City of Bullhead City
Water Conservation Plan Update

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TABLE OF CONTENTS PAGE

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

ADWR	Arizona Department of Water Resources
acct	account
AF	acre-feet
AFY	acre-feet per year
AMI	Advanced Metering Infrastructure
AWE	Alliance for Water Efficiency
AWWA	American Water Works Association
AWWARF	American Water Works Association Research Foundation
CAP	Central Arizona Project
CII	Commercial, Industrial, and Institutional
DSS Model	Demand Side Management Least Cost Planning Decision Support System
EPA	Environmental Protection Agency
GPCD	gallons per capita per day
gpd	gallons per day
gpf	gallons per flush
gpm	gallons per minute
HET	High Efficiency Toilet
HEU	High Efficiency Urinal
HEW	High Efficiency Washing Machine
ILI	Infrastructure Leakage Index
MWM	Maddaus Water Management
N/A	not applicable
psi	pounds per square inch
PV	Present Value
RES	Residential
SCADA	Supervisory Control and Data Acquisition
USGS	United States Geological Survey
WAS	Water Accounting Surface
WRAC	Water Resources Advisory Committee
WUE	Water Use Efficiency

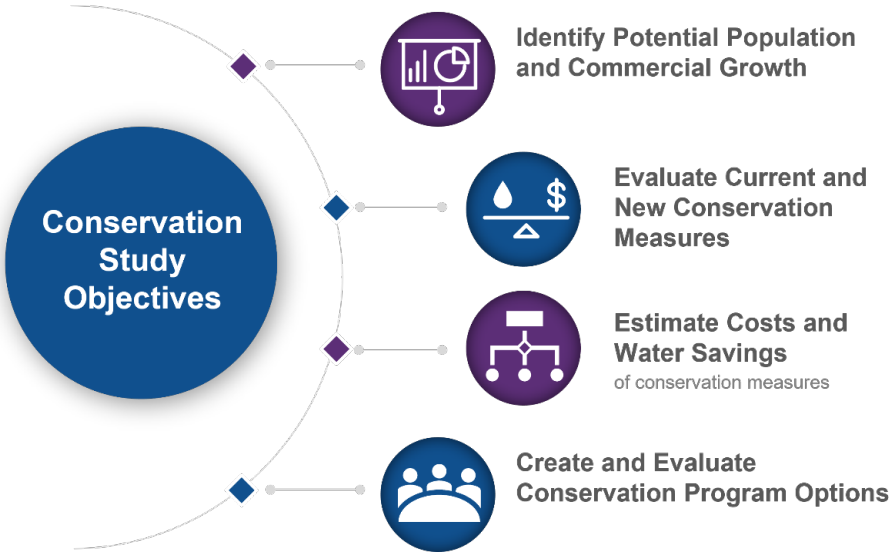
EXECUTIVE SUMMARY

The purpose of this Executive Summary is to briefly describe the City of Bullhead City's (City's) Water Conservation Plan Update (Plan Update).

Introduction

This conservation technical analysis was conducted by Maddaus Water Management Inc. (MWM) for the City of Bullhead City to accomplish the following objectives:

Figure ES-1. Conservation Study Objectives



Program Overview

Through the identification and prioritization of water conservation measures, this Plan Update will enable the City to project near-term water demands, identify attainable conservation goals, develop conservation strategies, and raise awareness of water-efficient practices throughout the community.

The planning process included the analysis of conservation measures and programs using the Least Cost Planning Decision Support System (DSS Model), developed by MWM. A screening of more than 100 measures, directed at existing customers and new development, was conducted following the methodology presented in the American Water Works Association Manual of Practice, *M52 Water Conservation Programs – A Planning Manual* (AWWA, 2017).

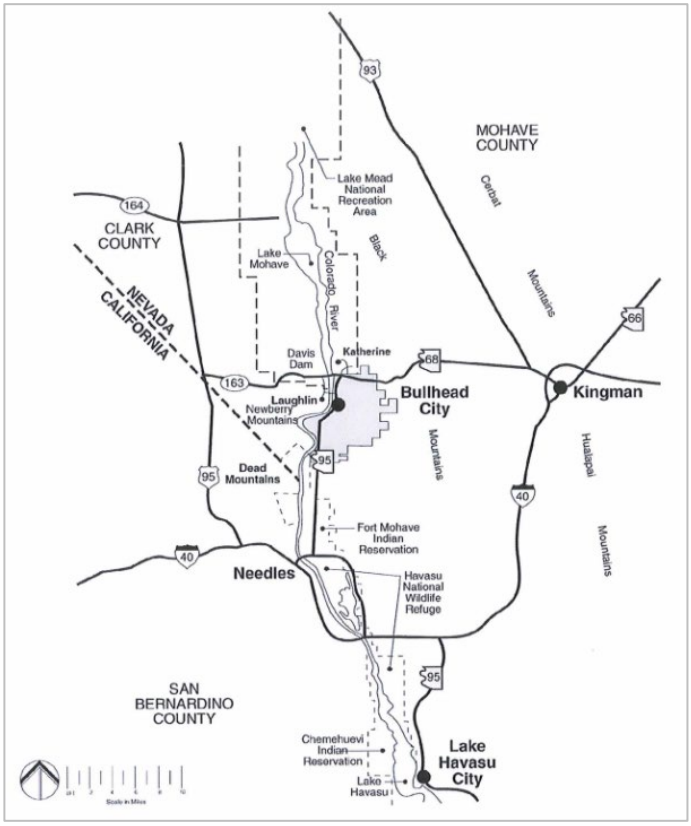
Following a thorough process of engagement from the City Council, City staff, stakeholders and the public, the City chose 12 conservation measures from the 100 screened to constitute a suite of measures for evaluation. This suite, called Program C throughout this Plan Update, includes residential, commercial, indoor and outdoor measures. Program C was used for comparison with two other program scenarios (Programs A and B) to determine the best ("optimized") conservation program for City implementation. After an evaluation of the three program scenarios, the City chose Program B as its optimized program scenario. By combining new initiatives with existing programs and plumbing code savings, the City's optimized program scenario is expected to save an estimated 512 acre-feet (AF) of water per year by 2027, depending on program participation and implementation schedule. All 12 measures that were evaluated as part of this Plan Update are listed in Figure ES-2 and described in more detail in Appendix D.

Figure ES-2. City of Bullhead City Selected Measures for Evaluation

1 INTRODUCTION

The City of Bullhead City's (the City's) water service area is located in northeastern Arizona in Mohave County, primarily along the south shore of Big Bear Lake. The Town of Laughlin, Nevada is located across the Colorado River to the west and the City of Kingman, Arizona is located approximately 35 miles to the east. The specific service area includes most of the incorporated area of Bullhead City as well as additional lands adjacent and east of the City. In total, the City's service area covers approximately 72 square miles and serves more than 21,000 homes and businesses. According to the Arizona Department of Water Resources (ADWR) the City is in the Low Elevation Climate Zone where annual precipitation ranges from 3 to 12 inches.

Figure 1-1. City of Bullhead City Location



1.1 Project Background

The City entered a water service contract with the U.S. Bureau of Reclamation (USBR) on November 9, 1984, for an allocation of water from the Colorado River. As part of that contract, the City is required to update its Water Conservation Plan every five years, the last of which occurred November 2016.

For this current Plan Update, Administrative Analyst served as the lead staff person and worked directly with Maddaus Water Management (MWM), the Water Resources Advisory Committee (WRAC), and key City staff. City staff were responsible for soliciting stakeholder engagement throughout the process.

1.2 Overview of the City's Water System

The Colorado River Compact of 1922 provides the framework from which the State of Arizona receives its allocation of river water. As described in its 2016 *Drought/Water Shortage Plan*, the City is exclusively dependent on the Colorado River and diverts its surface water allocation through groundwater wells. The withdrawn groundwater is accounted for as Colorado River surface water due to it being drawn from the Colorado River aquifer below the "water accounting surface" (WAS) elevation as defined by the United States Geological Survey (USGS) and as stated in the water contract with USBR. The City has a pilot program grant with USBR for effluent injection wells. The injection well project was a partnership to inject water serving the Central Arizona Project (CAP). The City also has a subcontract with Mohave County Water Authority.

The City took possession of the water systems operated by EPCOR USA on September 1, 2021. According to EPCOR, in 2019 the Bullhead City-area districts – Mohave and North Mohave – used an average of 5.30 to 9.0 million gallons per day (5,941 to 10,088 acre-feet per year [AFY]).[1] The system includes 21 wells and operates as 6 separate stand-alone systems with little or no interconnection. These include Mohave Main, Desert

[1] https://www.epcor.com/about/news-announcements/Pages/new-well-bullhead-city.aspx

Foothills/Laughlin Ranch, Lake Mohave Highlands and North Mohave systems in Bullhead City and Rio Vista and Camp Mohave systems in Fort Mohave.

The City Water Conservation Program annual budget, including a water conservation rebate program, was $250,000 for each year from 2017 to 2020. The Water Conservation Program includes a turf conversion rebate as well as rebates for fixture upgrades including toilets, washing machines and irrigation controllers. The program has saved an estimated 2,000 acre-feet of water per year.

The City is also working to acquire another local water system. This Plan Update will facilitate a smooth integration of the two systems by ensuring that the City's existing system is as efficient as possible. Once the other water system is owned by the City, it can be assimilated into the Plan Update with additional analysis and evaluation at that time.

1.3 Modeling Future Water Conservation Program Scenarios using the DSS Model

MWM's Demand Side Management Least Cost Planning Decision Support System (DSS Model) prepares near-term or long-range water demand and conservation savings projections. First developed in 1999 and continuously updated, the DSS Model is an end-use model that breaks down total water production (i.e., water demand in the service area) into specific water end uses (toilets, faucets, irrigation etc.). This "bottom-up" approach allows for detailed criteria to be considered when estimating future demands, such as the effects of natural fixture replacement, plumbing codes, and conservation efforts. The purpose of using end-use data 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.

The DSS Model can use one of the following: a statistical approach to forecast demands (e.g., an econometric model), a forecasted increase in population and employment, predicted future demands, or a demand projection input into the model from an outside source. For the City, the demand was based on a forecasted increase in population (an accurate employment estimate for the service area is not available currently). The DSS Model evaluates conservation measures using benefit cost analysis with the cost of water saved and benefit-to-cost ratio as economic indicators. The quantitative analysis is performed from the perspectives of both the utility and the City's customers.

More background information on the DSS Model can be found in Appendix A.

1.4 Purpose and Scope of Plan Update

The purpose of this Plan Update is to systematically evaluate and quantify a near-term water conservation strategy for the service area. The Plan Update details the assessment, analysis, and measurement of completed and existing programs and identifies new water use efficiency (WUE) opportunities. It is intended to serve as a guide for conservation programming and to set measurable targets for the City regarding future WUE investments and activities.

Through identification and prioritization of water conservation measures, the City can project water demands, identify attainable conservation goals, develop conservation strategies, and raise awareness of water-efficient practices throughout the community. By combining new initiatives with existing programs, this comprehensive strategy and slate of conservation activities will contribute to a more sustainable management of water supplies in the City's service area and community. All water savings associated with the Update will conserve Colorado River water, resulting in an increased volume available for environmental and other populace consumptive use.

Potential water savings from the individual conservation measures analyzed and/or combinations thereof were determined to assess their water use reduction. The Plan Update identifies several cost-effective, water use efficiency projects and programs that businesses, residents, and the City can implement over the near-term, while creating a foundation of knowledge, projections and planning in the long-term.

1.5 Plan Update Development

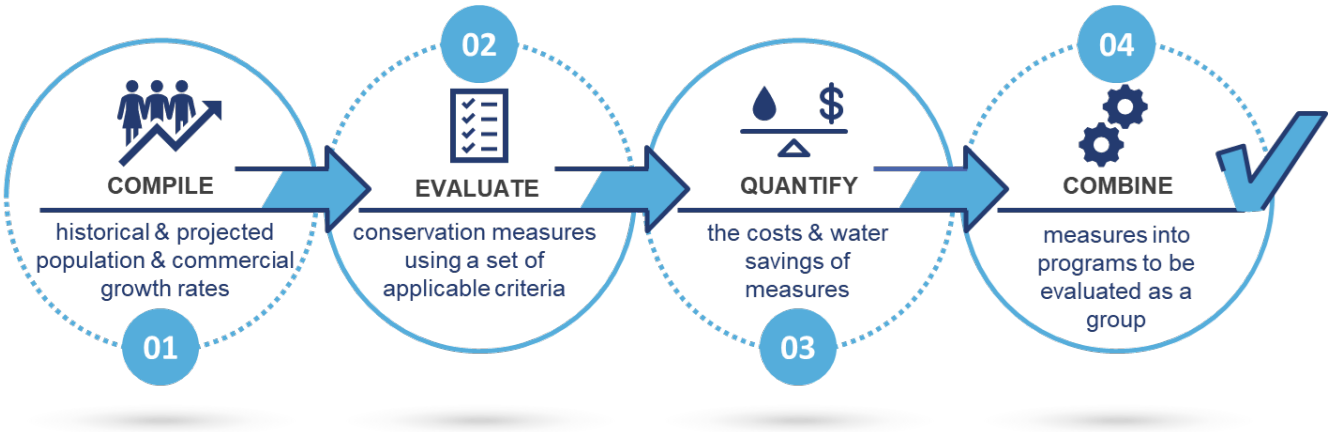
MWM reviewed existing City practices and procedures to create a comprehensive list of water conservation measures currently in place. The team also reviewed relevant literature and practices of other agencies to determine potential measures that could be implemented by the City. MWM used its master potential measures database and followed the process outlined in the AWWA Manual *M52*.

Throughout the planning process, the City and MWM conducted multiple meetings, primarily to complete the DSS Model, which prepares water demand and conservation water savings projections. In the DSS Model, measures are designed with identified fixture costs, applicable customer classes, length of implementation, measure life, administrative costs, end uses, end-use savings per replacement, and a target number or percentage of accounts per measure year. The analysis is planned to be used in support of City conservation program budgeting, staffing and state reporting.

2 ANALYSIS OF WATER DEMAND

This section presents information about the data collection process, historical production, and customer category consumption data as well as a summary of the City's conservation efforts. The City's current water use patterns were analyzed based on City-provided water production, consumption, and water loss data. Historical water use patterns were based on water production and consumption data only. More than 10 years of monthly water production were analyzed (2010–2020). Consumption data from two major customer categories were reviewed separately.

Figure 2-1. Conservation Planning Process



2.1 Information Review and Data Collection Methods

Collection and review of available information relevant to this effort were conducted, entered and tracked in a robust checklist worksheet kept by MWM and the City known as the Data Collection Workbook. To help streamline the process, MWM initially entered data from readily available sources prior to sending the file to City staff for updating and review. Using the provided consumption and account values from the City, MWM and City staff confirmed the number and types of customers within the service area. Several follow-up actions of data review were conducted to compile all relevant and valuable information and to identify the unique customer categories to be tracked. Figure 2-2 presents data topics and items requested, gathered, and stored in the City's Data Collection Workbook.

Figure 2-2. Data Collection Workbook Topics and Items Requested

Due to the recent acquisition of the other local water system, long-term and detailed consumption data prior to February 2020 were not available. However, the City worked closely with MWM to compile as much recent data as possible on the region, the water service area, conservation measures, production, consumption, weather, and various census data points. Together, these formed the foundation for MWM's DSS Model. As the DSS Model was developed, the MWM team verified and tested data against available historical records to ensure accuracy and logic. Historical data was segregated into indoor and outdoor water use by customer type using the monthly billing data. Non-residential water use was analyzed separately.

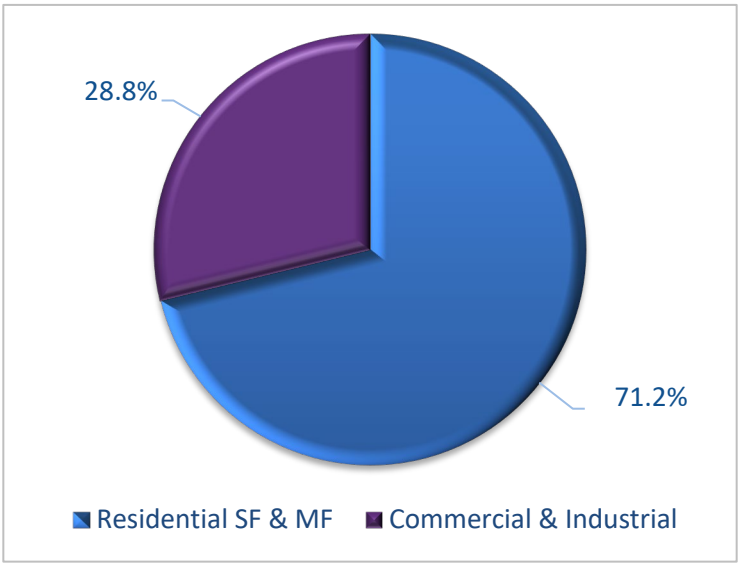
More detailed information about the DSS Model can be found in the appendices of this Plan Update, including a description of the assumptions, analysis and methodology used.

2.2 Production and Consumption

Water production data were measured at their respective sources and available on a monthly basis from 2010 through 2020. Monthly water consumption data in 2020 were measured at the customer meters. Consumption data prior to 2020 was not available due to the change in system ownership.

The City has a variety of customer categories utilized in its billing system. This Plan Update has organized users into Residential and Business (Commercial/ Industrial). Residential is the largest category of water users, representing 71.2% of the water consumed. Figure 2-3 illustrates the water usage breakdowns within the service area.

Figure 2-3. Water Use Breakdown



The breakdown of water use into indoor and outdoor components was based on the assumption that indoor use is equivalent to the minimum use in the winter as well as industry standards for typical indoor water use per person for the residential customer category. Year 2020 water use data were selected to represent this non-residential indoor water use. While there may be minimal landscape watering in the winter, or leakage from irrigation systems, it is assumed that this is minor at no more than 5-10% of the average winter water use. This analysis helped determine historical use patterns and allow water conservation planning to focus on the area with the highest overall category of use.

3 CONSERVATION MEASURE EVALUATION

Experience by many utilities has shown that there is a reasonable limit to the number of conservation measures that can be feasibly implemented at one time. Historically, programs that consist of too many measures are difficult to implement successfully. Therefore, prioritization of measures is important both as an outcome of this planning effort and as the program is implemented.

This section presents the City's conservation measure evaluation process to support its goal of developing a Plan Update that would result in the greatest ease and efficiency of program administration, the lowest cost of implementation, and the greatest water savings.

3.1 Conservation Measure Screening

An important step in updating the City's water conservation program included identification of new measures that may be appropriate and the screening of these measures to a short list for detailed review. A thorough screening process was necessary to scale a reasonably short list of measures for evaluation in the DSS Model. Potential new measures for the City's 2021 Water Conservation Plan Update were screened using qualitative evaluation. This evaluation was specific to the factors that were unique to the City service area, such as water use characteristics, economies of scale and demographics.

City staff reviewed an initial list of more than 100 potential water conservation measures drawn from MWM and City experience. The complete list was trimmed down to the following proposed measures that went to the City Council for further review:

1. Real Water Loss Reduction
2. Real Water Loss Reduction – Leak Repair Assistance
3. Distribution System Pressure Regulation
4. Home Leak Devices/Flow Sensors
5. AMI Installation
6. AMI Installation for New Development
7. Targeted AMI to Irrigation or Large User Accounts
8. Real Water Loss Reduction – Leak Repair and Plumbing Emergency Assistance
9. High Efficiency Urinal Rebate
10. Garbage Disposal Removal
11. Non-Regenerative Water Softeners Incentives
12. Require Hot Water on Demand for New Development
13. Provide a Rebate for Hot Water on Demand Pump Systems
14. Efficient Dishwasher Rebate
15. Landscape Irrigation Restricted to Designated Days and Times
16. Require or Rebate Swimming Pool Covers
17. Conservation Print Media
18. Electronic Conservation Options/Web Site/Social Media
19. Residential High Efficiency Toilet (HET) Rebate
20. CII High Efficiency Toilet (HET) Rebate
21. Residential High Efficiency Washing Machine Rebate
22. CII High Efficiency Washing Machine Rebate
23. Residential Landscape Conversion with Turf Removal
24. CII Landscape Conversion with Turf Removal
25. Smart Irrigation Controller Rebate

On November 16, 2021, the City Council met in a working session to discuss revisions and updates to the Water Conservation Program, vetting the measures that would be considered for inclusion in the final Plan Update and choosing a final list of 12 measures to be analyzed. Following that meeting, the list of measures was taken to the

City Council meeting for approval. Public participation was welcomed at both the workshop and the City Council meeting.

3.2 Conservation Measures Evaluated

Table 3-1 describes the 12 measures that were selected for further analysis in the City's DSS Model analysis. Information about the DSS Model analysis approach to measure unit costs, water savings, and market penetrations is in Appendix C. Actual measure inputs used in the DSS Model to evaluate the water conservation measures selected by the City, and their results, can be found in individual measure screenshots provided in Appendix D.

Table 3-1. Measure Descriptions

Measure Name	Description
Advanced Metering Infrastructure (AMI) Installation for New Development	Require that new customers install AMI meters and possibly purchase means of viewing daily consumption inside their home/business either through the Internet (if available) or separate device. The AMI system would, on demand, indicate to the customer and utility where and how the water is used, facilitating water use reduction and prompt leak identification. This would require the utility to install an AMI system. The developer would purchase the meter and the utility would install the AMI meter. This measure would benefit the utility by minimizing manual meter reading and assisting with leak detection.
High Efficiency Urinal Rebate	COMMERCIAL ONLY: Provide a rebate or voucher for the installation of high efficiency urinals (flushing at 0.5 gpf or less). Rebate amounts would reflect the incremental purchase cost.
Non-Regenerative Water Softeners Incentives	RESIDENTIAL ONLY: Incentive program for ion exchange-based water softening systems, which perform onsite regeneration of the exchange resin. Offer rebate to switch out existing water softeners; installation of upgraded version of water softeners would be eligible with pre-approval.
Hot Water on Demand Rebate	RESIDENTIAL ONLY: Provide a rebate to equip homes with efficient hot water on demand systems. These systems use a pump placed under the sink to recycle water sitting in the hot water pipes to reduce hot water waiting times by having an on-demand pump on a recirculation line. Can be installed on kitchen sink or master bath, wherever hot water waiting times are more than 1/2 minute. Requires an electrical outlet under the sink, which is not common in older home bathrooms but is in kitchens.
Efficient Dishwasher Rebate	RESIDENTIAL ONLY: Provide a rebate to encourage homeowner to purchase an efficient dishwasher (5 gallons/cycle or less) when replacing an existing dishwasher.
Swimming Pool Cover Rebate or Requirement	Provide a rebate through pool equipment supply stores for the purchase of a swimming pool cover.
Conservation Print Media	Use a range of printed materials to raise awareness of conservation measures available to customers, including incentive programs offered by the utility. This can include 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 ensure consistent messaging. Such programs would continue indefinitely.
Electronic Conservation Options	Provide a variety of conservation information on city or utility web sites, including distribution of videos. Also consider social media options such as cell phone apps, Facebook, interactive kiosk with view screen, TV station advertisements, etc.

Measure Name	Description
High Efficiency Toilet (HET) Rebate	City's current program provides a $50 rebate for the installation of one high efficiency toilet for residential customers. HETs are toilets flushing 1.28 gpf or less.
High Efficiency Washing Machine Rebate	City currently provides a $150 rebate for the installation of a high efficiency commercial washer (HEW), one per customer. Program will be shorter-lived as it is intended to be a market transformation measure and eventually will be stopped as efficient units reach saturation.
Landscape Conversion with Turf Removal	Provide a per-project incentive to remove turf and replace with low water use plants or permeable hardscape. Landscape conversion could include conversion of turf to lower-water-using turf varieties. Rebate based on project cost with an upper limit of 75% of project cost for residential and small-medium commercial or $50,000 for HOA/large landscape projects.
Smart Irrigation Controller Rebate	City currently provides a $175 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. Limit 1 per account.

3.3 Conservation Measure Analysis

MWM conducted an economic evaluation of each selected water conservation measure using the DSS Model. Appendix D contains actual measure design parameter inputs and presents detailed results including how much water each measure will save, 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/uses). Dollar savings from reduced water demand was quantified annually and based on avoided costs provided by the City.[2]

While each measure was analyzed independently, it is important to note that very few measures operate independently. For example, higher efficiency indoor fixtures measures correlate with education through print and electronic outreach. Savings from measures that address the same end use(s) are not additive; the model uses impact factors to avoid double counting in estimating the water savings from programs of measures.[3] This is why a measure like Public Education may show a distorted cost in comparison to water saved. Most, if not all, measures rely on public awareness. However, it is important to note that water savings are more directly attributable to an “active” measure, like a toilet rebate, than the less “active” public education/awareness measure that informs the community of the active measure.

[2] The City’s estimated average water production cost is $10,001/AF including purchases and treatment costs.

[3] For example, if two measures are planned to address the same end use and both save 10% of the prior water use, then the net effect is not the simple sum of 20%. Rather, it is the cumulative impact of the first measure reducing the use to 90% of what it was originally, without the first measure in place. Then, the revised use of 90% is reduced by another 10% (10% x 90% = 9%) to result in the use being 81% (90% - 9% = 81%). In this example, the net savings is 19%, not 20%. Using impact factors, the model computes the reduction as follows, 0.9 x 0.9 = 0.81 or 19% water savings.

4 CONSERVATION PROGRAM EVALUATION

This section provides a summary of which measures were included in each of the three conservation program scenarios and the program implementation strategy selected by the City. The three program scenarios were selected by the City and illustrate a range of various measure combinations and resulting water savings.

The following key items were taken into consideration during measure selection for Programs A, B, and C:

- Existing conservation measures
- Conservation measures recommended by AWWA, ADWR and others
- New and innovative measures
- Measure equitability among customer categories
- Customer demographics

In addition, this section identifies and prioritizes the conservation programs and projects by quantifiable water savings, and compliance with the American Water Works Association G480 Water Conservation Program Operation and Management Standard (G480 Standard). The G480 Standard is defined on the AWWA web page as follows:

> *The G480-20 Water Conservation and Efficiency Program Operation and Management Standard (G480 Standard) is a voluntary standard that can be adopted by water providers at their own discretion. The G480-20 Standard describes the critical elements of an effective water conservation and efficiency program. This standard encompasses activities undertaken by a utility within its own operations to improve water use on the supply side upstream of customer meters through distribution system management, and on the demand side through customer billing and education practices. A conservation program meeting this standard has the potential to impact all water users.*[4]

4.1 Measure Selection for Conservation Program Alternatives

Using the data gathered, MWM created a list of potential program concepts that were appropriate for the City service area to meet future regulatory and conservation mandates. The list included existing program elements and traditional conservation measures as well as concepts that had yet to be implemented or considered by the City. Factors for determining which measure should be in each program included budgeting, feasibility to implement the program, and the time at which each measure would need to be introduced to promote conservation efforts. Programs also needed to address water conservation across customer categories.

The results of the program analysis were reviewed, at which point the City adjusted the program contents to determine which measures would be in each of the program scenarios. MWM then compiled descriptions and parameters of the program scenarios, which were not intended to be rigid but to demonstrate the range in savings that could be generated if selected measures were run at the same time. When programs were analyzed, any overlap in water savings (and benefits) from individual measures was considered to provide a total combined water savings (and benefits).

Following are brief descriptions of the resulting programs and an outline of their options (Figure 4-1):

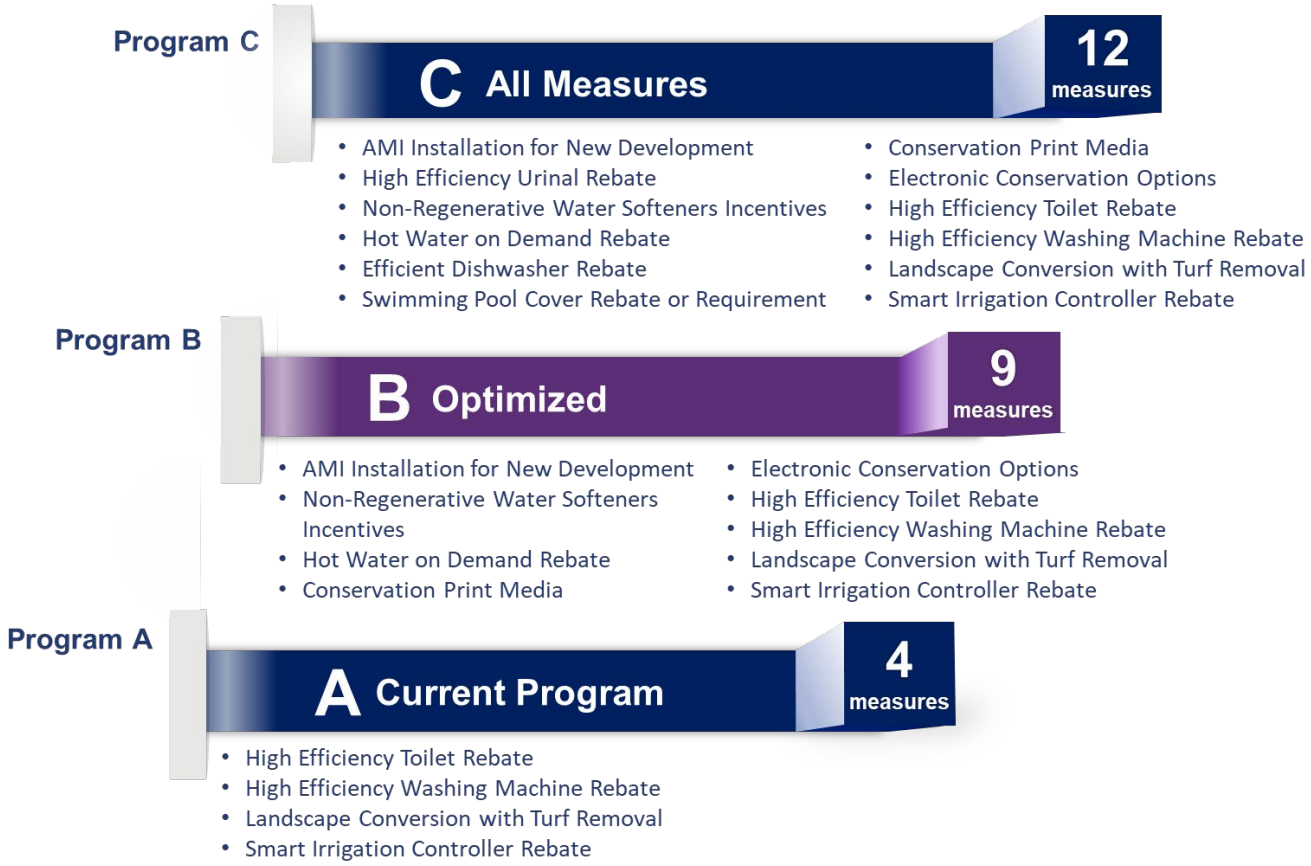
- **Program A: Current Measures** – Current conservation program with the addition of an HOA/large landscape component for the landscape conversion measure.
- **Program B: Optimized Measures** – In addition to Program A efforts, Program B includes more outreach via conservation print media and electronic conservation messaging options, a rebate for hot water on demand pump systems, AMI installation for new accounts, and non-regenerative water

[4] American Water Works Association. G480 Standard and AWE Leaderboard web page: https://www.allianceforwaterefficiency.org/resources/topic/g480-standard-and-awe-leaderboard

softeners incentives. These measures were specifically selected by the City for inclusion in the optimized program.

- **Program C: All Modeled Measures** – In addition to those in Program B, this suite includes efficient dishwasher rebates, rebate or requirements for swimming pool covers, and high efficiency urinal rebates.

Figure 4-1. Conservation Program Options



4.2 Conservation Program Analysis

The results of the conservation program analysis are listed in Table 4-1, which shows:

- Estimated annual demand for all three programs.
- Baseline demands with and without plumbing code.
- Benefit-cost ratios for each program.
- Present value of water savings and utility costs.

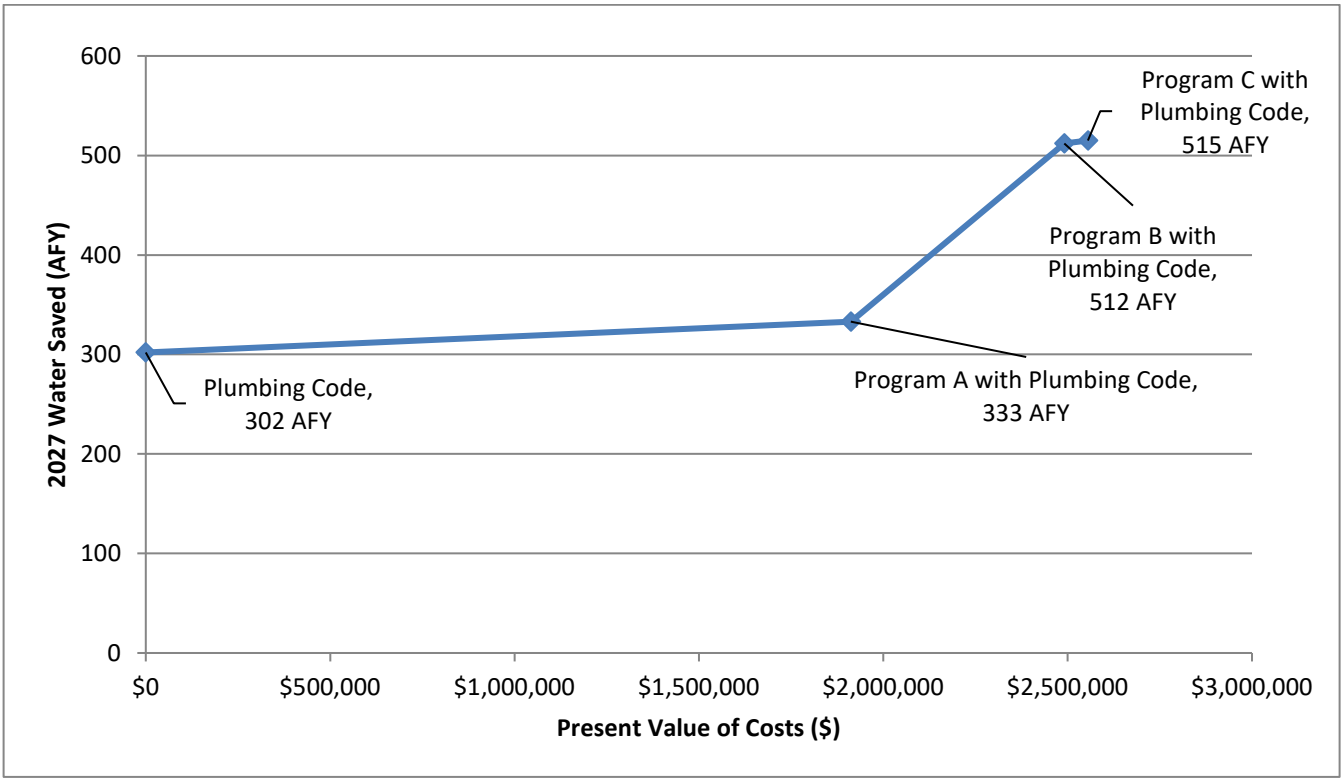
Table 4-1. Comparison of Program Results

	Year	Demands with No Plumbing Codes	Demands WITH Plumbing Code Savings	Demands with Program A and Plumbing Code Savings	Demands with Program B and Plumbing Code Savings	Demands with Program C and Plumbing Code Savings
Demand (AFY)[1]	2022	10,310	10,270	10,260	10,180	10,180
	2023	10,410	10,320	10,310	10,150	10,150
	2024	10,520	10,370	10,350	10,190	10,190
	2025	10,620	10,420	10,400	10,230	10,230
	2026	10,730	10,480	10,450	10,280	10,270
	2027	10,830	10,530	10,500	10,320	10,320
Water Utility Benefit to Cost Ratio				0.05	0.40	0.39
Present Value of Water Savings[2]				$102,000	$990,000	$1,000,000
Present Value of Utility Costs[2,3]				$1,912,000	$2,491,000	$2,555,000
Water Utility Cost of Water Saved ($/AF)[3,4]				$17,530	$2,410	$2,450
2022–2027 Average Annual Cost[3,5]				$353,000	$460,000	$472,000

[1] Demands are rounded to the nearest 10 AFY.
[2] Present value savings and costs are rounded to the nearest $1,000.
[3] Costs presented in this table are directly attributable to the utility conservation budget only.
[4] Water Utility Cost of Water Saved is rounded to the nearest $10.
[5] 2022–2027 Average Annual Cost is rounded to the nearest $1,000.

Figure 4-2 illustrates how marginal returns change as more money is spent to achieve water savings in acre-fee per year (AFY) in 2027. A cost-effectiveness curve displays the results of the present value of each program's costs versus the cumulative water savings at the end of the planning period. This curve is helpful in determining how far to push the "conservation envelope" as the point of diminishing economic returns is evident. Note that the figure shows that there is a slight increase in savings from Program B to Program C.

Figure 4-2. Present Value of Utility Costs vs. Water Saved in 2027



4.3 Selected Program

The City has indicated that they intend to select Program B, an approach that offers significant water savings and includes a suite of water use efficiency measures that will ensure the City meets its short-term water efficiency goals. Program B includes nine measures and was selected because several of the measures are currently being implemented while the others could be reasonably accomplished within the City's Water Conservation Plan implementation timeframe. Additionally, this optimized program is comparable in costs and savings to Program C yet has fewer measures to implement. Program B is expected to result in a cumulative savings of 1,042 AF of water over six years (2022–2027).

5 IMPLEMENTATION STRATEGY

The approach to conservation program implementation is viewed as a "living" process where new opportunities may be adopted as new technologies become available over time. Program timelines can also be adjusted, but with the recognition that doing so will impact the savings objectives. This section presents an overview of the conservation planning options for the service area including budgeting and data monitoring strategies.

5.1 Monitoring Progress

Each year City Staff will conduct a progress update to analyze the steps being made to meet the Plan Update's recommended conservation program targeted water savings. It will be imperative to track activities and water demand to understand the level of progress being made in meeting overall Plan Update goals. Costs, participation rates and water use will be tracked to ensure that the Plan Update is being implemented effectively and on target to meet goals. As new promising technologies and methodologies emerge, they will be researched and tested, and could replace measures that are underachieving. Summary reports will be issued citing progress and recommending changes in Plan Update content.

A tracking database in an Excel spreadsheet could store monthly data from each conservation measure and program. Program participation by individual accounts, and related to each measure, will be evaluated by tracking the following:

- Customer information such as name, address, account number, type of business (CII customers)
- WUE measure or device information such as type (including make and model), quantity, unit water savings, life expectancy
- Cost information such as rebate amount
- Number and type of rebates or other incentives issued (including water savings details for rebates such as efficiency level of washing machines installed through incentive program)
- Number and square footage of turf removal rebates
- Collaboration with Planning Department to quantify and verify compliance with water efficiency codes and AMI installation
- Water use before and after documented changes in replacement of fixtures or other implementation

5.2 Track and Update for New Codes and Emerging Technologies

It is more challenging to track the changes in the consumer marketplace for the vast array of water-using appliances and plumbing fixtures in both the residential and commercial sectors. Following are some options for tracking the latest in national standards and building codes as well as technologies and emerging trends in customer preferences:

- Have staff member(s) participate on the AWWA Water Conservation Division's committees with attendance at the Annual Conference Committee meetings and quarterly conference calls, in particular the Water Efficiency Programs and Technology Committee.
- Monitor the Alliance for Water Efficiency (AWE) for updates on changes in National Standards and Codes as well as opportunities to comment on future national changes to codes and regulations. Frequently, AWE has performance testing results posted on their websites that provide particularly useful information to consumers.
- Consider becoming a WaterSense Partner. Track the U.S. Environmental Protection Agency (EPA) WaterSense posts on new technologies and updated equipment lists.
- Monitor performance information that may also be available through Consumer Reports or Consortium for Energy Efficiency (http://www.cee1.org).
- Attend the WaterSmart Innovations Conference for exposure to the vendors participating in the exhibition and to gather information on emerging trends in water conservation programs.

- Leverage state and county process for adopting new building codes and regulations, especially building codes, to help implement proactive changes in future development in the City's service area.
- Maintain and use a network of 10–20 key contacts at progressive utilities to inquire about new technologies (e.g., through known contacts or new contacts made at conferences).
- Host events with other partner utilities and applicable stakeholders on related water loss control programs or conservation measures.
- Conduct surveys every three years with other utilities to gain insight on programs and product testing.

Staying on or ahead of the curve with tracking new technologies could lead to water savings without City investment for later upgrades through incentive programs. Emerging products may be worthy of pilot programs and could be potentially attractive for grant funding projects through agencies like the U.S. EPA or USBR. However, use caution when adopting new technologies that have yet to be adequately researched or tested.

5.3 Six-Year Implementation Recommendations

Recommendations to assist with implementation over the next six years:

- Track state regulations regarding residential, CII, landscape, and water loss management.
- Consider launching pilot studies for new measures.
- Consider soliciting and tracking community input and feedback via an online or phone survey or at outreach and education events.
- Prioritize measures that contribute the most to meeting the per capita water use targets and are relatively easy to operate with limited staff.
- Consider working with the largest 100 water using customers to reduce water use.
- Develop an annual work plan for each plan year as soon as the budget is adopted (or in concert with the budget planning process).
- Form partnerships and apply for grants where appropriate.
- Outsource to gain enough staff support to administer the expanded programs (as needed).
- Develop analytical tools to track water use by customer class and overall per capita water use, adjusted for the weather and external factors.
- Use the analytical tools annually to help decide on priorities for the following plan year.
- Set up a database to store and manage measure participation, cost, and other data to gauge successes and areas that need improvement/added attention.
- Annually update the plan, including actual measure participation, projected water savings, and expected per capita water use reductions, to ensure the City is on track to meet conservation goals.
- Consider an additional measure to assess and manage distribution system water loss (see more below).

Assess and Manage Distribution System Water Loss

While the City's water losses have been estimated, the data are limited due to the change in system ownership and operations. The water loss percentage provided by the City for use in the DSS Model was 25%. However, as of January 2022, the City is working on refining its estimates and this percentage could be as low as 19%. These percentages are substantially higher than industry standard and warrant further review, which the City intends to prioritize going forward. As a result, MWM highly recommends that the City begin a comprehensive water loss program starting with data collection, source meter testing, testing of customer meters, Supervisory Control and Data Acquisition (SCADA) system review, and a billing system analysis. It would be prudent to take a phased approach over the next few years as the City further develops the data needed to complete a full-scale audit.

Operations, conservation, and the finance department must work together to maintain a thorough annual accounting of water production, sales by customer class and volume of water produced but not sold (non-revenue water). In conjunction with system accounting, include audits that identify and quantify known legitimate uses of non-revenue water to determine remaining potential for reducing water losses (bleeders, tank

overflows, system testing, etc.). Given that there are distinct systems within the service area, comparing production and consumption by system may help to pinpoint a problem area that could be further reviewed.

Following testing and calibration of meters, implementing a system-wide audit program is a top priority for the City. The City may want to hire a contractor to look into potential sources for real losses (leaks, tank overflows, etc.) or apparent losses (billing errors, inaccurate meter readings, etc.), in order to determine the best course of action to address chronic water losses.

Continuously analyze billing data for system errors and under-registering meters. Address meter testing and repair/replacement to insure more accurate meter reads and revenue collection. Additional actions could include meter calibration and accelerated meter replacement.

Implementation of a water loss measure is a critical strategy in meeting the City's goals for 2027 and beyond. The City does not have an active leak detection and repair program. Additional actions could include installation of data loggers, accelerated main and service line replacement, and proactive full-system leak detection and repair. Specific goals and methods are to be developed by the City. One goal may 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).

5.4 Suggestions for Future DSS Model Updates

With the recent acquisition of the other local water system, City staff should be ready with an answer to the question: "How much water has been saved and at what cost?" In addition, due to the need for ongoing water conservation efforts to attain and maintain more water savings, the City will need to track program water savings, costs and benefits (i.e., cost savings).

The following two types of updates are envisioned for the DSS Model:

- **Annual or more frequent model updates for monitoring costs and water savings** – The conservation measure worksheets can be used to track actual activities and compare them to the planned activities defined as part of the model development for this program. It is recommended that this update be done in conjunction with the development of an annual work plan and budget. At minimum, it should happen every 3–5 years, but more frequent updates are recommended as the City expands and improves upon its data.
- **Recalibration of the model** – The DSS Model has a base "year" of 2020. Depending on water demand and account growth rates, it is advisable to update the base year as soon as a complete year of comprehensive data is available, and on a 5-year basis thereafter. This update requires reviewing historical demand trends, future population and demand forecasts, fixture models calibration, new or updated conservation measures, and cost and water savings assumptions.

Specific triggers for updates may include:

- Significant cost in the water pumped (more than 10-20% energy or chemical cost increase or decrease would modify the "savings worksheet" and change the benefit-cost ratios).
- Significant change in population or accounts for one of the billing categories (more than a 5% shift).
- Significant changes to water system balance (e.g., more than 10% change in water losses or other parameter on the Demands Section of the DSS Model).
- New codes or regulations that affect natural replacement rates of fixtures.
- Alternatives for staffing versus outsource contracting or other changes to the cost of implementation of a conservation measure (change to conservation measure worksheet only).
- New technologies for conservation measure being considered (change or addition of new conservation measure worksheet).
- Any other change in conservation measures (i.e., updates to the measure worksheets can be changed or modified at any time without altering the water system balance worksheets or affecting fixture model calibration).

6 NEXT STEPS AND CONCLUSIONS

Current conditions have encouraged the City to implement Program B. However, water use in a service area is very dynamic and responds to changes in population, economy, weather, efficiency of devices, and types of industry. In the future, as the City of Bullhead City community evolves and water use patterns and weather change, there remains the possibility that the City will elect to adjust measure implementation targets and schedules. This may include expounding upon or scaling back various program components and measures to increase efficiency, improve benefit-cost ratios, adopt better technology or methods, or meet budget and staffing restrictions.

Whether additional measures become necessary would be dependent on several factors including potential future drought conditions and the City's ability to support new and more innovative programs. With individual measures clearly defined and water savings objectives and customer target goals measurable, the City has quantifiable performance goals to track on both a measure and overall program level basis.

6.1 Selected Program Estimated Water Savings and Budget

The estimated average annual cost to the City to implement Program B as described in this Plan Update is approximately $460,000 for years 2022–2027 including administration costs or staff labor. The budget includes expenses (materials, rebates, giveaways, etc.) and was developed while working closely with City staff. The City should develop a detailed annual work plan and use the DSS Model to monitor progress on demand reductions along with updates to the implementation cost estimates and associated budgets on an annual basis.

Approximately 71% of the City's service area water usage is associated with residential water use. Consequently, residential and irrigation conservation programs will produce the most savings. The City's service area overall does not include intensive commercial and industrial activity (approximately 29% of total water use); thus, the conservation potential for this sector is less.

Overall Conclusions

- The total range of conservation program savings between Program A (which includes all existing measures) and Program C (which also includes all new evaluated and selected measures listed in Appendix D) is 0.3%-2% of projected demand with passive savings.
- The cost of water saved for the Plan Update's selected Program B from the utility standpoint is $2,410 per AF.
- Programs A, B, and C each have the potential to reduce per capita water use.

6.2 Recommended Funding Sources and Partnerships

It is recommended that the City seek additional funding sources and partnership opportunities both nationally and regionally to expand the conservation programs and pilot programs that have high potential for water savings within City demographics.

Partnership opportunities and funding sources may include the following:

- City conservation budget
- County partnerships
- State and federal grants
- Local schools/university students or student organizations
- Local community organizations with an interest in water efficiency (e.g., gardening groups)
- Partnerships with energy utilities

6.3 Recommended Next Steps

Recommendations to assist with implementation include the following next steps:

- Engage in state processes – Review state documents, present key information to City stakeholders and gather feedback, submit written comments as needed, and participate in public workshops and stakeholder groups.
- Review program staff needs and hire staff to adequately support the program.
- Prioritize measures for implementation, with the highest priority for implementation given to those that contribute the most to meeting water saving targets and/or can be implemented with relative ease. To launch implementation of a conservation program, the City may consider answering a series of key questions to determine measures, budget, and schedules for the Plan Update. These questions include:
- What level of support will be required from conservation staff to run the selected measures?
- What other support is needed or wanted to run these programs (e.g., outsourced support or other sources of funding)?
- Develop Implementation Plans that describe in detail how each conservation measure will be implemented.
- Prepare an annual work plan for each Plan Update year in concert with the budget planning process.
- Form partnerships and apply for grants where appropriate.
- Set up a method to store and manage measure participation, cost and other data to gauge successes and areas that need improvement.
- Review Plan Update goals in the DSS Model annually and update measure participation or other elements that are refined.
- Use the input from the City and annual work planning process as the forum to amend the Plan elements to stay on track (e.g., budgets, staffing, contracting, schedule, etc.).

6.4 Conclusions

The following is a summary of the water conservation analysis findings:

- Conservation is the least expensive means of meeting future water supply needs for the area. The implementation of these conservation measures should reduce per capita water use and have the potential to defer the need for further infrastructure expansion. While the conservation actions identified can have a significant cost, the costs are even higher to not implement conservation and then have to address increased demands through engineering solutions. Furthermore, with climate change, long-term drought, and environmental restrictions on the delivery of imported water, additional water supplies may not be available to meet future increases in demands without conservation.
- Invest in water conservation efforts that are a feasible and cost-effective means of:
    - Being more sustainable within existing water supplies.
    - Addressing reduction in water use as required based on reductions in allocation.
- Through the DSS Model analysis, the City identified fixture costs, applicable customer classes, time period of implementation, measure life, administrative costs, end uses, end-use savings per replacement, and a target number or percentage of accounts per program year. This thorough analysis may be used in a rate case or additional planning documents.
- Based on the analysis, the City has selected to implement Program B.

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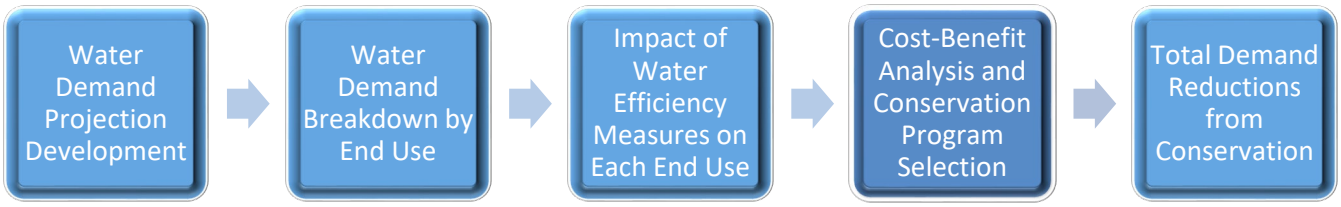
U.S. Department of Energy. Energy Star Calculators. Online: https://www.energystar.gov/

APPENDIX A – DSS MODEL OVERVIEW



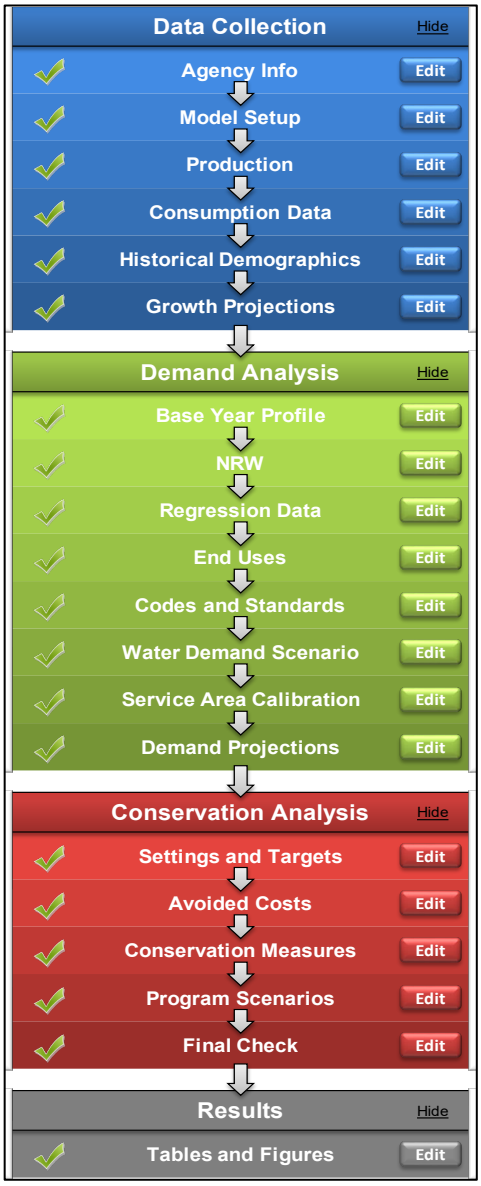


Figure A-1. DSS Model Main Page

DSS Model Overview: The Demand Side Management Least Cost Planning Decision Support System (DSS Model) as shown in left figure 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.

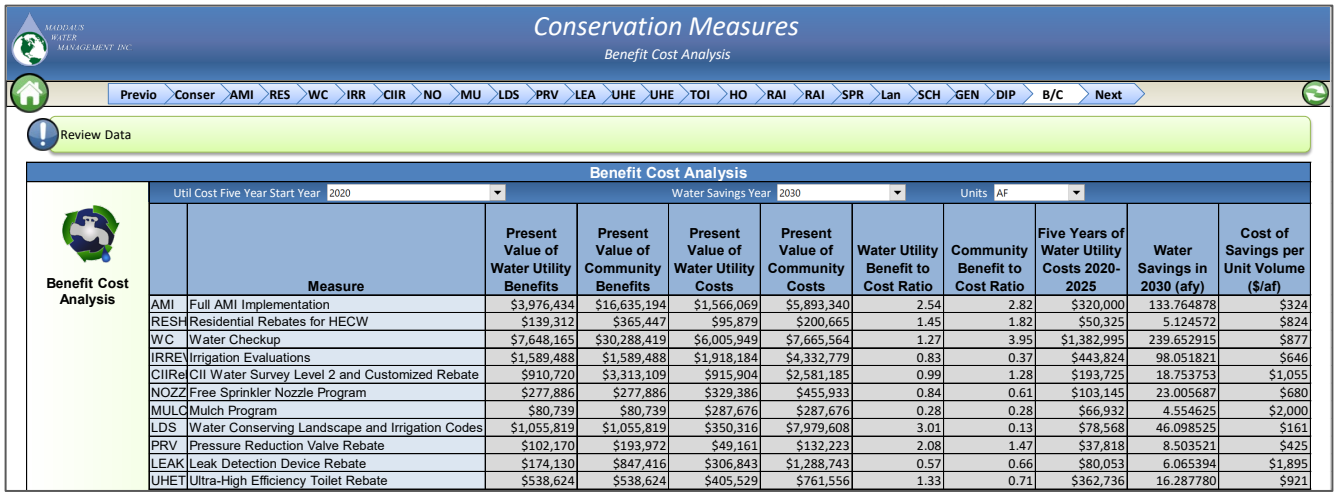
Originally developed in 1999 and continuously updated, the DSS Model is an "end-use" model that breaks down total water production (water demand in the service area) to specific water end uses, such as plumbing fixtures and appliance uses. The model uses a bottom-up approach that allows for multiple 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 are obtained from the water agency being modeled. Demand data are 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 are 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: 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. The figures on the previous page illustrate the processes for forecasting conservation water savings, including the impacts of fixture replacement due to existing plumbing codes and standards.

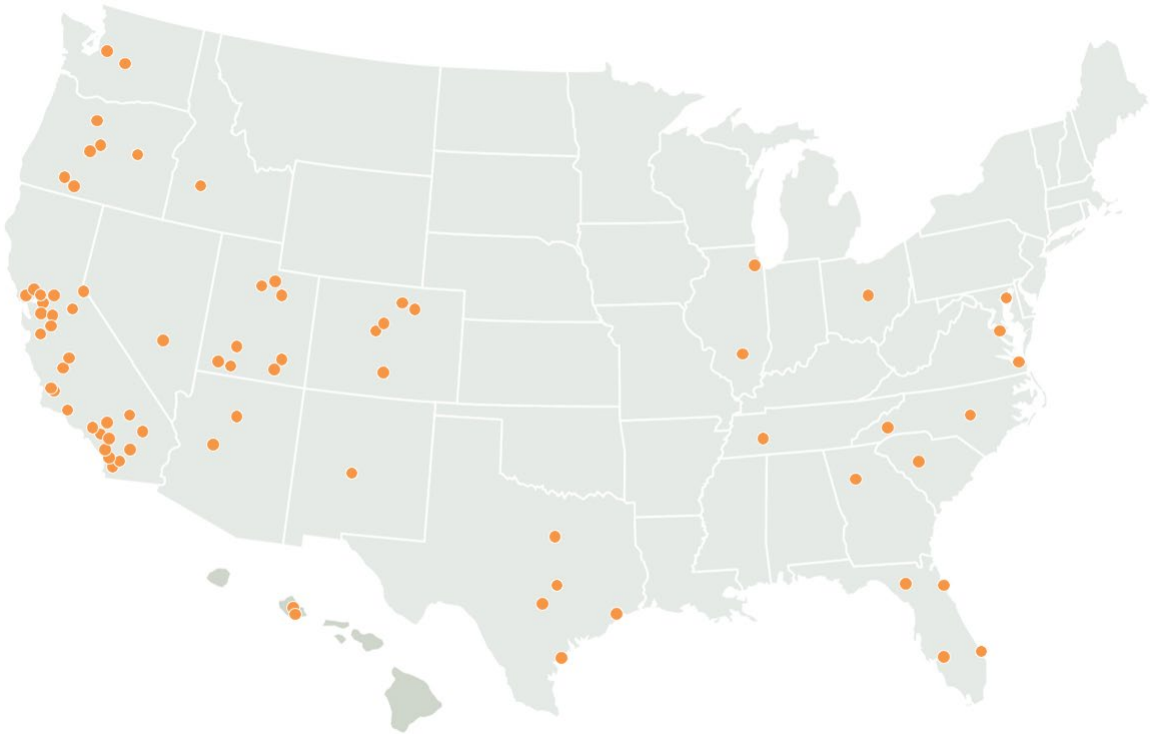
Figure A-2. Benefit-Cost Analysis Summary Example



	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
IRREV	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

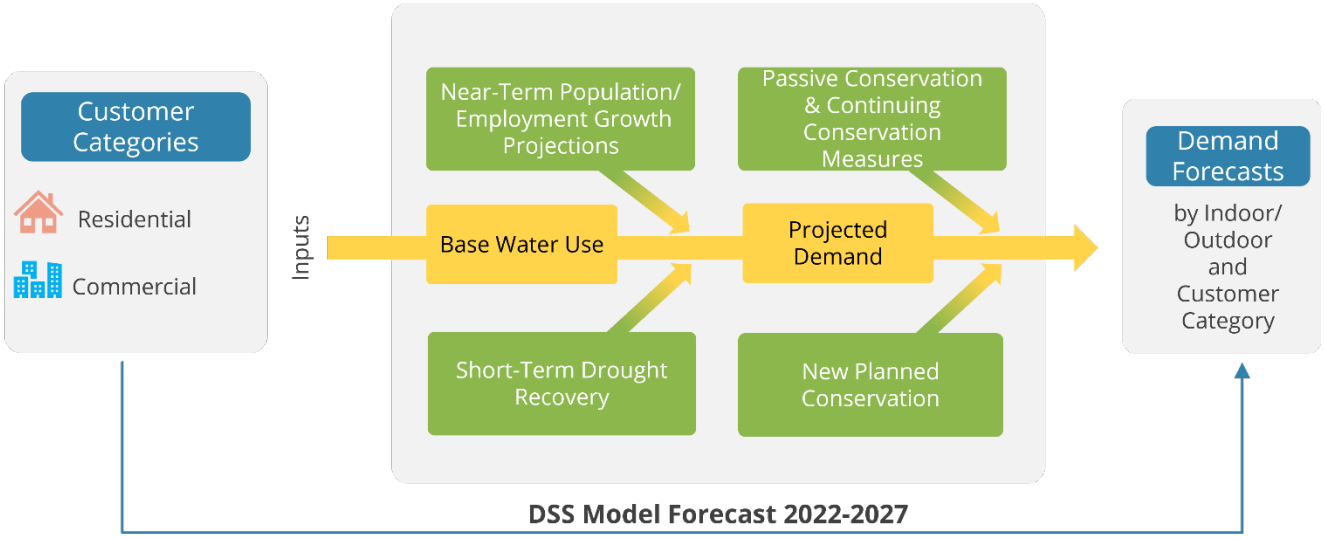
Model Use and Validation: The DSS Model has been used for over 20 years for practical applications of conservation planning in over 300 service areas representing 60 million people, including extensive efforts nationally and internationally in Australia, New Zealand, and Canada.

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



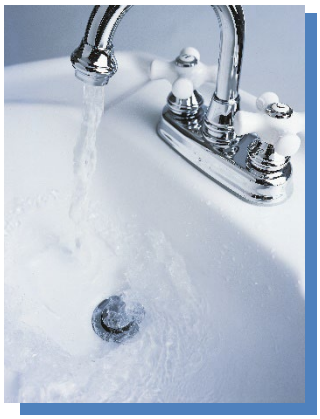
The DSS Model can use one of the following: 1) a statistical approach to forecast demands (e.g., an econometric model); 2) a forecasted increase in population and employment; 3) predicted future demands; or 4) a demand projection entered into the model from an outside source. The following figure presents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

Figure A-4. DSS Model Analysis Flow



APPENDIX B – DSS MODEL PLUMBING CODE ASSUMPTIONS

This section presents the methodology used to determine the City's 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.



B.1 National Plumbing Codes

The Federal 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 30-50% 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 6.5. 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 around 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.

B.2 State Plumbing Codes

Plumbing codes for toilets, urinals, showerheads, and faucets for the state of Arizona align with federal standards.

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

The following tables present the key assumptions and references that are used in the DSS Model in determining projected demands. 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 B-1. List of Key Assumptions

Parameter	Model Input Value, Assumptions, and Key References				
Model Start Year for Analysis	2021				
Water Demand Basis	Population Growth				
Population Projection Source	Arizona DWR *Designation of Adequate Water Supply Designated Water Provider 2019 Annual Report* (~1% annual population growth)				
Avoided Cost of Water	$10,001/AF water production avoided cost representing $10,000/AF cost for water purchase, plus ~ $1/AF for treatment per Bullhead City.				
Potable Water System Base Year Water Use Profile					
Customer Categories	**Start Year Accounts**	**Start Year Total Water Use Distribution**	**Start Year Demand Factors (gpd/acct)**	**Start Year Indoor Use %**	**Start Year Residential Indoor Water Use (GPCD)**
Residential SF & MF	19,135	71%	254	40%	46
Commercial & Industrial	1,032	29%	1,904	73%	N/A
Total/Avg	**20,167**	**100%**	**N/A**	**50%**	**N/A**

Table B-2. Key Assumptions Resources

Parameter	Resource
Residential End Uses	Key Reference: 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.

Parameter	Resource
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). 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). The City 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. Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.
Residential Frequency of Use Data, Toilets, Showers, Faucets, Washing Machines, 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.

Parameter	Resource
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 0.5 gallons per minute (gpm) 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, MWM reconciled water efficient fixtures and devices installed within the City's 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 washing machines. 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 washing machines, 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 (REUWS). Water utilities, industry regulators, and government planning agencies consider it the industry benchmark for single family home indoor water use. This Plan Update incorporates recent study results that reflect the change to the water use profile in residential homes including adoption of more water efficient fixtures over the 15 years that transpired from 1999 to 2014. REUWS results were combined with the City's 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 the 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.
- Adding the change due to rebate measure minus the "free rider effect."[5]

Further adjustments were made to initial proportions to account for the reduction in fixture use due to lower occupancy and based on field observations. More information about the development of initial and projected fixture proportions can be found in the DSS Model "Codes and Standards" section.

The model is capable of modeling multiple types of fixtures, including ones with different designs. For example, currently toilets can be purchased that flush at a rate of 0.8 gpf, 1.0 gpf, 1.28 gpf and 1.6 gpf. 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 fixtures is listed as a percentage within the DSS Model. A value of 100% would indicate that all toilets installed would be of one flush volume. A value of 75% means that three out of every four toilets installed would be of that particular flush volume.

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 with a feature that determines the "saturation" of 1.6 gpf toilets from 1992-2014 while the 1992 Federal Energy Policy Act was in effect for 1.6 gpf toilet replacements. 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.

[5] 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.

APPENDIX C – DSS MODEL MEASURE ASSUMPTIONS

This appendix presents an overview of the water reduction methodology, benefit-cost perspectives, present value analysis, and costs and savings assumptions for the measure analysis.

C.1 Water Reduction Methodology

Each conservation measure targets a particular water use, such as indoor single family water use. Targeted water uses are categorized by water user group and by end use. Targeted water user groups include single family residential; multifamily residential; commercial, industrial, and institutional; and so forth. Measures may apply to more than one water user group. Targeted end uses include indoor and outdoor use. The targeted water use is important to identify because the water savings are generated from reductions in water use for the targeted end use. For example, a residential retrofit conservation measure targets single family and multifamily residential indoor use, and in some cases, specifically shower use. When considering the water savings potential generated by a residential retrofit, one considers the water saved by installing low-flow showerheads in single family and multifamily homes.

The market penetration goal for a measure is the extent to which the product or service related to the conservation measure occupies the potential market. Essentially, the market penetration goal identifies how many fixtures, rebates, surveys, and so forth that the wholesale customer would have to offer or conduct over time to reach its water savings goal for that conservation measure. This is often expressed in terms of the number of fixtures, rebates, or surveys offered or conducted per year.

The potential for error in market penetration goal estimates for each measure can be significant because the estimates are based on previous experience, chosen implementation methods, projected utility effort, and funds allocated to implement the measure. The potential error can be corrected through reevaluation of the measure as the implementation of the measure progresses. For example, if the market penetration required to achieve specific water savings turns out to be different than predicted, adjustments to the implementation efforts can be made. Larger rebates or additional promotions are often used to increase the market penetration. The process is iterative to reflect actual conditions and helps to ensure that market penetration and needed savings are achieved regardless of future variances between estimates and actual conditions.

In contrast, market penetration for mandatory ordinances can be more predictable with the greatest potential for error occurring in implementing the ordinance change. For example, requiring dedicated irrigation meters for new accounts through an ordinance can assure an almost 100% market penetration for affected properties.

C.2 Present Value Analysis and 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 using the DSS Model, 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 use for each single family account.

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 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.

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. 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.

Due to a limitation on the historic data available, for the purposes of this update the planning period was limited to six years. During this time, it is anticipated that the City can gather more thorough and accurate data for future planning purposes.

C.3 Measure Cost and Water Savings Assumptions

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 to implement measures. The assumed dollar values for the measure unit costs were closely reviewed by staff and are found to be adequate for each individual measure. The values in most cases are in the range of what is currently offered by other water utilities in the region, excluding the landscape conversion/turf removal program.
- **Retail Customer Unit Cost** – Cost for implementing measures that is paid by retail customers (i.e., the remainder of a measure's cost that is not covered by a utility rebate or incentive).
- **Utility Administration and Marketing Cost** – The cost to the utility for administering the measure, including consultant contract administration, marketing, and participant tracking. The mark-up is sufficient (in total) to cover conservation staff time, general expenses, and overhead.

Costs are determined for each of the measures based on industry knowledge, past experience, and data provided by the City. Costs may include incentive costs, usually determined on a per-participant basis; fixed costs, such as marketing; variable costs, such as the cost 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 2027. 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 conservation measures evaluated herein generally take effect over a long span of time. This span is sufficient to enable timely rate adjustments, if necessary, to meet fixed cost obligations and savings on variable costs such as energy and chemicals.

The unit costs vary according to the type of customer account and implementation method being addressed. For example, a measure might cost a different amount for a single family residential account than for a multifamily residential account, and for a rebate versus an ordinance requirement or a direct installation implementation method. Typically, water utilities have found there are increased costs associated with achieving higher market saturation, such as more surveys per year. The DSS 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

Data necessary to forecast water savings of measures include specifics 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 3 to 10 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 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 of about five years.

APPENDIX D – INDIVIDUAL CONSERVATION MEASURE DESIGN INPUTS AND RESULTS

The following figures present the DSS Model starting values for the conservation measures that were analyzed for the City's conservation program.

AMI Installation for New Development

Overview

Name	AMI Installation for New Development
Abbr	1
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2022
Last Year	2027
Measure Length	6

Measure Life

Permanent ☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
RES	$150.00	$500.00	1
CI	$150.00	$500.00	3

Administration Costs

Method: Percent

Markup Percentage	0%

Description

Require that new customers install AMI meters and possibly purchase means of viewing daily consumption inside their home/business either through the Internet (if available) or separate device. The AMI system would, on demand, indicate to the customer and Utility where and how their water is used, facilitating water use reduction and prompt leak identification. This would require Utility to install an AMI system. The developer would purchase the meter and the utility would install the AMI meter. This measure would benefit the utility by minimizing manual meter reading and assisting with leak detection.

Customer Classes

	RES	CI
	☑	☑

End Uses

	RES	CI
Toilets	☐	☐
Urinals		☐
Lavatory Faucets	☐	☐
Showers	☐	☐
Dishwashers	☐	☐
Clothes Washers	☐	☐
Process		☐
Kitchen Spray Rinse		☐
Internal Leakage	☑	☑
Baths	☐	
Other	☐	☐
Irrigation	☑	☑
Pools	☐	☐
Wash Down	☐	
Outdoor		
Cooling		☐
Car Washing	☐	
External Leakage	☑	☑
Non-Lavatory/Kitchen Faucets	☐	☐

Comments

• Utility Cost: $150 for meter installation and customer service time- notifying customer of leaks
• Admin Mark-Up: 0% markup- including all utility program costs within the utility cost of $150.
• Customer Cost: $500 for meter purchase, paid by developer
• End Use Water Savings: Savings based on significant reductions to leakage and irrigation end uses. Savings based on SFPUC case study per Julie Ortiz presentation on March 25, 2021 at Conservation AMI User Group, "You may have a leak! Leak alert program overview." Savings are estimated to be 54% reduction on leakage (internal and external) volume with automated leak alerts. To be conservation, 20% savings on leaks is used and 5% on irrigation due to AMI meters and leak notification.
• Targets: Target 100% of new accounts over the life of the program.
> a bit conservative; 400 expected for 2021. Will fluctuate depending on development.

Results

Units: AF

Average Water Savings (afy)	
9.708152	
Lifetime Savings - Present Value ($)	
Utility	$63,911
Community	$63,911
Lifetime Costs - Present Value ($)	
Utility	$216,874
Community	$939,715
Benefit to Cost Ratio	
Utility	0.29
Community	0.07
Cost of Savings per Unit Volume ($/af)	
Utility	$3,191

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
CI Internal Leakage	20.0%	139.5
CI Irrigation	5.0%	372.0
CI External Leakage	20.0%	35.7
RES Internal Leakage	20.0%	15.1
RES Irrigation	5.0%	135.7
RES External Leakage	20.0%	10.7

Targets

Target Method: Percentage

% of Accts Targeted/Yr	100.000%
Only Affects New Accts	☑

Costs

View: Summary

	Utility	Customer	Total
2022	$39,104	$130,333	$169,437
2023	$39,476	$131,575	$171,051
2024	$39,849	$132,816	$172,665
2025	$40,314	$134,368	$174,682
2026	$40,687	$135,609	$176,296
2027	$41,059	$136,850	$177,909

Targets

View: Accounts

	RES	CI	Total
2022	191	10	202
2023	193	10	204
2024	195	11	206
2025	197	11	208
2026	199	11	210
2027	201	11	212

Water Savings

Units: afy

	Total Savings (afy)
2022	3.183356
2023	6.397029
2024	9.641020
2025	12.922908
2026	16.235114
2027	19.577638

High Efficiency Urinal Rebate

Overview	
Name	High Efficiency Urinal Rebate
Abbr	2
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
CI	$100.00	$200.00	2

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Provide a rebate or voucher for the installation of high efficiency urinals (flushing at 0.5 gpf or less). Rebate amounts would reflect the incremental purchase cost.

Customer Classes	RES	CI
	☐	☑

End Uses	RES	CI
Toilets		☐
Urinals		☑
Lavatory Faucets		☐
Showers		☐
Dishwashers		☐
Clothes Washers		☐
Process		☐
Kitchen Spray Rinse		☐
Internal Leakage		☐
Baths		
Other		☐
Irrigation		☐
Pools		☐
Wash Down		
Outdoor		
Cooling		☐
Car Washing		
External Leakage		☐
Non-Lavatory/Kitchen Faucets		☐

Comments

- Utility Cost: Rebate amount of $100/urinal. Up to 2 urinals per account.
- Customer Cost: Customer cost reflects the remaining fixture and installation costs.
- Administration Cost: Staff time to run program and track program savings and participation.
- End Use Water Savings Assumptions: Water savings based on the 1.0 gpf being replaced with 0.125 gpf (pint) urinals.
- Targets: Target 1% of accounts due to expected participation

Results	
Units	AF
Average Water Savings (afy)	
	1.192355
Lifetime Savings - Present Value ($)	
Utility	$7,977
Community	$7,977
Lifetime Costs - Present Value ($)	
Utility	$13,300
Community	$36,431
Benefit to Cost Ratio	
Utility	0.60
Community	0.22
Cost of Savings per Unit Volume ($/af)	
Utility	$1,594

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
CI Urinals	87.5%	41.8

Targets	
Target Method:	Percentage
% of Accts Targeted/Yr	1.000%
Only Affects New Accts	☐

Costs — View: Summary

	Utility	Customer	Total
2022	$2,397	$4,169	$6,567
2023	$2,421	$4,211	$6,632
2024	$2,446	$4,253	$6,699
2025	$2,470	$4,296	$6,766
2026	$2,495	$4,339	$6,833
2027	$2,520	$4,382	$6,902

Targets — View: Accounts

	CI	Total
2022	10	10
2023	11	11
2024	11	11
2025	11	11
2026	11	11
2027	11	11

Water Savings — Units: afy

	Total Savings (afy)
2022	0.418934
2023	0.824739
2024	1.217665
2025	1.597936
2026	1.965787
2027	2.321426

Non-Regenerative Water Softeners Incentives

Overview	
Name	Non-Regenerative Water Softeners Incentives
Abbr	3
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
RES	$200.00	$800.00	1

Administration Costs

Method:	Percent
Markup Percentage	15%

Description

Incentive program for ion exchange-based water softening systems, which perform on-site regeneration of the exchange resin. Offer rebate to switch out existing water softeners; installation of upgraded version of water softener would be eligible with pre-approval.

Customer Classes

	RES	CI
	☑	☐

End Uses

	RES	CI
Toilets	☐	
Urinals		
Lavatory Faucets	☐	
Showers	☐	
Dishwashers	☐	
Clothes Washers	☐	
Process		
Kitchen Spray Rinse		
Internal Leakage	☑	
Baths	☐	
Other	☑	
Irrigation	☐	
Pools	☐	
Wash Down	☐	
Outdoor		
Cooling		
Car Washing	☐	
External Leakage	☐	
Non-Lavatory/Kitchen Faucets	☐	

Comments

- Utility Cost: $200 rebate amount
- Admin Markup: 15%
- Customer Cost: Remaining cost- $800 based on average cost of $1,000 per softener
- End Use Water Savings: Pelicanwater.com estimates 6,200 gpy saved (or 17 gpd) per residential account. https://www.pelicanwater.com/water-softeners/salt-free-water-softeners/?gclid=CI7O9Ou6hLQCFcN_QgodNh0ADA. EPA estimates that WaterSense labeled water softeners use 20% less water than standard models which consume an average of 25 gallons of water or more per day during regeneration; a 5 gpd per acct savings.
- Targets: Target of 0.25% based on expected participation- potentially conservative

>Only non-regenerative

Results

Units	AF
Average Water Savings (afy)	
	0.839316
Lifetime Savings - Present Value ($)	
Utility	$5,607
Community	$5,607
Lifetime Costs - Present Value ($)	
Utility	$61,652
Community	$276,093
Benefit to Cost Ratio	
Utility	0.09
Community	0.02
Cost of Savings per Unit Volume ($/af)	
Utility	$10,494

End Use Savings Per Replacement

Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Internal Leakage	25.0%	15.1
RES Other	30.0%	4.3

Targets

Target Method:	Percentage
% of Accts Targeted/Yr	0.250%
Only Affects New Accts	☐

Costs

View: Summary

	Utility	Customer	Total
2022	$11,113	$38,653	$49,766
2023	$11,224	$39,039	$50,263
2024	$11,336	$39,429	$50,765
2025	$11,449	$39,824	$51,274
2026	$11,564	$40,222	$51,786
2027	$11,680	$40,624	$52,304

Targets

View: Accounts

	RES	Total
2022	48	48
2023	49	49
2024	49	49
2025	50	50
2026	50	50
2027	51	51

Water Savings

Units: afy

	Total Savings (afy)
2022	0.275141
2023	0.553033
2024	0.833701
2025	1.117179
2026	1.403493
2027	1.692668

Hot Water on Demand Rebate

Overview	
Name	Hot Water on Demand Rebate
Abbr	4
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
RES	$200.00	$300.00	1

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Provide a rebate to equip homes with efficient hot water on demand systems. These systems use a pump placed under the sink to recycle water sitting in the hot water pipes to reduce hot water waiting times by having an on-demand pump on a recirculation line. Can be installed on kitchen sink or master bath, wherever hot water waiting times are more than 1/2 minute. Requires an electrical outlet under the sink, which is not common on older home bathrooms but is on kitchen sinks.

Customer Classes	RES	CI
	☑	☐

End Uses	RES	CI
Toilets	☐	
Urinals		
Lavatory Faucets	☑	
Showers	☑	
Dishwashers	☐	
Clothes Washers	☐	
Process		
Kitchen Spray Rinse		
Internal Leakage	☐	
Baths	☐	
Other	☐	
Irrigation	☐	
Pools	☐	
Wash Down	☐	
Outdoor		
Cooling		
Car Washing	☐	
External Leakage	☐	
Non-Lavatory/Kitchen Faucets	☑	

Comments

- Utility Cost: Rebate cost
- Admin Markup: For staff time to run program.
- Customer Cost: Includes remaining cost of pump and installation cost.
- End Use Water Savings: Water savings based on Jim Lutz 2005 paper "Estimating Energy and Water Losses in Residential Hot Water Distribution Systems" and information from Gary Klein and David Grieshop. See spreadsheet titled "Hot Water On Demand Water Savings Estimate_2013" includes 1750 sq ft house saves 1571 gallons per year or 4.3 gpd/acct and a total of 99.5 gpd per SF home, equates to ~4.3% savings per home. Based on a RES indoor water use this results in an equivalent savings of approximately 24.9 gpd savings or 40% on shower and faucet end uses. More information on ACT system at: www.gothotwater.com
- Targets: Target of 0.25% based on expected participation-potentially conservative.

Results	
Units	AF
Average Water Savings (afy)	
2.301076	
Lifetime Savings - Present Value ($)	
Utility	$15,395
Community	$25,650
Lifetime Costs - Present Value ($)	
Utility	$61,652
Community	$142,067
Benefit to Cost Ratio	
Utility	0.25
Community	0.18
Cost of Savings per Unit Volume ($/af)	
Utility	$3,828

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Lavatory Faucets	40.0%	6.7
RES Showers	40.0%	19.3
RES Non-Lavatory/Kitchen Faucets	40.0%	12.5

Targets	
Target Method:	Percentage
% of Accts Targeted/Yr	0.250%
Only Affects New Accts	☐

Costs

View: Summary

	Utility	Customer	Total
2022	$11,113	$14,495	$25,607
2023	$11,224	$14,640	$25,864
2024	$11,336	$14,786	$26,122
2025	$11,449	$14,934	$26,383
2026	$11,564	$15,083	$26,647
2027	$11,680	$15,234	$26,914

Targets

View: Accounts

	RES	Total
2022	48	48
2023	49	49
2024	49	49
2025	50	50
2026	50	50
2027	51	51

Water Savings

Units: afy

	Total Savings (afy)
2022	0.813409
2023	1.595704
2024	2.350452
2025	3.080783
2026	3.789459
2027	4.477728

Efficient Dishwasher Rebate

Overview	
Name	Efficient Dishwasher Rebate
Abbr	5
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☐
Years	10
Repeat	☐

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
RES	$100.00	$500.00	1

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Provide a rebate to encourage homeowner to purchase an efficient dishwasher (5 gallons/cycle or less) when replacing an existing dishwasher.

Customer Classes	RES	CI
	☑	☐

End Uses	RES	CI
Toilets	☐	
Urinals		
Lavatory Faucets	☐	
Showers	☐	
Dishwashers	☑	
Clothes Washers	☐	
Process		
Kitchen Spray Rinse		
Internal Leakage	☐	
Baths	☐	
Other	☐	
Irrigation	☐	
Pools	☐	
Wash Down	☐	
Outdoor		
Cooling		
Car Washing	☐	
External Leakage	☐	
Non-Lavatory/Kitchen Faucets	☐	

Comments

- Utility Cost: $100 rebate
- Admin Markup: 15%
- Customer Cost: RES energy star dishwashers are about ~$600 on average.
- End Use Water Savings: Assuming older units function at an estimated 7.5 gallons per cycle. When replaced with 5 gallons per cycle units, results in 33% savings.
- Targets: targeting .25% of accounts.

>10 year lifespan on dishwashers

Results	
Units	AF
Average Water Savings (afy)	
	0.066219
Lifetime Savings - Present Value ($)	
Utility	$442
Community	$1,695
Lifetime Costs - Present Value ($)	
Utility	$30,826
Community	$164,851
Benefit to Cost Ratio	
Utility	0.01
Community	0.01
Cost of Savings per Unit Volume ($/af)	
Utility	$66,502

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Dishwashers	33.0%	1.2

Targets	
Target Method:	Percentage
% of Accts Targeted/Yr	0.250%
Only Affects New Accts	☐

Costs — View: Summary

	Utility	Customer	Total
2022	$5,556	$24,158	$29,714
2023	$5,612	$24,400	$30,011
2024	$5,668	$24,643	$30,311
2025	$5,725	$24,890	$30,615
2026	$5,782	$25,139	$30,921
2027	$5,840	$25,390	$31,230

Targets — View: Accounts

	RES	Total
2022	48	48
2023	49	49
2024	49	49
2025	50	50
2026	50	50
2027	51	51

Water Savings — Units: afy

	Total Savings (afy)
2022	0.021707
2023	0.043632
2024	0.065776
2025	0.088141
2026	0.110730
2027	0.133545

Swimming Pool Cover Rebate or Requirement

Overview	
Name	Swimming Pool Cover Rebate or Requirement
Abbr	6
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	
Years	6
Repeat	

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
RES	$50.00	$100.00	1
CI	$200.00	$300.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Provide a rebate through pool equipment supply stores for purchase of a swimming pool cover.

Customer Classes	RES	CI
	☑	☑

End Uses	RES	CI
Toilets	☐	☐
Urinals		☐
Lavatory Faucets	☐	☐
Showers	☐	☐
Dishwashers	☐	☐
Clothes Washers	☐	☐
Process		☐
Kitchen Spray Rinse		☐
Internal Leakage	☐	☐
Baths	☐	
Other	☐	☐
Irrigation	☐	☐
Pools	☑	☑
Wash Down	☐	
Outdoor		
Cooling		☐
Car Washing	☐	
External Leakage	☐	☐
Non-Lavatory/Kitchen Faucets	☐	☐

Comments

- Utility Cost: $50/$200 rebate cost of pool cover.
- Customer Cost: Remaining cost of pool cover after rebate.

> Residential: Assume a SF pool cover costs ~ $120-$300 and lasts approximately 6 years.

> Assume a large facility pool covers costs ~$300-$800 and lasts approx. 6 years

- Administration Cost: Cost to manage program.
- End Use Water Savings Assumptions: Conservative savings estimate of 30% based on 30-50% savings range from evaporation and landscape design/yard layout per 2001 AWWA Annual Conference paper "Splash or Sprinkle? A Comparison of Water Use of Swimming Pools and Irrigated Landscape Area" by Peter Mayer and Lisa Maddaus.
- Targets: Target of 0.25% based on expected participation.

Results	
Units	AF
Average Water Savings (afy)	
	0.219293
Lifetime Savings - Present Value ($)	
Utility	$1,434
Community	$1,434
Lifetime Costs - Present Value ($)	
Utility	$20,367
Community	$51,509
Benefit to Cost Ratio	
Utility	0.07
Community	0.03
Cost of Savings per Unit Volume ($/af)	
Utility	$13,268

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Pools	30.0%	3.1
CI Pools	30.0%	25.5

Targets	
Target Method:	Percentage
% of Accts Targeted/Yr	0.250%
Only Affects New Accts	☐

Costs — View: Summary

	Utility	Customer	Total
2022	$3,671	$5,613	$9,285
2023	$3,708	$5,669	$9,377
2024	$3,745	$5,726	$9,471
2025	$3,782	$5,783	$9,566
2026	$3,820	$5,841	$9,662
2027	$3,858	$5,900	$9,758

Targets — View: Accounts

	RES	CI	Total
2022	48	3	51
2023	49	3	51
2024	49	3	52
2025	50	3	52
2026	50	3	53
2027	51	3	54

Water Savings — Units: afy

	Total Savings (afy)
2022	0.071887
2023	0.144494
2024	0.217825
2025	0.291891
2026	0.366698
2027	0.442252

Conservation Print Media

Overview	
Name	Conservation Print Media
Abbr	7
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☐
Years	2
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
RES	$2.00	$0.50	1
CI	$2.00	$0.50	1

Administration Costs

Method:	Percent
Markup Percentage	25%

Description

Use a range of printed materials to raise awareness of conservation measures available to customers, including incentive programs offered by Utility. This can include 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 ensure consistent message. Such programs would continue indefinitely.

Customer Classes

	RES	CI
	☑	☑

End Uses

	RES	CI
Toilets	☑	☑
Urinals		☑
Lavatory Faucets	☑	☑
Showers	☑	☑
Dishwashers	☑	☑
Clothes Washers	☑	☑
Process		☑
Kitchen Spray Rinse		☑
Internal Leakage	☑	☑
Baths	☑	
Other	☑	☑
Irrigation	☑	☑
Pools	☑	☑
Wash Down	☑	
Outdoor		
Cooling		☐
Car Washing	☑	
External Leakage	☑	☑
Non-Lavatory/Kitchen Faucets	☑	☑

Comments

- Admin Mark-Up: Staff time to create educational content
- Utility Cost: Minimal average cost to utility for printing conservation materials. May also pay for some print ads and signage.
- Customer Cost: Minimal average cost to customer since some will take action that costs money as a result of the educational initiative and many others will not.

> Cooling towers are unlikely to be affected - very few

- End Use Water Savings: Minimal water savings, mostly behavioral changes.
- Targets: Assumes 50% of population is targeted every other year, with 100% of the population reached every 2 years.

Results

Units	AF
Average Water Savings (afy)	60.243776
Lifetime Savings - Present Value ($)	
Utility	$405,448
Community	$519,612
Lifetime Costs - Present Value ($)	
Utility	$168,059
Community	$201,671
Benefit to Cost Ratio	
Utility	2.41
Community	2.58
Cost of Savings per Unit Volume ($/af)	
Utility	$399

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
RES Toilets	1.0%	24.6
CI Toilets	1.0%	146.4
CI Urinals	1.0%	41.8
RES Lavatory Faucets	1.0%	6.7
CI Lavatory Faucets	1.0%	55.8
RES Showers	1.0%	19.3
CI Showers	1.0%	125.5
RES Dishwashers	1.0%	1.2
CI Dishwashers	1.0%	83.7
RES Clothes Washers	1.0%	15.3
CI Clothes Washers	1.0%	209.2
CI Process	1.0%	285.9
CI Kitchen Spray Rinse	1.0%	69.7
RES Internal Leakage	1.0%	15.1
CI Internal Leakage	1.0%	139.5
RES Baths	1.0%	2.6
RES Other	1.0%	4.3
CI Other	1.0%	139.5
RES Irrigation	1.0%	135.7
CI Irrigation	1.0%	372.0
RES Pools	1.0%	3.1
RES Wash Down	1.0%	1.5
RES Car Washing	1.0%	1.5
RES External Leakage	1.0%	10.7
CI External Leakage	1.0%	35.7
RES Non-Lavatory/Kitchen Faucets	1.0%	12.5
CI Non-Lavatory/Kitchen Faucets	1.0%	97.6
CI Pools	1.0%	25.5

Targets

Target Method:	Percentage
% of Accts Targeted/Yr	50.000%
Only Affects New Accts	☐

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Util Total
2022	$24,234	$6,059	$30,293
2023	$24,476	$6,119	$30,595
2024	$24,721	$6,180	$30,901
2025	$24,968	$6,242	$31,210
2026	$25,218	$6,305	$31,523
2027	$25,470	$6,368	$31,838

Targets

View: Accounts

	RES	CI	Total
2022	9,663	521	10,184
2023	9,760	526	10,286
2024	9,857	532	10,389
2025	9,956	537	10,493
2026	10,056	542	10,598
2027	10,156	548	10,704

Water Savings

Units: afy

	Total Savings (afy)
2022	37.997754
2023	75.968547
2024	76.337122
2025	76.724523
2026	77.129847
2027	77.548640

Electronic Conservation Options

Overview	
Name	Electronic Conservation Options
Abbr	8
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☐
Years	2
Repeat	☐

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
RES	$1.00	$0.50	1
CI	$1.00	$0.50	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Provide a variety of conservation information on city or utility web site, distribution of videos. Also consider social media options such as cell phone apps, Facebook, interactive kiosk with view screen, TV station advertisements, etc.

Customer Classes	RES	CI
	☑	☑

End Uses	RES	CI
Toilets	☑	☑
Urinals		☑
Lavatory Faucets	☑	☑
Showers	☑	☑
Dishwashers	☑	☑
Clothes Washers	☑	☑
Process		☑
Kitchen Spray Rinse		☑
Internal Leakage	☑	☑
Baths	☑	
Other	☑	☑
Irrigation	☑	☑
Pools	☑	☑
Wash Down	☑	
Outdoor		
Cooling		☐
Car Washing	☑	
External Leakage	☑	☑
Non-Lavatory/Kitchen Faucets	☑	☑

Comments

- Admin Mark-Up: Staff time to create educational content
- Utility Cost: Minimal average cost to utility since all online. May pay for some ads, apps, and/or website design assistance.
- Customer Cost: Minimal average cost to customer since some will take action that costs money as a result of the educational initiative and many others will not.

> Cooling towers are unlikely to be affected - very few

- End Use Water Savings: Minimal water savings, mostly behavioral changes.
- Targets: Assumes 50% of population is targeted every other year, with 100% of the population reached every 2 years.

Results	
Units	AF
Average Water Savings (afy)	
60.243776	
Lifetime Savings - Present Value ($)	
Utility	$405,448
Community	$519,612
Lifetime Costs - Present Value ($)	
Utility	$70,627
Community	$98,878
Benefit to Cost Ratio	
Utility	5.74
Community	5.26
Cost of Savings per Unit Volume ($/af)	
Utility	$167

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Toilets	1.0%	24.6
CI Toilets	1.0%	146.4
CI Urinals	1.0%	41.8
RES Lavatory Faucets	1.0%	6.7
CI Lavatory Faucets	1.0%	55.8
RES Showers	1.0%	19.3
CI Showers	1.0%	125.5
RES Dishwashers	1.0%	1.2
CI Dishwashers	1.0%	83.7
RES Clothes Washers	1.0%	15.3
CI Clothes Washers	1.0%	209.2
CI Process	1.0%	285.9
CI Kitchen Spray Rinse	1.0%	69.7
RES Internal Leakage	1.0%	15.1
CI Internal Leakage	1.0%	139.5
RES Baths	1.0%	2.6
RES Other	1.0%	4.3
CI Other	1.0%	139.5
RES Irrigation	1.0%	135.7
CI Irrigation	1.0%	372.0
RES Pools	1.0%	3.1
RES Wash Down	1.0%	1.5
RES Car Washing	1.0%	1.5
RES External Leakage	1.0%	10.7
CI External Leakage	1.0%	35.7
RES Non-Lavatory/Kitchen Faucets	1.0%	12.5
CI Non-Lavatory/Kitchen Faucets	1.0%	97.6
CI Pools	1.0%	25.5

Targets	
Target Method:	Percentage
% of Accts Targeted/Yr	50.000%
Only Affects New Accts	☐

Costs			
View:	Summary		
	Utility	Customer	Total
2022	$12,730	$5,092	$17,823
2023	$12,858	$5,143	$18,001
2024	$12,986	$5,194	$18,181
2025	$13,116	$5,246	$18,363
2026	$13,247	$5,299	$18,546
2027	$13,380	$5,352	$18,732

Targets			
View	Accounts		
	RES	CI	Total
2022	9,663	521	10,184
2023	9,760	526	10,286
2024	9,857	532	10,389
2025	9,956	537	10,493
2026	10,056	542	10,598
2027	10,156	548	10,704

Water Savings	
Units	afy
	Total Savings (afy)
2022	37.997754
2023	75.968547
2024	76.337122
2025	76.724523
2026	77.129847
2027	77.548640

High Efficiency Toilet Rebate

Overview	
Name	High Efficiency Toilet Rebate
Abbr	9
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☑

Fixture Cost per Device	Utility	Customer	Fix/Acct
RES	$50.00	$200.00	2
CI	$50.00	$200.00	5

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Bullhead City's current program provides a $50 rebate for the installation of one high efficiency toilet (HET) for residential customers. HETs are toilets flushing 1.28 gpf or less.

Customer Classes	RES	CI
	☑	☑

End Uses	RES	CI
Toilets	☑	☑
Urinals		☐
Lavatory Faucets	☐	☐
Showers	☐	☐
Dishwashers	☐	☐
Clothes Washers	☐	☐
Process		☐
Kitchen Spray Rinse		☐
Internal Leakage	☐	☐
Baths	☐	
Other	☐	☐
Irrigation	☐	☐
Pools	☐	☐
Wash Down	☐	
Outdoor		
Cooling		☐
Car Washing	☐	
External Leakage	☐	☐
Non-Lavatory/Kitchen Faucets	☐	☐

Comments

Note: toilet, washer and irrigation controller rebates have a combined budget of $50k.
- Utility Cost: rebate cost
- Customer Cost: remaining cost
- Targets: Target based on previous participation/current saturation, and new construction already being efficient.
- End use savings: All toilets rebated are for 1.28 gpf. Assumes primarily 1.6 gpf toilets are replaced.
- Admin Cost: Staff time to run program.

Results	
Units	AF
Average Water Savings (afy)	1.073240
Lifetime Savings - Present Value ($)	
Utility	$7,180
Community	$7,180
Lifetime Costs - Present Value ($)	
Utility	$21,797
Community	$97,613
Benefit to Cost Ratio	
Utility	0.33
Community	0.07
Cost of Savings per Unit Volume ($/af)	
Utility	$2,901

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Toilets	20.0%	24.6
CI Toilets	20.0%	146.4

Targets	
Target Method:	Count
# of Accts Targeted/Yr	10

Costs — View: Summary

	Utility	Customer	Total
2022	$4,025	$14,000	$18,025
2023	$4,025	$14,000	$18,025
2024	$4,025	$14,000	$18,025
2025	$4,025	$14,000	$18,025
2026	$4,025	$14,000	$18,025
2027	$4,025	$14,000	$18,025

Targets — View: Accounts

	RES	CI	Total
2022	10	10	20
2023	10	10	20
2024	10	10	20
2025	10	10	20
2026	10	10	20
2027	10	10	20

Water Savings — Units: afy

	Total Savings (afy)
2022	0.377272
2023	0.742386
2024	1.095806
2025	1.437956
2026	1.769258
2027	2.089999

High Efficiency Washing Machine Rebate

Overview	
Name	High Efficiency Washing Machine Rebate
Abbr	10
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
RES	$150.00	$600.00	1
CI	$150.00	$1,850.00	1

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Bullhead City currently provides a $150 rebate for the installation of a high efficiency commercial washer (HEW), one per customer.
Program will be shorter lived as it is intended to be a market transformation measure and eventually would be stopped as efficient units reach saturation.

Customer Classes	RES	CI
	☑	☑

End Uses	RES	CI
Toilets	☐	☐
Urinals		☐
Lavatory Faucets	☐	☐
Showers	☐	☐
Dishwashers	☐	☐
Clothes Washers	☑	☑
Process		☐
Kitchen Spray Rinse		☐
Internal Leakage	☐	☐
Baths	☐	
Other	☐	☐
Irrigation	☐	☐
Pools	☐	☐
Wash Down	☐	
Outdoor		
Cooling		☐
Car Washing	☐	
External Leakage	☐	☐
Non-Lavatory/Kitchen Faucets	☐	☐

Comments

Note: toilet, washer and irrigation controller rebates have a combined budget of $50k.
• Utility Cost: Rebate amount.
• Customer Cost: Remaining cost of washer.
>Residential HEWCs are $750 on average. >Commercial washers range from $1,000 - $3,000. Assume on average $2000 per washer.
• Admin Mark-Up: Staff time to run program.
• End Use Water Savings: A 2013 report by the American Council for an Energy-Efficient Economy and the Natural Resources Defense Council Water (https://www.aceee.org/sites/default/files/pdf/white-paper/great-lakes-clothes-washers.pdf) suggests that upgrades of commercial washing machines can result in savings of 9.3 to 29.6 gallons of water per cycle
• Targets: Targets based expected participation and previous participation rates.

Results	
Units	AF
Average Water Savings (afy)	
	1.506808
Lifetime Savings - Present Value ($)	
Utility	$10,070
Community	$22,380
Lifetime Costs - Present Value ($)	
Utility	$18,683
Community	$151,362
Benefit to Cost Ratio	
Utility	0.54
Community	0.15
Cost of Savings per Unit Volume ($/af)	
Utility	$1,771

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Clothes Washers	20.0%	15.3
CI Clothes Washers	20.0%	209.2

Targets	
Target Method:	Count
# of Accts Targeted/Yr	10

Costs

View: Summary

	Utility	Customer	Total
2022	$3,450	$24,500	$27,950
2023	$3,450	$24,500	$27,950
2024	$3,450	$24,500	$27,950
2025	$3,450	$24,500	$27,950
2026	$3,450	$24,500	$27,950
2027	$3,450	$24,500	$27,950

Targets

View: Accounts

	RES	CI	Total
2022	10	10	20
2023	10	10	20
2024	10	10	20
2025	10	10	20
2026	10	10	20
2027	10	10	20

Water Savings

Units: afy

	Total Savings (afy)
2022	0.502979
2023	1.005572
2024	1.507736
2025	2.009433
2026	2.510632
2027	3.011305

Landscape Conversion with Turf Removal

Overview	
Name	Landscape Conversion with Turf Removal
Abbr	11
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	☐
Years	15
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
RES	$7,500.00	$2,500.00	1
CI	$36,000.00	$32,000.00	1

Administration Costs	
Method:	Percent
Markup Percentage	15%

Description

Provide a per project incentive to remove turf and replace with low water use plants or permeable hardscape. Landscape conversion could include conversion of turf to lower-water-using turf varieties. Rebate based on project cost, and capped at an upper limit: 75% of project cost for residential and small-medium commercial, $50,000 for HOA/large landscape projects.

Customer Classes

	RES	CI
	☑	☑

End Uses

	RES	CI
Toilets	☐	☐
Urinals		☐
Lavatory Faucets	☐	☐
Showers	☐	☐
Dishwashers	☐	☐
Clothes Washers	☐	☐
Process		☐
Kitchen Spray Rinse		☐
Internal Leakage	☐	☐
Baths	☐	
Other	☐	☐
Irrigation	☑	☑
Pools	☐	☐
Wash Down	☐	
Outdoor		
Cooling		☐
Car Washing	☐	
External Leakage	☑	☑
Non-Lavatory/Kitchen Faucets	☐	☐

Comments

Current measure has an annual budget of $200,000. Additional $150,000 to be added for HOA/large landscape projects, for a total measure budget of $350,000.

• Utility Cost: Rebate of 75% of project up to $7,500 for residential and $15,000 for small-medium commercial. Dollar for dollar matched rebate between $25,000 and $50,000 for HOA/large landscape projects. CI cost averaged assuming 3 HOA/large landscape projects at $100,000 ($50,000 rebate) and 2 small-medium commercial projects at $20,000 ($15,000 rebate).

• Customer Cost: Remaining cost of project. Assumes total project cost is about $10,000 for residential,$20,000 for commercial, and $100,000 for HOA/large landscape projects.

• Admin Mark-Up: Staff time to run program.

•End Use Savings: BC provided savings of .623 gallons of water saved per square foot per day, with an average of 1,100 sqare foot removed. Based on these savings, conservatively esimating 90% of outdoor water use saved. Assumes 100% of landscape is turf and therefore removed. Assumes 50% external leakage savings for updated irrigation equipment.

•Targets: Targets based on expected participation and budget. 3 HOA/large landscape customers expected annually. Minimal small-medium commercial participation in the past.

Results

Units	AF
Average Water Savings (afy)	
12.789387	
Lifetime Savings - Present Value ($)	
Utility	$83,677
Community	$83,677
Lifetime Costs - Present Value ($)	
Utility	$1,868,330
Community	$2,951,420
Benefit to Cost Ratio	
Utility	0.04
Community	0.03
Cost of Savings per Unit Volume ($/af)	
Utility	$20,869

End Use Savings Per Replacement

Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Irrigation	90.0%	135.7
CI Irrigation	90.0%	372.0
RES External Leakage	50.0%	10.7
CI External Leakage	50.0%	35.7

Targets

Target Method: Detailed

Enter Annual Targets Below

Costs

View: Summary

	Utility	Customer	Total
2022	$345,000	$200,000	$545,000
2023	$345,000	$200,000	$545,000
2024	$345,000	$200,000	$545,000
2025	$345,000	$200,000	$545,000
2026	$345,000	$200,000	$545,000
2027	$345,000	$200,000	$545,000

Targets

View: Accounts

	RES	CI	Total
2022	16	5	21
2023	16	5	21
2024	16	5	21
2025	16	5	21
2026	16	5	21
2027	16	5	21

Water Savings

Units: afy

	Total Savings (afy)
2022	4.263129
2023	8.526258
2024	12.789387
2025	17.052516
2026	21.315645
2027	25.578773

Smart Irrigation Controller Rebate

Overview	
Name	Smart Irrigation Controller Rebate
Abbr	12
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2022
Last Year	2027
Measure Length	6

Measure Life	
Permanent	
Years	15
Repeat	

Fixture Cost per Device

	Utility	Customer	Fix/Acct
RES	$175.00	$175.00	1
CI	$175.00	$2,825.00	1

Administration Costs

Method:	Percent
Markup Percentage	15%

Description

Bullhead City currently provides a $175 rebate for the purchase of a weather-based irrigation controller. These controllers have on-site weather sensors or rely on a signal from a central weather station that modifies irrigation times at least weekly. Limit 1 per account.

Customer Classes

	RES	CI
	☑	☑

End Uses

	RES	CI
Toilets	☐	☐
Urinals		☐
Lavatory Faucets	☐	☐
Showers	☐	☐
Dishwashers	☐	☐
Clothes Washers	☐	☐
Process		☐
Kitchen Spray Rinse		☐
Internal Leakage	☐	☐
Baths	☐	
Other	☐	☐
Irrigation	☑	☑
Pools	☐	☐
Wash Down	☐	
Outdoor		
Cooling		☐
Car Washing	☐	
External Leakage	☑	☑
Non-Lavatory/Kitchen Faucets	☐	☐

Comments

Note: toilet, washer and irrigation controller rebates have a combined budget of $50k.
• Utility Cost: Rebate amount.
• Customer Cost: Remaining cost of irrigation controller.
>Assumes residential controller is $350 on average
>Assumes commercial controller is $3,000 on average
• Admin Mark-Up: Staff time to run program.
• End Use Water Savings: Based on 2014 "Estimates of Savings Achievable from Irrigation Controller" study by A. Williams, H. Fuchs, and C. Whitehead from Environmental Energy Technologies Division of Lawrence Berkeley National Laboratory in Berkeley, CA.
• Targets: Target 3 accounts based on expected participation. Per Bullhead City Staff, targeting residential accounts since rarely have CI participation, however, want to continue offering this rebate to CI customers as well.

Results

Units	AF
Average Water Savings (afy)	
0.210794	
Lifetime Savings - Present Value ($)	
Utility	$1,379
Community	$1,379
Lifetime Costs - Present Value ($)	
Utility	$3,270
Community	$6,113
Benefit to Cost Ratio	
Utility	0.42
Community	0.23
Cost of Savings per Unit Volume ($/af)	
Utility	$2,216

End Use Savings Per Replacement

Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
RES Irrigation	15.0%	135.7
CI Irrigation	15.0%	372.0
RES External Leakage	5.0%	10.7
CI External Leakage	5.0%	35.7

Targets

Target Method:	Detailed
Enter Annual Targets Below	

Costs

View: Summary

	Utility	Customer	Total
2022	$604	$525	$1,129
2023	$604	$525	$1,129
2024	$604	$525	$1,129
2025	$604	$525	$1,129
2026	$604	$525	$1,129
2027	$604	$525	$1,129

Targets

View: Accounts

	RES	CI	Total
2022	3	0	3
2023	3	0	3
2024	3	0	3
2025	3	0	3
2026	3	0	3
2027	3	0	3

Water Savings

Units: afy

	Total Savings (afy)
2022	0.070265
2023	0.140529
2024	0.210794
2025	0.281059
2026	0.351324
2027	0.421588

APPENDIX E – DEFINITIONS

Utility Costs – costs that the City as a water utility will incur to operate the measure, including administrative costs.

Utility Benefits – the avoided cost of producing water at the identified rate.

Customer (Community) Costs – those costs customers will incur to implement a measure in the City's conservation program and maintain its effectiveness over the life of the measure.

Customer (Community) Benefits – the additional savings, such as energy savings resulting from reduced use of hot water. These savings are additional as customers would also have reduced water bills (since the utility costs and benefits transfer to the customers).

Community Costs – includes Utility Costs plus Customer Costs.

Community Benefits – includes Utility Benefits plus Customer Benefits.

Present Value (PV) of Utility and Community Costs and Benefits ($) = the present value of the program period time stream of annual costs or benefits, discounted to the base year.

Utility Benefit to Cost Ratio = PV of Utility Benefits divided by PV of Utility Costs, over the program period.

Community Benefit to Cost Ratio = (PV of Utility Benefits plus PV of customer energy savings) divided by (PV of Utility Costs plus PV of Customer Costs), over the program period.

Water Utility Costs ($) = the sum of the annual Utility Costs for the Program years. Utility costs include administrative costs and staff labor.

Cost of Savings per Unit Volume ($/AF) = PV of Utility Costs over program period divided by the program period of water savings. This value is compared to the utility's avoided cost of water as one indicator of the cost-effectiveness of conservation efforts. Note that this value somewhat minimizes the cost of savings because program costs are discounted to present value, but water benefits are not.