
ratory/Kitchen Faucets	☐								
Cooling									

Comments

> **Utility Costs** - Time estimates includes field time, drive time, scheduling, and data entry. Assume staff avg fully burdened Rate with fringe and overhead is $136/hr., (ACWD Water Conservation Rate is $50/hr. for base rate with fringe and overhead add 1.72%). Utility fixture costs assume all surveyed accounts receive a kit with $9 of supplies including a rain gauge, an auto shut-off hose nozzle, and a soil moisture sensor. Utility Cost = ((136*2.75 hours per survey) +($9 supplies))* 25% admin markup> Administration Costs - Based on Big Bear, CA program, administration time assumes 75 min/audit (primarily 70% staff, 30% supervisor).

> **End Use Water Savings** - Savings based off of California Urban Water Agencies water Savings Study (4/13/15); Outdoor Residential Water Surveys saved on average 21 gpd per audit. Assumed 10% savings on outdoor end uses and 5% selected on pools to be conservative which total up to an approximate average savings of 21 gpd per residential audit.

> **Targets** - WCWDB FY16/17 & FY17/18 ~11 BAWSCA agencies reported. 0.8% SF survey participation.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Fixed	
	Savings GPD/Acct	Avg GPD/Acct
SF Irrigation	18.0	agency-specific
SF Wash Down	0.5	agency-specific
SF Car Washing	0.5	agency-specific
SF External Leakage	2.0	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	0.800%
Only Effects New Accts	☐

Measure 5: Large Landscape Outdoor Water Surveys

Overview	
Name	Large Landscape Outdoor Water Surveys
Abbr	5
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
IRR	$1,500.00	$1,000.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Outdoor water audits offered for existing large landscape customers. Normally those with high water use are targeted and provided a customized report on how to save water. All large multifamily residential, CII, and public irrigators of large landscapes would be eligible for free landscape water audits upon request. Tied to the Water Budget Program.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☐	☐	☐	☐	☐	☐	☑	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets									
Urinals									
Lavatory Faucets									
Showers									
Dishwashers									
Clothes Washers									
Process									
Kitchen Spray Rinse									
Internal Leakage									
Baths									
Other									
Irrigation							☑		
Pools									
Wash Down									
Car Washing									
External Leakage							☑		
Outdoor									
vatory/Kitchen Faucets									
Cooling									

Comments

> **Utility Costs** - Assumes all large landscape accounts can apply. Assume 3 acres cost $500/Acre, $1,500 per site.

> **Customer Costs** - Assumes cost to review/update controller programming or fix minor leaks to align water use to an appropriate level for the amount and type of landscaping at the site.

> **End Use Water Savings** - Savings based off of California Urban Water Agencies water savings study (4/13/15) of 326 gpda, average of 15% for CII landscape accounts; distributed between irrigation and external leakage. The actual savings for the DSS Model is directly tied to service area irrigation characteristics for COM or IRR accounts based on billing categories and will vary by service area. The actual water savings of 20% of irrigation and 10% of leakage is conservative but yields representative end use water savings for this measure.

> **Targets** - Customer participation based on BAWSCA Water Conservation Data Base measure record.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
IRR Irrigation	20.0%	agency-specific
IRR External Leakage	10.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	1.000%
Only Effects New Accts	☐

Measure 6: Large Landscape (Waterfluence) Program

Overview	
Name	Large Landscape (Waterfluence) Program
Abbr	6
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2039
Measure Length	20

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
IRR	$1,480.00	$0.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Website provides feedback on irrigation water use (budget vs. actual). Current Waterfluence Program.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☐	☐	☐	☐	☐	☐	☑	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets									
Urinals									
Lavatory Faucets									
Showers									
Dishwashers									
Clothes Washers									
Process									
Kitchen Spray Rinse									
Internal Leakage									
Baths									
Other									
Irrigation							☑		
Pools									
Wash Down									
Car Washing									
External Leakage							☐		
Outdoor									
atory/Kitchen Faucets									
Cooling									

Comments

> **Utility Costs** - Water Budgeting software like Waterfluence at $74 per site. Assuming a five-year investment per site, unit cost is set at $1,480 per 20 year site monitoring fee. Monitoring fee is adjusted to account for accounts coming online over the program duration.

> **Administrative Costs** - represents approximately $5,000 for staff time and an annual service fee of $2,000 to administer the program.

> **Customer Costs** - No cost to customers as these are mostly adjustments to existing controller programming or change in landscape maintenance practices.

> **End Use Water Savings** - Savings is estimated based on past experience with other utilities. Also accounts for behavior and watering schedule changes.

> **Targets** - Customer participation of 5% based on BAWSCA Water Conservation Database. Based on percent of IRR/Dedicated Landscape Accounts when available.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
IRR Irrigation	30.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	5.000%
Only Effects New Accts	☐

Measure 7: Lawn Be Gone! and Rainwater Capture Rebates

Overview	
Name	Lawn Be Gone! And Rainwater Capture Rebates
Abbr	7
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☐
Years	5
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
SF	$500.00	$2,000.00	1
MF	$2,500.00	$20,000.00	1
COM	$2,500.00	$20,000.00	1
IND	$2,500.00	$20,000.00	1
GOV	$2,500.00	$20,000.00	1
IRR	$2,500.00	$20,000.00	1

Administration Costs

Method:	Percent
Markup Percentage	25%

Description

Provide a per square foot incentive for to remove turf and replace with low water use plants or permeable hardscape. Landscape conversion includes conversion of turf to lower-water-using turf varieties. Rebate based on dollars per square foot removed, and capped at an upper limit for single family residence, multifamily residence and/or commercial account.

Customer Classes

SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
☑	☑	☑	☐	☑	☑	☑	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐	☐	☐		☐	☐			
Urinals			☐		☐	☐			
Lavatory Faucets	☐	☐	☐		☐	☐			
Showers	☐	☐	☐		☐	☐			
Dishwashers	☐	☐	☐		☐	☐			
Clothes Washers	☐	☐	☐		☐	☐			
Process			☐		☐				
Kitchen Spray Rinse			☐			☐			
Internal Leakage	☐	☐	☐		☐	☐			
Baths	☐	☐							
Other	☐	☐	☐		☐	☐			
Irrigation	☑	☑	☑		☑	☑	☑		
Pools	☐	☐				☐			
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☐	☐	☐		☐	☐	☐		
Outdoor									
atory/Kitchen Faucets	☐	☐	☐		☐	☐			
Cooling			☐		☐	☐			

Comments

> **Utility Costs** - Assume rebate of $1/sq foot of turf removed which equates to approximately 25% of total project cost. Assume MF/CII costs of $2,500 and SF costs of $500. Assume large sites have more than one meter. Therefore large sites can qualify for multiple rebates to make it a worthwhile effort with a higher total site incentive value.

> **Customer Cost** - Per 2013 BAWSCA effort MF/CII costs of $20,000/customer and SF cost of $2,000/customer.

> **End Use Water Savings** - Water Savings based upon Valley Water program at 31 gallons per square foot/yr. for years 2-5, and saving 48 gal/feet squared/yr. during the fifth year following conversion. Assume an average of 18% over the 5 years of the study.

> **Targets** - WCWDB FY16/17 & FY17/18 average measure participation rate of: 0.13%. ~15 BAWSCA agencies reported. Includes SF, MF and CII customer categories combined.

Results

Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Irrigation	18.0%	agency-specific
MF Irrigation	18.0%	agency-specific
COM Irrigation	18.0%	agency-specific
IND Irrigation	18.0%	agency-specific
GOV Irrigation	18.0%	agency-specific
IRR Irrigation	18.0%	agency-specific

Targets

Target Method:	Percentage
% of Accts Targeted / yr	0.130%
Only Effects New Accts	☐

Measure 8: Financial Incentives for Irrigation & Landscape Upgrades

Overview	
Name	Financial Incentives for Irrigation & Landscape Upgrades
Abbr	8
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2023
Last Year	2045
Measure Length	23

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
SF	$250.00	$100.00	1
MF	$500.00	$500.00	1
COM	$500.00	$500.00	1
IND	$500.00	$500.00	1
GOV	$500.00	$500.00	1
IRR	$500.00	$500.00	1

Administration Costs

Method:	Percent
Markup Percentage	25%

Description

For customers with landscape, provide incentives for substantive landscape retrofits or installation of water efficient equipment upgrades; Rebates can also contribute towards the purchase and installation of water-wise plants, compost, mulch and selected types of irrigation equipment upgrades.
> Rebate for residential accounts and up to 50% more for commercial customers.
> Financial incentives for: WBICs, rotating sprinkler nozzles, rainwater containers (barrels and cisterns), and greywater retrofits
> Landscape conversion and turf removal is not part of this measure.

Customer Classes

SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
☑	☑	☑	☐	☑	☑	☑	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐	☐	☐		☐	☐			
Urinals			☐		☐	☐			
Lavatory Faucets	☐	☐	☐		☐	☐			
Showers	☐	☐	☐		☐	☐			
Dishwashers	☐	☐	☐		☐	☐			
Clothes Washers	☐	☐	☐		☐	☐			
Process			☐		☐				
Kitchen Spray Rinse			☐			☐			
Internal Leakage	☐	☐	☐		☐	☐			
Baths	☐	☐							
Other	☐	☐	☐		☐	☐			
Irrigation	☑	☑	☑		☑	☑	☑		
Pools	☐	☐				☐			
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☐	☐	☐		☐	☐	☐		
Outdoor									
atory/Kitchen Faucets	☐	☐	☐		☐	☐			
Cooling			☐		☐	☐			

Comments

> **Utility Costs** - $250 for SF accounts. $500 utility cost is per non-residential account. Large sites will have more than one account and qualify for a larger total rebate per site. EBMUD and Valley Water programs offer up to $2,000-$3,000 for residential customers and up to $15,000-$60,000 for commercial customers.
> **Customer Costs** - Customer costs per account will vary significantly based on devices.
> **End Use Water Savings** - The water savings are based on the following from the 2018 Landscape Rebate Water Savings Study from Valley Water:
> The annual water savings for replacing timer-based automatic irrigation controllers with weather-based irrigation controllers with rain shut-off devices were statistically significant each year following conversion, incrementally increased each year following conversion, and were on average 9 gal/ft2/yr or an average of 27%
> The annual water savings for replacing old sprinklers with high-efficiency nozzles were 1,243 gal/unit/yr on average. or an average of 15.3%
>Annual savings for replacing old sprinklers with high-efficiency nozzles including pressure regulation and/or check valves were significant in the first year following conversion, saving 1,661 gal/unit/yr on average, or an average of 18%.
> Total average irrigation savings is 20.1%
> Soil moisture sensor savings may be 20% of irrigation use is based on more than 10 California site water use reports conducted over multiple months in years 2015-2017 as provided by Brian Holland www.sustainablewatersavings.com. Studies show a range of 20%-60% savings for trained soil moisture sensor device installation and site management. A lower savings estimate is assumed for layperson usage and non-drought normal planning years. The manufacturer claims device batteries last 10-12 years.
> **Targets** - 0.25% to keep total utility budget and staff time for this program to reasonable levels.

Results

Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Irrigation	20.1%	agency-specific
MF Irrigation	20.1%	agency-specific
COM Irrigation	20.1%	agency-specific
IND Irrigation	20.1%	agency-specific
GOV Irrigation	20.1%	agency-specific
IRR Irrigation	20.1%	agency-specific

Targets

Target Method:	Percentage
% of Accts Targeted / yr	0.250%
Only Effects New Accts	☐

Measure 9: Landscape & Irrigation Codes

Overview	
Name	Landscape & Irrigation Codes
Abbr	9
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
SF	$100.00	$2,000.00	1
MF	$100.00	$2,000.00	1
COM	$100.00	$2,000.00	1
IND	$100.00	$5,000.00	1
GOV	$100.00	$2,000.00	1
IRR	$100.00	$2,000.00	1

Administration Costs

Method:	Percent
Markup Percentage	25%

Description

Existing Model Water Efficient Landscape Ordinance (MWELO), as amended in 2015, which establishes specific outdoor water efficiency requirements for new accounts and existing accounts undergoing eligible site renovations.

Customer Classes

SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
☑	☑	☑	☐	☑	☑	☑	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐	☐	☐		☐	☐			
Urinals			☐		☐	☐			
Lavatory Faucets	☐	☐	☐		☐	☐			
Showers	☐	☐	☐		☐	☐			
Dishwashers	☐	☐	☐		☐	☐			
Clothes Washers	☐	☐	☐		☐	☐			
Process			☐		☐				
Kitchen Spray Rinse			☐			☐			
Internal Leakage	☐	☐	☐		☐	☐			
Baths	☐	☐							
Other	☐	☐	☐		☐	☐			
Irrigation	☑	☑	☑		☑	☑	☑		
Pools	☐	☐				☐			
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☑	☑	☑		☑	☑	☑		
Outdoor									
ratory/Kitchen Faucets	☐	☐	☐		☐	☐			
Cooling			☐		☐	☐			

Comments

> **Utility Costs** - $100/fixture and 25% admin costs represent staff time for enforcement and inspection of landscapes.

> **Customer Costs** - Assume average additional cost to build landscape by MWELO standards (cost to comply versus install typical all-turf) landscape ($2000-$5000/acct). Also includes non-residential customer smart irrigation controller cost of $750 based on $700 device unit cost (per RainBird ITC-LX) and $50 unit installation cost per controller with 3 controllers needed for large sites.

> **End Use Water Savings** - The maximum applied water allowance (MAWA) has been lowered from 70% of the reference evapotranspiration (ETo) to 55% for residential landscape projects, and to 45% of ETo for non-residential projects. Savings are simplified to be the difference from the prior standard to the new MWELO standard budget difference of 70-55% for residential or 70-45% for non-residential. This water allowance reduces the landscape area that can be planted with high water use plants such as cool season turf. For typical residential projects, the reduction in the MAWA reduces the percentage of landscape area that can be planted to high water use plants from 33% to 25%. The site-wide irrigation efficiency of the previous ordinance (2010) was 0.71; for the purposes of estimating total water use, the revised MWELO defines the irrigation efficiency (IE) of drip irrigation as 0.81 and overhead irrigation and other technologies must meet a minimum IE of 0.75. Also assumed that the amount of irrigated landscape per new development for each individual parcel is reducing over time (meaning that the lot size for homes/businesses is shrinking when comparing existing homes versus new homes/businesses.) Assume some external leakage reduction (since new development would not have much) in addition to irrigation water use reduction. Assume end use savings as compared to existing account irrigation water end use.

> **Targets** - Assumes 90% of new accounts will comply. High because assumes total accounts targeted includes a number of existing account remodels that are eligible.

Results

Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Irrigation	25.0%	agency-specific
MF Irrigation	25.0%	agency-specific
COM Irrigation	25.0%	agency-specific
IND Irrigation	25.0%	agency-specific
GOV Irrigation	25.0%	agency-specific
IRR Irrigation	25.0%	agency-specific
SF External Leakage	10.0%	agency-specific
MF External Leakage	10.0%	agency-specific
COM External Leakage	10.0%	agency-specific
IND External Leakage	10.0%	agency-specific
GOV External Leakage	10.0%	agency-specific
IRR External Leakage	10.0%	agency-specific

Targets

Target Method:	Percentage
% of Accts Targeted / yr	90.000%
Only Effects New Accts	☑

Measure 10: Residential Indoor Water Surveys

Overview	
Name	Residential Indoor Water Surveys
Abbr	10
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☐
Years	5
Repeat	☐

Fixture Cost per Device	Utility	Customer	Fix/Acct
SF	$100.00	$50.00	1
MF	$100.00	$50.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Indoor water surveys for existing residential customers. Target those with high water use and provide a customized report to owner. May include give-away of efficient shower heads, aerators, toilet devices. Could be combined with Residential Outdoor Water Surveys measure.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☑	☑							
Urinals									
Lavatory Faucets	☑	☑							
Showers	☑	☑							
Dishwashers	☑	☑							
Clothes Washers	☑	☑							
Process									
Kitchen Spray Rinse									
Internal Leakage	☑	☑							
Baths	☑	☑							
Other	☑	☑							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☐	☐							
Outdoor									
atory/Kitchen Faucets	☑	☑							
Cooling									

Comments

> **Utility Costs** - Utility costs for this measure are primarily staff time. Admin costs/time estimates includes field time, drive time, scheduling, and data entry. Portion 25% to admin in measure design. Giveaway device costs and device rebates as a result of this measure are not included since these are covered in separate measures.

> **Customer Costs** - Customer costs represent average customer cost to implement any survey suggestions.

> **End Use Water Savings** - Savings represents average account savings. Savings based off of California Urban Water Agencies water savings study (4/13/15). Approximate 5.8% savings for indoor. Slightly lower value of 5% water savings were selected to account for efficient devices installed during the recent CA drought, and more efficient homes built to CALGreen on the market in the past 5 years.

> **Targets** - WCWDB FY16/17 & FY17/18 average measure participation rate of: 2.71%. ~11 BAWSCA agencies reported. 0.8% SF survey participation and 4.6% MF survey participation.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Toilets	5.0%	agency-specific
MF Toilets	5.0%	agency-specific
SF Lavatory Faucets	5.0%	agency-specific
MF Lavatory Faucets	5.0%	agency-specific
SF Showers	5.0%	agency-specific
MF Showers	5.0%	agency-specific
SF Dishwashers	5.0%	agency-specific
MF Dishwashers	5.0%	agency-specific
SF Clothes Washers	5.0%	agency-specific
MF Clothes Washers	5.0%	agency-specific
SF Internal Leakage	5.0%	agency-specific
MF Internal Leakage	5.0%	agency-specific
SF Baths	5.0%	agency-specific
MF Baths	5.0%	agency-specific
SF Other	5.0%	agency-specific
MF Other	5.0%	agency-specific
SF Non-Lavatory/Kitchen Faucets	5.0%	agency-specific
MF Non-Lavatory/Kitchen Faucets	5.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	2.710%
Only Effects New Accts	☐

Measure 11: Residential Water-Savings Devices Giveaway

Overview	
Name	Residential Water-Savings Devices Giveaway
Abbr	11
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
SF	$12.00	$15.00	2
MF	$12.00	$15.00	8

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Utility would buy high efficiency showerheads and faucets, aerators in bulk and give them away at Utility office or community events.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐	☐							
Urinals									
Lavatory Faucets	☑	☑							
Showers	☑	☑							
Dishwashers	☐	☐							
Clothes Washers	☐	☐							
Process									
Kitchen Spray Rinse									
Internal Leakage	☐	☐							
Baths	☐	☐							
Other	☐	☐							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☐	☐							
Outdoor									
ratory/Kitchen Faucets	☑	☑							
Cooling									

Comments

> **Utility Costs** - Devices are ordered in bulk. Devices are given away individually, and not necessarily as a "kit". Average cost for devices: 1.2 gpm bathroom aerators ($1/ea.), 1.8 gpm kitchen aerators ($2.10/ea.), 1.8 gpm showerheads ($4.60/ea.). Admin costs for tracking of program

> **Customer Costs** - Assumes minimal cost for installation.

> **End Use Water Savings** - Assume kits save 27.6% (reduced to be conservative) by assuming only 25% of kits are actually installed in the homes and yield water savings. Assumed Kit savings of 27.6% * 0.25 installed = 6.9% actual savings

> **Targets** - WCWDB FY16/17 & FY17/18 average measure participation rate of: 1.24%. ~12 BAWSCA agencies reported.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Lavatory Faucets	6.9%	agency-specific
MF Lavatory Faucets	6.9%	agency-specific
SF Showers	6.9%	agency-specific
MF Showers	6.9%	agency-specific
SF Non-Lavatory/Kitchen Faucets	6.9%	agency-specific
MF Non-Lavatory/Kitchen Faucets	6.9%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	1.250%
Only Effects New Accts	☐

Measure 12: Flowmeter Rebate

Overview	
Name	Flowmeter Rebate
Abbr	12
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2024
Measure Length	5

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
SF	$200.00	$400.00	1
MF	$200.00	$400.00	1
COM	$200.00	$400.00	1
IND	$200.00	$400.00	1
GOV	$200.00	$400.00	1

Administration Costs

Method: Percent

Markup Percentage	25%

Description

Program provides rebates for flow measuring devices which inform customers of their water use and provide leak detection and remote shutoff with a smart phone interface. Devices are targeted to residential users and can monitor indoor only, whole site meter use, and/or irrigation only use.

Customer Classes

SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
☑	☑	☑	☐	☑	☑	☐	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐	☐	☐		☐	☐			
Urinals			☐		☐	☐			
Lavatory Faucets	☐	☐	☐		☐	☐			
Showers	☐	☐	☐		☐	☐			
Dishwashers	☐	☐	☐		☐	☐			
Clothes Washers	☐	☐	☐		☐	☐			
Process			☐		☐				
Kitchen Spray Rinse			☐			☐			
Internal Leakage	☑	☑	☑		☑	☑			
Baths	☐	☐							
Other	☐	☐	☐		☐	☐			
Irrigation	☑	☑	☑		☑	☑			
Pools	☐	☐				☐			
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☑	☑	☑		☑	☑			
Outdoor									
vatory/Kitchen Faucets	☐	☐	☐		☐	☐			
Cooling			☐		☐	☐			

Comments

> Focus of Program: non-irrigation accounts

> **Utility Costs** - $200 rebate amount based off of EBMUD flowmeter rebate program https://www.ebmud.com/water/conservation-and-rebates/rebates/flowmeter-rebate/

> **Administration Costs** - Assume 25% admin to cover management of measure.

> **Customer Costs** - Customer costs assume half the customers would install more-costly remote or auto-shut-off device and half the less-costly sensor. Product examples: Flume, Flo, Buoy, Phyn Flume sensor straps around water meter and provides intelligent leak detection and real-time water use via mobile app. No pipes cut. ($200).
Water Hero Leak Detection & Automatic Water Shut Off System ($650). Plumbed components last 20+ years; electronics last ~10 yrs.

> **End Use Water Savings** - Savings based on study results from EBMUD, San Antonio, and WaterNow Alliance savings of 7% of total SF account use provided Feb 2020.

> **Targets** - Assume 0.5% of accounts targeted each year.

Results

Units: MG

Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
SF Internal Leakage	35.0%	agency-specific
MF Internal Leakage	35.0%	agency-specific
COM Internal Leakage	35.0%	agency-specific
IND Internal Leakage	35.0%	agency-specific
GOV Internal Leakage	35.0%	agency-specific
SF Irrigation	15.0%	agency-specific
MF Irrigation	15.0%	agency-specific
COM Irrigation	15.0%	agency-specific
IND Irrigation	15.0%	agency-specific
GOV Irrigation	15.0%	agency-specific
SF External Leakage	35.0%	agency-specific
MF External Leakage	35.0%	agency-specific
COM External Leakage	35.0%	agency-specific
IND External Leakage	35.0%	agency-specific
GOV External Leakage	35.0%	agency-specific

Targets

Target Method: Percentage

% of Accts Targeted / yr	0.500%
Only Effects New Accts	☐

Measure 13: Leak Repair & Plumbing Emergency Assistance

Overview	
Name	Leak Repair & Plumbing Emergency Assistance
Abbr	13
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2023
Last Year	2045
Measure Length	23

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
SF	$200.00	$100.00	1
MF	$200.00	$100.00	2

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Program provides leak identification and possible rebates and/or pre-negotiated pricing with approved plumbers to assist customers in locating and repair leaks.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐	☐							
Urinals									
Lavatory Faucets	☐	☐							
Showers	☐	☐							
Dishwashers	☐	☐							
Clothes Washers	☐	☐							
Process									
Kitchen Spray Rinse									
Internal Leakage	☑	☑							
Baths	☐	☐							
Other	☐	☐							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☑	☑							
Outdoor									
vatory/Kitchen Faucets	☐	☐							
Cooling									

Comments

> **Utility Costs** - Utility costs might represent staff time for account leak identification, multiple notifications and a possible site survey (incl drive time) and reporting.
> **Customer Costs** - Cost to fix the leak.
> **End Use Water Savings** - Savings might be over 200% if based on a targeted account's using 2-4 times the amount of the previous year's water use. Assume 50% of internal leaks are fixed. Assume 1 leak per SF, 2 leaks per MF (typically duplex owners), as these programs typically are for owner-occupied residences.
> **Targets** - Assume 0.1% of accounts per year need leak repair and plumbing assistance.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Internal Leakage	50.0%	agency-specific
MF Internal Leakage	50.0%	agency-specific
SF External Leakage	50.0%	agency-specific
MF External Leakage	50.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	0.100%
Only Effects New Accts	☐

Measure 14: Multifamily HET Direct Install

Overview	
Name	Multifamily HET Direct Install
Abbr	14
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2023
Last Year	2027
Measure Length	5

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
MF	$350.00	$25.00	25

Administration Costs	
Method:	Percent
Markup Percentage	20%

Description

Program provides property owners and managers of multi-family housing direct installation of high-efficiency toilets.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☐	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets		☑							
Urinals									
Lavatory Faucets		☐							
Showers		☐							
Dishwashers		☐							
Clothes Washers		☐							
Process									
Kitchen Spray Rinse									
Internal Leakage		☐							
Baths		☐							
Other		☐							
Irrigation		☐							
Pools		☐							
Wash Down		☐							
Car Washing		☐							
External Leakage		☐							
Outdoor									
vatory/Kitchen Faucets		☐							
Cooling									

Comments

> **Utility Cost** - Cost reflects cost of 1.1 gpf or lower toilet and installation fees based upon City of Santa Monica, CA program. https://www.smgov.net/uploadedFiles/Departments/OSE/Categories/Water/DirectInstall_Toilet.pdf

> **Administrative Cost** - reflects utility staff time to track and run program.

> **Customer Cost** - Minimal customer cost.

> **End Use Water Savings** - Savings estimates assume the difference between 0.8 gpf and 1.6 gpf or 50% savings on average.

> **Targets** - Assumes 0.1% of multifamily accounts targeted per year.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
MF Toilets	50.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	0.100%
Only Effects New Accts	☐

Measure 15: Multifamily Submetering for Existing Accounts

Overview	
Name	Multifamily Submetering for Existing Accounts
Abbr	15
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2045
Measure Length	26

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
MF	$150.00	$450.00	20

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Provide submeters for individual units in condos developments and mobile home parks. This program is intended to be modeled after the existing Valley Water program.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☐	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets		☑							
Urinals									
Lavatory Faucets		☑							
Showers		☑							
Dishwashers		☑							
Clothes Washers		☑							
Process									
Kitchen Spray Rinse									
Internal Leakage		☑							
Baths		☑							
Other		☐							
Irrigation		☐							
Pools		☐							
Wash Down		☐							
Car Washing		☐							
External Leakage		☐							
Outdoor									
vatory/Kitchen Faucets		☑							
Cooling									

Comments

> **Utility Cost** - Utility costs for this measure are primarily staff time and $150 rebate modeled off the Valley Water submeter rebate program.
> **Customer Cost** - Customer cost is for the meter (~$600/acct) minus the rebate amount.
> **End Use Water Savings** - Savings based on estimated metering retrofit projects and education measure estimated savings. Leak savings are higher since submetering should make leaks easier to identify and locate. Assume savings on indoor only. No outdoor because it would have a separate meter likely. Assumed average 15-30% water savings per meter based off of Valley Water 2007 Pilot Study on mobile homes which saved an average of 23% per meter.
> **Targets** - assumes only 0.1% of accounts targeted each year

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
MF Toilets	20.0%	agency-specific
MF Lavatory Faucets	20.0%	agency-specific
MF Showers	20.0%	agency-specific
MF Dishwashers	20.0%	agency-specific
MF Clothes Washers	20.0%	agency-specific
MF Internal Leakage	20.0%	agency-specific
MF Baths	20.0%	agency-specific
MF Non-Lavatory/Kitchen Faucets	20.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	0.100%
Only Effects New Accts	☐

Measure 16: New Development Submetering

Overview	
Name	New Development Submetering
Abbr	16
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☑

Fixture Cost per Device	Utility	Customer	Fix/Acct
MF	$20.00	$600.00	20

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

This is an existing code that, as of January 1, 2018, requires the metering of individual units in new multifamily, condos, townhouses, mobile-home parks and business centers (less than four stories and with water heater in the units).

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☐	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets		☑							
Urinals									
Lavatory Faucets		☑							
Showers		☑							
Dishwashers		☑							
Clothes Washers		☑							
Process									
Kitchen Spray Rinse									
Internal Leakage		☑							
Baths		☐							
Other		☐							
Irrigation		☐							
Pools		☐							
Wash Down		☐							
Car Washing		☐							
External Leakage		☐							
Outdoor									
vatory/Kitchen Faucets		☑							
Cooling									

Comments

> This is a CA regulation as of 1/1/2018

> **Utility Costs** - For this measure cost is staff time for enforcement for plan checks and random inspections. Assume no fixture costs to the utility. Assume average of 20 submeters per MF account (i.e. 20 apartment units per utility meter). The time per submeter verification could be averaged across smaller sites if the service area has smaller or fewer apartments.

> **Customer Costs** - Cost of submeter which would be purchased by the customer.

> **Administration Costs** - Cost for staff to administer and track participants.

> **End Use Water Savings** - Valley Water has an existing submetering program since 2001 that was analyzed. Measure saved 22% when analyzed on mobile home parks in 2007. This program on new development starting in 2020 and into the future is modified to new accounts which use less water due to newer building standards, therefore there are less savings by adding individual submeters. To be conservative, assume savings on indoor only. No outdoor savings are assumed because typically large sites have separate irrigation meters.

> **Targets** - Per code this applies to mixed-use accounts, assume that 50% of new MF accounts are eligible.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
MF Toilets	5.0%	agency-specific
MF Lavatory Faucets	5.0%	agency-specific
MF Showers	5.0%	agency-specific
MF Dishwashers	5.0%	agency-specific
MF Clothes Washers	5.0%	agency-specific
MF Internal Leakage	5.0%	agency-specific
MF Non-Lavatory/Kitchen Faucets	5.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	50.000%
Only Effects New Accts	☑

Measure 17: New Development Hot Water On Demand

Overview	
Name	New Development Hot Water On Demand
Abbr	17
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☑

Fixture Cost per Device	Utility	Customer	Fix/Acct
SF	$50.00	$500.00	1
MF	$50.00	$500.00	3

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Existing code which requires new residential development to include efficient hot water on demand systems. Systems reduce hot water waiting times. Coordination with building department and tracking.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐	☐							
Urinals									
Lavatory Faucets	☑	☑							
Showers	☑	☑							
Dishwashers	☐	☐							
Clothes Washers	☐	☐							
Process									
Kitchen Spray Rinse									
Internal Leakage	☐	☐							
Baths	☐	☐							
Other	☐	☐							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☐	☐							
Outdoor									
vatory/Kitchen Faucets	☑	☑							
Cooling									

Comments

> **Utility Costs** - Utility costs represent time to monitor implementation.

> **Customer Costs** - Customer costs represent new development installation and device (less than existing retrofit costs).

> **End Use Water Savings** - Water savings based on Jim Lutz paper and information from Gary Klein and David Grieshop. See spreadsheet titled "Hot Water On Demand Water Savings Estimate_2013" which purports that a 1750 sq. ft house saves ~ 1600 gallons per year or 4.3 gpd. Assumes equivalent percentage savings on shower and faucet end uses. Conservatively assumes 3 units or homes per MF account. More information for example system by ACT on www.gothotwater.com.

> **Targets** - Assume applies to all new residential accounts

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Lavatory Faucets	4.0%	agency-specific
MF Lavatory Faucets	4.0%	agency-specific
SF Showers	4.0%	agency-specific
MF Showers	4.0%	agency-specific
SF Non-Lavatory/Kitchen Faucets	4.0%	agency-specific
MF Non-Lavatory/Kitchen Faucets	4.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	90.000%
Only Effects New Accts	☑

Measure 18: Low Impact New & Remodeled Development

Overview	
Name	Low Impact New & Remodeled Development
Abbr	18
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2029
Measure Length	10

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
SF	$400.00	$2,000.00	1
MF	$500.00	$5,000.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Utility would require developers of new/remodeled sites to follow low impact development concepts, standards, and Best Management Practices for stormwater and water conservation benefits. Encourage or require use of bio-retention facilities, rain water cisterns, gray water plumbing, etc.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☑	☑							
Urinals									
Lavatory Faucets	☑	☑							
Showers	☑	☑							
Dishwashers	☑	☐							
Clothes Washers	☑	☑							
Process									
Kitchen Spray Rinse									
Internal Leakage	☑	☑							
Baths	☑	☑							
Other	☑	☑							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☐	☐							
Outdoor									
ratory/Kitchen Faucets	☑	☑							
Cooling									

Comments

> **Utility Costs** - Assume utility costs for plan checks and inspection time. Assume administrative costs for scheduling, follow-up, and reporting.
> **Customer Costs** - Customer costs represent fees and device upgrade costs.
> **End Use Water Savings** - Depending on ordinance design (site budget or matching average of last 5 years of site use), etc., assume reduction to all end uses. Up to 100% if a totally water neutral site, but assume 50% of all end uses saved as compared to average account use since these are water-efficient measures taken to above and beyond existing plumbing codes. 5% savings is conservative at this early stage of measure design. Savings include rainwater catchment and graywater, which historically do not yield high water savings.
> **Targets** - Targeting 50% of new development, as not all will qualify; some redevelopment will be subject. Affects new development for all customer categories except irrigation only accounts.
> Program is assume to end in 10 years to account for saturation of efficient fixtures due to new housing regulations in California.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Toilets	5.0%	agency-specific
MF Toilets	5.0%	agency-specific
SF Lavatory Faucets	5.0%	agency-specific
MF Lavatory Faucets	5.0%	agency-specific
SF Showers	5.0%	agency-specific
MF Showers	5.0%	agency-specific
SF Dishwashers	5.0%	agency-specific
SF Clothes Washers	5.0%	agency-specific
MF Clothes Washers	5.0%	agency-specific
SF Internal Leakage	5.0%	agency-specific
MF Internal Leakage	5.0%	agency-specific
SF Baths	5.0%	agency-specific
MF Baths	5.0%	agency-specific
SF Other	5.0%	agency-specific
MF Other	5.0%	agency-specific
SF Non-Lavatory/Kitchen Faucets	5.0%	agency-specific
MF Non-Lavatory/Kitchen Faucets	5.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	50.000%
Only Effects New Accts	☑

Measure 19: Fixture Retrofit on Resale or Water Account Change

Overview	
Name	Fixture Retrofit on Resale or Water Account Change
Abbr	19
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
SF	$272.00	$100.00	1
MF	$408.00	$100.00	3
COM	$408.00	$200.00	3
IND	$408.00	$200.00	3
GOV	$408.00	$200.00	3

Administration Costs

Method: Percent

Markup Percentage	10%

Description

This is an existing code requiring fixture retrofit upon resale or permitted alteration. Model assumes agencies will take active role in ensuring compliance, in participation by sending retrofit letters to new accounts holders who do not have a certificate on file. Random inspections would be conducted by utility staff to ensure process is valid and yields fixture replacements.

Customer Classes

SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
☑	☑	☑	☐	☑	☑	☐	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☑	☑	☑		☑	☑			
Urinals			☑		☑	☑			
Lavatory Faucets	☑	☑	☑		☑	☑			
Showers	☑	☑	☑		☑	☑			
Dishwashers	☐	☐	☐		☐	☐			
Clothes Washers	☐	☐	☐		☐	☐			
Process			☐		☐				
Kitchen Spray Rinse			☐			☐			
Internal Leakage	☐	☐	☐		☐	☐			
Baths	☐	☐							
Other	☐	☐	☐		☐	☐			
Irrigation	☐	☐	☐		☐	☐			
Pools	☐	☐				☐			
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☐	☐	☐		☐	☐			
Outdoor									
vatory/Kitchen Faucets	☑	☑	☑		☑	☑			
Cooling			☐		☐	☐			

Comments

> **Utility Costs** - Random inspections would be conducted by utility staff to ensure process is valid and yields fixture replacements. Assume staff avg fully burdened Rate with fringe and overhead is $136/hr, (ACWD Water Conservation Rate is $50/hr for base rate with fringe and overhead add 1.72%) Assuming 2 hours for single family and 3 for MF/CII on average per site, assuming inspections are random. Assume a typical unit has 2 toilets, 1 showerhead, 2 bath aerators, and 1 kitchen aerator replaced as needed. Non-residential units are assume to have 1 urinal too. Assume multiple units per non-SF account.

> **Customer Costs** - Represent any fixture cost to comply with California standards. CII cost accounts for urinals too.

> **Administration Costs** - 10% costs represent staff time to administer the measure.

> **End Use Water Savings** - Savings from this code measure assume 2.2 gpm faucets, 2.5 showerheads, 1.6 gpf toilets and 1.0 gpf urinals are replaced with 1.2 gpm bathroom aerators ($1/ea), 1.8 gpm kitchen aerators ($2.10/ea), 1.8 gpm showerheads ($4.60/ea), 1.28 gpf ($100/ea), and 0.125 gpf urinals ($150/ea).

> **Targets** - Target % percent of accounts is a conservative assumption for recent resale and water account change rates.

> This measure is modeled through the full analysis period in order to reach ALL pre-1992 housing stock.

Results

Units: MG

Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
SF Toilets	20.0%	agency-specific
MF Toilets	20.0%	agency-specific
COM Toilets	20.0%	agency-specific
IND Toilets	20.0%	agency-specific
GOV Toilets	20.0%	agency-specific
COM Urinals	87.5%	agency-specific
IND Urinals	87.5%	agency-specific
GOV Urinals	87.5%	agency-specific
SF Lavatory Faucets	45.5%	agency-specific
MF Lavatory Faucets	45.5%	agency-specific
COM Lavatory Faucets	45.5%	agency-specific
IND Lavatory Faucets	45.5%	agency-specific
GOV Lavatory Faucets	45.5%	agency-specific
SF Showers	28.0%	agency-specific
MF Showers	28.0%	agency-specific
COM Showers	28.0%	agency-specific
IND Showers	28.0%	agency-specific
GOV Showers	28.0%	agency-specific
SF Non-Lavatory/Kitchen Faucets	18.2%	agency-specific
MF Non-Lavatory/Kitchen Faucets	18.2%	agency-specific
COM Non-Lavatory/Kitchen Faucets	18.2%	agency-specific
IND Non-Lavatory/Kitchen Faucets	18.2%	agency-specific
GOV Non-Lavatory/Kitchen Faucets	18.2%	agency-specific

Targets

Target Method: Percentage

% of Accts Targeted / yr	0.200%
Only Effects New Accts	☐

Measure 20: Public & School Education

Overview	
Name	Public & School Education
Abbr	20
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2045
Measure Length	27

Measure Life	
Permanent	☐
Years	2
Repeat	☐

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
SF	$1.00	$0.00	1

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Program includes in-person and online outreach to residential customers, schools and all CII customers, landscapers and contractors. Outreach includes tools and resources specific to outdoor water use efficiency (e.g. WaterWise gardening tool and landscape watering calculator) as well as general information on water conservation through community events, websites, and social media.

Customer Classes

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☑	☐	☐	☐	☐	☐	☐	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☑								
Urinals									
Lavatory Faucets	☑								
Showers	☑								
Dishwashers	☑								
Clothes Washers	☑								
Process									
Kitchen Spray Rinse									
Internal Leakage	☑								
Baths	☑								
Other	☑								
Irrigation	☑								
Pools	☑								
Wash Down	☑								
Car Washing	☑								
External Leakage	☑								
Outdoor									
atory/Kitchen Faucets	☑								
Cooling									

Comments

> **Utility Cost** - Cost based off of BAWSCA FY17/18 Water Wise School Education summary. Program Cost ($90,669) + BAWSCA Admin Cost ($2,315) / Number of Agencies. 8 agencies are participating so total cost is $11,623 per agency. Assume a total of $1.00 per account per agency to cover cost of all BAWSCA public information activities including school education.
> **Customer Costs** - Assume no cost to customers.
> **End Use Water Savings** - Public information water savings is assumed at 0.5% on all end uses.
> **Targets** - Target 50% of accounts every year. Assumes a service area reaches half of their customers each year on average.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Toilets	0.1%	agency-specific
SF Lavatory Faucets	0.5%	agency-specific
SF Showers	0.5%	agency-specific
SF Dishwashers	0.5%	agency-specific
SF Clothes Washers	0.5%	agency-specific
SF Internal Leakage	0.5%	agency-specific
SF Baths	0.5%	agency-specific
SF Other	0.5%	agency-specific
SF Irrigation	0.5%	agency-specific
SF Pools	0.5%	agency-specific
SF Wash Down	0.5%	agency-specific
SF Car Washing	0.5%	agency-specific
SF External Leakage	0.5%	agency-specific
SF Non-Lavatory/Kitchen Faucets	0.5%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	50.000%
Only Effects New Accts	☐

Measure 21: Billing Report Educational Tool Non-AMI

Overview	
Name	Billing Report Educational Tool Non-AMI
Abbr	21
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2019
Last Year	2028
Measure Length	10

Measure Life	
Permanent	☐
Years	4
Repeat	☐

Fixture Cost per Device	Utility	Customer	Fix/Acct
SF	$2.00	$20.00	1

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Program provides a customer portal and optional water use reports to show customers their individualized current and historical water use patterns and relative efficiency (e.g. BAWSCA WaterSmart Software Program). Modeled for agencies with monthly meter reads and billing, not AMI meter data.

Customer Classes	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
	☑	☐	☐	☐	☐	☐	☐	☐	☐

End Uses	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☑								
Urinals									
Lavatory Faucets	☑								
Showers	☑								
Dishwashers	☑								
Clothes Washers	☑								
Process									
Kitchen Spray Rinse									
Internal Leakage	☑								
Baths	☐								
Other	☐								
Irrigation	☑								
Pools	☐								
Wash Down	☑								
Car Washing	☑								
External Leakage	☑								
Outdoor									
ıatory/Kitchen Faucets	☑								
Cooling									

Comments

> **Utility Cost** - Includes a set up fee of $9,000 per Agency. $1.75/account for email notification per year. This cost was increased by $.25/account for set up fees.

> **Customer Cost** - Reflects cost of minor action. Would on average be very small for behavior change or fixing minor leaks based on access to their billing data. If customer takes action for a significant change assume the costs and savings are captured in other active conservation programs.

> **Administration Costs** - Cost for utility staff to track and monitor program ran by WaterSmart software.

> **End Use Water Savings assumptions** - Water savings of 4% for residential customers was developed through a 2017 WaterSmart program analysis for BAWSCA agencies is an average across the 85% of accounts targeted. The analysis was conducted during the end of a drought period and savings can overlap other active and passive conservation programs. For long term water savings, the savings has been reduced to 1% which is still very cost effective.

> **Targets** - The target % is based on the BAWSCA's agreement for WaterSmart software which includes and estimated customer target range of 50%-85%. According to 2020 efforts, the BAWSCA agencies select to target 85% of their customers.

> **Measure length** - Assume this measure lasts 10 years, as after that time most BAWSCA agencies will have switched to AMI meters and AMI water data portals to share information with their customers.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Toilets	1.0%	agency-specific
SF Lavatory Faucets	1.0%	agency-specific
SF Showers	1.0%	agency-specific
SF Dishwashers	1.0%	agency-specific
SF Clothes Washers	1.0%	agency-specific
SF Internal Leakage	1.0%	agency-specific
SF Irrigation	1.0%	agency-specific
SF Wash Down	1.0%	agency-specific
SF Car Washing	1.0%	agency-specific
SF External Leakage	1.0%	agency-specific
SF Non-Lavatory/Kitchen Faucets	1.0%	agency-specific

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	85.000%
Only Effects New Accts	☐

Measure 22: AMI Customer Portal

Overview	
Name	AMI Customer Portal
Abbr	22
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2045
Measure Length	26

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
SF	$110.00	$300.00	1
MF	$110.00	$300.00	1
COM	$110.00	$1,000.00	1
IND	$110.00	$1,000.00	1
GOV	$110.00	$1,000.00	1

Administration Costs

Method: Percent

Markup Percentage	25%

Description

Program provides customer portal for accounts with AMI meters capable of providing continuous consumption data to customers and utility. System provides identification and notification of suspected customer leaks as well as improved customer service and enhanced ability to identify water theft. This measure is only applicable to agencies that already have AMI.

Customer Classes

SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
☑	☑	☑	☐	☑	☑	☐	☐	☐

End Uses

	SF	MF	COM	INST	IND	GOV	IRR	FIRE	REC
Toilets	☐	☐	☐		☐	☐			
Urinals			☐		☐	☐			
Lavatory Faucets	☐	☐	☐		☐	☐			
Showers	☐	☐	☐		☐	☐			
Dishwashers	☐	☐	☐		☐	☐			
Clothes Washers	☐	☐	☐		☐	☐			
Process			☐		☐				
Kitchen Spray Rinse			☐			☐			
Internal Leakage	☑	☑	☑		☑	☑			
Baths	☐	☐							
Other	☐	☐	☐		☐	☐			
Irrigation	☑	☑	☑		☑	☑			
Pools	☐	☐				☐			
Wash Down	☐	☐							
Car Washing	☐	☐							
External Leakage	☑	☑	☑		☑	☑			
Outdoor									
vatory/Kitchen Faucets	☐	☐	☐		☐	☐			
Cooling			☐		☐	☐			

Comments

> **Utility Costs** - Basis for the starting value cost estimate is $200 per AMI customer where assumes (a) customer AMI portal cost: $1.75/account for 5 years, equals $9/account based on WaterSmart Portal cost for AMI meter. This cost was increased by $1/acct to account for set up fees.; (b) cost estimate includes an average of $100 leak repair for those customer-side leaks found and fixed; (c) $200 meter cost estimated by Valley Water staff assumed to be covered by other utility departments. Cost estimate does not include service leak repair (assume included in Water Loss measure).
> **Administration Costs** - This is for utility staff to track and monitor program ran by WaterSmart software.
> **Customer Costs** - Customer cost includes leak repair.
> **End Use Water Savings** - AMI savings based on significant reductions to leakage and irrigation end uses. Savings based on SFPUC case study per Julie Ortiz ppt at 2019 Peer-to-Peer "AMI: Everything you need to know to run a successful program." Savings are estimated to be 20%-50% on leakage (internal and external) with a potential additional 5% savings on all other end uses due to behavioral changes, 5% savings to irrigation.
> **Targets** - Assumes 0.5% per year take action to actually save water based on information provided by AMI customer portal, ether by behavior or leak repair.

Results

Units: MG

Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
SF Internal Leakage	20.0%	agency-specific
MF Internal Leakage	20.0%	agency-specific
COM Internal Leakage	20.0%	agency-specific
IND Internal Leakage	20.0%	agency-specific
GOV Internal Leakage	20.0%	agency-specific
SF Irrigation	5.0%	agency-specific
MF Irrigation	5.0%	agency-specific
COM Irrigation	5.0%	agency-specific
IND Irrigation	5.0%	agency-specific
GOV Irrigation	5.0%	agency-specific
SF External Leakage	20.0%	agency-specific
MF External Leakage	20.0%	agency-specific
COM External Leakage	20.0%	agency-specific
IND External Leakage	20.0%	agency-specific
GOV External Leakage	20.0%	agency-specific

Targets

Target Method: Percentage

% of Accts Targeted / yr	0.500%
Only Effects New Accts	☐

Measure 23: Water Loss

Overview	
Name	Water Loss
Abbr	23
Category	Default
Measure Type	Water Loss Measure

Time Period	
First Year	2019

Backlog Costs	
Total Backlog Work Costs	$1,000,000
Years to Complete Backlog	10

Maintenance Costs	
Annual Maintenance Costs	$50,000

Target	
Total GPCD Reduction	0.3

Description

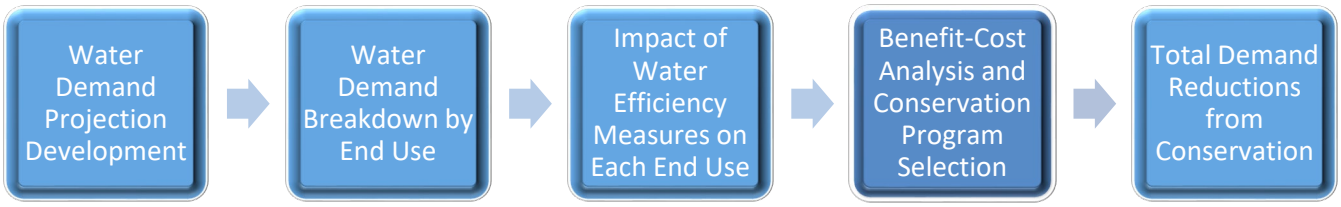
> Water Loss Audit - Based on SB 555 requirements, maintain a thorough annual accounting using AWWA water system audit software submitted to California DWR. Includes accounting for production, sales by customer class and quantity of water produced but not sold (non-revenue water). This provides a picture of your system, including water usage patterns and trends needed to identify appropriate conservation activities. In conjunction with system accounting, include audits that identify and quantify known legitimate uses of non-revenue water in order to determine remaining non-revenue water losses. Goal would be to lower the Infrastructure Leakage Index (ILI) and non-revenue water every year by a pre-determined amount based on cost-effectiveness. Continuously analyze billing data for system errors and mis-registering meters. Identify and quickly notify customers of apparent leaks. Address meter testing and repair/replacement to insure more accurate meter reads and revenue collection. Actions could include meter calibration and accelerated meter replacement.
> Real Water Loss Reduction - Measure covers efforts to find and repair leaks in the distribution system to reduce real water loss. Actions could include installation of data loggers and proactive leak detection. Leak repairs would be handled by existing crews at no extra cost.
> Distribution System Pressure Regulation - Install additional pressure regulators in portions of distribution system to maintain pressure within limits so accounts do not receive excessive pressure.

Results	
Units	MG
Average Water Savings (mgd)	
agency-specific	
Lifetime Savings - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Lifetime Costs - Present Value ($)	
Utility	agency-specific
Community	agency-specific
Benefit to Cost Ratio	
Utility	agency-specific
Community	agency-specific
Cost of Savings per Unit Volume ($/mg)	
Utility	agency-specific

Comments

> **Backlog cost and years basis** - based on agency information.
> **Annual maintenance cost basis** - based on agency information.
> **Savings target basis** - based on agency information.
> The savings is over the life of the measure which is tied to the agency current Non-Revenue Water percentage which can be found in the GREEN "Non-Revenue Water" portion of the DSS Model. All measures are advised to have “Annual Maintenance Costs” inputted to allow for budget estimates for complete program. Additional water savings of “NRW” real water losses may be available when technically feasible. Rule of thumb is minimum system water losses below approximately 6% (as defined as the difference between production and consumption or alternatively as a percent of System Input Volume using AWWA Water System Audit definitions). For NRW below 6% (which can be found in the GREEN "NRW" portion of the DSS Model), input “0%” for new real water savings and “$0” in the Backlog Cost section. For NRW above 6%, a GPCD savings input volume can be computed (an estimate of annual savings volume divided by total population). For example a 4.0 GPCD is equivalent to a 2% reduction for the system with a 150 GPCD water use.
> Additional Water Loss Control Program budget to achieve these water savings is inputted into the “Backlog Cost” section along with the duration of the years to accomplish the estimated reduction. In other words, $250,000 over 5 years would add $50,000 per year to assist with meeting NRW reduction goals.

APPENDIX G – DSS MODEL OVERVIEW



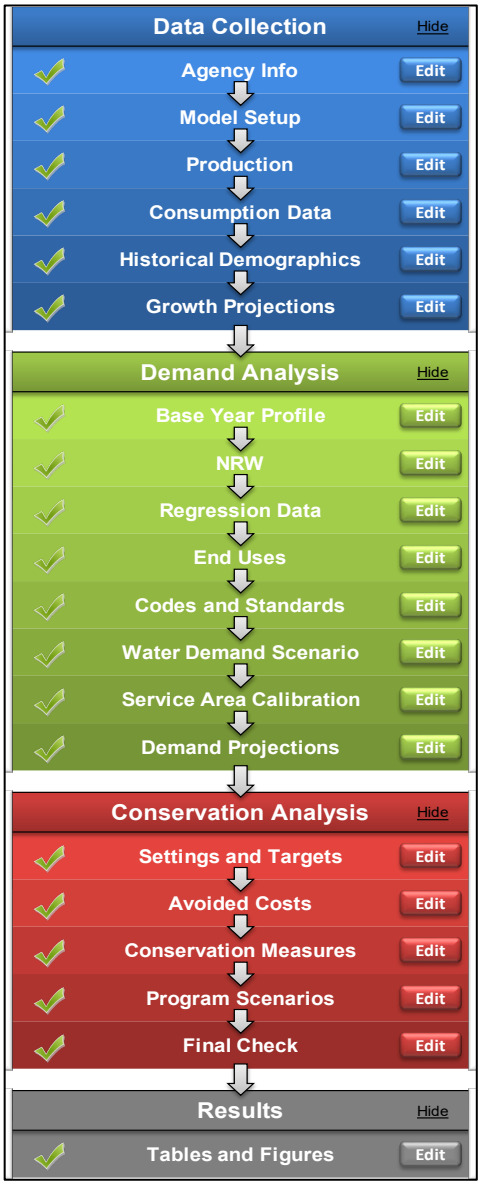


Figure G-1 DSS Model Main Page

DSS Model Overview: The Demand Side Management Least Cost Planning Decision Support System Model (DSS Model) as shown in Figure G-1 is used to prepare long-range, detailed demand projections. The purpose of the extra detail is to enable a more accurate assessment of the impact of water efficiency programs on demand and to provide a rigorous and defensible modeling approach necessary for projects subject to regulatory or environmental review.

Originally developed in 1999 and continuously updated, the DSS Model is an "end-use" model that breaks down total water production (water demand in the service area) to specific water end uses, such as plumbing fixtures and appliance uses. The model uses a bottom-up approach that allows for multiple criteria to be considered when estimating future demands, such as the effects of natural fixture replacement, plumbing codes, and conservation efforts. The DSS Model may also use a top-down approach with a utility-prepared water demand forecast.

Demand Forecast Development and Model Calibration: To forecast urban water demands using the DSS Model, customer demand data is obtained from the water agency being modeled. Demand data is reconciled with available demographic data to characterize water usage for each customer category in terms of number of users per account and per capita water use. Data is further analyzed to approximate the split of indoor and outdoor water usage in each customer category. The indoor/outdoor water usage is further divided into typical end uses for each customer category. Published data on average per capita indoor water use and average per capita end use is combined with the number of water users to calibrate the volume of water allocated to specific end uses in each customer category. In other words, the DSS Model checks that social norms from end studies on water use behavior (e.g., flushes per person per day) are not exceeded or drop below reasonable use limits.

Passive Water Savings Calculations: The DSS Model is used to forecast service area water fixture use. Specific end-use type, average water use, and lifetime are compiled for each fixture. Additionally, state and national plumbing codes and appliance standards are modeled by customer category. These fixtures and plumbing codes can be added to, edited, or deleted by the user. This process yields two demand forecasts, one with plumbing codes and one without plumbing codes.

Active Conservation Measure Analysis Using Benefit-Cost Analysis: As shown in Figure G-2, the DSS Model evaluates active conservation measures using benefit-cost analysis with the present value of the cost of water saved ($/Million Gallons or $/Acre-Feet). Benefits are based on savings in water and wastewater facility operations and maintenance (O&M) and any deferred capital expenditures.

Figure G-2. Sample Benefit-Cost Analysis Summary

Conservation Measures

Benefit Cost Analysis

Previo | Conser | AMI | RES | WC | IRR | CIIR | NO | MU | LDS | PRV | LEA | UHE | UHE | TOI | HO | RAI | RAI | SPR | Lan | SCH | GEN | DIP | B/C | Next

Review Data

Benefit Cost Analysis

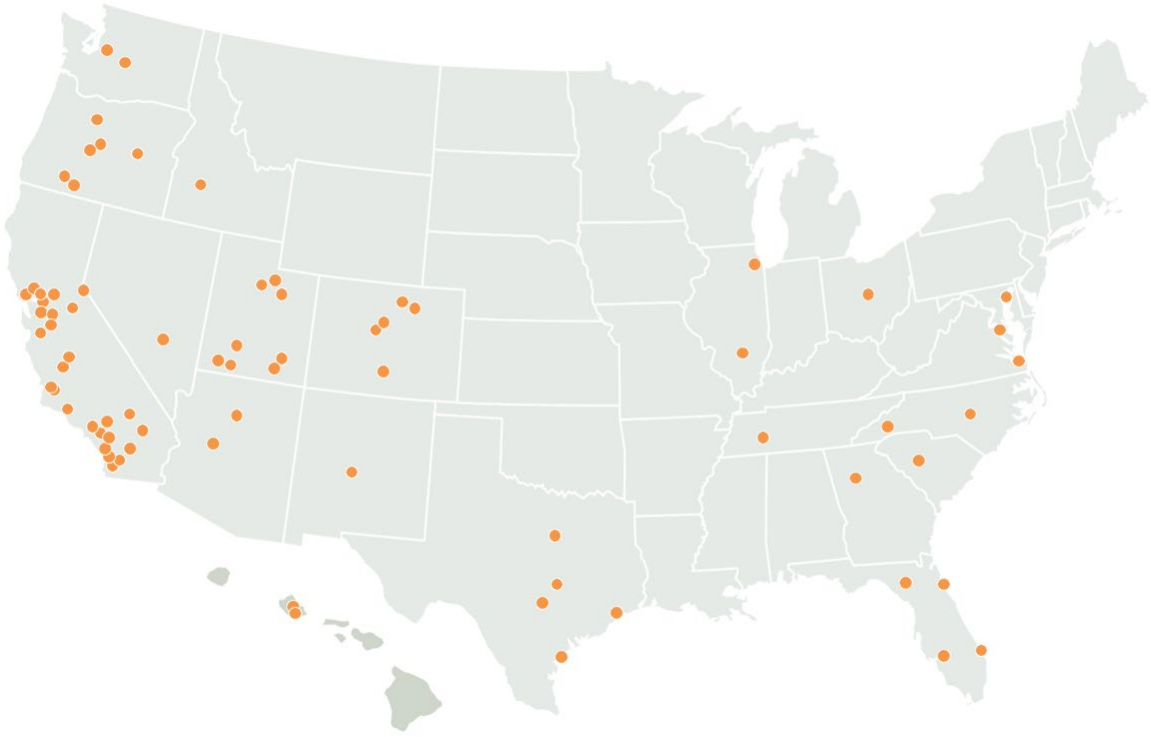
Util Cost Five Year Start Year: 2020 | Water Savings Year: 2030 | Units: AF

Benefit Cost Analysis

	Measure	Present Value of Water Utility Benefits	Present Value of Community Benefits	Present Value of Water Utility Costs	Present Value of Community Costs	Water Utility Benefit to Cost Ratio	Community Benefit to Cost Ratio	Five Years of Water Utility Costs 2020-2025	Water Savings in 2030 (afy)	Cost of Savings per Unit Volume ($/af)
AMI	Full AMI Implementation	$3,976,434	$16,635,194	$1,566,069	$5,893,340	2.54	2.82	$320,000	133.764878	$324
RESH	Residential Rebates for HECW	$139,312	$365,447	$95,879	$200,665	1.45	1.82	$50,325	5.124572	$824
WC	Water Checkup	$7,648,165	$30,288,419	$6,005,949	$7,665,564	1.27	3.95	$1,382,995	239.652915	$877
IRRE	Irrigation Evaluations	$1,589,488	$1,589,488	$1,918,184	$4,332,779	0.83	0.37	$443,824	98.051821	$646
CIIRe	CII Water Survey Level 2 and Customized Rebate	$910,720	$3,313,109	$915,904	$2,581,185	0.99	1.28	$193,725	18.753753	$1,055
NOZZ	Free Sprinkler Nozzle Program	$277,886	$277,886	$329,386	$455,933	0.84	0.61	$103,145	23.005687	$680
MULC	Mulch Program	$80,739	$80,739	$287,676	$287,676	0.28	0.28	$66,932	4.554625	$2,000
LDS	Water Conserving Landscape and Irrigation Codes	$1,055,819	$1,055,819	$350,316	$7,979,608	3.01	0.13	$78,568	46.098525	$161
PRV	Pressure Reduction Valve Rebate	$102,170	$193,972	$49,161	$132,223	2.08	1.47	$37,818	8.503521	$425
LEAK	Leak Detection Device Rebate	$174,130	$847,416	$306,843	$1,288,743	0.57	0.66	$80,053	6.065394	$1,895
UHET	Ultra-High Efficiency Toilet Rebate	$538,624	$538,624	$405,529	$761,556	1.33	0.71	$362,736	16.287780	$921

Model Use and Validation: As shown in Figure G-3, the DSS Model has been used for over 20 years for practical applications of conservation planning in over 300 service areas representing 60 million people, including extensive efforts nationally and internationally in Australia, New Zealand, and Canada.

Figure G-3. DSS Model Analysis Locations in the U.S.



The California Urban Water Conservation Council, (now known as theCalifornia Water Efficiency Partnership) has peer reviewed and endorsed the model since 2006. It is offered to all CalWEP members for use to estimate water demand, plumbing code, and conservation program savings.

The DSS Model can use one of the following: 1) a statistical approach to forecast demands (e.g., an Econometric Model); 2) a forecasted increase in population and employment; 3) predicted future demands; or 4) a demand projection entered into the model from an outside source. The following figure presents the flow of information in the DSS Model Analysis.

Figure G-4. DSS Model Analysis Flow