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City of Flagstaff

WATER CONSERVATION STRATEGIC PLAN

FLAGSTAFF WATER SERVICES

WATER RESOURCES & CONSERVATION

2020

CITY OF FLAGSTAFF ARIZONA ESTABLISHED 1882

TABLE OF CONTENTS PAGE

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

The authors of this report would like to thank the following participants for supporting the City of Flagstaff's Water Conservation Strategic Plan. The Plan was developed as a partnership between the City of Flagstaff, its stakeholders, and Maddaus Water Management Inc.

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LIST OF ABBREVIATIONS AND ACRONYMS

Acct	account
ADWR	Arizona Department of Water Resources
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
COM	commercial
CII	commercial, industrial, and institutional
DSS Model	Demand Side Management Least Cost Planning Decision Support System
FY	Fiscal Year
GPCD	gallons per capita per day
gpd	gallons per day
gpf	gallons per flush
gpm	gallons per minute
IBC	International Building Code
MF	multifamily
MWM	Maddaus Water Management Inc.
NRW	non-revenue water
REST	restaurant
SF	single family
USBR	United States Bureau of Reclamation
WCP	City of Flagstaff Water Conservation Program
WET	Arizona Project Water Education Today
WUE	water use efficiency

EXECUTIVE SUMMARY

In 2016, the Flagstaff City Council gave staff direction to develop an innovative Water Conservation Strategic Plan (Plan), which was funded in FY18. The Plan aims to determine the appropriate investment in conservation-derived water savings in order to defer costly future water supply development and infrastructure. To this end, the Plan provides an assessment of current and future water conservation actions to ensure that conservation dollars and staff time are invested in strategies that provide the best return on investment and coverage of all sectors of the Flagstaff customer base.

To complete the Plan, the City of Flagstaff (City) Water Conservation Program (WCP) employed Maddaus Water Management Inc. (MWM) to meet the following overarching goals:

1. Become a national leader in water conservation in all sectors (Council goal)
2. Generate quantitative water conservation savings projections for use in Water Resources Master Plan
3. Provide conservation guidance for next water rate study
4. Ensure water conservation program expenditures result in broad community participation and return on investment

During the strategic planning process, 11 conservation activities (referred to as "measures" in the modeling effort) were selected from the WCP's current actions and then were assessed for return on investment using MWM's quantitative benefit-cost computational model. In addition, Water Conservation staff worked with community stakeholders to select 11 additional conservation strategies that the program and utility could consider for the future. These additional activities also were processed through the model. The stakeholder engagement process was assisted by consultants from Southwest Decision Resources, who helped to recruit participants from groups throughout the Flagstaff community.

After considering several combinations of current and future conservation activities, the WCP and MWM compiled a selection that provided both good return on investment and coverage of all customer classes. This new combination of water conserving actions is known as the Optimized Conservation Program. When implemented, this new program will provide the best return on investment for conservation dollars spent; save the City money by avoiding future water production and supply costs; and accomplish the City Council's goal of being a leader in water conservation. Another outcome of this planning effort that will contribute toward demonstrating Flagstaff's national leadership in water conservation is the alignment of this plan with the elements of the Alliance for Water Efficiency G480 Leaderboard.[1]

Optimized Conservation Program – Proposed Program Overview

By combining new initiatives with existing programs as part of a comprehensive strategy for long-term savings, the Optimized Conservation Program is expected to save approximately 690 additional acre-feet (AF) of water over the next 20 years at an additional annual investment of $45,000. This is in addition to the 1,300 AF the Current Conservation Program is expected to save if it continues operating as it has been. This quantification of water savings over the next 20 years will be critical information for the Water Resources Master Plan.

The new water conservation programming includes proposed code changes, partnerships with K-12 and higher education institutions, opportunities for research and innovation, and expanded outdoor efficiency opportunities such as outdoor water budgeting for large irrigated areas.

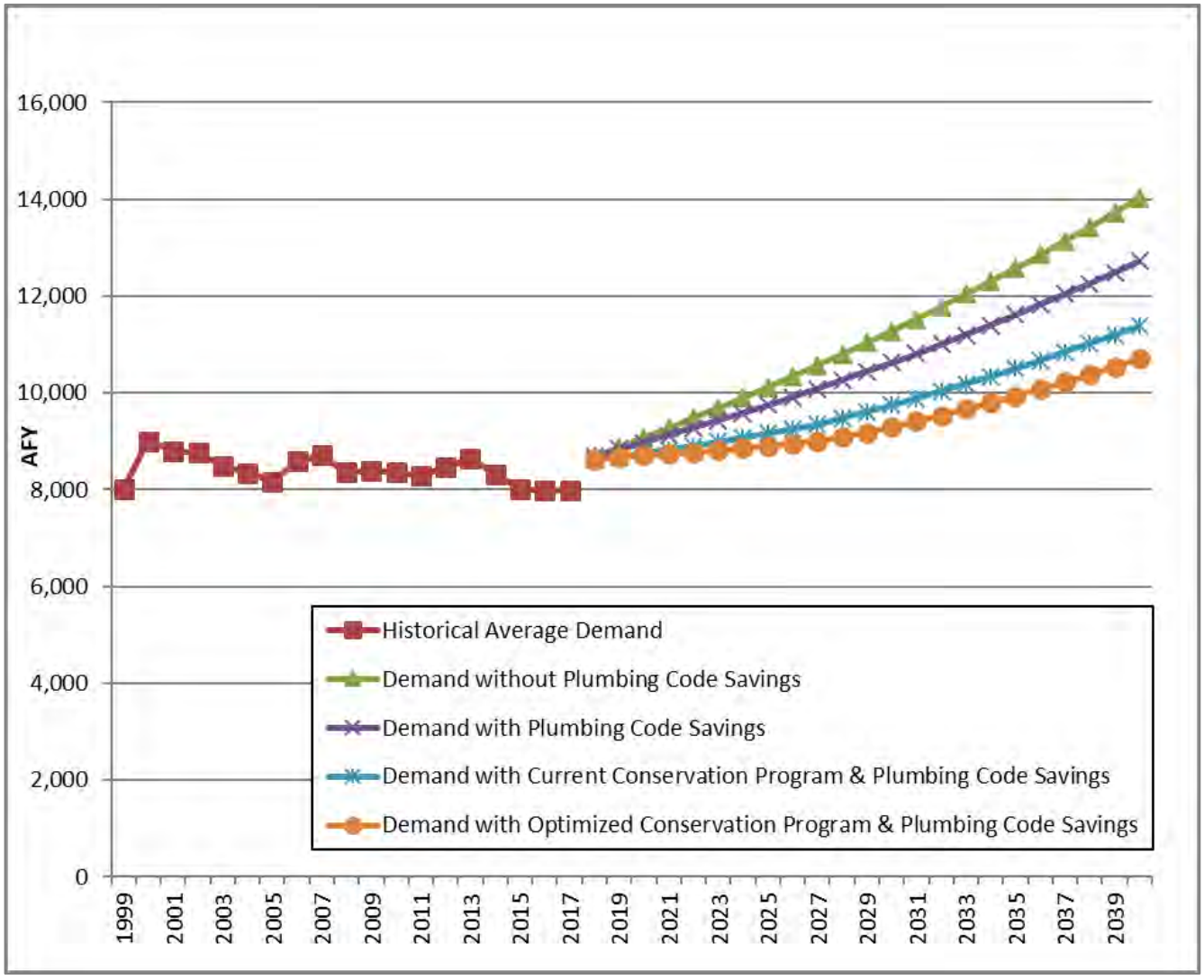
[1] G480 Standard and AWE Leaderboard web page: https://www.allianceforwaterefficiency.org/resources/topic/g480-standard-and-awe-leaderboard

All the measures that make up the Optimized Conservation Program are listed as follows and described in more detail in Section 5.3:

- Public Outreach and School Education
- Innovation, Research, and Pilot Studies
- Prohibit Water Waste and Practices
- System Water Loss Control
- Smart Meters
- Water Rates (Pricing)
- Outdoor Water Budgeting
- Water Efficient Landscape Rebate
- Landscape and Rainwater Retention Code
- Commercial Rebates and Consultations
- School Retrofits
- Residential Indoor Water Consultations
- High Efficiency Fixture Giveaway w/Spray Nozzles
- High Efficiency Toilet Rebate (New)
- Hot Water Recirculation Code
- Showerhead and Faucet WaterSense Code

The following figure presents historical and projected water demands for both the Current and Optimized Conservation Programs, along with the demand with and without plumbing code savings. Plumbing code elements include current local, state, and federal standards for retrofits of items such as toilets, showerheads, faucets, and pre-rinse spray valves.

Figure ES-1. City of Flagstaff Historical and Projected Potable Water System Demands



1 PROJECT BACKGROUND

The City of Flagstaff began earnest water conservation efforts in 1988 with a Water Conservation Ordinance. The Water Conservation Program was established in 2003 in response to water deliveries exceeding safe production capability in the summer of 2002. While conservation regulations existed before that time, that summer was a watershed moment. After this event, the City elected to implement Water Availability Strategy 1: Water Awareness at all times, which required every-other-day watering based on the physical address.

The Program is presently managed by two full-time staff and up to four part-time staff. Current conservation strategies include toilet, lawn, and rainwater harvesting rebates; a watering ordinance to lower peak demand and promote efficiency; tiered water rates for residential customers; water "consultations" for commercial and residential customers; and outreach and educational events throughout the year.

In January 2017, the Flagstaff City Council set a goal to amplify the City's conservation efforts to become more than just an Arizona leader. Later in 2017, the City was awarded first place in the National Mayor's Challenge in Water Conservation hosted by the Wyland Foundation. The City's current goal is to continue strengthening efforts as a national leader in water conservation in all sectors. To assist with this goal, the City hired Maddaus Water Management to evaluate the City's current conservation strategies, to suggest improvements for optimizing programmatic costs and water savings, and to adjust existing or add new conservation activities.

1.1 Overview of City of Flagstaff and Its Municipal Water System

Located on the southern edge of the Colorado Plateau, Flagstaff is the regional center and county seat for Coconino County. It is the largest city in northern Arizona with approximately 75,000 residents, 30,000 of whom are students at Northern Arizona University. At an elevation of 7,000 feet, Flagstaff is one of the highest elevation cities in the United States. There are on average 288 days of sunshine each year, and though the climate is semi-arid, 23 inches of precipitation fall annually, including an average 100 inches of snowfall. Recent years have shown some shifts in precipitation patterns. Examples include instances where more precipitation fell as rain rather than as snow and the 2019 monsoon season which was the driest on record.[2] In an average year, the City of Flagstaff's potable water supply consists of 70% groundwater and 30% surface water.

The City has nearly 15,000 single family residential water meters, 3,400 multifamily meters, and just over 2,000 non-residential meters. In 2016, single family homes used 36% of potable water, multifamily residences used 22%, and commercial properties used 26%. Water demand per capita has decreased by 47% since 1989, making per capita water use among the lowest in the state. Even though population has increased by 64% since 1989, total water production has remained steady.

1.2 Modeling Future Water Conservation Scenarios

Maddaus Water Management's Least Cost Planning Decision Support System (DSS Model) prepares long-range, water demand and conservation water savings projections to assess the impact of water efficiency programs. First developed in 1999 and updated continuously, 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. An additional purpose is to provide a rigorous and defensible modeling approach that is necessary for projects subject to regulatory or environmental review.

The DSS Model can use one of the following combinations of savings projection models: 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 which is input into the model from an outside source. The DSS Model also evaluates conservation measures using benefit-cost analysis with the cost of water saved and benefit-cost ratio as economic indicators. The quantitative analysis is performed considering both benefits and costs from the perspective of the utility and the City's customers. For example, the model accounts for the cost to the customer or the utility to implement the measure as well as the benefit to the customer or the utility in dollars and water saved. For the City of Flagstaff, the baseline potable demand without plumbing code savings used in this project was developed using the fourth option above—demand projection input from an outside source. The demand projection used was the demand published in the Arizona Department of Water Resources's (ADWR) Designation of Adequate Water Supply 2013,[3] which is one scenario of many published in the Annual Report to the Water Commission.

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

1.3 Purpose and Scope of Strategic Plan

This purpose of this Plan is to provide a comprehensive water conservation strategy for the City of Flagstaff for the 2018-2040 time period. The scope of the plan included the following tasks:

- Provide quantitative analysis of existing water conservation programming

[2] Average Flagstaff monsoon season produces 8.31 inches of precipitation; the 2019 season produced only 2.08 inches.

[3] https://www.flagstaff.az.gov/2263/Adequate-Water-Supply-Designation

- Identify new water conservation opportunities
- Determine prospects for leveraging City resources through partnership funding and identify potential challenges
- Leverage local stakeholders for technical and community perspectives and recommendations to Commissions and City Council
- Assess various water conservation actions for their feasibility and affordability
- Consider mid- to long-term water supply concerns due to population growth and climate change
- Evaluate the City's customer billing rates and structures for their effectiveness at promoting conservation and against other regional and national leaders in water conservation
- Demonstrate City of Flagstaff's commitment to water conservation on the state and national scale

The Plan also incorporates the following overarching goals:

- Long-term benefits – reinforce the positive impact of water conservation on water supplies and infrastructure investments.
- Community empowerment – outline actions that can be taken by all sectors of the community to achieve water efficiency and provide guidance on how the City of Flagstaff can best support all sectors in achieving these goals.
- Social Equity – detail impacts on different communities and groups in Flagstaff, and how the implementation will reach and benefit all members of the Flagstaff community.
- Community Values – inspire a conservation ethic/identity for City staff, residents, and businesses.

1.4 Plan Development and Project Timeline

In late 2017, the City of Flagstaff issued a Request for Proposals seeking a qualified consultant to develop a complete Water Conservation Strategic Plan. After a review and scoring by senior staff of the proposals received, the City awarded the contract to MWM.[4] A Professional Services Agreement was completed by all parties on May 3, 2018, including a draft work plan and timeline.

Between May 2018 and January 2019, the City worked closely with MWM to compile extensive historical data on the region, the City's service area, conservation measures, production, consumption, weather, and various census data points. Together, these formed the foundation for the DSS Model. The City project team utilized the template Data Collection Workbook provided by MWM to compile and verify data. This effort was assisted by an additional outside consultant group, Montgomery & Associates, who were able to assess bulk data from the City's customer billing system and combine all meters associated with the same address into one customer data point. Prior to this effort, large customers, such as medical facilities or large apartment complexes, were listed as multiple users in the dataset due to the property having multiple service meters, which affected the accuracy of an analysis. The project team at MWM verified and tested data against historical records to ensure measure design logic and accuracy throughout development of the DSS Model.

MWM reviewed existing City practices and procedures to create a comprehensive list of water use conservation measures currently in place. MWM 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 American Water Works Association (AWWA) Manual *M52 Water Conservation Programs – A Planning Manual* (AWWA, 2017).

[4] http://maddauswater.com/

In August 2018, the City met with MWM to discuss the model, method and approach to screening measures; how to conduct public outreach; and next steps. In September 2018, the City received the Measure Screening Template. The City developed screening criteria including water savings potential, account saturation, equitability, community and social acceptance, and feasibility of implementation related to cost and staff time. Then, City staff screened 130 potential conservation measures and began the outreach process to seek stakeholder input on the screened conservation measures.

After further review and sorting by the project team at MWM, a list of potential water use conservation measures was developed and presented to the City Water Commission in March 2019. The City Council approved the list of conservation measures to be modeled on April 30, 2019.

Throughout the planning process, the City and MWM conducted conference calls and online meetings, to complete the DSS Model, which is a robust design for each of the 22 measures modeled. In the model, for each measure the City identified staff time, 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.

Based on the approved measures, the presentation of results to the Advisory Committee and Water Commission for review and feedback, and the completion of the DSS Model, the City-recommended Optimized Conservation Program was presented to and approved by the City Council on December 3, 2019. At this time, the City Council gave staff direction to proceed with finalizing the Optimized Conservation Program.

The draft and final versions of the Water Conservation Strategic Plan were developed from 2018-2020. A final draft of the Plan was presented for public review to the City Council on XX, 2020 and final comments were incorporated into this document.

Summary List of Milestones Completed in the Planning Process for Adoption and Implementation:

- Prepare Draft Work Plan and review timeline
- Identify current and potential Water Use Efficiency (WUE) measures with the Stakeholder Group and outreach efforts
- Determine full cost of current WUE measures
- Conduct cost-effectiveness/benefit-cost analysis on WUE measures
- Set goals and priorities
- Identify strengths and weaknesses for current and potential WUE measures
- Prepare draft program scenarios for City Council consideration and direction
- Prepare Draft Water Conservation Strategic Plan and bring to City Council for public comment
- Finalize Water Conservation Strategic Plan
- Finalize Implementation Plan
- Implement, monitor, and evaluate performance versus model results

1.5 Public Participation in the Strategic Planning Process

The City of Flagstaff Water Conservation staff, with support from the City Council, embarked on a diverse strategy of stakeholder engagement over the course of the strategic planning process, including the screening of conservation measures. This effort involved convening an Advisory Committee and a broader Stakeholder Group; garnering input from the general public; and working with a local facilitation consulting group to ensure successful public outreach. Details in the Acknowledgements outlines who participated in leading this effort and the specifics of the public outreach efforts, such as visual aids presented and survey language used, is located in Appendix D – Public Outreach Details.

1.5.1 Advisory Committee

The Advisory Committee was comprised of community stakeholders with a direct link to water conservation and a technical or professional interest in the topic. Members came from the following public interest groups:

- Water Commission
- Sustainability Commission
- Commercial Landscaping Industry
- Northern Arizona University
- Sustainability Section
- Parks and Recreation Department
- Planning Department
- Economic Vitality Department
- Northern Arizona Building Association
- Hotels, Lodging, and Restaurant Industries
- Institute for Tribal Environmental Professionals

1.5.2 Stakeholder Group

The broader Stakeholder Group included all members of the Advisory Committee (as listed above) as well as the following groups:

- Coconino County Master Gardeners
- Southside Neighborhood Association
- Flagstaff Water Group
- Flagstaff Commercial Brewing Industry
- Coconino County Sustainable Building Program
- City of Flagstaff Convention and Visitor's Bureau
- Terra BIRDS
- Commercial Architecture Industry
- Commercial Property Management Industry
- Sierra Club
- Willow Bend
- Students from Flagstaff High School

1.5.3 Input from the General Public

Input from the general public was garnered throughout the strategic planning process. Venues for this feedback were as follows:

- Surveys
  - Online – City website/Strategic Plan page
  - In-person – handed out at Flagstaff Festival of Science 2019
- Public events
  - Open House – Flagstaff Festival of Science 2018
  - Tabling – Flagstaff Festival of Science 2019
- Neighborhood/club meetings[5]
  - Friends of the Rio de Flag
  - Sierra Club
  - Soroptimists
  - La Plaza Vieja Neighborhood Association

1.5.4 Key Outcomes from Public Outreach Effort

The stakeholder engagement over the course of the process provided the following guidance and direction for the Plan draft:

- Reduction of 38 conservation measures down to the final 22 measures for inclusion in the DSS Model
- Insights on how to build each future measure to fit the City of Flagstaff's needs
- Approval of the Optimized Conservation Program
- General feedback on importance of Water Conservation to the City of Flagstaff's community
- Ideas for the implementation of the Optimized Conservation Program, including opportunities and challenges

[5] Other clubs and interest groups were recruited over the course of the strategic planning process; those unable to meet with the conservation team during the draft completion process were recruited again later to discuss content of the final plan and implementation draft.

2 HISTORICAL AND CURRENT POTABLE WATER USE AND CONSERVATION EFFORTS

This section presents information about the analysis of the City's water use patterns, which was based on collected historical water production, consumption, and water loss data. Also provided is a summary of the City's past and current conservation efforts.

2.1 Historical Data Collection

Thorough collection and review of historical data relevant to this effort was organized into a Data Collection Workbook created for the City by MWM. This workbook was populated by City staff and reviewed collaboratively with MWM. The following table presents the data topics and data items requested, gathered, and stored in the City's Data Collection Workbook.

Table 2-1. Data Collection Workbook Topics and Items Requested

Topic	Items Requested	
Historical Data	• Abnormal Years • Customer Category Descriptions • System Input Volume (Production) • Consumption and Accounts • Cost of Water • Maximum Day Demand	• Capital Improvements • Top 100 CII Users • SF Water Rates • COM Water Rates • COM Account Closures • SF Lot Sizes • Avoided Groundwater Costs
Demographic Data	• Population • Jobs	• Historical Weather • Unemployment
Conservation	• Conservation Targets • Historical Conservation • Water System Audits	• Water Loss Questionnaire • Landscape Area Measurement • CII Classification
Other	• New Development Ordinances	• ADWR Planning Guidance

Note: CII = Commercial, Industrial, and Institutional; SF = single family; COM = commercial.

Using monthly production, consumption,[6] and account values provided by the City, MWM and the City staff confirmed the number and types of customers within the City service area. Several follow-up data review actions were conducted by the City staff and/or MWM as a master City database was mined for valuable information and the unique customer categories to be tracked were identified. Data from each customer category was analyzed separately. Monthly production data from 1999 to 2017 was reviewed. Due to the labor-intensive process of extracting monthly use and account data by the selected customer categories, a smaller subset of monthly consumption data (2011 to 2017) was analyzed and used to derive typical average water use per account per day. Based on the City's water billing system, residential water use was further broken down into single family and multifamily categories. Historical data was segregated into indoor and outdoor water use by customer type using monthly billing data. Average daily commercial, institutional, and manufacturing water use

[6] Consumption data was pulled from Innoprise billing database and compared to numbers in each annual Report to the Water Commission. In cases where the total consumption published in the Report to the Water Commission and the data pulled from Innoprise differed for a particular category, an adjustment factor was applied to the Innoprise data. For example, if the Report to the Water Commission reported 10 AF for hypothetical customer category Breweries in 2015 and the Innoprise data showed 8 AF for Breweries in 2015, an adjustment factor of 1.25x was applied to all 2015 Breweries data.

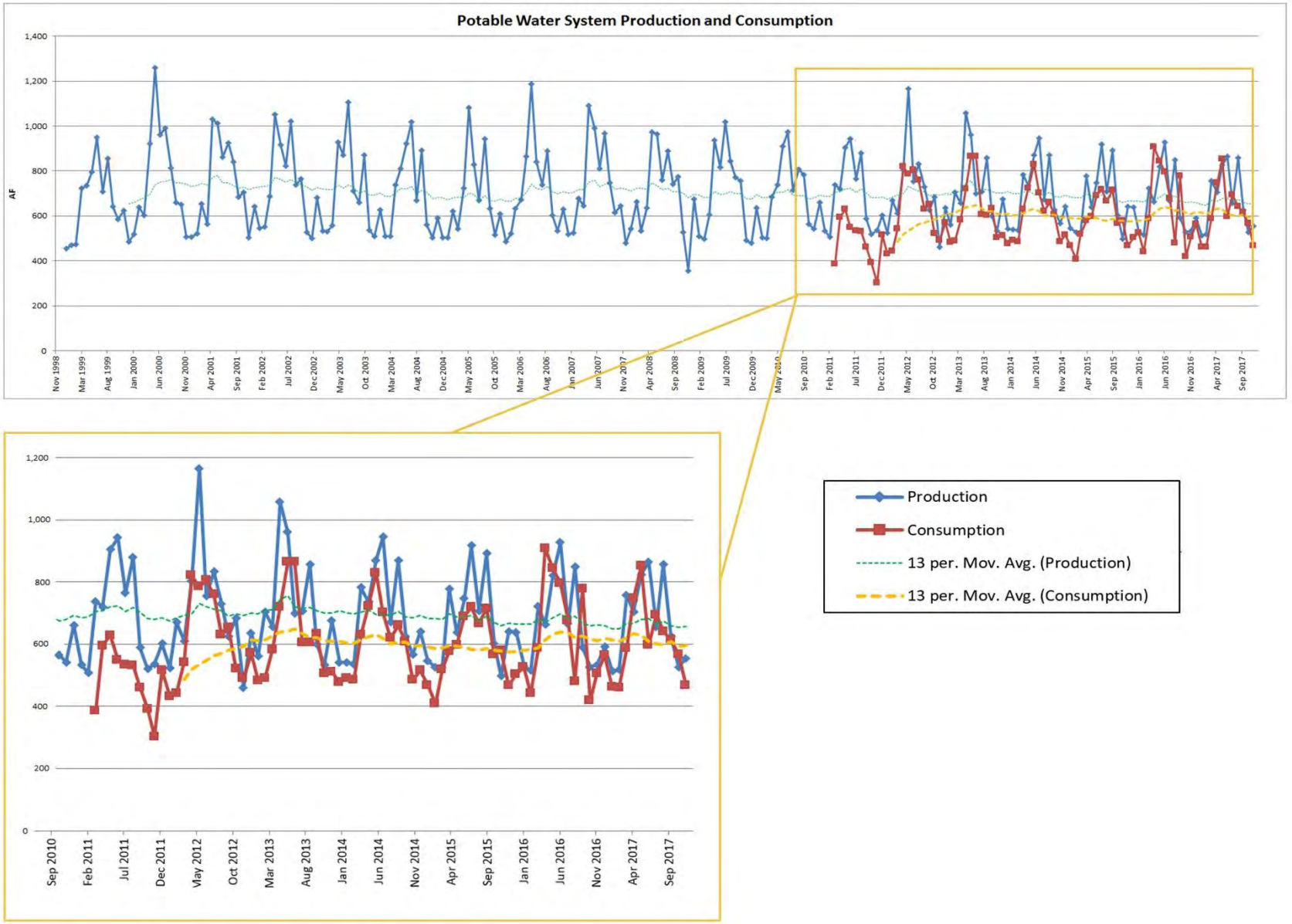
was expressed on a gallons-per-account basis; restaurants and hotels were broken out of the commercial rate class.

2.2 Production versus Consumption

The City's historical monthly potable water production and consumption data is illustrated in Figure 2-1 on the following page. In the figure, the City's monthly water production from groundwater and surface water sources is displayed from 1998 through 2017. Water production data was measured at the respective sources, whereas consumption data was measured at the customer meters. Consumption data was analyzed for the years 2011 through 2017;[7] data prior to 2011 was not readily available for the customer categories analyzed due to a change in City software. An average water loss of 11% non-revenue water (NRW) was estimated for 2014 through 2016 based on the difference between production and consumption.

[7] The process was so labor-intensive, another consulting group (Erroll L Montgomery & Associates Inc) was brought on board to assist in merging together all meters that belonged to a single address. Unfortunately, prior to this effort, every meter was listed as its own account. Therefore, a large customer, such as a medical facility, would be listed as multiple separate accounts rather than as a single user. It is also important to note that when the City switched billing software in 2016, there were a number of errors in the billing system and the importation of April 2011–April 2016 data from the old system was performed without significant quality control.

Figure 2-1. Potable Water Production and Consumption, 2011-2017



Note: Consumption data prior to April 2011 was not readily available for the customer categories analyzed.

2.3 Consumption by Customer Category

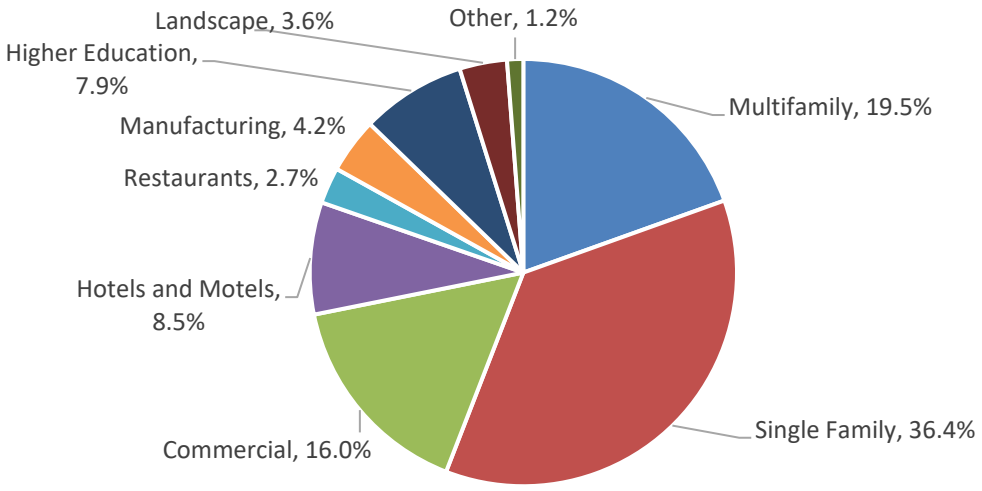
This section presents the City's potable customer categories and the distribution of water use among them. Historical monthly water use by customer category can be found in Appendix B.

The City has several types of potable water users with approximately 20,249 active connections, all of which are metered. For the purpose of this analysis, current and projected user categories are classified as follows:

- Single Family
- Multifamily
- Commercial
- Hotels and Motels
- Restaurants
- Manufacturing
- Higher Education
- Landscape
- Other

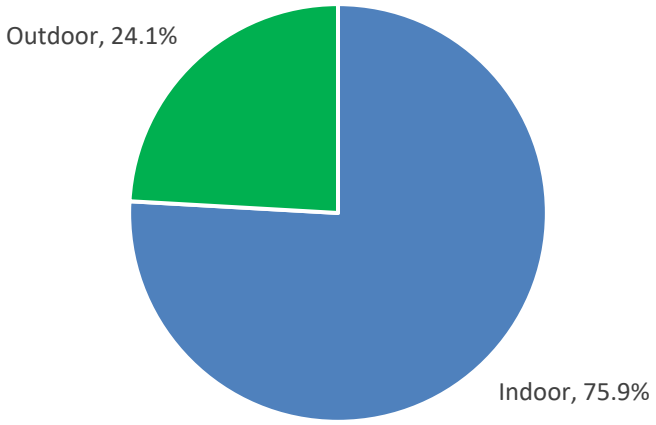
Figure 2-2 presents the water use profile of the various user categories' average annual billed consumption based on data from 2012-2017. It excludes 2016 for the Multifamily and Restaurants customer categories due to several months of software transition issues.

Figure 2-2. Average Potable Water System Consumption by User Category, 2012-2017



The same dataset from 2012-2017 was also analyzed to approximate the percentages of potable water used indoors and outdoors. According to the analysis provided for this Plan, approximately 76% of the City's potable water is used indoors. Figure 2-3 shows the breakdown of indoor and outdoor water consumption, based on the assumption that indoor use is approximately equal to winter consumption. While there may be a small amount of landscape watering in the winter or leakage from irrigation systems, it is assumed that this is less than 5-10% of winter water use.

Figure 2-3. Average Potable Water System Indoor versus Outdoor Overall Water Use, 2012-2017



2.4 Historic and Current Conservation Program

In 1988, the City of Flagstaff passed a Water Conservation Ordinance that established every-other-day irrigation requirements by physical address and defined four Water Conservation Strategy levels (later reduced to three in 2003) (Flagstaff City Code: 7-03-001-0014). Since the Water Conservation Program was established in 2003, it has provided a variety of rebates, including high efficiency washing machines, high efficiency toilets and urinals, rainwater catchment installations, and lawn conversions. In addition, the program has provided general water conservation outreach and free efficient fixtures, including showerheads, aerators, and pre-rinse spray valves. In 2011, the City also passed an amendment to the International Plumbing Code to require a maximum 1.3 gallons per flush for newly installed toilets (Ordinance 2011-12, July 19, 2011). This was followed by a 2013 amendment that required public facilities to install urinals with a maximum 1 pint flush (Ordinance 2013-19, August 26, 2013).[8]

As of 2019, the Water Conservation Program provides the following:

- Public Education and Outreach
    - Water Conservation staff conduct general outreach such as time spent on tabling, talks for schools and community groups, the annual Arizona Water Awareness Month and Wyland Foundation National Mayor's Challenge for Water Conservation efforts, and the annual partnership with Arizona Project Water Education Today (WET).[9]
- Water Conservation Ordinance Enforcement
    - Staff drive or bike around town in the summer months to ensure that residents are abiding by the every-other-day watering code. Enforcement strategy includes an initial conversation with the resident to remind them of the code (and provide them with materials such as a magnet with the watering schedule and a hose nozzle) then escalates to a warning followed by a fine.

[8] All City of Flagstaff codes are published online: https://www.codepublishing.com/AZ/Flagstaff/

[9] https://www.projectwet.org/

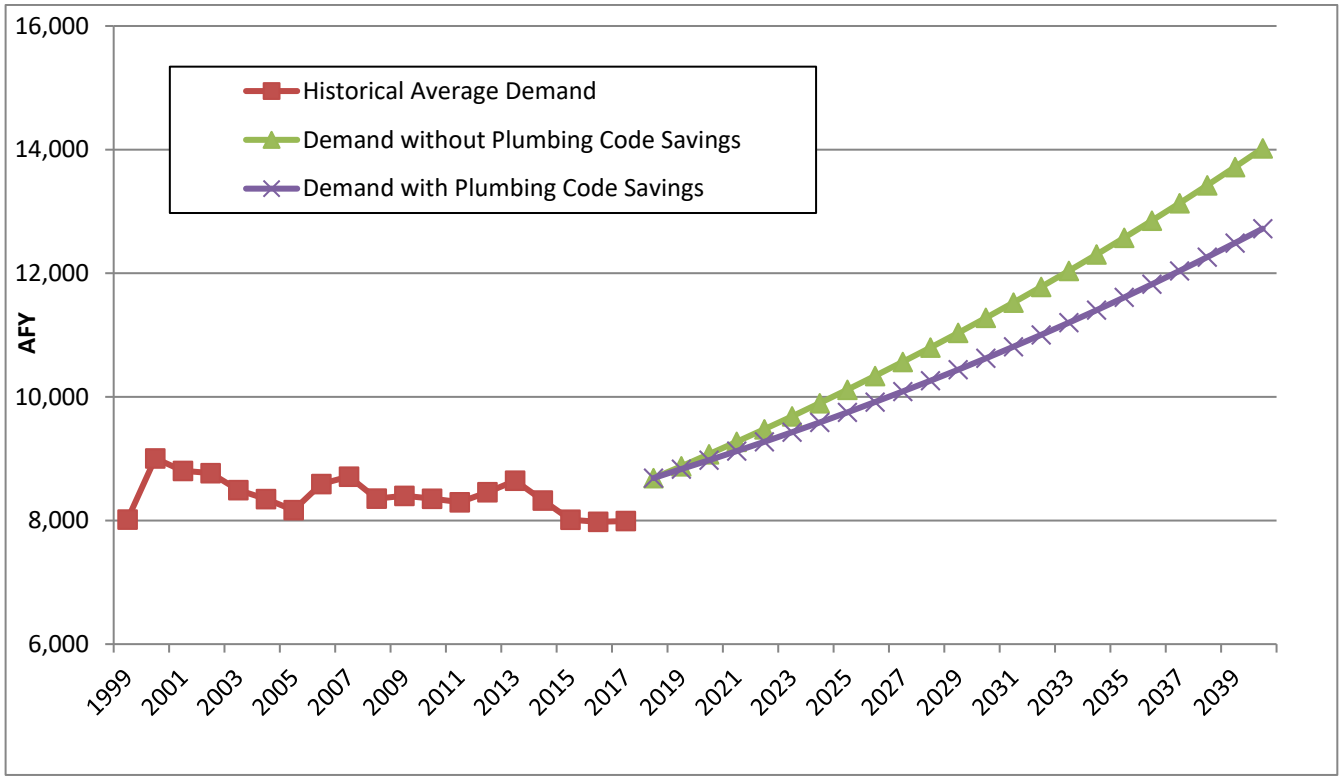
- Water Efficient Landscape Conversions
    - Residents receive $0.25 per square foot of lawn that is replaced with low water plants. Applicants must provide a site plan of new plants, plants must cover approximately 50% of replaced space, and no more than 20% of the retrofitted area can be covered with rock.
- Rainwater Container Program
    - Staff receive barrels from Joy Cone (local ice cream cone manufacturer) and retrofit them into 55 gallon rain barrels. The barrels are then provided to residents who have attended a rain barrel workshop. Occasionally, 270 gallon containers are available from the water treatment plant for this purpose as well. Finally, if a resident installs an active rainwater capture feature with a capacity of more than 1,000 gallons, that resident is eligible for a $100 rebate.

- Commercial Programming
    - Staff audit commercial businesses to assess fixture efficiency across an entire property. Then, these businesses are eligible to apply for rebates or to enroll in the Water Wise Business program.
- Residential Consultations
    - Staff audit residential homes to assess fixture efficiency. High efficiency showerheads and aerators are provided to any resident who wants them.
- High Efficiency Fixtures
    - High efficiency showerheads, aerators, and pre-rinse spray valves are provided to the public at no charge.
- High Efficiency Toilet Rebates
    - Residents can receive $50 for converting their pre-2009 toilet to a 1.3 gallons per flush (gpf) toilet. They can receive an additional $50 if the new toilet has a flush volume lower than 1.3 gpf.

3 BASELINE WATER DEMANDS

The Plan water and cost saving calculations are based on projected potable water demands for the City of Flagstaff. This forecast is based on the Arizona Office of Economic Opportunity's 2017 population estimate of 72,961, the City's growth rate of 2.2% over the decade (2000-2010), and a per capita water use estimate of 104 gallons per capita per day (GPCD). The 104 GPCD rate is the City's calculated 5-year average per capita water use across all uses. The baseline demand also includes the estimated 5-year average NRW of 11%. The assumptions that have the most substantial effect on future demands are estimated real water losses and residential and commercial use projections, including water fixture use. This includes estimates of average water use and longevity for fixtures and appliances. Additionally, local, state, and national plumbing codes and appliance standards for toilets, urinals, showers, and clothes washers are modeled by customer category. This yields two potable demand forecasts: one with plumbing code savings and one without plumbing code savings. The demand projection with plumbing code savings assumes that Water Services takes no further water conserving actions, but does benefit from local, state, and federal codes that limit water consumption across fixtures and devices. Since the plumbing code requires purchase of more efficient water fixtures, it is estimated that the City's customers will save 0.40% of their total demand each year as they replace older fixtures with new, more efficient ones.

Figure 3-1. Potable Water System Demand Projection to 2040



A more detailed summary of key assumptions used in the City's Potable DSS Model can be found in Appendix A – DSS Model Overview and Assumptions.

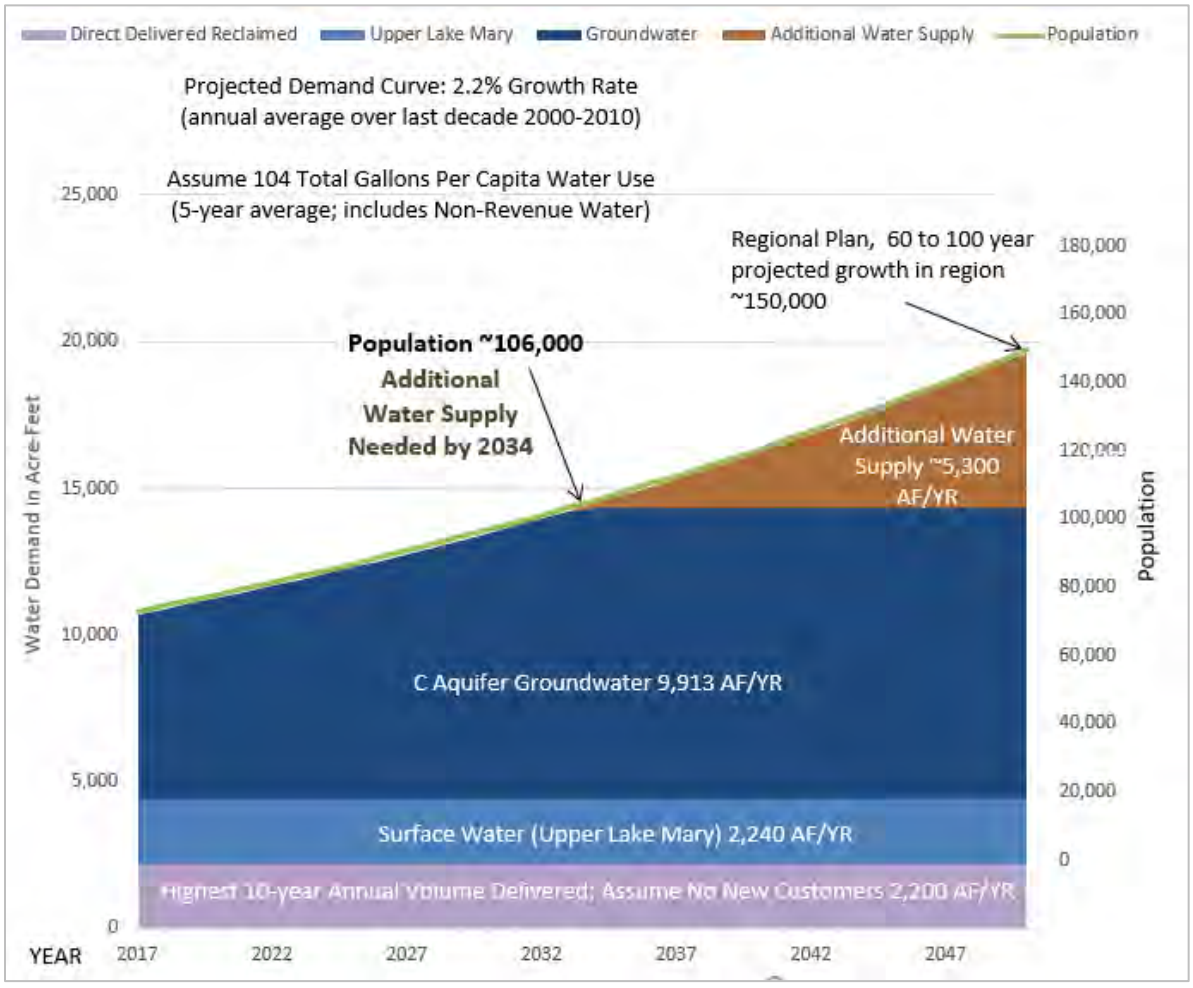
4 WATER CONSERVATION IN RESOURCE PLANNING

Water Conservation is regarded as equal to other water supply options in the City of Flagstaff's water resource planning efforts. As an example, beginning in the mid 1990s, the City started transitioning 2,000 AF of potable water a year (1/5 of total annual demand) to reclaimed water. When the City conducts supply and demand forecasting analyses, the estimated water made available through conservation is a part of the supply portfolio. This is evident in the Water Resources Chapter of the City's 2011 Utilities Integrated Master Plan (City of Flagstaff, 2011) and will be included again as a supply in the 2020-2021 update.

4.1 Water Conservation as a Source of Supply

One way the City evaluates conservation as a supply is by comparing water supply needs against different per capita water use scenarios. Figure 4-1 illustrates the City's current water supply strategy. For example, ADWR issued the City a Designation of Adequate Water Supply in 2013. The Designation identified 9,913 AFY (acre-feet per year) of local groundwater (Lake Mary, Woody Mountain and local well fields), 3,585 AFY from Upper Lake Mary, 16,500 AFY from Red Gap Ranch, and 2,212 AFY of reclaimed water as available supplies to meet 100 years of projected water demand. While ADWR does not include scenario planning in the Designation, water demand is based upon a historical population growth projection of 1.44% annually. The City incorporates a gallon-per-capita reduction due to conservation against this growth projection to plan for water supplies accordingly. The updated Water Resources Master Plan will be the first to base future supply needs on a robust analysis of water conservation in the community.

Figure 4-1. Future Water Supply and Demand Forecast, 2020–2050



4.2 Recommendation for Further Study of Flagstaff Water Rates

Water Rate Studies are often performed every two to five years. The City last completed a Water, Sewer and Stormwater Rate Study in 2015. Periodic rate studies ensure that revenue can keep pace with utility costs. If rates are not increased for years at a time, utilities often have to implement large increases to "catch-up" to actual expenses. These large increases are politically challenging, making it best practice to implement small yearly increases rather than no adjustments for several years followed by a large increase.

Looking ahead to the City's next rate study (scheduled to occur in FY21), following the completion of this Water Conservation Strategic Plan, the City should explore rate pricing objectives that include conservation, affordability, equity, simplicity, and revenue stability. Both the future estimates for conserved water and stakeholder feedback on pricing objectives should be used to inform rate structure design. Two requests were made by stakeholders during the strategic planning process for consideration in the City's next rate study:

1. Higher rates on water used outdoors (e.g., landscape meters, sewer usage estimates)
2. Tiered rates for customer classes outside single family residential

It is important to note that other utilities have found the implementation of tiered rates for non-residential classes challenging due to the non-homogenous needs of non-residential customers. The City should explore these topics with stakeholders to ensure that a future rate design fits the community's desires. Given that the City's leadership and stakeholders have committed to conservation as a critically important future water supply, the next rate study should evaluate pricing models that encourage conservation while keeping in mind social equity.

5 CONSERVATION MEASURE EVALUATION

An important step in updating the City's water conservation program included identification of new measures (or water conserving actions) that could be appropriate for the City of Flagstaff to consider.

5.1 Initial Screening of Conservation Measures

A thorough screening process was necessary to achieve a short enough list of measures for evaluation in the DSS Model. The initial review of the list of 130 measures was conducted by Water Resources and Conservation Section staff using the following qualitative criteria:

- Water Savings Potential – emphasis on measure's ability to reduce water use and current level of saturation
  - Higher savings = 5 (e.g., high end use water savings, low saturation), lower savings = 0 (e.g., low end use savings, or very saturated)
- Quantifiable – can verify and quantify water savings for dollars spent
  - Emphasis on measures where water savings can be accurately predicted
- Cost/Benefit – can verify and quantify avoided cost of water savings for dollars spent on the conservation program
  - Highly quantifiable/cost-effective = 5 (e.g., substantial evidence exists to demonstrate reliable, accurate conservation savings), measure savings not quantifiable/high cost-to-savings ratio = 0
- Longevity of Measure – emphasis on savings lifetime/reliability
  - Permanent = 5 (e.g., codes and technological changes ensure future reliable savings); short, temporary savings/behavioral change = 0
- Community Preference – emphasis on willingness to participate, out of pocket expenses, equity/perceived fairness, aesthetics
  - High expected participation = 5, low expected acceptance/reject mandatory participation = 0
- Feasibility – emphasis on ability to achieve objectives/staff time/financial ability
  - Fully within City capacity/legally possible = 5, fatally flawed = 0 (e.g., insurmountable obstacle to implementation, not in City's control)
- Additional Benefits – emphasis on achieving additional goals including reduction in energy/greenhouse gas emissions and/or reduction in peak season use, providing valuable customer service, or other non-quantifiable benefits (e.g., behavioral change, public awareness)
  - Contributes to City's goals/programs (e.g., Climate Action Plan, Low Impact Development, Water Quality) and/or multiple benefits = 2, singular or very limited benefits = 0

This process allowed staff to narrow down the list to 38 potential measures (including those in the Current Conservation Program) for further input. The second round of measure screening, which was provided by the Advisory Committee, Stakeholder Group and general public input, is detailed in the following section.

5.2 Advisory Committee, Stakeholder Group, and General Public Screening of Conservation Measures

After the City of Flagstaff Water Resources Section staff reduced the measures down to a list of 38, the Advisory Committee, the Stakeholder Group, and members of the general public provided input on which measures were the highest priority to the City of Flagstaff's community. This input was gathered through public surveys and community meetings. Community members were asked to review the list of measures and to indicate their preferences. The end result of these efforts was the reduction of the measure list from 38 to 22. Much of this work was facilitated by the team at Southwest Decision Resources, a local consulting group with expertise in facilitating public input for strategic planning processes. Full details on the public outreach efforts, such as visual aids and survey language, are located in Appendix D – Public Outreach Details.

5.3 Conservation Measures Analyzed

The following is a list of the 22 conservation measures analyzed in the DSS Model, along with brief descriptions of each:

Current Measures

- ***Public outreach and school education***
  - General public outreach, including tabling, social media, public presentations
- ***Prohibit water waste and practices***
  - Enforcement of the Water Conservation Ordinance
- ***Tiered water rates***
  - Water gets more expensive as usage increases for single-family residential meters
- ***Water efficient landscape rebate***
  - Customers receive a rebate for converting from lawn to low water landscaping
- ***System water loss control***
  - Check system for leaks, verify meter accuracy, theft prevention
- ***Rainwater container program***
  - Barrels and totes provided for free, rebate provided for large installations
- ***Commercial rebates and consultations***
  - Commercial properties surveyed for efficiency, rebates available for efficiency upgrades
- ***Residential indoor water consultations***
  - Residential properties surveyed for efficiency
- ***High efficiency fixture giveaways***
  - High efficiency showerheads, aerators, and pre-rinse spray valves provided for free
- ***Hot water recirculation code***
  - Hot water recirculation required in new construction as of 2020
- ***High efficiency toilet rebate (current)***
  - Toilet conversion rebates, higher rebates for older toilets

Potential Future Measures

- ***Innovation research and pilot studies***
  - Pilot project to explore innovative technologies or practices for conservation
- ***SmartMeters***
  - Implementation of SmartMeters across the system and utilization of the data collected for efficiency
- ***Outdoor water budgeting***
  - Outdoor water budgeting software for high volume irrigators
- ***Landscape and rainwater retention code***
  - Improvement of landscape code and plant list for conservation outcomes
- ***WaterSense showerhead and faucet code***
  - Amend plumbing code to require WaterSense certification in new developments
- ***School retrofits***
  - Partner with K-12 and higher education institutions to improve water use efficiency
- ***Government building retrofits***
  - Retrofits of City owned properties to improve water efficiency
- ***Hot water recirculation retrofits***
  - Provide rebates for existing buildings to add hot water recirculation systems
- ***Low income leak assistance***
  - Provide financial assistance for low income customers to address leaks
- ***Submetering***
  - Submeter apartments and/or individual businesses in strip malls
- ***High efficiency toilet rebate (new)***
  - Only rebate toilets than exceed the plumbing code standards

5.4 Comparison of Individual Conservation Measures

Presented here are the potential water saved and financial investment required for each conservation measure. Cost and benefit categories in this section are defined as follows:

- Utility Costs – those 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 a uniquely identified rate for potable and reclaimed water. Information about these values can be found in the Avoided Cost discussion presented in Appendix A, Section A.5.5 Assumptions about Avoided Costs.

Table 5-1 presents a comparison of the different measures and their cost of water saved. The column headings in the table are defined as follows:

- Present Value (PV) of Utility Costs and Benefits ($) – the present value of the 22-year time stream of annual costs or benefits, discounted to the base year. The measures start in the years as specified for each measure shown in Appendix E. Utility costs include administrative costs and staff labor.
- Utility Benefit to Cost Ratio – this is the PV of Utility Costs divided by PV of Utility Benefits over 22 years.
- Cumulative Water Savings 2018-2040 (AF) – water saved in acre-feet over the analysis period.
- Water Savings in 2040 (AFY) – water saved in acre-feet per year. The year 2040 is the selected endpoint of this planning effort.
- Cost of Savings per Volume of Water Saved ($/AF) – this is the PV of Utility Costs over 22 years divided by the 22-year water savings. The analysis period is 2018-2040. This value is compared to the utility's avoided cost of water as one indicator of the cost effectiveness of conservation efforts. It should be noted that this value somewhat minimizes the cost of savings because program costs are discounted to present value, but water benefits are not.

MWM conducted an economic evaluation of each water conservation measure using the DSS Model. Financial savings from reduced water demand was quantified annually and based on avoided costs provided by the City for both potable and reclaimed water sources. While each measure was analyzed independently, it is important to note that very few measures operate independently in the real world.[10] For example, Advanced Metering Infrastructure-based (AMI-based) irrigation and notification may lead to an outdoor survey or low water landscape retrofit. Higher efficiency indoor fixtures go hand-in-hand with indoor surveys and public education. It should also be noted that the water savings from Public Education are not double counted with other conservation measures. As a result, the costs appear significantly higher for Public Education than for other measures due to the minimal water savings estimated for the cost investment. However, other measures certainly would be less effective or possibly infeasible without an active Public Education program. Without Public Education, customers would be unaware of other conservation measures and participation would likely plummet.

[10] Calculations are performed as if the measures were to be implemented on a stand-alone basis (i.e., without interaction or overlap from other measures that might address the same end use or uses). Savings from measures which address the same end use(s) are not additive; the model uses impact factors to avoid double counting when estimating the water savings from programs of measures. 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 a less "active" measure like public education/awareness that simply informs the community of active measures. Since interaction between measures has not been accounted for in this section, it is not appropriate to present totals at this point. However, the values presented do offer a close approximation of the cost effectiveness of each measure.

Additional information about the water reduction methodology, perspectives on benefits and costs, and assumptions about avoided costs, present value parameters, and measure costs and savings can be found in Appendix A – DSS Model Overview and Assumptions.

Table 5-1. Potable Water Conservation Measures – Estimated Water Savings and Financial Costs

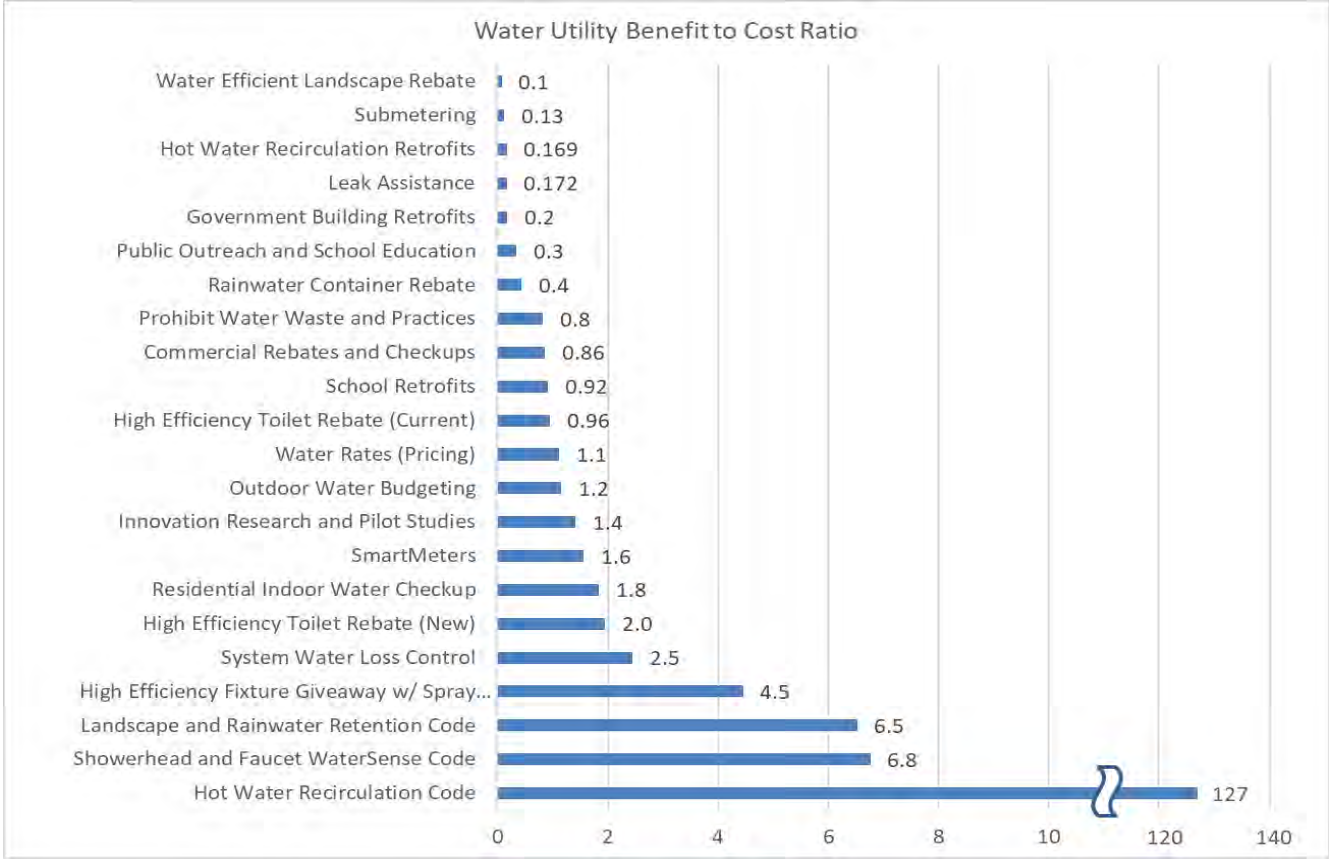
Measure	Present Value of Water Utility Benefits[1]	Present Value of Water Utility Costs[1]	Water Utility Benefit to Cost Ratio	Cumulative Water Savings 2018-2040 (AF)[2]	Water Savings in 2040 (AFY)[2]	Cost of Savings per Unit Volume ($/AF)[3]
Public Outreach and School Education	$695,000	$1,997,000	0.3	1,140	60	$1,750
Innovation Research and Pilot Studies	$92,000	$65,000	1.4	170	10	$390
Prohibit Water Waste and Practices	$106,000	$129,000	0.8	210	10	$630
System Water Loss Control	$2,996,000	$1,219,000	2.5	6,210	400	$200
SmartMeters	$1,793,000	$1,151,000	1.6	3,200	200	$360
Water Rates (Pricing)	$410,000	$367,000	1.1	7,130	630	$50
Outdoor Water Budgeting	$352,000	$303,000	1.2	780	70	$390
Water Efficient Landscape Rebate	$17,000	$224,000	0.1	40	3	$6,060
Rainwater Container Rebate	$129,000	$296,000	0.4	270	20	$1,080
Landscape and Rainwater Retention Code	$956,000	$147,000	6.5	2,130	210	$70
Commercial Rebates and Consultations	$800,000	$926,000	0.9	1,480	130	$630
School Retrofits	$318,000	$347,000	0.9	620	60	$560
Government Building Retrofits	$26,000	$141,000	0.2	50	4	$2,850

Measure	Present Value of Water Utility Benefits[1]	Present Value of Water Utility Costs[1]	Water Utility Benefit to Cost Ratio	Cumulative Water Savings 2018-2040 (AF)[2]	Water Savings in 2040 (AFY)[2]	Cost of Savings per Unit Volume ($/AF)[3]
Residential Indoor Water Consultations	$61,000	$33,000	1.8	100	10	$330
High Efficiency Fixture Giveaway w/ Spray Nozzles	$524,000	$118,000	4.5	930	60	$130
High Efficiency Toilet Rebate (Current)	$28,000	$29,000	1.0	40	2	$690
High Efficiency Toilet Rebate (New)	$230,000	$118,000	2.0	420	40	$280
Hot Water Recirculation Code	$893,000	$7,000	126.9	1,620	150	$4
Hot Water Recirculation Retrofits	$17,000	$102,000	0.2	30	3	$3,240
Showerhead and Faucet WaterSense Code	$1,334,000	$197,000	6.8	2,430	230	$80
Leak Assistance	$23,000	$135,000	0.2	40	3	$3,280
Submetering	$22,000	$169,000	0.1	40	3	$4,260

[1] Value is in current dollars of the total avoided costs (benefits) over the model analysis period of 22 years. Values are rounded to the nearest $1,000.
[2] Values are rounded to the nearest 10 AF.
[3] Values are rounded to the nearest $10/AF except the Hot Water Recirculation Code measure.

Figure 5-1 presents in graphical format the benefit-cost ratio of each Potable Water DSS Model conservation measure.

Figure 5-1. Comparison of Potable Water Conservation Measure Analysis Utility Benefit-Cost Ratios



6 CONSERVATION PROGRAM EVALUATION

After the conservation measures were evaluated for water savings and financial costs, they were placed together in various configurations, or programs. The programs were designed to illustrate the total costs and savings for the current water conservation program and for a future or "optimized" conservation program that had an improved benefit-cost ratio.

6.1 Selection of Conservation Measures for the Optimized Conservation Program

The following key items were taken into consideration during measure selection for the Optimized Conservation Program:

- Existing conservation measures
- Conservation measures recommended by AWWA, AWE, the United States Bureau of Reclamation (USBR), and others
- New and innovative measures
- Measure equitability among customer categories
- Customer demographics
- Alignment with the voluntary *AWWA G480-13 Water Conservation Program Operation and Management Standard* (AWWA, 2013)
- Coordination with AWE G-480 leaderboard review process for national recognition[11]

Using the data gathered, MWM created a list of all potential program concepts that were appropriate for the City's service area to meet future regulatory and conservation compliance mandates. The list included existing program elements and traditional conservation measures as well as concepts that had not been implemented or considered by the City yet. 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 all relevant 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 either of the two conservation program scenarios. MWM then compiled descriptions and parameters of the programs.

These program scenarios were not intended to be rigid but rather dynamic and used 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).

Both of the modeled conservation programs are described below:[12]

- Current Conservation Program – Current conservation program with no changes (except to comply with 2018 International Building Code (IBC) code requiring hot water recirculation on all new development); includes 11 measures.
- Optimized Conservation Program – In addition to continuing most existing measures, this program includes measures that will be required by law, are more customer-centric, and are more innovative. For example, this program supports innovation research and pilot studies as well as incentivizing ultra-

[11] G480 Standard and AWE Leaderboard web page: https://www.allianceforwaterefficiency.org/resources/topic/g480-standard-and-awe-leaderboard

[12] An additional program scenario was analyzed that included all measures modeled in this effort for a total of 22 measures. This program scenario is not included in this Plan.

high efficiency toilets; includes 16 total measures. It is intended this is optimized program is reviewed annually for new innovative measures and technologies, whereas the City's program moves forward as a dynamic scenario that will evolve over time.

The following table presents the City's potable water system conservation measure program scenarios, indicating which measures were selected and modeled within each program.

Table 6-1. Selected Conservation Program Measures

Measures	Current Conservation Program	Optimized Conservation Program
Public Outreach and School Education	X	X
Innovation Research and Pilot Studies		X
Prohibit Water Waste and Practices	X	X
System Water Loss Control	X	X
SmartMeters		X
Water Rates (Pricing)	X	X
Outdoor Water Budgeting		X
Water Efficient Landscape Rebate	X	X
Rainwater Container Rebate	X	
Landscape and Rainwater Retention Code		X
Commercial Rebates and Consultations	X	X
School Retrofits		X
Residential Indoor Water Consultations	X	X
High Efficiency Fixture Giveaway w/Spray Nozzles	X	X
High Efficiency Toilet Rebate (Current)	X	
High Efficiency Toilet Rebate (New)		X
Hot Water Recirculation Code	X	X
Showerhead and Faucet WaterSense Code		X

6.2 Results of Potable Water System Conservation Program Evaluation

Figure 6-1 presents historical and projected water demand in AFY given multiple demand and conservation scenarios as well as the estimated annual savings in acre-feet per year. Plumbing code elements include current local, state, and federal plumbing code standards for retrofits of items such as toilets, showerheads, faucets, and pre-rinse spray valves. Additional details are presented in Appendix C in five-year increments for plumbing codes only with no active conservation activity and for plumbing codes with the various conservation programs. Also presented in Appendix C are City and customer benefit-cost ratios for each program as well as the present value of water savings and utility costs.

Figure 6-1. City Historical and Projected Potable Demand (AFY)

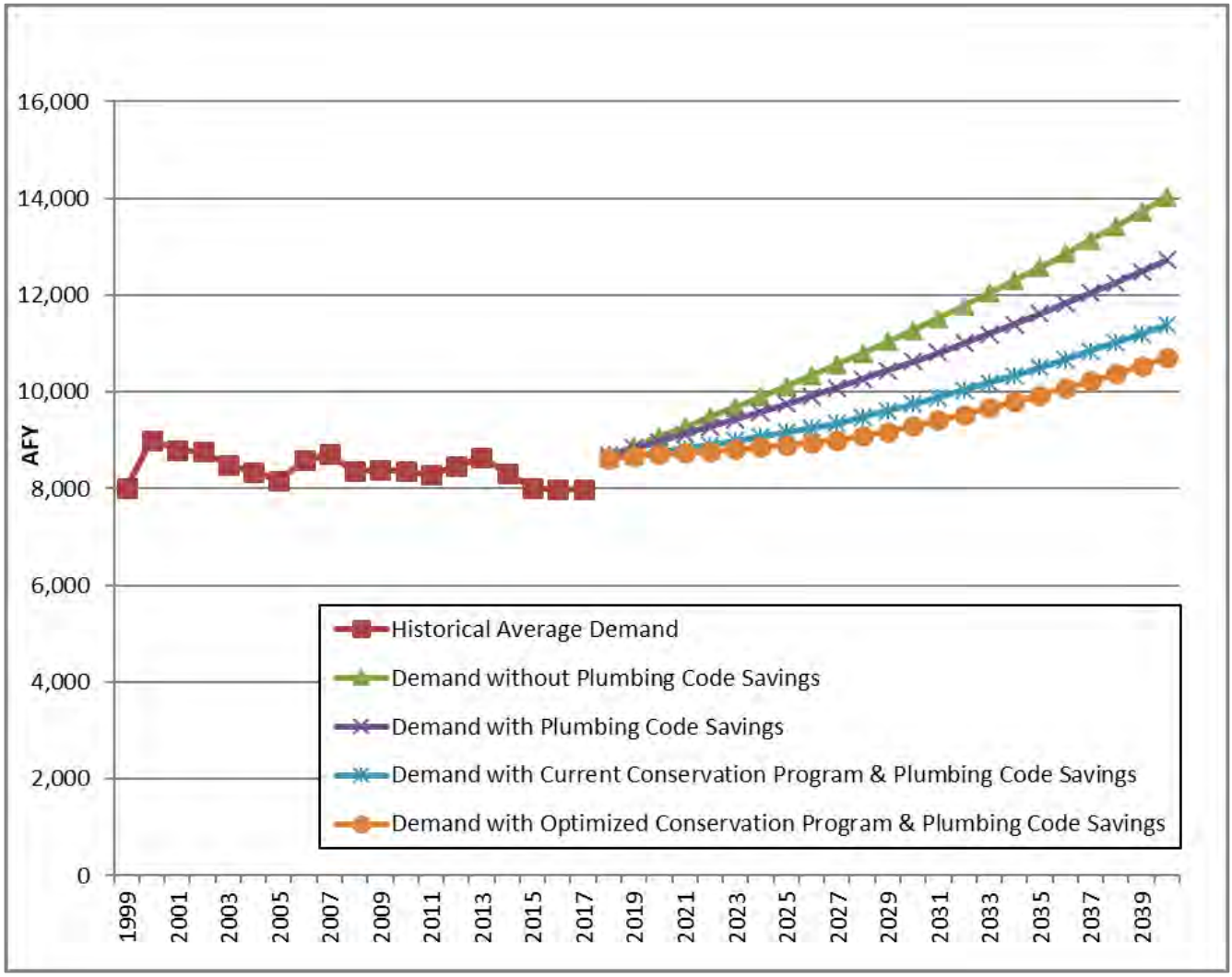
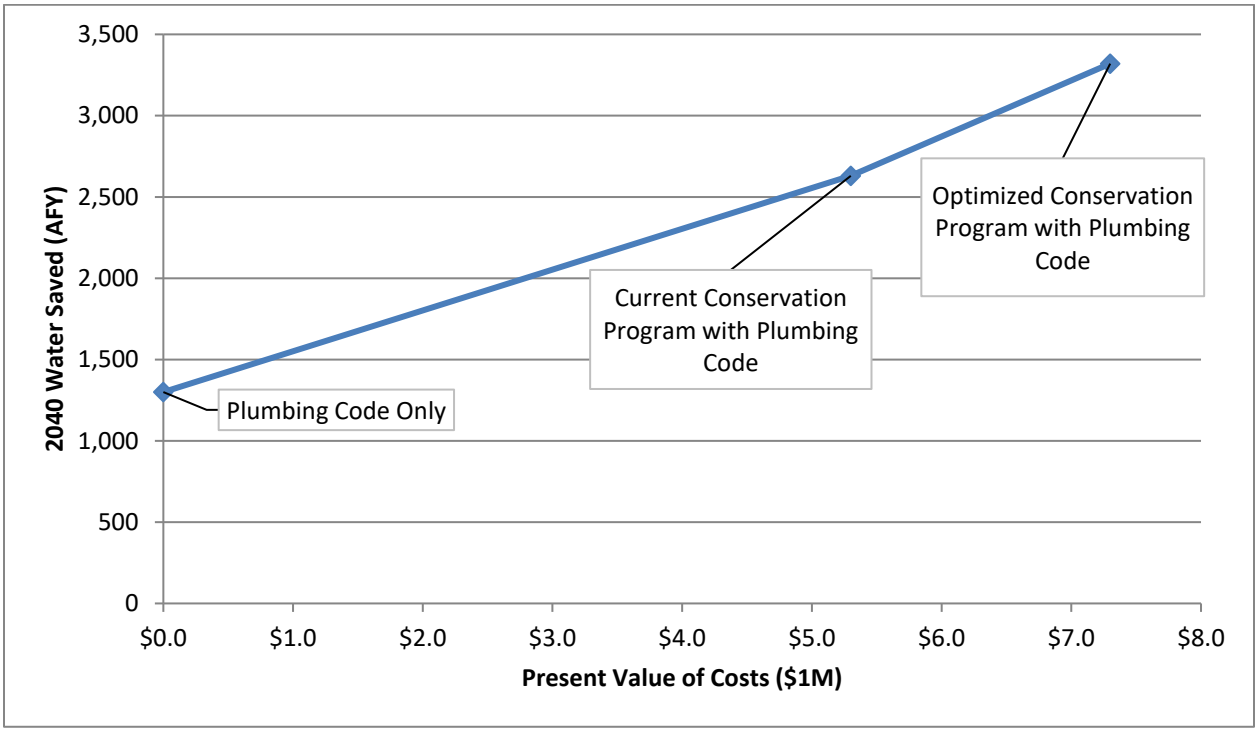


Figure 6-2 illustrates how marginal returns change as more money is invested to achieve water savings in AFY in 2040. A cost-effectiveness curve displays the results of the present value of each program's costs versus the cumulative water savings at the end of the planning period. This curve is helpful in determining how far to push the "conservation envelope" as the point of diminishing economic returns is evident. As the figure shows, the costs increase as the water savings increase from the Current Conservation Program to the Optimized Conservation Program, which corresponds to increasing the budget, staffing, and participation in the conservation programs.

Figure 6-2. Present Value of Potable Water System Utility Costs versus Water Saved in 2040



The following table shows the potable water system demands for the City. Demand is shown in acre-feet in five-year increments over the 20-year modeling period (years 2020-2040). Both the table and the figure include historical demand and demand with and without plumbing code in five-year increments.

Table 6-2. City of Flagstaff Potable Water System Demands for Years 2020-2040, Acre-feet[2]

	2020	2025	2030	2035	2040
Baseline Demands[1]	9,070	10,120	11,280	12,580	14,020
Plumbing Code Savings	100	370	650	960	1,300
Demands with Plumbing Code Savings	8,980	9,750	10,620	11,610	12,720
Conservation Current Conservation Program Savings	230	590	880	1,100	1,330
Demands with Plumbing Code and Current Conservation Program Savings	8,750	9,160	9,750	10,510	11,390
Optimized Conservation Program Savings	270	840	1,330	1,670	2,020
Demands with Plumbing Code and Optimized Conservation Program Savings	8,710	8,910	9,290	9,940	10,700

Notes:

1. Baseline potable demand forecast provided by City staff and based on (a) Office of Economic Opportunity Arizona Data 2017 population (72,961) and the City's higher growth rate of 2.2% over the decade 2000–2010 versus the historical growth rate of 1.35%; and (b) this population projection applied to a per capita water use estimate of 104 gallons per capita per day. The 104 GPCD rate is based on the City's calculated 5-year average per capita water use. Furthermore, baseline demand includes an estimated 5-year average NRW of 11%.
2. Values are rounded to the nearest 10 AF.

6.3 Selected Program

The City selected the Optimized Conservation Program as the most beneficial and comprehensive option. The Optimized Conservation Program provides a full range of measures, builds goodwill with institutional partners, and provides benefits for all City customer categories.

Figure 6-1, earlier in this section, illustrates year 2040 conservation program estimated water savings by implementing the Optimized Conservation Program. This program includes measures that are customer-centric and innovative. For example, this program supports innovation research and pilot studies as well as incentivizing partnerships with K-12 schools and higher education institutions.

6.4 Estimated Budget and Staffing Needs

To achieve the programmatic changes in the Optimized Conservation Program, staff moved funds away from some programs (e.g., rainwater harvesting) and asked the City Council for $45,000 in additional annual funding. Of this additional funding, $30,000 was required for direct costs and $15,000 was required for personnel. The total budget for staff time and expenses (e.g., materials, rebates, giveaways, etc.) was developed for each measure by evaluating the level of activity by year. Individual measure costs (including utility, administrative, and customer costs) can be found in the measure input sheets in Appendix E – Individual Conservation Measure Design Inputs and Results.

As part of this planning effort, consideration has been given to program staffing levels. Addressing the initiatives needed to reduce water demand is applicable across many departments for the City's staff and will require a coordinated effort. This includes staff time from different areas of the operation, such as the Distribution Section of Water Services, who contribute significantly to water loss control. It should be noted that, dependent upon position, Water Conservation staff may not spend 100% of their time implementing conservation measures. Administrative tasks such as timesheets, professional development, and broader organizational committees also utilize personnel time without contributing to total water savings.

7 CONSERVATION POTENTIAL FOR RECLAIMED WATER

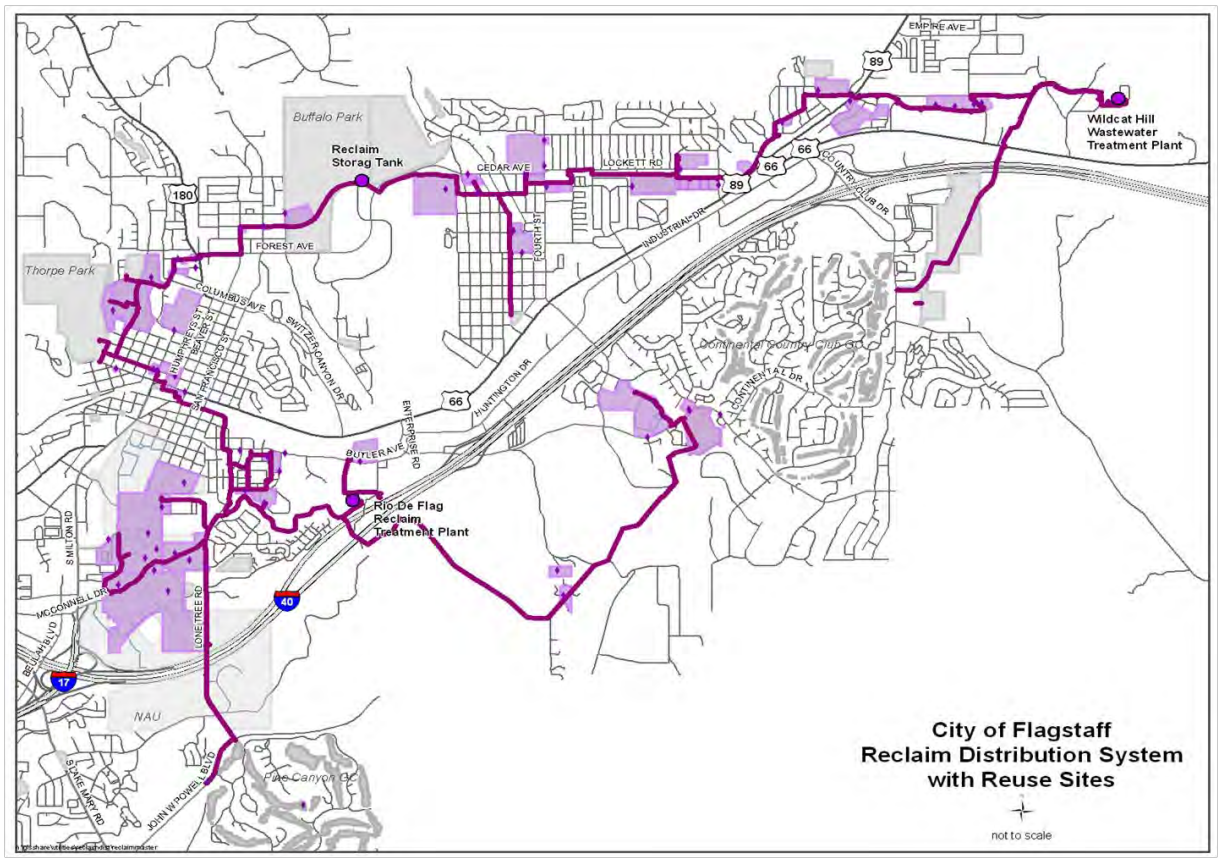
As technology and water supply issues advance, more water utilities are expanding their conceptual water systems to embrace the One Water for America Policy Framework.[13] This approach considers the value of water holistically independent of its quality, whether it be potable water, stormwater, wastewater, or reclaimed water. With this lens, the City of Flagstaff team and Maddaus Water Management built a separate model to consider water conservation potential for reclaimed water uses. This tool will be an important component in making decisions about reclaimed water in the coming years, especially as options to treat this water to a higher degree are considered.

7.1 Reclaimed Water System

The City of Flagstaff expanded to a city-wide reclaimed water system in 1996. In 2019, reclaimed water comprised approximately 18% of total water demand. At this time, uses are almost entirely outdoors, including irrigation at municipal parks, athletic fields, golf courses, snowmaking, and municipal beautification efforts such as medians and curbside landscaping. Smaller users include car washes, construction/dust abatement, and single family residences. In the past, there had been significant indoor use from a paper manufacturer, but it has since closed.

The addition of reclaimed water to the City's water portfolio has provided an excellent reduction in potable demand. Expansion of the system is one option for future consideration that will be explored in the Reclaimed Water Master Plan, which will begin in 2020.

Figure 7-1 Reclaimed Water System Map

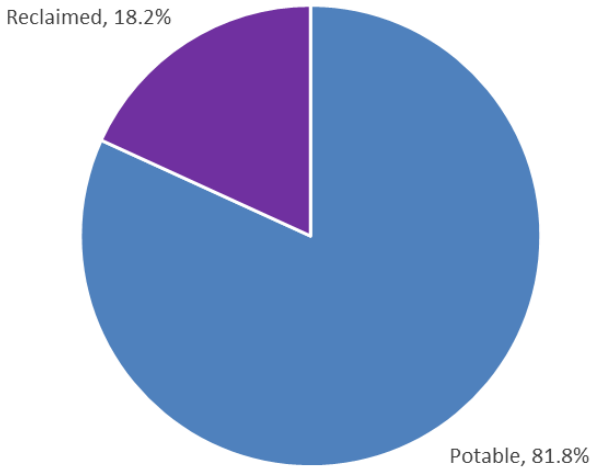


[13] http://uswateralliance.org/one-water

7.2 Total Water Balance – Reclaimed and Potable

The following figure presents how much of the City's total water consumption on average was potable water versus reclaimed water, over the period 2012-2017.

Figure 7-2 Potable and Reclaimed Water Production, 2012–2017



7.3 Reclaimed Measures for Future Consideration

Five of the water conservation measures considered for this Plan could be applied to reclaimed water in the future:

- System water loss control
  - Regular checks for leaks in the reclaimed system; verification of meter accuracy for both production and consumption; theft mitigation efforts such as locking hydrants
- Outdoor water budgeting
  - Outdoor water budgeting efforts for large irrigated sites such as athletic fields and public parks
- Water efficient landscape rebate
  - Conversion of lawn to low water landscaping for locations currently utilizing reclaimed water
- Prohibit water waste and practices
  - Extension of the every-other-day watering schedule to reclaimed sites and enforcement of the rules therein
- Innovation research and pilot studies
  - Experimental projects to improve reclaimed efficiency, such as GPS units at golf courses to evaluate which sections of the course are not visited and naturalizing those areas

These measures will be explored as the City's water conservation strategy evolves and as the Water Resources Master Plan and Reclaimed Water Master Plan progress.

8 IMPLEMENTATION AND CONCLUSION

This section provides suggestions for the implementation of this Plan, including an estimated implementation schedule, tracking and monitoring ideas, and potential partnerships with stakeholders.

8.1 Proposed Measure Implementation Schedule of Selected Program

The following figure presents the proposed implementation schedule for all 16 ongoing, planned, potential and analyzed conservation measures in the Optimized Conservation Program.[14]

Figure 8-1. Optimized Conservation Program Measure Implementation Schedule

Measure	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Public Outreach and School Education	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Innovation Research and Pilot Studies			■	■	■	■	■																
Prohibit Water Waste and Practices	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
System Water Loss Control	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
SmartMeters			■	■	■	■	■	■	■	■	■	■											
Water Rates (Pricing)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Outdoor Water Budgeting			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Water Efficient Landscape Rebate	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Landscape and Rainwater Retention Code			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Commercial Rebates and Checkups	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
School Retrofits			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Residential Indoor Water Checkup	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
High Efficiency Fixture Giveaway w/ Spray Nozzles	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
High Efficiency Toilet Rebate (New)			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hot Water Recirculation Code			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Showerhead and Faucet WaterSense Code			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

8.2 Implementation Tracking and Monitoring Progress

It is recommended that the City continue to monitor progress and track the level of participation and effectiveness for all measures in the conservation program. An expanded tracking database in an Excel spreadsheet could store monthly data collected by the City from each conservation measure. The tracking database could be designed to easily filter data for reporting purposes and be updated monthly to reflect program participation.

The tracking database could incorporate the following data which is already tracked for indoor and outdoor surveys and rebates:

- Customer information – name, address, account number, type of business (e.g., CII customers)
- Water Use Efficiency measure or device – type (including make and model), quantity, unit water savings, life expectancy
- Cost information – rebate amount
- Other documentation or data as appropriate (e.g., survey reports)

Each year a progress update should be used to analyze the momentum being made meeting the Plan's targets. It is imperative to track activities, as well as water demand, to understand the level of progress being made in meeting overall goals.

[14] This may need to be reviewed and adjusted over time as economic conditions change and as state and federal plumbing codes evolve.

Plan participation by the general public may be evaluated by tracking the following:

- Number of hits on the public information campaign website
- Number of visits and level of interaction with customer portal
- Number of water bills with campaign messaging
- Number of customers reached by water bills with campaign messaging
- Quantity and cost of electronic messaging
- Quantity and cost of radio and television advertising
- Number of impressions generated by radio and television advertising
- Tracking the path taken to get to the City website
- Formulate specific URLs by campaign to determine reach, number of users using that URL
- Number of teachers implementing lesson plans about water and water conservation
- Number and age range of students reached through teacher lesson plans
- Number of contests held to promote water efficiency and number of participants
- Number, cost, and attendance of workshops
- Number and installation costs of demonstration gardens as well as cost of maintenance
- Number of citizen visits or tours of demonstration garden
- Customer surveys indicating satisfaction and/or dissatisfaction with the program

Program participation by individual accounts may be evaluated by tracking the following:

- Number of occupants in the home or business
- Number and types of rebates or other incentives issued, including water saving details for rebates such as efficiency level of sprinkler nozzles installed through incentive program
- Water use before and after documented fixture replacement or other implementation, including behavioral changes from surveys or efficiency of other equipment on-site

To track the success of the City's conservation program, overall water use will be reviewed by customer category sector (single family, multifamily, commercial, etc.) to assess the 13-month moving average extending the information presented in Appendix B. In addition, the City staff will maintain a database of water use records for conservation measure participation with the intention to measure water savings. Water use will be recorded before and after a conservation measure's initiation for participating accounts. In some instances, to the extent feasible, evaluation may be done on an individual site basis. In addition, data may be normalized to account for unusual events that will affect water use, such as the following:

- Abnormal weather
- Recessions and recovery
- Water price increases
- Changes in plumbing and appliance code regulations
- Different visitation trends for rental properties
- Changes in home ownership
- Changes in occupancy or uses of the facility

To address the above factors, 5 to 10 years of monthly pre-program initiation water use data and 2 to 3 years of post-program initiation water use data should be gathered and statistically evaluated by qualified professionals.

8.3 Potential Stakeholder Group Participation

The City has expressed interest in optimizing existing partnerships and creating new partnerships with other public agencies, neighboring water utilities, and regional stakeholder groups that could provide cost-sharing or in-kind program support for the Plan, such as maximizing outreach, customer awareness, and participation. The City also will continue to actively pursue applications for state and federal grants as well as partnering opportunities. The following list contains suggested actions for the City related to stakeholder engagement:

- Look for new or expanded partnerships with local irrigation equipment contractors.
- Strengthen relationships with landscape professional associations and non-profits (e.g., Master Gardeners, etc.) to gain more word-of-mouth exposure to the community that is installing or re-landscaping properties. This will help capture the maximum water savings from the point of initial installation.
- Market conservation opportunities through accredited program membership lists as a low-cost means to spread the word to other professionals in the water industry (e.g., Green Plumbers, WaterSense Partners, Irrigation Association Certified Professionals, etc.).
- Form additional partnerships and continue to apply for grants where appropriate.

8.4 Implementation Recommendations

Recommendations to assist with implementation include the following:

- Prioritize measures for implementation, with the highest priority for implementation given to those measures that contribute the most to meeting water savings targets and/or can be implemented with relative ease. To launch implementation of the OCP, the City may consider asking key questions to determine measures, budget, and schedule for the Plan, such as:
    - What level of support will be required from conservation staff to run the selected measures?
    - What other support is needed (e.g., outsourced support or other sources of funding) to run these measures?
    - Which measures contribute the most to meeting per capita use targets and are relatively easy to operate with limited staff?
    - Which measrues should be launched initially as pilots?
- Develop analytical tools to track water use by customer class and overall per capita water use, adjusted for weather and external factors.
- Set up a database to store and manage measure participation, cost, and other data to gauge successes and determine areas that need improvement or added attention.
- Plan staffing appropriately so that customer participation is successful. Both the Plan and state mandates are largely driven by voluntary customer changes in equipment and behaviors that need to be permanent (despite drought conditions).
- Seek testimonials of success to help with outreach materials and presentations to garner more customer participation.
- Track upcoming state regulations regarding residential, CII, landscape, and water loss management.
- Consider soliciting and tracking community input and feedback through an online or phone survey or at outreach and education events.
- Consider working with the 100 largest water using customers to seek to maximize water use efficiency.
- Outsource, as needed, to gain enough staff support to administer the expanded program.
- Seek additional new funding sources, such as U.S. Bureau of Reclamation funds to support Plan budget needs. The existing budgets may be used as a cost-share to leverage into funding more activities, especially the less cost-effective measures.

Tasks that should be perfomed on an annual basis include:

- Develop an annual work plan for each plan year as soon as the budget is adopted (or in concert with the budget planning process). Perform a data assessment of the previous year's progress to determine priorities for the next year.
- Review Plan inputs and goals in the DSS Model annually and update measure participation, projected water savings, and anticipated per capita water use reductions to ensure the City is on track to meet conservation goals.
- Track and assess water use across all customer categories.

8.5 Recommended Next Steps

Water Conservation Program staff will write an initial implementation plan to cover the first five years of the Plan, with details on important steps for the successful development of each new conservation measure. Staff will also propose initial metrics for evaluating the effectiveness of each measure, utilizing the suggestions provided by MWM. Stakeholders from the strategic planning effort will be kept updated on the Plan's progress and will provide guidance as new measures are developed and executed.

8.6 Conclusion

The implementation of expanded water conservation efforts is a feasible and cost-effective means of improving Flagstaff's sustainability as a community through long-term water resource reliability. Conservation is the least expensive means of meeting future water supply needs for the Flagstaff area. The implementation of these conservation measures should reduce per capita water use and have the potential to defer the need for further costly infrastructure expansion. While the conservation actions identified have a significant cost, the cost of neglecting conservation and having to address increased demands through engineered solutions are even higher. 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.

9 REFERENCES

All links following were accessed in June 2020 unless otherwise indicated:

Alliance for Water Efficiency. Web page: G480 Standard and AWE Leaderboard. https://www.allianceforwaterefficiency.org/resources/topic/g480-standard-and-awe-leaderboard

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

American Water Works Association. (2013). *AWWA G480-13 Water Conservation Program Operation and Management Standard*. https://www.awwa.org/Store/Product-Details/productId/35009354

Ibid. (2017). *M52 Water Conservation Programs – A Planning Manual*, *2nd Edition,* principally authored by Maddaus Water Management. https://www.awwa.org/Store/Product-Details/productId/61841578

Arizona Office of Economic Opportunity. (2017). *Arizona Population Estimates.* Phoenix, AZ : Arizona Commerce Authority.

California Energy Commission. (2014). *Staff Analysis of Toilets, Urinals and Faucets*, Report # CEC-400-2014-007-SD.

City of Flagstaff. (2011). *Utilities Integrated Master Plan*. https://www.flagstaff.az.gov/3485/Water-Services-Master-Planning

Ibid. Web page: Adequate Water Supply Designation. https://www.flagstaff.az.gov/2263/Adequate-Water-Supply-Designation

Ibid. Web page: Code Publishing. https://www.codepublishing.com/AZ/Flagstaff/

Consortium for Efficient Energy website. www.cee1.org

DeOreo, W.B. (2016). *Residential End Uses of Water, Version 2 - 4309.* Denver, Colorado: AWWA Research Foundation. https://www.circleofblue.org/wp-content/uploads/2016/04/WRF_REU2016.pdf

DeOreo, W.B., P.W. Mayer, Leslie Martien, Matthew Hayden, Andrew Funk, Michael Kramer-Duffield, Renee Davis, James Henderson, Bob Raucher, Peter Gleick, and Matt Heberger. (2011). *California Single Family Water Use Efficiency Study*. Sacramento, California: Department of Water Resources. https://www.irwd.com/images/pdf/save-water/california_single_family_water_use_efficiency_study.pdf

Dziegielewski, B., J. C. Kiefer, W. DeOreo, P. Mayer, E. M. Opitz, G. A. Porter, G. L. Lantz, and J. O. Nelson. (2000). *Commercial and Institutional End Uses of Water*. Denver, Colorado: AWWA, Research Foundation and American Water Works Association with Cooperation of the U.S. Bureau of Reclamation. Catalog No.90806. 264 pp. ISBN 1-58321-035-0. https://books.google.com/books/about/Commercial_and_Institutional_End_Uses_of.html?id=tZsMak36dw8C

Energy Star. *Unit Shipment and Market Penetration Report Calendar Year 2011 Summary*. http://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2011_USD_Summary_Report.pdf

Environmental Defense Fund. Web page: How cap and trade works. https://www.edf.org/climate/how-cap-and-trade-works

Federal Reserve Economic Data. Web page: FRED Graph Observations, August 2018. https://fred.stlouisfed.org

GMP Research, Inc. (2019). *2019 U.S. WaterSense Market Penetration Industry Report*, commissioned by Plumbing Manufacturers International. https://www.safeplumbing.org/files/safeplumbing.org/documents/misc/7-1-19-WaterSense-2019-Report.pdf

Koeller & Company. (2005). *High Efficiency Plumbing Fixtures – Toilets and Urinals*. https://ufdcimages.uflib.ufl.edu/WC/04/99/22/19/00001/WC04992219.pdf http://toolbox.calwep.org/wiki/High_Efficiency_Toilets_and_Urinals

Oak Ridge National Laboratory, Energy Division. (1998). *Bern Clothes Washer Study, Final Report*, prepared for U.S. Department of Energy. https://digital.library.unt.edu/ark:/67531/metadc691712/

Plumbing Efficiency Research Coalition. (2012). *The Drainline Transport of Solid Waste in Buildings, PERC Phase 1 Report*, Table 2-A: Water Consumption by Water-Using Plumbing Products and Appliances – 1980-2012. http://www.map-testing.com/assets/files/PERC%20Report_Final_Phase%20One_Nov%202011_v1.1.pdf

Santa Clara Valley Water District Water Use Efficiency Unit. (2008). *SCVWD CII Water Use and Baseline Study*.

U.S. Census Bureau. Web page: 2010 Census Data. https://www.census.gov/programs-surveys/decennial-census/data/datasets.2010.html

U.S. Congress. Energy Policy Act of 1992; amended in 2005. https://www.epa.gov/laws-regulations/summary-energy-policy-act

U.S. Water Alliance. Web page: One Water Hub. http://uswateralliance.org/one-water

APPENDIX A – DSS MODEL OVERVIEW AND ASSUMPTIONS

This appendix presents an overview of the DSS Model and the key assumptions made in this analysis.

A.1 DSS Model Overview

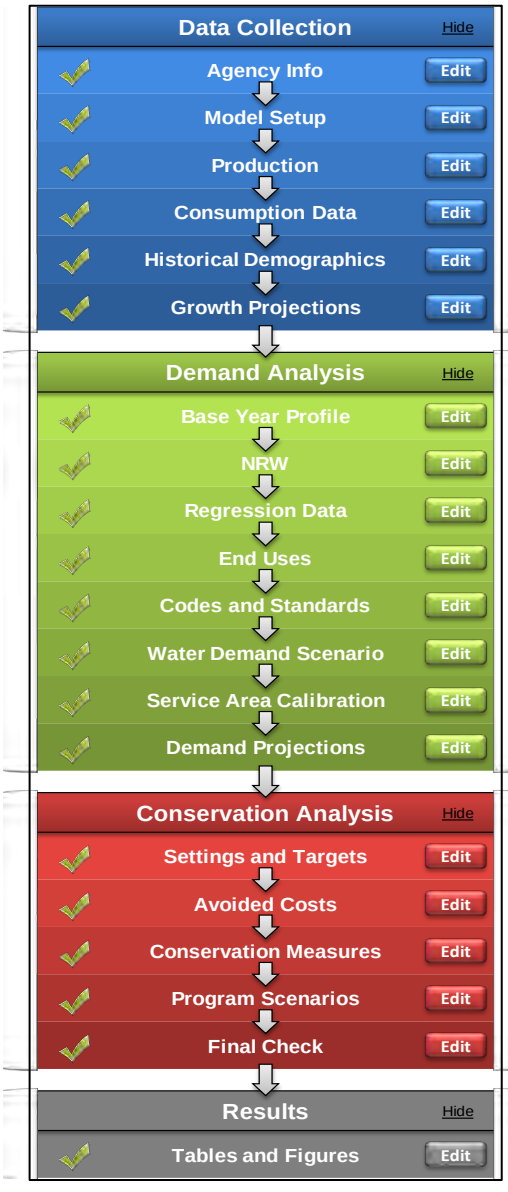


Figure A-1 DSS Model Main Page

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

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

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

Passive Water Savings Calculations: The DSS Model is used to forecast service area water fixture use. Specific end-use type, average water use, and lifetime are compiled for each fixture. Additionally, state and national plumbing codes and appliance standards are modeled by customer category. These fixtures and plumbing codes can be added to, edited, or

deleted by the user. This process yields two demand forecasts, one with plumbing codes and one without plumbing codes.

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

Figure A-2. Sample Benefit-Cost Analysis Summary

Conservation Measures

Benefit Cost Analysis

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

Review Data

Benefit Cost Analysis

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

Benefit Cost Analysis

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

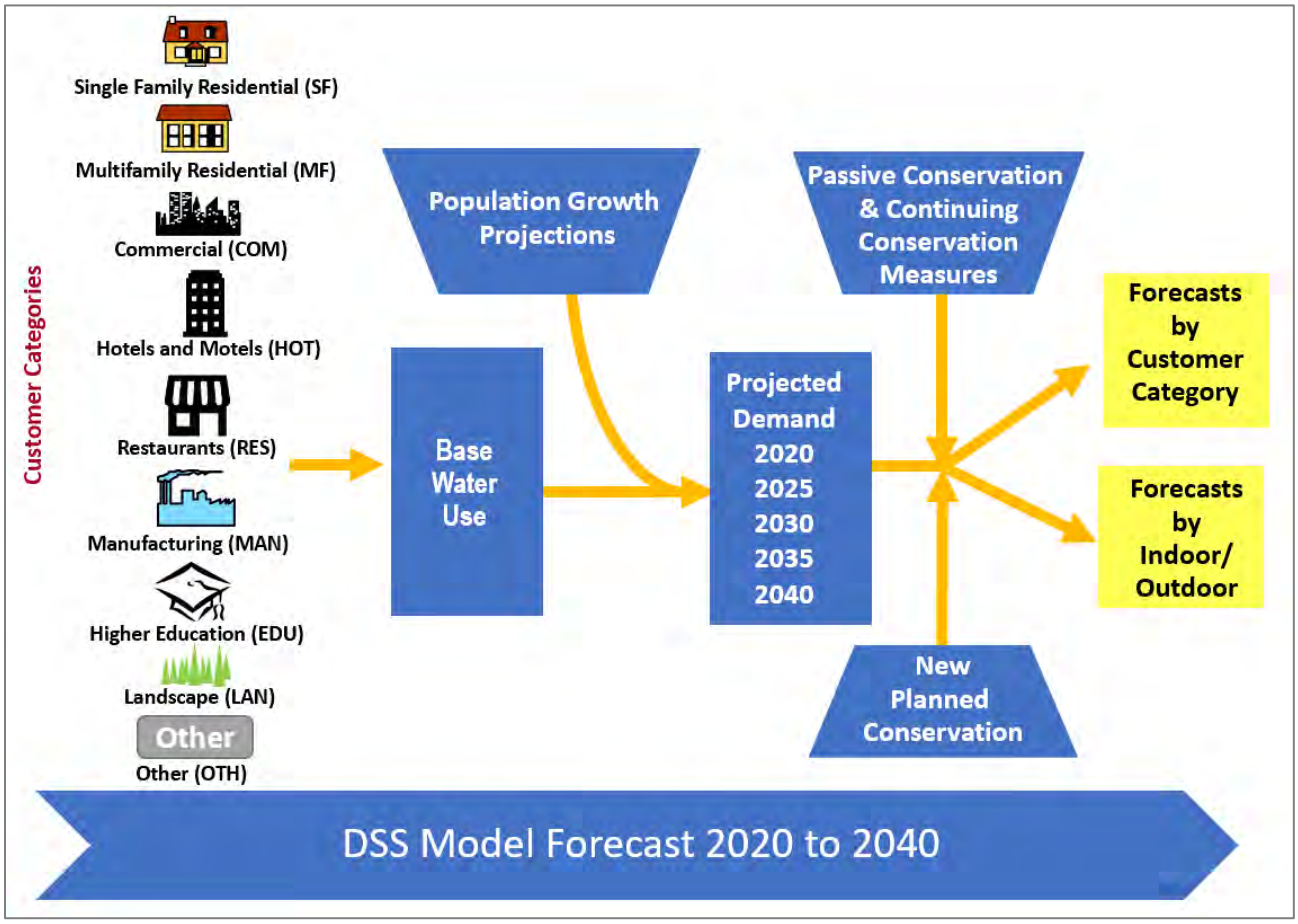
Model Use and Validation: As shown in the following figure, the DSS Model has been used for over 20 years for practical applications of conservation planning in over 300 service areas representing 60 million people, including extensive efforts nationally and internationally in Australia, New Zealand,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

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

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

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

Figure A-4. DSS Model Analysis Flow Diagram



A.2 Passive Savings Modeling Approach using the Plumbing Code

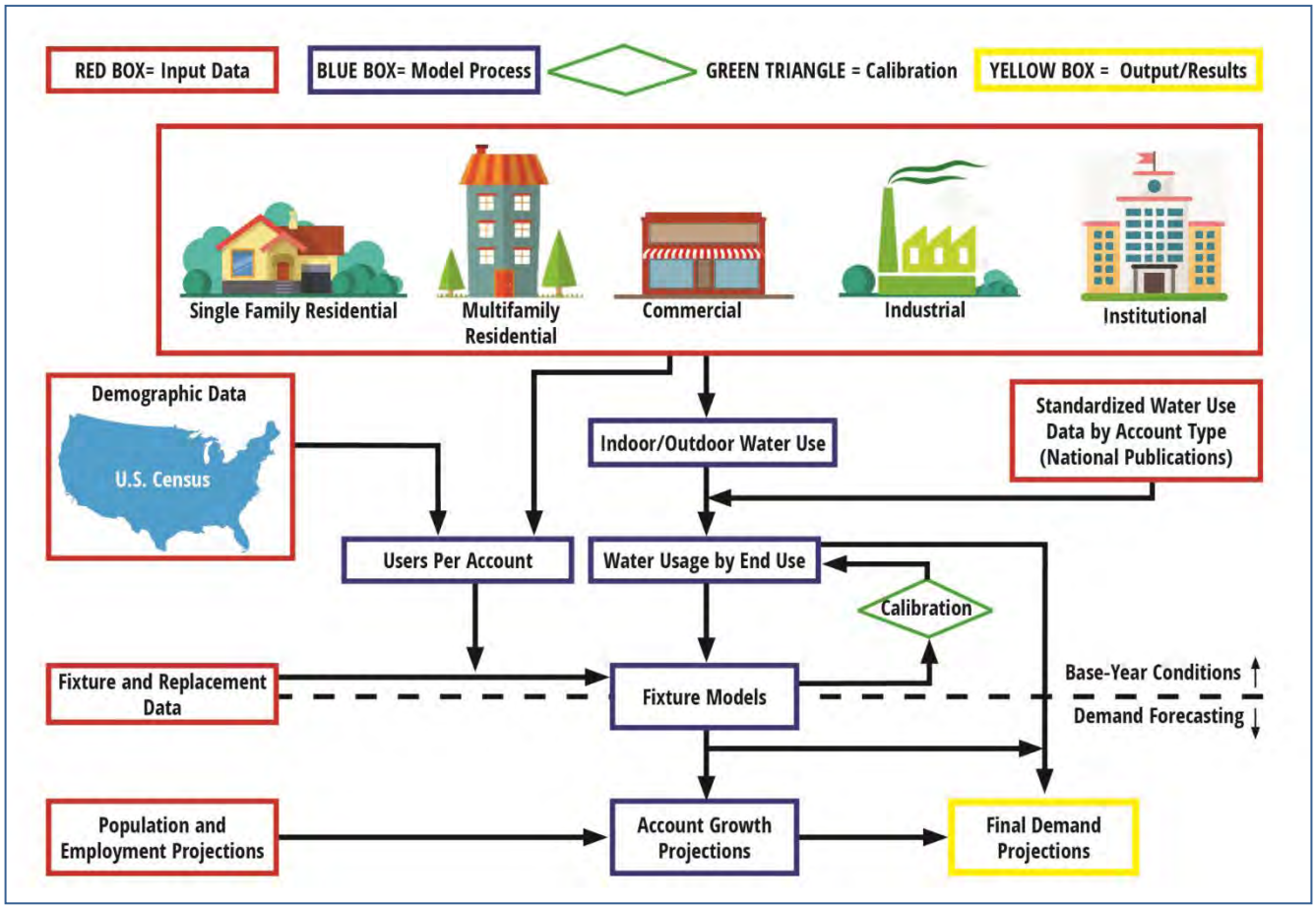
Plumbing code measures are independent of any conservation program; they are based on customers following applicable current local, state and federal laws, building codes, and ordinances. Plumbing code related water savings are considered "passive", reliable, long-term savings and can be counted on over time to help reduce overall system water demand. In contrast, water savings are considered "active" if a specific action unrelated to the implementation of codes and standards is taken by the water agency to accomplish conservation measure savings. The DSS Model incorporates the following items as a "code" meaning that the savings are assumed to occur and are therefore "passive" savings:

- The Federal Energy Policy Act of 1992 (amended in 2005)
- Flagstaff Plumbing Code Amendment – Toilets (July 2011)[15]

[15] All City of Flagstaff codes are published online: https://www.codepublishing.com/AZ/Flagstaff/

The following figure conceptually describes how The DSS Model incorporates data inputs into the flow of the DSS Model analysis. The demand projections, including plumbing code savings, assumes no active involvement by the water utility, and that the costs of purchasing and installing replacement equipment (and new equipment in new construction) are borne solely by the customers, occurring at no direct utility expense. The inverse of the fixture life is the natural replacement rate, expressed as a percent (i.e., 10 years is a rate of 10% per year).

Figure A-5. DSS Model Overview Used to Make Potable Water Demand Projections



A.2 National, State and Local Plumbing Codes

This section describes national plumbing codes and Arizona State Laws and City of Flagstaff Code of Regulations applicable to the City.

A.2.1 National Plumbing Code

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 to 50% less water than conventional models (which are still available).

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

A.2.2 Arizona State Law

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

A.2.3 City of Flagstaff

Fixture characteristics in the DSS Model are tracked in new accounts, which are subject to the requirements of applicable City building codes. City efficiency standards supersede federal standards for toilets. Per City of Flagstaff 2013 Amendments to the Flagstaff City Code, Title 4, Building Code, Section 403.11,[16] as of July 2011, all newly installed toilets must be "high efficiency toilets (HET) units which have a maximum of 1.3 gallons for solids." This bill requires high efficiency toilets (1.28 gpf) to be exclusively sold in the City.

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

Table A-1 presents the key assumptions and references that are used in the DSS Model in determining projected demands with plumbing code savings. The assumptions having the most dramatic effect on future demands are the natural replacement rate of fixtures, how residential or commercial future use is projected, and the percent of estimated real water losses.

[16] All City of Flagstaff codes are published online: https://www.codepublishing.com/AZ/Flagstaff/

Table A-1. List of Key Assumptions and Resources for Potable DSS Model Analysis

Parameter	Model Input Value, Assumptions, and Key References		
Model Start Year	2018		
Water Demand Factor Years (Base Years)	2012-2017 when available (excluding 2016 for MF and REST customer categories due to several months of software transition issues)		
Non-Revenue Water in Start Year	11%		
	Based on average 2014-2016 NRW.		
Population Source	Office of Economic Opportunity Arizona Data 2017 population used as starting data (72,961). Used higher growth rate of 2.2% over last decade (2000-2010).		
Employment Source	FRED Graph Observations (Federal Reserve Economic Data) https://fred.stlouisfed.org August 2018		
Base Year Water Use Profile			
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**
Multifamily	2,940	19.5%	458
Single Family	15,344	36.4%	163
Commercial	1,380	16.0%	797
Hotels and Motels	91	8.5%	6,429
Restaurants	131	2.7%	1,444
Manufacturing	39	4.2%	7,390
Higher Education	1	7.9%	546,852
Landscape	322	3.6%	770
Other	1	1.2%	84,410
Total	**20,249**	**100%**	**N/A**

Parameter	Resource
Residential End Uses	Key Reference: CA DWR Report *California Single Family Water Use Efficiency Study* (DeOreo, 2011 – Page 28, Figure 3: Comparison of household end-uses) and AWWA Research Foundation (AWWARF) Report *Residential End Uses of Water, Version 2 – 4309* (DeOreo, 2016). Table 2-A. *Water Consumption by Water-Using Plumbing Products and Appliances – 1980-2012*. PERC Phase 1 Report. Plumbing Efficiency Research Coalition. 2012. Model Input Values are found in the "End Uses" section of the DSS Model on the "Breakdown" worksheet.

Non-Residential End Uses, percent	Key Reference: AWWARF Report *Commercial and Institutional End Uses of Water* (Dziegielewski, 2000 – Appendix D: Details of Commercial and Industrial Assumptions, by End Use). Santa Clara Valley Water District Water Use Efficiency Unit. *SCVWD CII Water Use and Baseline Study*. February 2008. Model Input Values are found in the "End Uses" section of the DSS Model on the "Breakdown" worksheet.
Efficiency Residential Fixture Current Installation Rates	U.S. Census, Housing age by type of dwelling plus natural replacement plus rebate program (if any). Key Reference: GMP Research, Inc. (2019). *2019 U.S. WaterSense Market Penetration Industry Report*. Key Reference: California Urban Water Conservation Council Potential Best Management Practice Report *High Efficiency Plumbing Fixtures – Toilets and Urinals* (Koeller, 2005 – Page 42, Table 8 and Table 9: Residential toilet installation rates in California). Key Reference: Consortium for Efficient Energy (www.cee1.org). Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.
Water Savings for Fixtures, gal/capita/day	Key Reference: AWWARF Report *Residential End Uses of Water, Version 2 - 4309* (DeOreo, 2016). Key Reference: CA DWR Report *California Single Family Water Use Efficiency Study* (DeOreo, 2011 – Page 28, Figure 3: Comparison of household end-uses). WCWCD supplied data on costs and savings; professional judgment was made where no published data was available. Key Reference: California Energy Commission*, Staff Analysis of Toilets, Urinals and Faucets*, Report # CEC-400-2014-007-SD, 2014. Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model.
Non-Residential Fixture Efficiency Current Installation Rates	Key Reference: 2010 U.S. Census, Housing age by type of dwelling plus natural replacement plus rebate program (if any). Assume commercial establishments built at same rate as housing, plus natural replacement. California Energy Commission, *Staff Analysis of Toilets, Urinals and Faucets*, Report # CEC-400-2014-007-SD, 2014. Santa Clara Valley Water District Water Use Efficiency Unit. *SCVWD CII Water Use and Baseline Study*. February 2008. Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.
Residential Frequency of Use Data, Toilets, Showers, Faucets, Washers, Uses/user/day	Key Reference: AWWARF Report *Residential End Uses of Water, Version 2 - 4309* (DeOreo, 2016). Summary values can be found in the full report: http://www.waterrf.org/Pages/Projects.aspx?PID=4309

	Key Reference: California Energy Commission, *Staff Analysis of Toilets, Urinals and Faucets*, Report # CEC-400-2014-007-SD, 2014. Key Reference: Alliance for Water Efficiency, *The Status of Legislation, Regulation, Codes & Standards on Indoor Plumbing Water Efficiency*, January 2016. Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model and confirmed in each "Service Area Calibration End Use" worksheet by customer category.
Non-Residential Frequency of Use Data, Toilets, Urinals, and Faucets, Uses/user/day	Key References: Estimated based on AWWARF Report *Commercial and Institutional End Uses of Water* (Dziegielewski, 2000 – Appendix D: Details of Commercial and Industrial Assumptions, by End Use). Key Reference: California Energy Commission, *Staff Analysis of Toilets, Urinals and Faucets*, Report # CEC-400-2014-007-SD, 2014. Fixture uses over a 5-day work week are prorated to 7 days. Non-residential 0.5 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. 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)	Toilets 2%-2.5%
	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).
	Model Input Value is found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model.
Future Water Use	Increases Based on Population Growth and Demographic Forecast

There are several aspects of the DSS Model that were not used in this analysis effort, which result in empty spreadsheets within the DSS Model. They remain available in the DSS Model should the City choose to employ them in future efforts.

A.3.1 Fixture Replacement

The DSS Model is capable of modeling multiple types of fixtures, including fixtures with different designs. For example, currently toilets can be purchased that flush at a rate of 0.8 gpf, 1.0 gpf or 1.28 gpf. The 1.6 gpf and higher toilets still exist but can no longer be purchased in the City. Therefore, they cannot be used for replacement or new installation of a toilet. So, the DSS Model utilizes a fixture replacement table to determine what type of fixture should be used for a new install or replacement. The replacement of the fixtures is listed as a percentage. A value of 100% would indicate that all the toilets installed would be of one particular flush volume. A value of 75% means that three out of every four toilets installed would be of that particular flush volume.

The DSS Model provides inputs and analysis of the number, type and replacement rates of fixtures for each customer category (i.e., single family toilets, multifamily toilets, commercial toilets, residential clothes washing

machines, commercial washing machines). For example, the DSS Model incorporates the effects of the 1992 Federal Energy Policy Act and AB 715 on toilet fixtures. A DSS Model feature determines the "saturation" of 1.6 gpf toilets as the 1992 Federal Energy Policy Act was in effect from 1992-2014 for 1.6 gpf toilet replacements. AB 715 now applies for the replacement of toilets at 1.28 gpf. Further consideration and adjustments were made to replacement rates to account for the reduction in fixture use and wear due to lower occupancy and based on field observations.

The DSS Model forecasts service area water fixture use. In the codes and standards part of the DSS Model, specific fixture end-use type (point of use fixture or appliance), average water use, and lifetime are compiled. Additionally, state and national plumbing codes and appliance standards for toilets, urinals, showers, and clothes washers are modeled by customer category. These fixtures and plumbing codes can be added to, edited, or deleted by the user. This yields two demand forecasts: with plumbing codes and without plumbing codes.

A.3.2 Fixture Estimates

Determining the current level of efficient fixtures in a service area is part of the standard process while evaluating the passive savings in the DSS Model and is called "initial fixture proportions." MWM reconciled water efficient fixtures and devices installed within the City's service area and estimated the number of inefficient fixtures outstanding.

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

In late 2014, the Water Research Foundation updated its 1999 Residential End Uses of Water Study (REUWS). Water utilities, industry regulators, and government planning agencies have considered it the industry benchmark for single family home indoor water use. This Plan incorporates the recent study results which reflect the change to the profile of water use in residential homes including the adoption of more water efficient fixtures over the past 15 years (1999 to 2014). The REUWS results were combined with the City's historical rebate and billing data to enhance and verify assumptions made for all customer accounts. This particularly included saturation levels on toilets, urinals, showerheads, clothes washers, and faucets.

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

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

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

It is also important to note that in water conservation program management "free-ridership" 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 in their purchase but a "bonus." Rebate measures are designed to target those customers needing financial incentive to install the more efficient fixture beyond current codes or standards.

A.4 Key Baseline Reclaimed Demand Inputs and Assumptions

The following table presents a list of key assumptions used in the City's Reclaimed Water System DSS Model.

Table A-2. List of Key Assumptions and Resources for Reclaimed DSS Model Analysis

Parameter	Model Input Value, Assumptions, and Key References		
Model Start Year	2018		
Water Demand Factor Years (Base Years)	2012-2018* *Excluding 2012 for Construction due to unexplained data; excluding 2012-2017 for Manufacturing due to the paper tissue factory closing and stopping reclaimed water use 2017; and excluding 2012-2013 for Offices/Commercial Retail due to many more accounts, including a large mall, coming online in more recent years.		
Non-Revenue Water in Start Year	7%		
	Based on 2016, 2017 and 2018 historical NRW. This value can be found in the green NRW section of the DSS Model.		
Base Year Water Use Profile			
Customer Categories	**Start Year Accounts**	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**
Golf Courses - Reclaimed Water	3	64%	325,736
Winter Recreation - Reclaimed Water	1	11%	163,372
Higher Education - Reclaimed Water	1	8.4%	128,801
Parks/Cemeteries - Reclaimed Water	9	6.0%	10,179
K-12 Schools - Reclaimed Water	10	3.1%	4,772
Car Washes - Reclaimed Water	2	0.6%	4,948
Construction - Reclaimed Water	4	5.7%	21,976
Manufacturing - Reclaimed Water	1	0.1%	1,203
Offices/Commercial Retail - Reclaimed Water	10	0.93%	1,424
Residential MF - Reclaimed Water	2	0.5%	3,760
Residential SF - Reclaimed Water	11	0.28%	398
Streetscape - Reclaimed Water	8	0.30%	586

A.5 Key Inputs for the DSS Model Conservation Analysis

The following subsections present information regarding the DSS Model's conservation measure benefit-cost analysis.

A.5.1 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, etc. 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, surveys offered or conducted per year.

The potential for errors in market penetration goal estimates for each measure can be significant because they 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 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.

BBLDWP is constantly looking at when a measure might reach saturation. Baseline surveys are the best approach to having the most accurate information on market saturation. This was considered when analyzing individual conservation measures where best estimates were made. MWM was not provided with any baseline surveys for this analysis, but discussions were held with BBLDWP regarding what best estimates were for saturation for its service area.

A.5.2 Perspectives on Benefits and Costs

The determination of the economic feasibility of water conservation programs involves comparing the costs of the programs to the benefits provided. This analysis was performed using the DSS Model developed by MWM. The DSS Model calculates 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.

A.5.3 Present Value Analysis

Present value analysis using present day dollars and a real discount rate of 3.72% 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, the perspectives most commonly used for benefit-cost analyses are the "utility" perspective and the "community" perspective. The "utility" benefit-cost analysis is based on the benefits and costs to the water provider. The "community" benefit-cost analysis includes the utility benefit and costs together with account owner/customer benefits and costs. These include customer energy and other capital or operating cost benefits plus costs of implementing the measure, beyond what the utility pays.

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

The community perspective is defined to include the utility and the customer costs and benefits. Costs incurred by customers striving to save water while participating in water use efficiency programs are considered, as well as the 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 the aggregate for reasons described above. 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. A long planning period of over 20 years is often used because costs and benefits that occur beyond year 2040 have very little influence on the total present value of the costs and benefits. The value of all future costs and benefits is discounted to the first year in the DSS Model (the base year), at the real interest rate of 3.72%. The DSS Model calculates this real interest rate, adjusting the current nominal interest rate (assumed to be approximately 6.0%) by the assumed rate of inflation (2.2%). 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.

A.5.4 Measure Cost and Water Savings Assumptions

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

- **Targeted Water User Group End Use** – Water user group (e.g., single family residential) and end use (e.g., indoor or outdoor water use).
- **Utility Unit Cost** – Cost of rebates, incentives, and contractors hired 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.
- **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 and 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 costs to staff the measures and to obtain and maintain equipment; and a one-time set-up cost. The set-up cost is for measure design by staff or consultants, any required pilot testing, and preparation of materials that are used in marketing the measure. Measure costs are estimated each year through 2040. Costs are spread over the time period depending on the length of the implementation period for the measure and estimated voluntary customer participation levels.

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

Data necessary to forecast water savings of measures include specific data on water use, demographics, market penetration, and unit water savings. Savings normally develop at a measured and predetermined pace, reaching full maturity after full market penetration is achieved. This may occur three to ten years after the start of implementation, depending upon the implementation schedule.

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 residential single family account than for a residential multifamily 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 specific data on water use, demographics, market penetration, and unit water savings. Savings normally develop at a measured and predetermined pace, reaching full maturity after full market penetration is achieved. This may occur three to seven years after the start of implementation, depending upon the implementation schedule. For every water use efficiency activity or replacement with more efficient devices, there is a useful life. The useful life is called the “Measure Life” and is defined to be how long water use conservation measures stay in place and continue to save water. It is assumed that measures implemented because of codes, standards or ordinances, like toilets for example, 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 behavioral 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 new homeowners may have less efficient water using practices around the home). Surveys typically have a measure life on the order of five years.

A.5.5 Assumptions about Avoided Costs

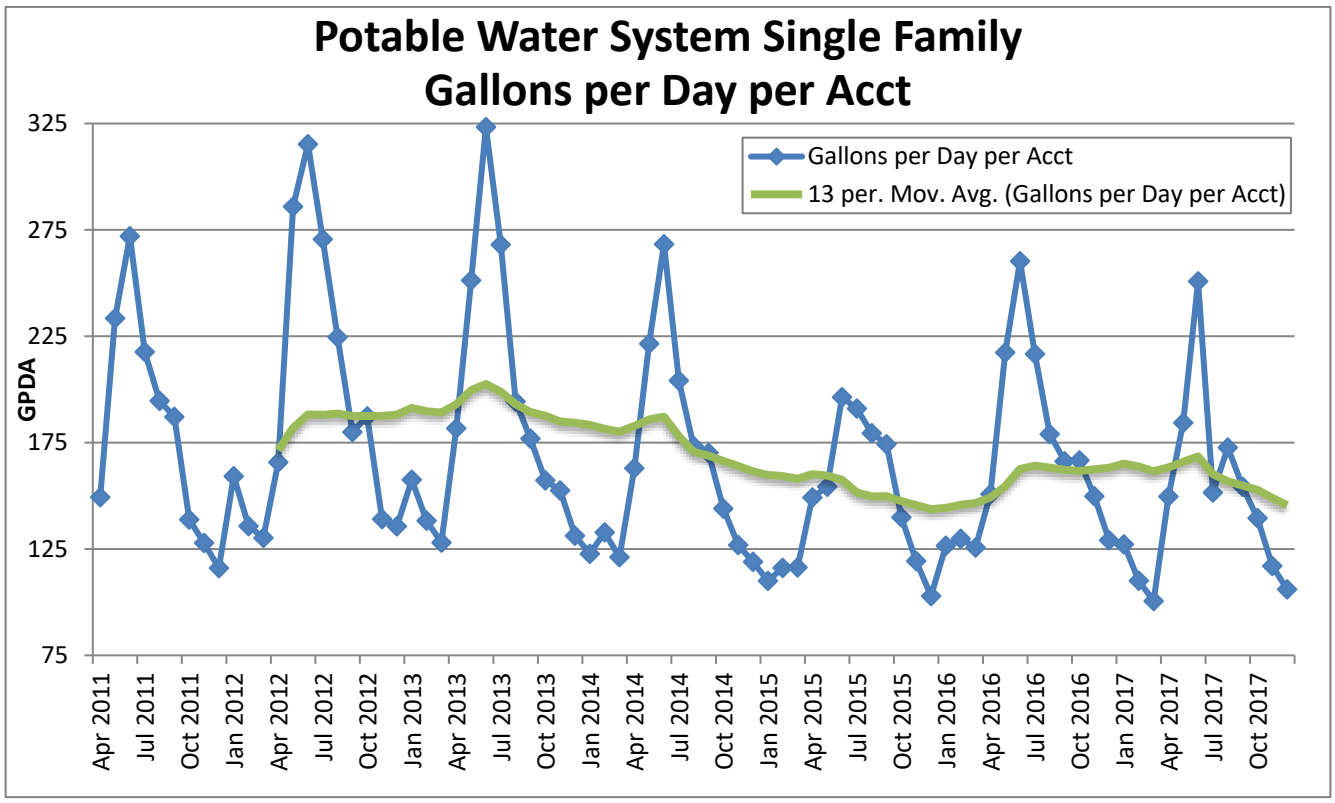
The City’s primary source of water is potable groundwater supplied by natural precipitation. Surface water from Lake Mary and Inner Basin Springs accounts for approximately 25% of the City’s water. Costing over $290 per AF for chemicals, treatment, pumping, moving and compliance testing and permit fees, the City reduces groundwater use when demands are reduced (with conservation) as compared to surface water which costs approximately $188 per AF. These costs are based on year 2017 volume and expenditures. Additional avoided

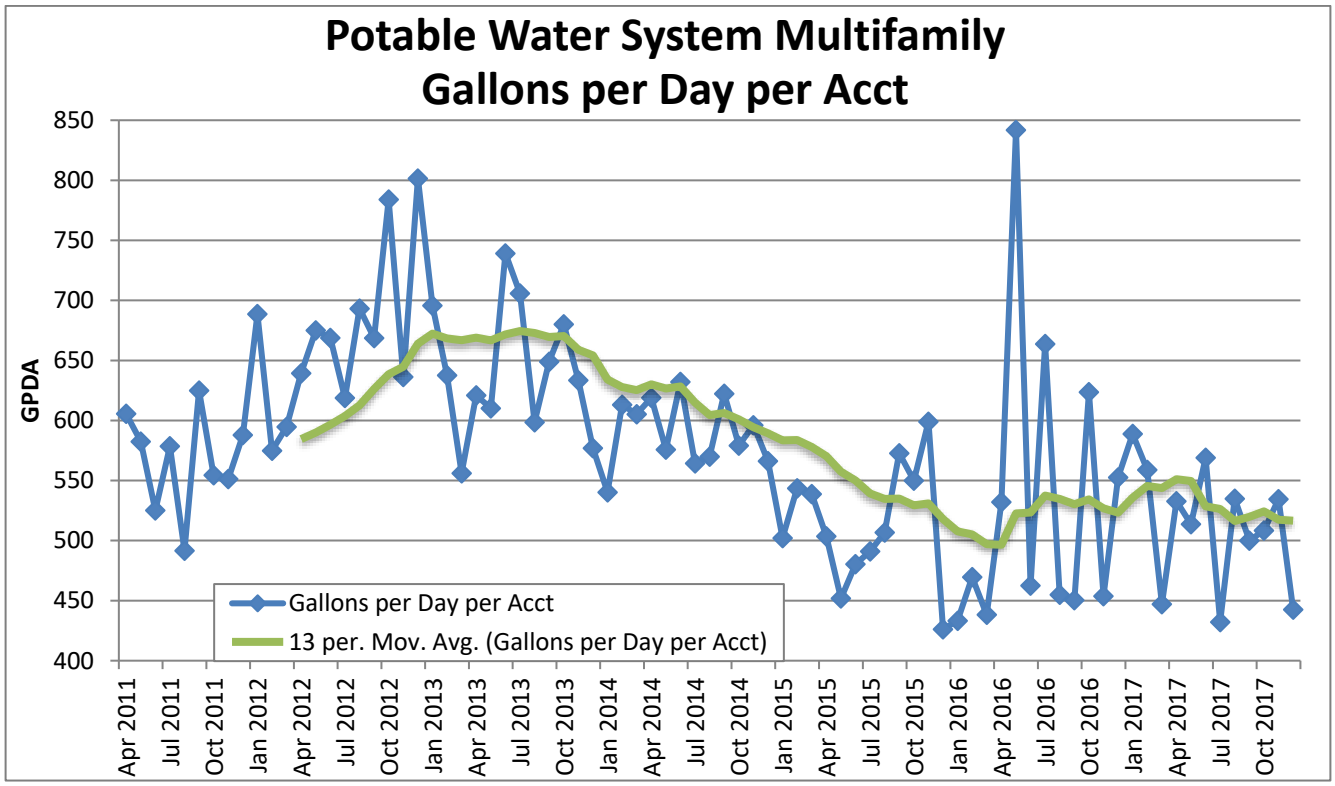
costs that are considered when determining the value of water saved due to conservation are the cost savings from deferring the Red Gap Ranch project as a result of passive and active conservation water savings. Without conservation, a future significant water supply expansion project has been estimated to begin its 10-year construction in year 2023, be online by 2032, and have a project capacity volume of 12,000 AF. Life-cycle construction costs are estimated to be $268 million with annual operational costs of approximately $1.34 million. Designed to be "triggered" when average demands exceed 12,000 AF per year (in year 2032), it is estimated that passive and active conservation effort savings could delay the project need by more than 15 years to year 2048, deferring both construction and annual maintenance costs. The estimated total cost savings by deferring a future significant water supply expansion project is $175.4 million for a cost-of-water savings estimate of $487/AF.

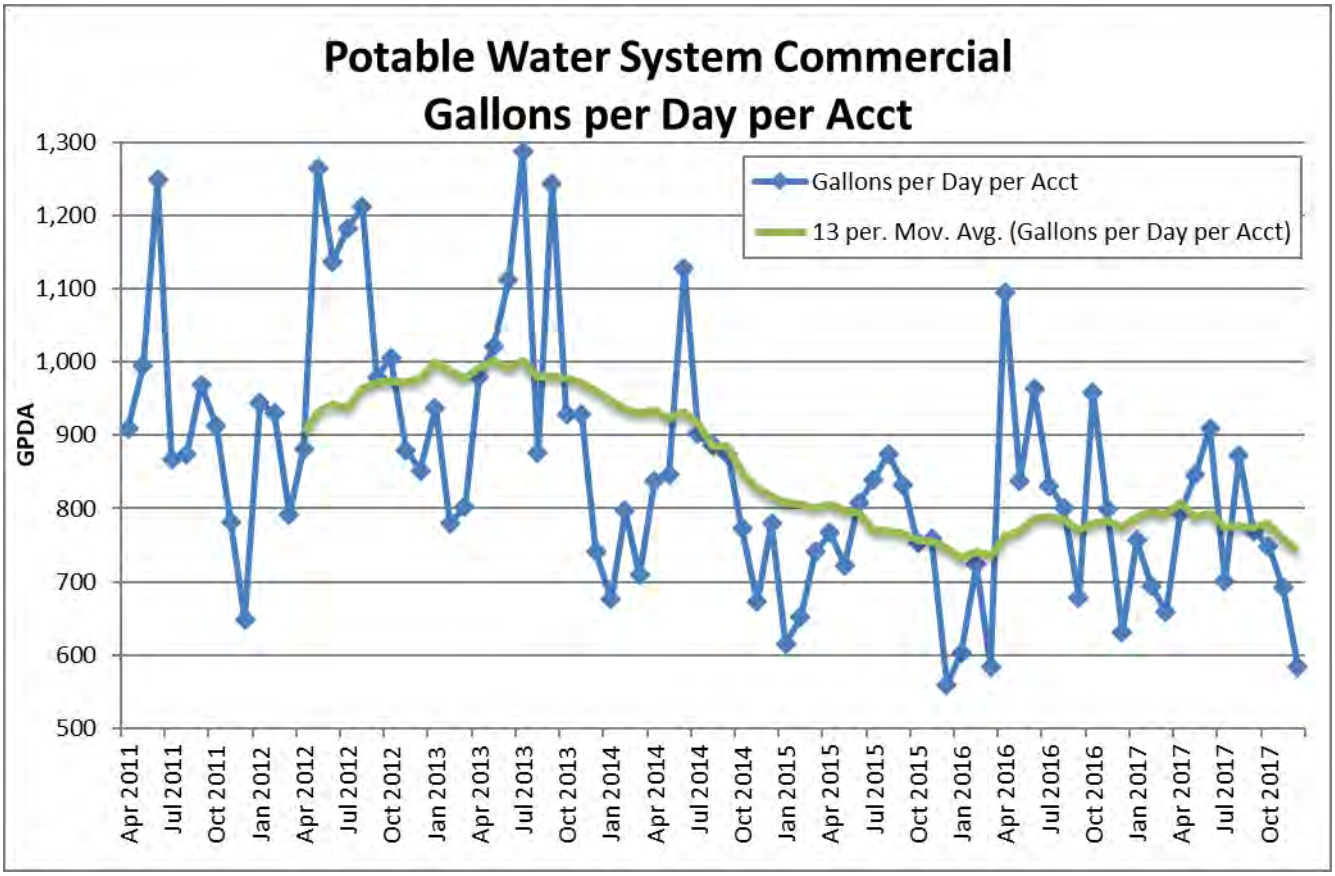
The City's average wastewater cost of approximately $171/AF is based on 2017 annual chemical/treatment costs and 2017 annual energy costs for pumping/moving the wastewater.

Reclaimed water is estimated to cost approximately $67 per AF based on 2017 volumes and expenditures for annual chemical/treatment, annual energy costs for pumping and moving the water, and permitting fees.

APPENDIX B – HISTORICAL MONTHLY POTABLE WATER USE PER ACCOUNT TYPE






Potable Water System Commercial
Gallons per Day per Acct
GPDA
1,300
1,200
1,100
1,000
900
800
700
600
500
Gallons per Day per Acct
13 per. Mov. Avg. (Gallons per Day per Acct)
Apr 2011
Jul 2011
Oct 2011
Jan 2012
Apr 2012
Jul 2012
Oct 2012
Jan 2013
Apr 2013
Jul 2013
Oct 2013
Jan 2014
Apr 2014
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Oct 2014
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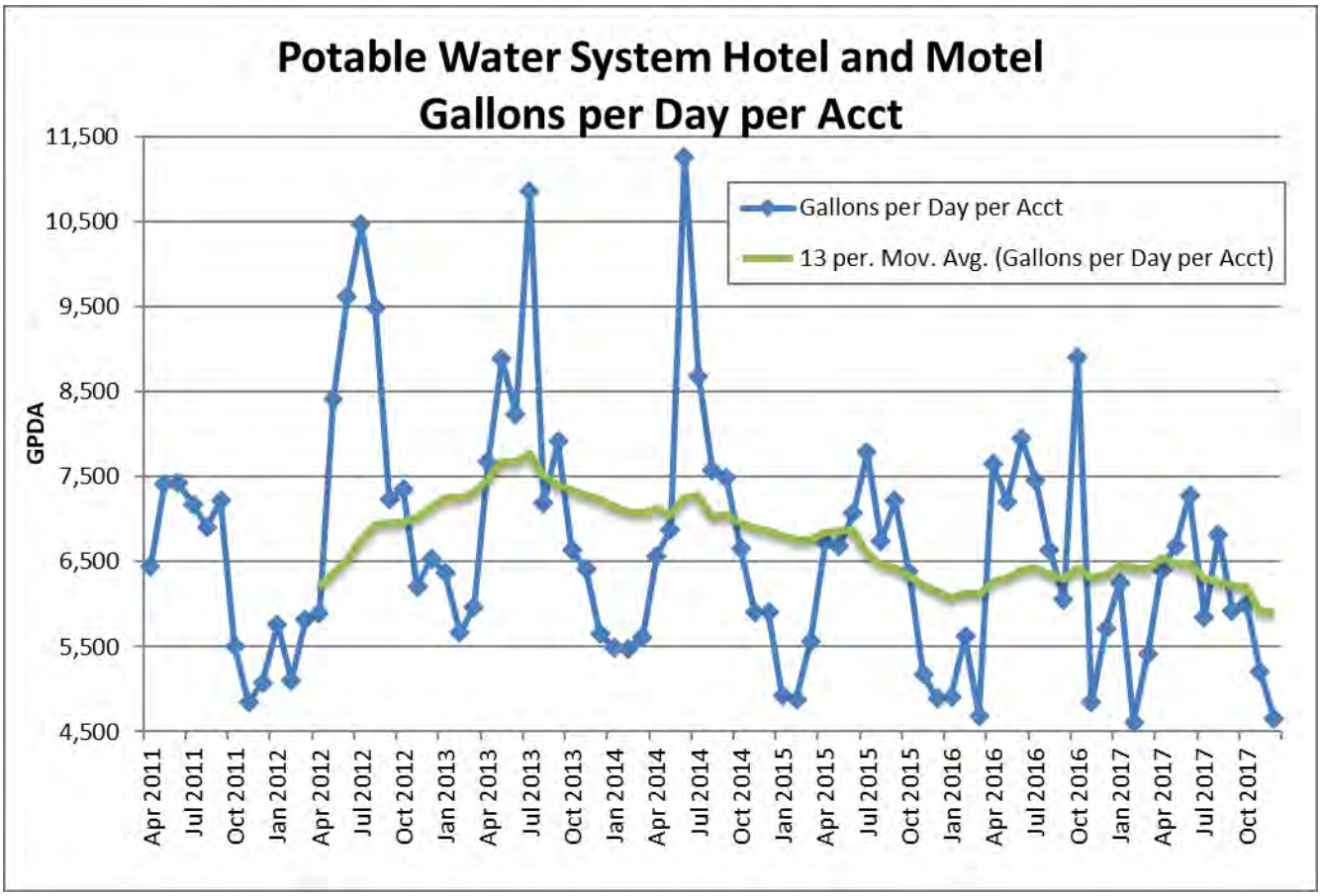
Oct 2017


Potable Water System Hotel and Motel
Gallons per Day per Acct
GPDA
11,500
10,500
9,500
8,500
7,500
6,500
5,500
4,500
Gallons per Day per Acct
13 per. Mov. Avg. (Gallons per Day per Acct)
Apr 2011
Jul 2011
Oct 2011
Jan 2012
Apr 2012
Jul 2012
Oct 2012
Jan 2013
Apr 2013
Jul 2013
Oct 2013
Jan 2014
Apr 2014
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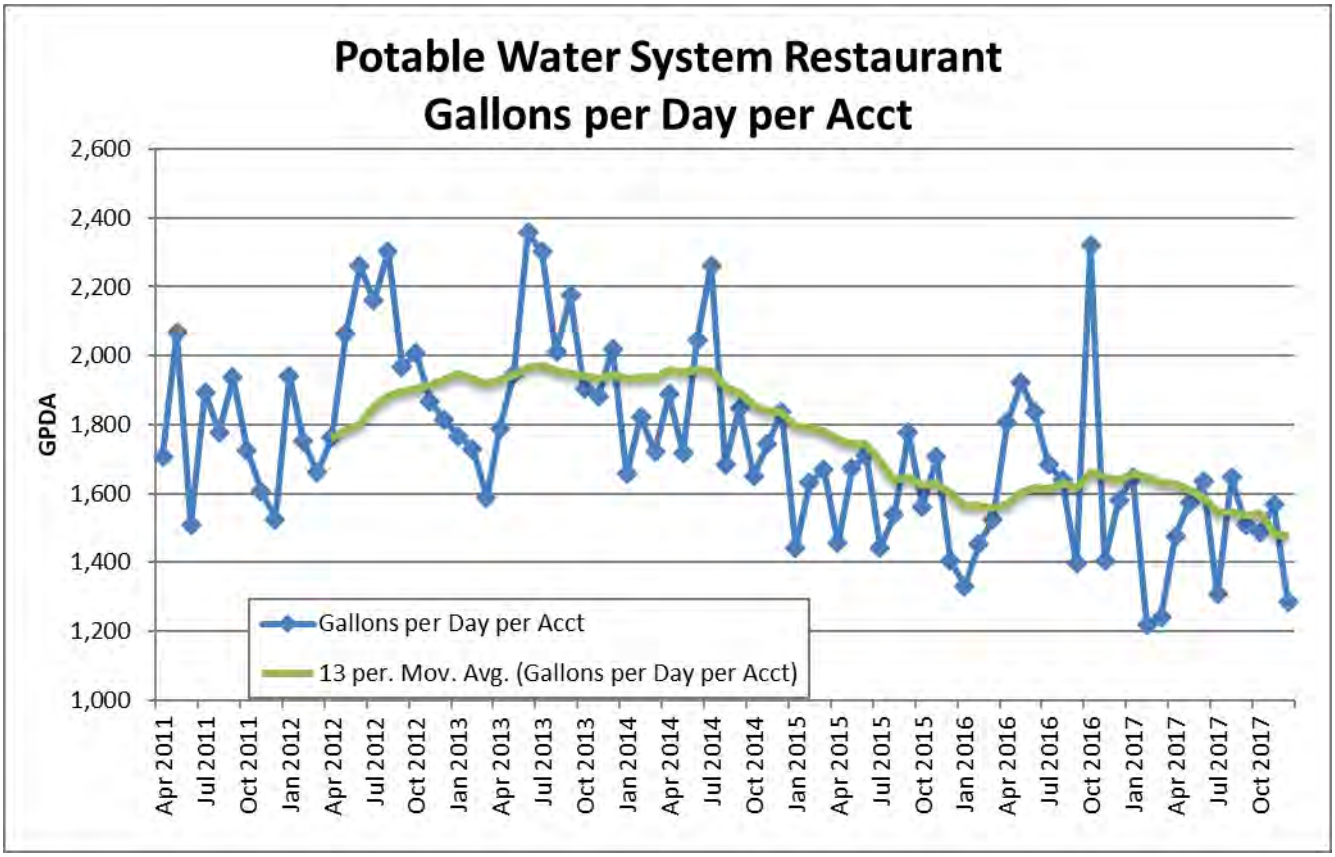
Potable Water System Restaurant
Gallons per Day per Acct
GPDA
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
Gallons per Day per Acct
13 per. Mov. Avg. (Gallons per Day per Acct)
Apr 2011
Jul 2011
Oct 2011
Jan 2012
Apr 2012
Jul 2012
Oct 2012
Jan 2013
Apr 2013
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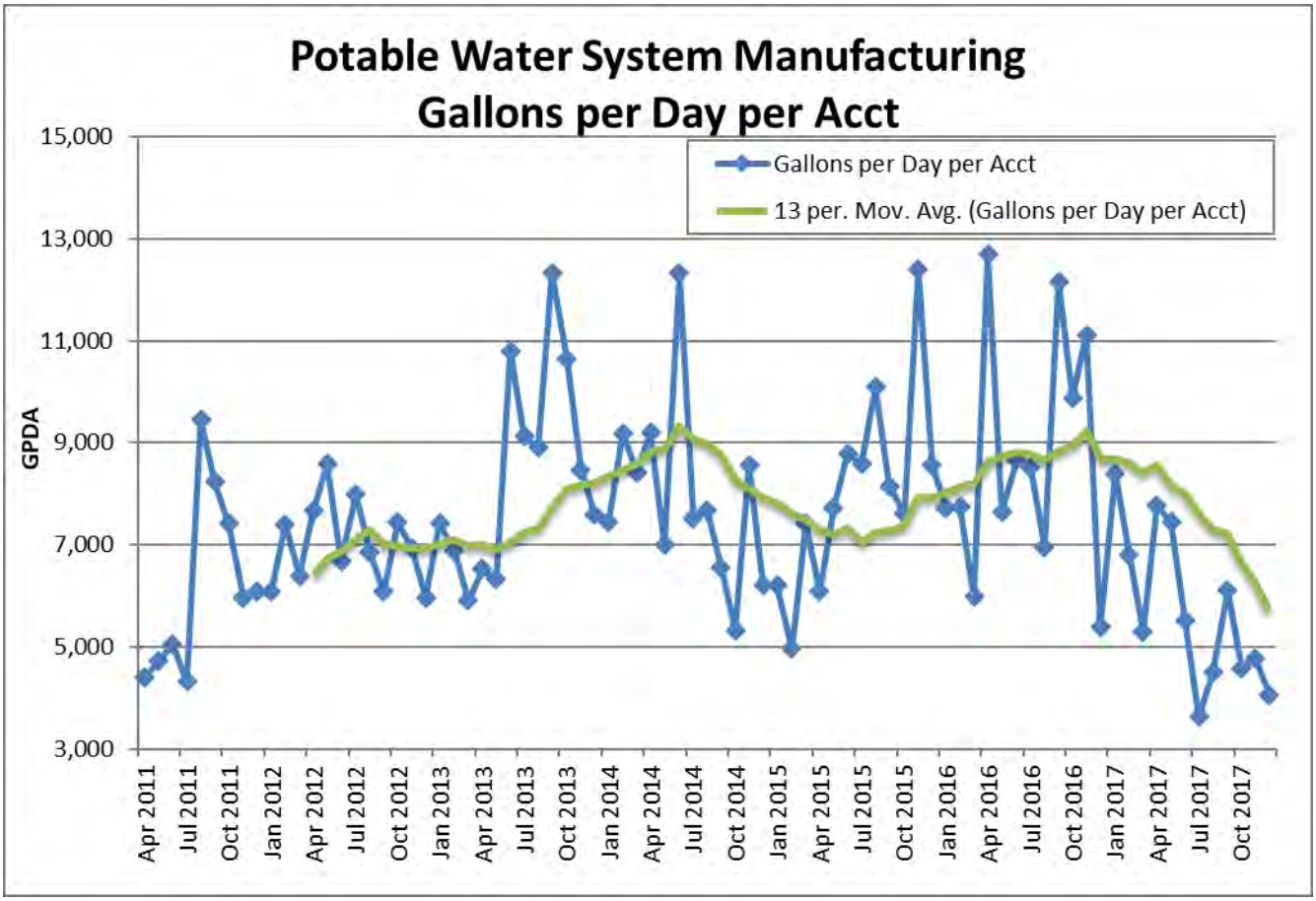
Potable Water System Manufacturing
Gallons per Day per Acct
GPDA
15,000
13,000
11,000
9,000
7,000
5,000
3,000
Gallons per Day per Acct
13 per. Mov. Avg. (Gallons per Day per Acct)
Apr 2011
Jul 2011
Oct 2011
Jan 2012
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Jul 2012
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Jan 2013
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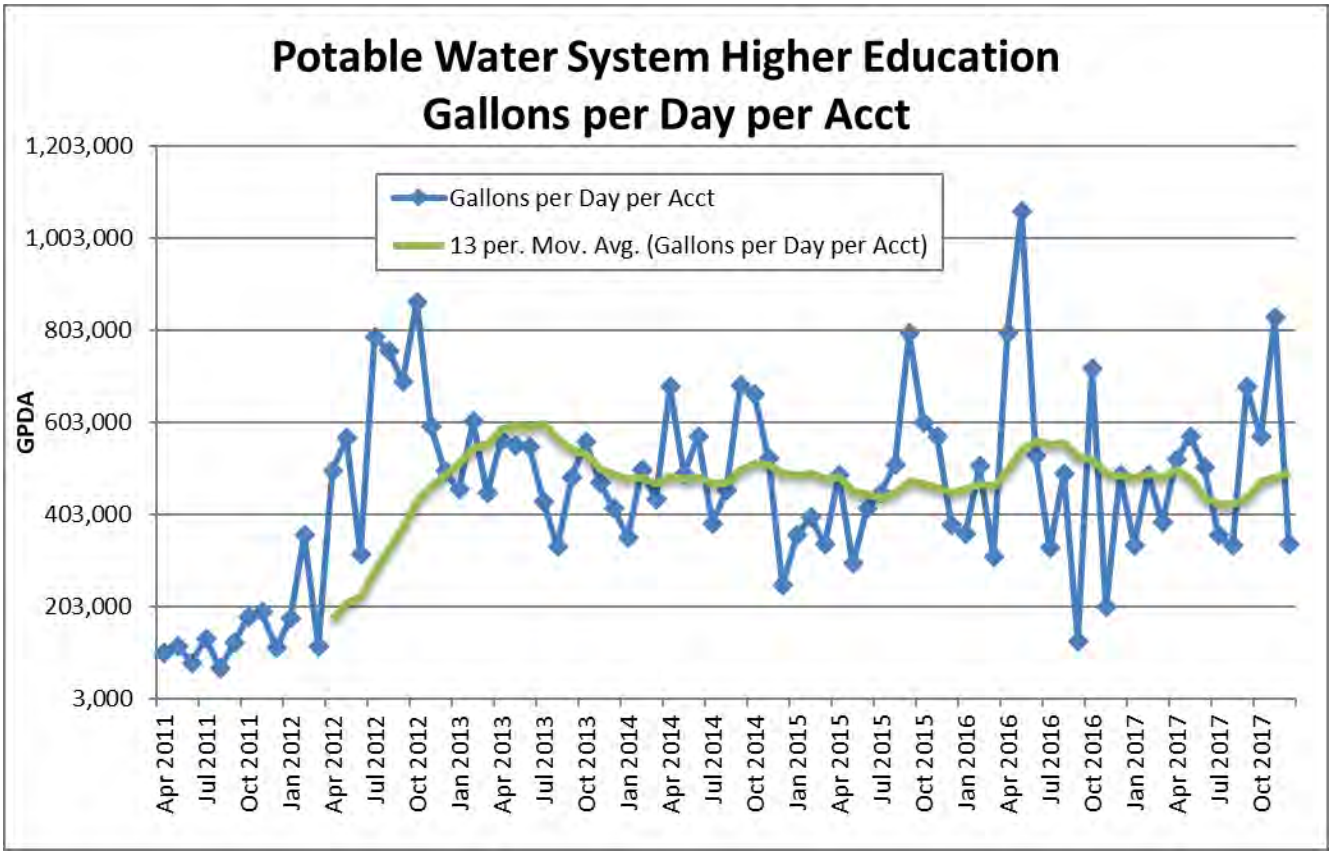
Oct 2017


Potable Water System Higher Education
Gallons per Day per Acct
GPDA
1,203,000
1,003,000
803,000
603,000
403,000
203,000
3,000
Gallons per Day per Acct
13 per. Mov. Avg. (Gallons per Day per Acct)
Apr 2011
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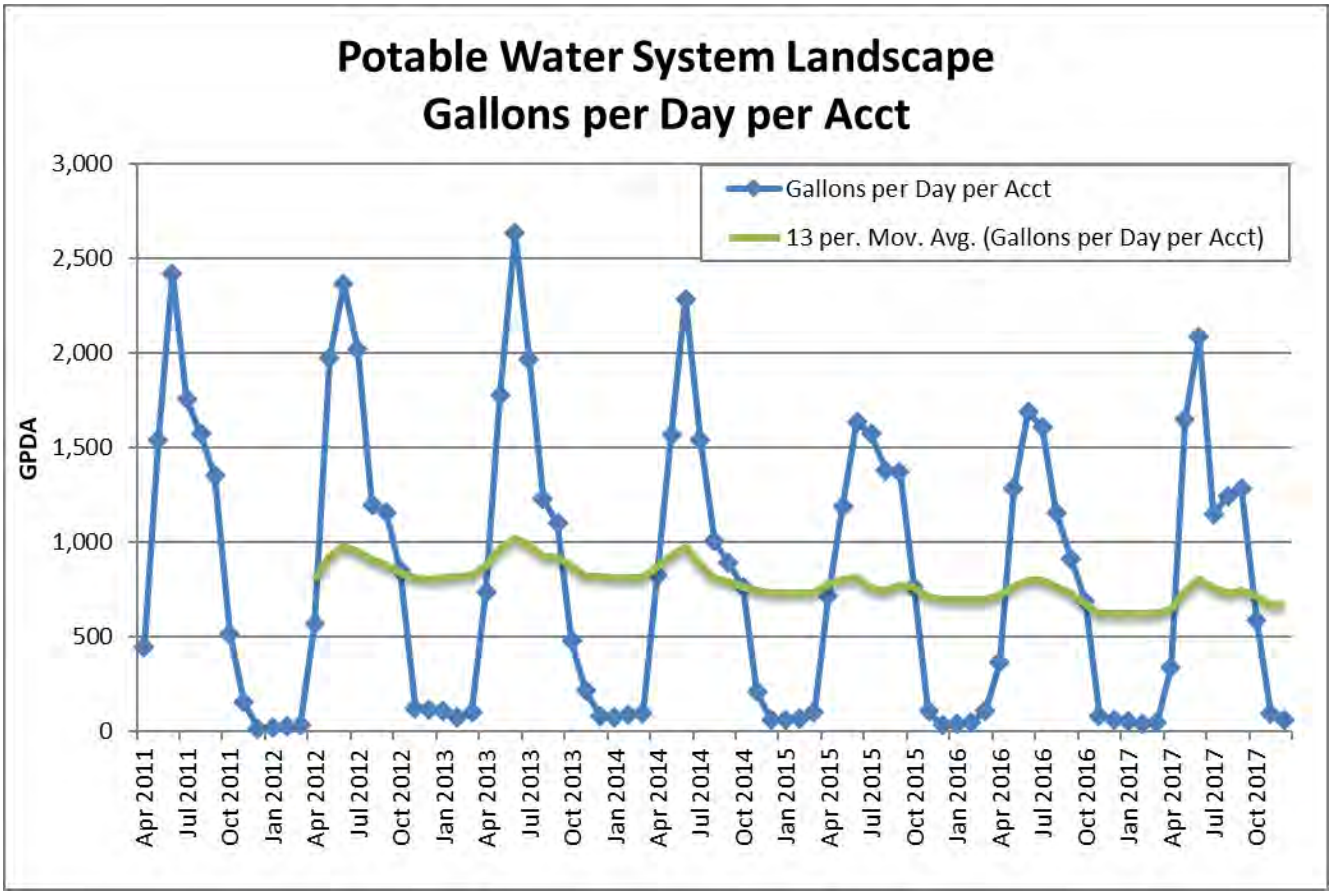
Potable Water System Landscape
Gallons per Day per Acct
GPDA
3,000
2,500
2,000
1,500
1,000
500
0
Gallons per Day per Acct
13 per. Mov. Avg. (Gallons per Day per Acct)
Apr 2011
Jul 2011
Oct 2011
Jan 2012
Apr 2012
Jul 2012
Oct 2012
Jan 2013
Apr 2013
Jul 2013
Oct 2013
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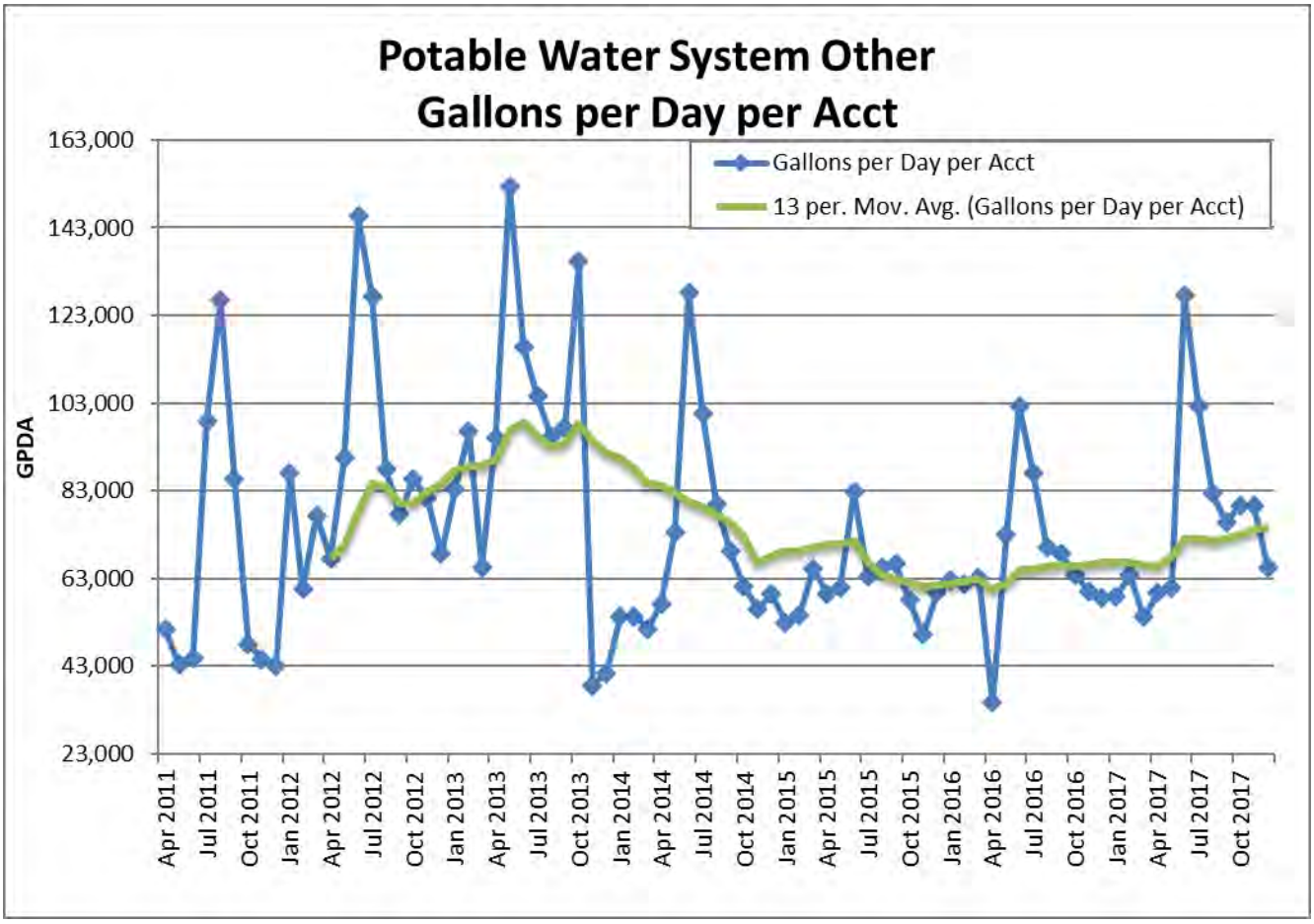
Potable Water System Other
Gallons per Day per Acct
GPDA
163,000
143,000
123,000
103,000
83,000
63,000
43,000
23,000
Gallons per Day per Acct
13 per. Mov. Avg. (Gallons per Day per Acct)
Apr 2011
Jul 2011
Oct 2011
Jan 2012
Apr 2012
Jul 2012
Oct 2012
Jan 2013
Apr 2013
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Oct 2016
Jan 2017
Apr 2017
Jul 2017
Oct 2017

APPENDIX C – CONSERVATION ANALYSIS RESULTS

The following table shows the estimated annual savings in acre-feet per year in five-year increments for plumbing codes only with no active conservation activity and for plumbing codes with the Current and Optimized Conservation Programs. City and customer benefit-cost ratios are presented for each program as well as the present value of water savings and utility costs.

Table C-1. Potable Water System Conservation Program Estimated Costs and Water Savings Comparison

Conservation Program	Water Savings (AFY)					Water Utility Benefit-Cost Ratio	Water Utility Present Value of Water Savings	Water Utility Present Value of Utility Costs	Water Utility Cost of Water Saved ($/AF)
	2020	2025	2030	2035	2040				
Plumbing Code Only	100	370	650	960	1,300	N/A	N/A	N/A	N/A
Current Conservation Program with Plumbing Code	230	590	880	1,100	1,330	1.7	$8,842,000	$5,345,000	$300
Optimized Conservation Program with Plumbing Code	270	840	1,330	1,670	2,020	1.8	$13,331,000	$7,347,000	$280

Notes:

1. Costs presented here are directly attributable to the City only.
2. Present value costs and savings are rounded to the nearest $1,000.

APPENDIX D – PUBLIC OUTREACH DETAILS

This Appendix contains details about public outreach efforts conducted over the strategic planning process.

D.1 Open House – Flagstaff Festival of Science 2018

At an open house during the 2018 Flagstaff Festival of Science, members of the public were asked to place dot votes on their favorite measures on a set of posters. The water droplet symbols on the posters indicated current measures. Members of the Water Resources Section were available to answer questions at the event.

Figure D-1. Open House Dot Vote Posters

D.2 Advisory Committee and Stakeholder Group Meetings

The Advisory Committee met on these dates:

- September 12th, 2018
- November 27th, 2018
- December 18th, 2018
- October 9th, 2019
- February 6th, 2020

The Stakeholder Group met on the following dates:

- February 26th, 2019
- October 23rd, 2019
- March 12th, 2020

D.3 SurveyMonkey Survey

Figure D-2. Image of Survey Open to Public

The City of Flagstaff Water Conservation Program is undergoing a strategic planning process during 2018 and 2019. We're asking you to help us evaluate different water conserving actions we might take in the future.

Your responses to this survey are anonymous. If you have questions or feedback, please contact us at savewater@flagstaffaz.gov or (928) 213-2116

* 1. In the future in Flagstaff I want to see ... (please select 20 options)

- ☐ Lawns are replaced with plants that use little to no water
- ☐ City of Flagstaff helps customers calculate appropriate water use for a healthy landscape
- ☐ Customers can only water their lawns every other day based on their address
- ☐ Stormwater is captured for outdoor use on new developments
- ☐ Rainwater harvesting systems are eligible for rebates
- ☐ City of Flagstaff regularly checks the water system for leaks and wasted water
- ☐ Water meters can provide water use data minute by minute instead of once a month
- ☐ Outdoor water use is billed at a higher rate than indoor water use
- ☐ New building plans are reviewed for water efficiency opportunities
- ☐ All government buildings use water efficient practices and fixtures
- ☐ City of Flagstaff provides water conservation information at community events and online
- ☐ Demonstration gardens educate the public on the benefits of low water landscapes
- ☐ Free training is provided for landscapers on outdoor water conservation methods
- ☐ All school buildings use water efficient practices and fixtures
- ☐ City of Flagstaff enforces regulations that address water wasting practices
- ☐ New developments must have a dedicated water meter for irrigation
- ☐ Irrigation professionals are required to be certified in water efficiency practices
- ☐ Other (please specify)
- ☐ Landscaping design standards for new buildings are water efficient and climate appropriate
- ☐ New developments must have water efficient showerheads and faucets
- ☐ Water from sinks and showers can be reused to flush toilets
- ☐ Businesses are given rebates to improve water efficiency
- ☐ Hotels and motels are targeted to improve water efficiency
- ☐ Water conservation staff are available to provide in-person water checkups for businesses
- ☐ Golf courses are targeted to improve water efficiency
- ☐ Cooling towers are targeted to improve water efficiency
- ☐ Individual water meters are installed for each apartment in a building and each business in a strip mall to track water usage
- ☐ Water efficient irrigation systems are eligible for rebates
- ☐ Water efficient washing machines are eligible for rebates
- ☐ Water efficient toilets and urinals are eligible for rebates
- ☐ Water efficient spray nozzles for dish washing are given to restaurants and commercial kitchens
- ☐ Water efficient showerheads and aerators are given to the public
- ☐ Hot water recirculators that save water (by delivering hot water instantly to water fixtures) are eligible for rebates
- ☐ Low income customers can receive financial assistance to fix water leaks
- ☐ Water conservation staff are available to provide in-home water checkups for residents

D.4 Festival of Science 2019

At the 2019 Festival of Science – Science in the Park, staff administered a survey to participants, asking them to select measures to insert into the Optimized Conservation Program.

Figure D-3 Public Survey – Measures for Optimized Conservation Program (FRONT)

Water Conserving Actions	Daily Water Savings	Annual Cost	Pick 3
Efficient Toilet Rebates	💧💧	$$	
Commercial Rebates and Consultations	💧💧	$$$	
Government Building Retrofits	💧	$	
Leak Assistance for Low Income Customers	💧	$	
Hot Water Recirculation Retrofits	💧	$	
Outdoor Water Budgeting for Large Lawns	💧💧	$$	
School Retrofits (K12 and college)	💧💧	$$	
Low Water Landscape Rebates	💧	$$	
Rainwater Container Rebate	💧💧	$$	
Submetering	💧	$	

💧 0 - 10k gals	**$ 0-10k**
💧💧 10-100k gals	**$$ 10-25k**
💧💧💧 100k+ gals	**$$$ 25k+**

Figure D-4 Public Survey – Measures for Optimized Conservation Program (BACK)

Water Conserving Actions	Daily Water Savings	Annual Cost
Tiered Rates for Residential	💧💧💧	$$
Check System for Leaks & Repair	💧💧💧	$$$
Community Outreach	💧💧	$ $$
Enforce Watering Code	💧	$
Residential Water Consultations	💧	$
Give Away Efficient Showerheads and Aerators	💧💧	$
Landscape and Rainwater Retention Code	💧💧💧	$
Efficient Showerhead and Faucet Code	💧💧💧	$
Utilize SmartMeters	💧💧💧	$$$
Hot Water Recirculation Code	💧💧💧	$
Innovation and Pilot Projects	💧	$$

💧 0 - 10k gals	**$ 0-10k**
💧💧 10-100k gals	**$$ 10-25k**
💧💧💧 100k+ gals	**$$$ 25k+**

APPENDIX E – DSS MODEL INDIVIDUAL CONSERVATION MEASURE DESIGN INPUTS AND RESULTS FOR POTABLE WATER SYSTEM

Public Outreach and School Education

Overview

Name	Public Outreach and School Education
Abbr	Outreach
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2018
Last Year	2040
Measure Length	23

Measure Life

Permanent	☐
Years	2
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$5.00	$0.00	4
SF	$5.00	$0.00	1

Administration Costs

Method: Percent

Markup Percentage	50%

Description

This measure includes promotional items, time spent on tabling, the annual Water Awareness Month efforts, and the annual partnership with Arizona Project WET. Does not include aerators, showerheads, pre rinse spray nozzles, and hose nozzles giveaway. Outreach regarding the National Mayor's Challenge for Water Conservation Award is also encompassed.

Customer Classes

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☑	☑							
Urinals									
Lavatory Faucets	☑	☑							
Showers	☑	☑							
Dishwashers	☑	☑							
Clothes Washers	☑	☑							
Process									
Kitchen Spray Rinse									
Internal Leakage	☑	☑							
Baths	☑	☑							
Other	☑	☑							
Irrigation	☑	☑							
Pools	☐	☐							
Wash Down	☑	☑							
Cooling									
Car Washing	☑	☑							
External Leakage	☑	☑							
Outdoor									
Non-Lavatory/Kitchen Faucets	☑	☑							

Comments

Savings basis: industry standard
> Find cost basis on black-tabbed worksheet "2019 Measure Cost Basis"
> Pools are unlikely to be affected - very few outdoor pools in Flagstaff.
> COF estimates 50%-75% of the residential community is "touched" annually via outreach per year, including CityScape, social media, street banners, etc.

Results

Units: MG

Average Water Savings (mgd)	
0.044363	
Lifetime Savings - Present Value ($)	
Utility	$698,959
Community	$1,316,929
Lifetime Costs - Present Value ($)	
Utility	$1,997,211
Community	$1,997,211
Benefit to Cost Ratio	
Utility	0.35
Community	0.66
Cost of Savings per Unit Volume ($/mg)	
Utility	$5,359

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Toilets	1.0%	102.6
SF Toilets	1.0%	23.2
MF Lavatory Faucets	1.0%	25.7
SF Lavatory Faucets	1.0%	8.1
MF Showers	1.0%	124.0
SF Showers	1.0%	25.7
MF Dishwashers	1.0%	4.3
SF Dishwashers	1.0%	2.3
MF Clothes Washers	1.0%	72.7
SF Clothes Washers	1.0%	19.1
MF Internal Leakage	1.0%	34.2
SF Internal Leakage	1.0%	15.1
MF Baths	1.0%	8.6
SF Baths	1.0%	3.5
MF Other	1.0%	8.6
SF Other	1.0%	3.8
MF Irrigation	1.0%	25.2
SF Irrigation	1.0%	39.4
MF Wash Down	1.0%	1.2
SF Wash Down	1.0%	1.9
MF Car Washing	1.0%	1.2
SF Car Washing	1.0%	1.9
MF External Leakage	1.0%	2.1
SF External Leakage	1.0%	3.3
MF Non-Lavatory/Kitchen Faucets	1.0%	47.0
SF Non-Lavatory/Kitchen Faucets	1.0%	15.1

Targets

Target Method: Percentage

% of Accts Targeted / yr	50.000%
Only Effects New Accts	☐

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$67,760	$33,880	$101,640
2019	$69,251	$34,626	$103,877
2020	$70,774	$35,387	$106,161
2021	$72,332	$36,166	$108,498
2022	$73,923	$36,961	$110,884
2023	$75,549	$37,774	$113,323
2024	$77,211	$38,605	$115,816
2025	$78,910	$39,455	$118,365
2026	$80,646	$40,323	$120,969
2027	$82,420	$41,210	$123,629
2028	$84,233	$42,117	$126,350
2029	$86,086	$43,043	$129,129
2030	$87,980	$43,990	$131,970
2031	$89,916	$44,958	$134,873
2032	$91,894	$45,947	$137,841
2033	$93,916	$46,958	$140,874
2034	$95,981	$47,991	$143,972
2035	$98,093	$49,047	$147,140
2036	$100,251	$50,126	$150,377
2037	$102,457	$51,228	$153,685
2038	$104,711	$52,355	$157,066
2039	$107,014	$53,507	$160,521
2040	$109,369	$54,684	$164,053

Targets

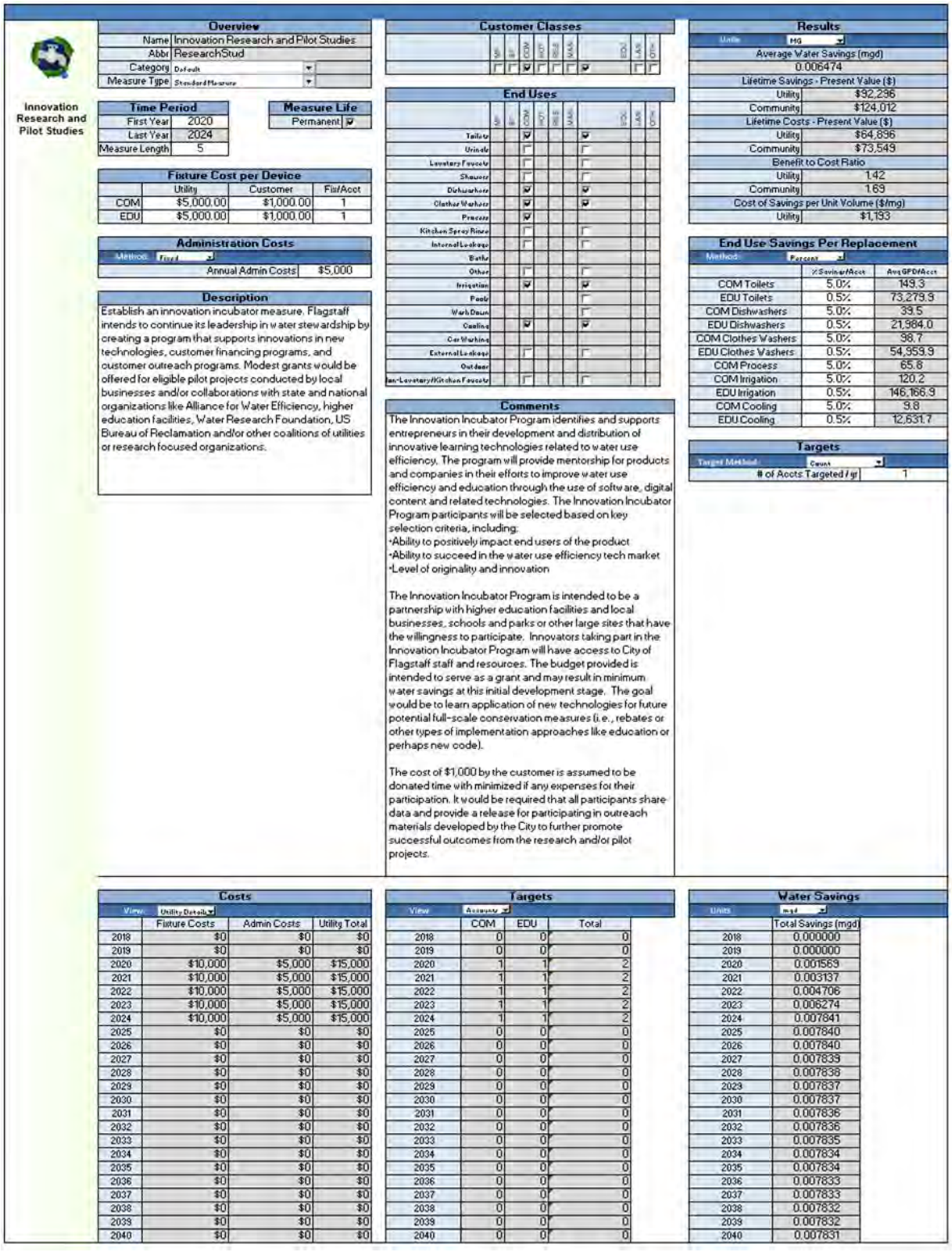
View: Accounts

	MF	SF	Total
2018	1,470	7,672	9,142
2019	1,502	7,841	9,343
2020	1,535	8,013	9,549
2021	1,569	8,190	9,759
2022	1,604	8,370	9,973
2023	1,639	8,554	10,193
2024	1,675	8,742	10,417
2025	1,712	8,934	10,646
2026	1,750	9,131	10,881
2027	1,788	9,332	11,120
2028	1,827	9,537	11,365
2029	1,868	9,747	11,615
2030	1,909	9,961	11,870
2031	1,951	10,181	12,131
2032	1,994	10,405	12,398
2033	2,037	10,633	12,671
2034	2,082	10,867	12,950
2035	2,128	11,106	13,234
2036	2,175	11,351	13,526
2037	2,223	11,600	13,823
2038	2,272	11,856	14,127
2039	2,322	12,116	14,438
2040	2,373	12,383	14,756

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.019192
2019	0.038504
2020	0.039053
2021	0.039619
2022	0.040204
2023	0.040806
2024	0.041426
2025	0.042064
2026	0.042719
2027	0.043391
2028	0.044079
2029	0.044784
2030	0.045505
2031	0.046243
2032	0.047001
2033	0.047780
2034	0.048579
2035	0.049398
2036	0.050239
2037	0.051099
2038	0.051979
2039	0.052880
2040	0.053802



Innovation Research and Pilot Studies

Overview

Name	Innovation Research and Pilot Studies
Abbr	ResearchStud
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2020
Last Year	2024
Measure Length	5

Measure Life

Permanent ☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
COM	$5,000.00	$1,000.00	1
EDU	$5,000.00	$1,000.00	1

Administration Costs

Method: Fixed

Annual Admin Costs	$5,000

Description

Establish an innovation incubator measure. Flagstaff intends to continue its leadership in water stewardship by creating a program that supports innovations in new technologies, customer financing programs, and customer outreach programs. Modest grants would be offered for eligible pilot projects conducted by local businesses and/or collaborations with state and national organizations like Alliance for Water Efficiency, higher education facilities, Water Research Foundation, US Bureau of Reclamation and/or other coalitions of utilities or research focused organizations.

Customer Classes

SIN	SFI	COM	INST	RES	MAN	EDU	LAN	OTH
☐	☐	☑	☐	☐	☐	☑	☐	☐

End Uses

	SIN	SFI	COM	INST	RES	MAN	EDU	LAN	OTH
Toilets			☑				☑		
Urinals			☐				☐		
Lavatory Faucets			☐				☐		
Showers			☐				☐		
Dishwashers			☑				☑		
Clothes Washers			☑				☑		
Process			☑						
Kitchen Spray Rinse			☐				☐		
Internal Leakage			☐				☐		
Baths									
Other			☐				☐		
Irrigation			☑				☑		
Pools							☐		
Wash Down							☐		
Cooling			☑				☑		
Car Washing									
External Leakage			☐				☐		
Outdoor									
Non-Lavatory/Kitchen Faucets			☐				☐		

Comments

The Innovation Incubator Program identifies and supports entrepreneurs in their development and distribution of innovative learning technologies related to water use efficiency. The program will provide mentorship for products and companies in their efforts to improve water use efficiency and education through the use of software, digital content and related technologies. The Innovation Incubator Program participants will be selected based on key selection criteria, including:

- Ability to positively impact end users of the product
- Ability to succeed in the water use efficiency tech market
- Level of originality and innovation

The Innovation Incubator Program is intended to be a partnership with higher education facilities and local businesses, schools and parks or other large sites that have the willingness to participate. Innovators taking part in the Innovation Incubator Program will have access to City of Flagstaff staff and resources. The budget provided is intended to serve as a grant and may result in minimum water savings at this initial development stage. The goal would be to learn application of new technologies for future potential full-scale conservation measures (i.e., rebates or other types of implementation approaches like education or perhaps new code).

The cost of $1,000 by the customer is assumed to be donated time with minimized if any expenses for their participation. It would be required that all participants share data and provide a release for participating in outreach materials developed by the City to further promote successful outcomes from the research and/or pilot projects.

Results

Units: MG

Average Water Savings (mgd)	
	0.006474
Lifetime Savings - Present Value ($)	
Utility	$92,236
Community	$124,012
Lifetime Costs - Present Value ($)	
Utility	$64,896
Community	$73,549
Benefit to Cost Ratio	
Utility	1.42
Community	1.69
Cost of Savings per Unit Volume ($/mg)	
Utility	$1,193

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
COM Toilets	5.0%	149.3
EDU Toilets	0.5%	73,279.9
COM Dishwashers	5.0%	33.5
EDU Dishwashers	0.5%	21,984.0
COM Clothes Washers	5.0%	38.7
EDU Clothes Washers	0.5%	54,959.9
COM Process	5.0%	65.8
COM Irrigation	5.0%	120.2
EDU Irrigation	0.5%	146,166.9
COM Cooling	5.0%	9.8
EDU Cooling	0.5%	12,631.7

Targets

Target Method: Count

# of Accts Targeted / yr	1

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$10,000	$5,000	$15,000
2021	$10,000	$5,000	$15,000
2022	$10,000	$5,000	$15,000
2023	$10,000	$5,000	$15,000
2024	$10,000	$5,000	$15,000
2025	$0	$0	$0
2026	$0	$0	$0
2027	$0	$0	$0
2028	$0	$0	$0
2029	$0	$0	$0
2030	$0	$0	$0
2031	$0	$0	$0
2032	$0	$0	$0
2033	$0	$0	$0
2034	$0	$0	$0
2035	$0	$0	$0
2036	$0	$0	$0
2037	$0	$0	$0
2038	$0	$0	$0
2039	$0	$0	$0
2040	$0	$0	$0

Targets

View: Accounts

	COM	EDU	Total
2018	0	0	0
2019	0	0	0
2020	1	1	2
2021	1	1	2
2022	1	1	2
2023	1	1	2
2024	1	1	2
2025	0	0	0
2026	0	0	0
2027	0	0	0
2028	0	0	0
2029	0	0	0
2030	0	0	0
2031	0	0	0
2032	0	0	0
2033	0	0	0
2034	0	0	0
2035	0	0	0
2036	0	0	0
2037	0	0	0
2038	0	0	0
2039	0	0	0
2040	0	0	0

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.001569
2021	0.003137
2022	0.004706
2023	0.006274
2024	0.007841
2025	0.007840
2026	0.007840
2027	0.007839
2028	0.007838
2029	0.007837
2030	0.007837
2031	0.007836
2032	0.007836
2033	0.007835
2034	0.007834
2035	0.007834
2036	0.007833
2037	0.007833
2038	0.007832
2039	0.007832
2040	0.007831

Prohibit Water Waste and Practices

Overview

Name	Prohibit Water Waste and Practices
Abbr	Enforce
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2018
Last Year	2040
Measure Length	23

Measure Life

Permanent	☐
Years	2
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$1.25	$0.00	1
SF	$1.25	$0.00	1
COM	$1.25	$0.00	1
HOT	$1.25	$0.00	1
RES	$1.25	$0.00	1
LAN	$1.25	$0.00	1

Administration Costs

Method: Fixed

Annual Admin Costs	$7,500

Description

This measure involves assisting customers reduce water waste. As part of Strategy Level I Water Awareness when water demand is equal to or less than safe water production capability, this measure includes every other day watering. Odd-numbered addresses may irrigate Tues, Thur, and Sat; even-numbered Wed, Fri, and Sun. No irrigation Mon. No irrigation between 9AM-5PM. Vehicle washing is allowed; spray-control nozzles and buckets are encouraged. Noncompliance could result in a $25 fee.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☑	☑	☑	☑	☐	☐	☑	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐	☐	☐	☐				
Urinals			☐	☐					
Lavatory Faucets	☐	☐	☐	☐	☐				
Showers	☐	☐	☐	☐					
Dishwashers	☐	☐	☐	☐	☐				
Clothes Washers	☐	☐	☐	☐	☐				
Process			☐						
Kitchen Spray Rinse			☐	☐	☐				
Internal Leakage	☐	☐	☐	☐	☐				
Baths	☐	☐		☐					
Other	☐	☐	☐	☐	☐				
Irrigation	☑	☑	☑	☑	☑			☑	
Pools	☐	☐		☐					
Wash Down	☐	☐		☐	☐				
Cooling			☐	☐	☐				
Car Washing	☑	☑							
External Leakage	☑	☑	☑	☑	☑			☑	
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐	☐	☐	☐				

Comments

> http://flagstaff.az.gov/104/Watering-Rules
> Incidental hand watering is allowed daily except between 9 am and 5 pm. Hand watering requires that the conveyance (hose, bucket, etc.) be in hand for the duration of a watering session; hoses running freely or sprinklers attached to hoses are not considered hand watering.
> Almost entirety of this measure is administrative costs - find cost basis on black-tabbed worksheet "2019 Measure Cost Basis"
> Measure life of 2 years based on COF experience of significant frequent re-engagement with customers on these issues.
> Target based on 2018 engagement.
> Very few customers are fined, and few have costs to address notifications so there is no customer cost estimated.
> Wash down use is only regulated during Stage 2 drought.

Results

Units: MG

Average Water Savings (mgd)	
	0.007983
Lifetime Savings - Present Value ($)	
Utility	$106,665
Community	$106,665
Lifetime Costs - Present Value ($)	
Utility	$128,789
Community	$128,789
Benefit to Cost Ratio	
Utility	0.83
Community	0.83
Cost of Savings per Unit Volume ($/mg)	
Utility	$1,920

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Irrigation	10.0%	25.2
SF Irrigation	10.0%	39.4
COM Irrigation	10.0%	120.2
HOT Irrigation	10.0%	1,135.0
RES Irrigation	10.0%	156.5
LAN Irrigation	10.0%	716.5
MF Car Washing	1.0%	1.2
SF Car Washing	1.0%	1.9
MF External Leakage	40.0%	2.1
SF External Leakage	40.0%	3.3
COM External Leakage	40.0%	9.8
HOT External Leakage	40.0%	98.1
RES External Leakage	40.0%	13.5
LAN External Leakage	40.0%	53.9

Targets

Target Method: Percentage

% of Accts Targeted / yr	2.000%
Only Effects New Accts	☐

Costs

View: Utility Detail

	Fixture Costs	Admin Costs	Utility Total
2018	$505	$7,500	$8,005
2019	$516	$7,500	$8,016
2020	$528	$7,500	$8,028
2021	$539	$7,500	$8,039
2022	$551	$7,500	$8,051
2023	$563	$7,500	$8,063
2024	$576	$7,500	$8,076
2025	$588	$7,500	$8,088
2026	$601	$7,500	$8,101
2027	$614	$7,500	$8,114
2028	$628	$7,500	$8,128
2029	$642	$7,500	$8,142
2030	$656	$7,500	$8,156
2031	$670	$7,500	$8,170
2032	$685	$7,500	$8,185
2033	$700	$7,500	$8,200
2034	$716	$7,500	$8,216
2035	$731	$7,500	$8,231
2036	$747	$7,500	$8,247
2037	$764	$7,500	$8,264
2038	$781	$7,500	$8,281
2039	$798	$7,500	$8,298
2040	$815	$7,500	$8,315

Targets

View: Accounts

	MF	SF	COM	HOT	RES	LAN	Total
2018	59	307	28	2	3	6	404
2019	60	314	28	2	3	7	413
2020	61	321	29	2	3	7	422
2021	63	328	29	2	3	7	431
2022	64	335	30	2	3	7	441
2023	66	342	31	2	3	7	451
2024	67	350	31	2	3	7	461
2025	68	357	32	2	3	7	471
2026	70	365	33	2	3	8	481
2027	72	373	34	2	3	8	492
2028	73	381	34	2	3	8	502
2029	75	390	35	2	3	8	513
2030	76	398	36	2	3	8	525
2031	78	407	37	2	3	9	536
2032	80	416	37	2	4	9	548
2033	81	425	38	3	4	9	560
2034	83	435	39	3	4	9	572
2035	85	444	40	3	4	9	585
2036	87	454	41	3	4	10	598
2037	89	464	42	3	4	10	611
2038	91	474	43	3	4	10	625
2039	93	485	44	3	4	10	638
2040	95	495	45	3	4	10	652

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.003197
2019	0.006463
2020	0.006606
2021	0.006751
2022	0.006899
2023	0.007051
2024	0.007206
2025	0.007365
2026	0.007527
2027	0.007693
2028	0.007862
2029	0.008035
2030	0.008211
2031	0.008392
2032	0.008577
2033	0.008765
2034	0.008958
2035	0.009155
2036	0.009357
2037	0.009563
2038	0.009773
2039	0.009988
2040	0.010208

System Water Loss Control

Overview	
Name	System Water Loss Control
Abbr	Loss
Category	Default
Measure Type	Water Loss Measure

Time Period	
First Year	2018

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

Maintenance Costs	
Annual Maintenance Costs	$50,000

Target	
Total GPCD Reduction	3.0

Description

The following water loss management elements are included in this measure: annual system water use accounting; annual computation of ILI; system pressure regulation.

Results

Units: MG

Average Water Savings (mgd)	
0.240733	
Lifetime Savings - Present Value ($)	
Utility	$3,017,691
Community	$3,017,691
Lifetime Costs - Present Value ($)	
Utility	$1,219,003
Community	$1,219,003
Benefit to Cost Ratio	
Utility	2.48
Community	2.48
Cost of Savings per Unit Volume ($/mg)	
Utility	$603

Comments

> COF's Leak Detection Program $30,000/year - outsourced. Approximately $25,000 for COF staff repairs. These costs represent the maintenance costs.
> Backlog Costs are assumed over 10 years at $1,000,000 attributed to water use efficiency (includes a water loss study)
> GPCD target assumes a 1% reduction in NRW within 5-10 years.
> Annual Waterline Replacement. 10 years to reach COF goal of replacing water pipelines every 70 years at a budget of $250/sq. ft.
> Customer meter replacement. 50% of meters are beyond useful life. Meter replacement program goal is every 15 years.
> Hydrant Replacement Program is $45,000/year. Replacing or repairing hydrants 50-60 years old. >Ongoing $4.383 million per year for aging infrastructure between 2030 - 2039
> City Water Meter Calibration Program – is funded approx. every 5 years. Assume a $50,000 study every 5 years
> Every 5 years, $75,000 for a water loss control study, followed by $75,000 for implementation of the results.

Costs

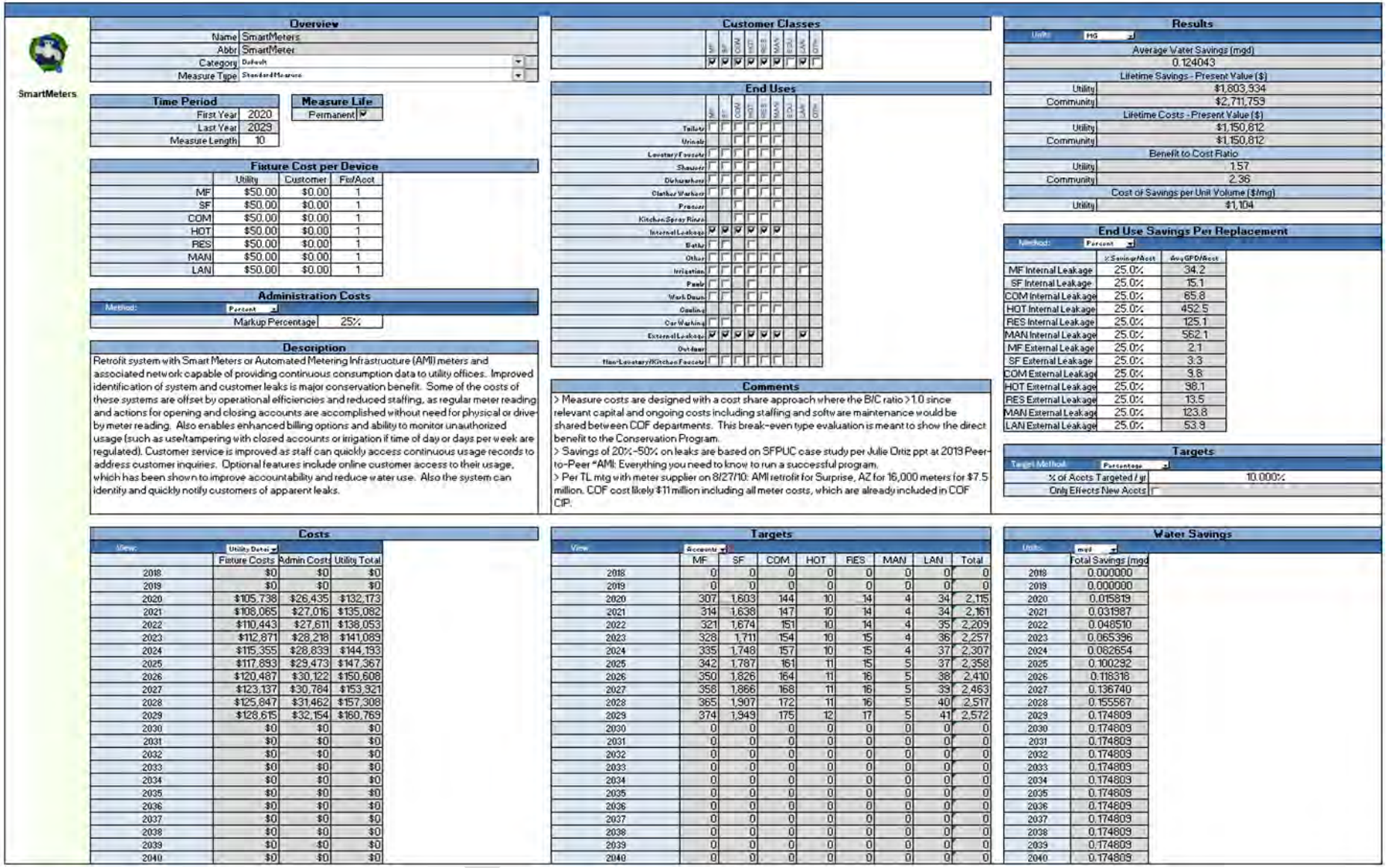
	Utility
2018	$100,000
2019	$100,000
2020	$100,000
2021	$100,000
2022	$100,000
2023	$100,000
2024	$100,000
2025	$100,000
2026	$100,000
2027	$100,000
2028	$50,000
2029	$50,000
2030	$50,000
2031	$50,000
2032	$50,000
2033	$50,000
2034	$50,000
2035	$50,000
2036	$50,000
2037	$50,000
2038	$50,000
2039	$50,000
2040	$50,000

Targets

	Projected NRW Percent
2018	10.9%
2019	10.8%
2020	10.7%
2021	10.6%
2022	10.5%
2023	10.4%
2024	10.3%
2025	10.2%
2026	10.1%
2027	10.0%
2028	10.0%
2029	10.0%
2030	10.0%
2031	10.0%
2032	10.0%
2033	10.0%
2034	10.0%
2035	10.0%
2036	10.0%
2037	10.0%
2038	10.0%
2039	10.0%
2040	10.0%

Water Savings (MG/d)

	Total Savings
2018	0.022370
2019	0.045724
2020	0.070095
2021	0.095516
2022	0.122022
2023	0.149647
2024	0.178429
2025	0.208406
2026	0.239614
2027	0.272094
2028	0.278082
2029	0.284199
2030	0.290451
2031	0.296841
2032	0.303372
2033	0.310047
2034	0.316866
2035	0.323838
2036	0.330963
2037	0.338244
2038	0.345684
2039	0.353289
2040	0.361062



SmartMeters

Overview

Name	SmartMeters
Abbr	SmartMeter
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2020
Last Year	2029
Measure Length	10

Measure Life

Permanent ☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$50.00	$0.00	1
SF	$50.00	$0.00	1
COM	$50.00	$0.00	1
HOT	$50.00	$0.00	1
RES	$50.00	$0.00	1
MAN	$50.00	$0.00	1
LAN	$50.00	$0.00	1

Administration Costs

Method: Percent

Markup Percentage	25%

Description

Retrofit system with Smart Meters or Automated Metering Infrastructure (AMI) meters and associated network capable of providing continuous consumption data to utility offices. Improved identification of system and customer leaks is major conservation benefit. Some of the costs of these systems are offset by operational efficiencies and reduced staffing, as regular meter reading and actions for opening and closing accounts are accomplished without need for physical or drive-by meter reading. Also enables enhanced billing options and ability to monitor unauthorized usage (such as use/tampering with closed accounts or irrigation if time of day or days per week are regulated). Customer service is improved as staff can quickly access continuous usage records to address customer inquiries. Optional features include online customer access to their usage, which has been shown to improve accountability and reduce water use. Also the system can identify and quickly notify customers of apparent leaks.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☑	☑	☑	☑	☑	☐	☑	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐	☐	☐	☐	☐			
Urinals			☐	☐	☐	☐			
Lavatory Faucets	☐	☐	☐	☐	☐	☐			
Showers	☐	☐	☐	☐	☐				
Dishwashers	☐	☐	☐	☐	☐	☐			
Clothes Washers	☐	☐	☐	☐	☐	☐			
Process			☐	☐		☐			
Kitchen Spray Rinse			☐	☐	☐				
Internal Leakage	☑	☑	☑	☑	☑	☑			
Baths	☐	☐		☐					
Other	☐	☐	☐	☐	☐	☐			
Irrigation	☐	☐	☐	☐	☐	☐		☐	
Pools	☐	☐		☐					
Wash Down	☐	☐		☐	☐				
Cooling			☐	☐	☐	☐			
Car Washing	☐	☐							
External Leakage	☑	☑	☑	☑	☑	☑		☑	
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐	☐	☐	☐	☐			

Comments

> Measure costs are designed with a cost share approach where the B/C ratio > 1.0 since relevant capital and ongoing costs including staffing and softw are maintenance would be shared between COF departments. This break-even type evaluation is meant to show the direct benefit to the Conservation Program.
> Savings of 20%-50% on leaks are based on SFPUC case study per Julie Ortiz ppt at 2013 Peer-to-Peer "AMI: Everything you need to know to run a successful program.
> Per TL mtg with meter supplier on 8/27/10: AMI retrofit for Surprise, AZ for 16,000 meters for $7.5 million. COF cost likely $11 million including all meter costs, which are already included in COF CIP.

Results

Units: MG

Average Water Savings (mgd)	
	0.124043
Lifetime Savings - Present Value ($)	
Utility	$1,803,934
Community	$2,711,753
Lifetime Costs - Present Value ($)	
Utility	$1,150,812
Community	$1,150,812
Benefit to Cost Ratio	
Utility	1.57
Community	2.36
Cost of Savings per Unit Volume ($/mg)	
Utility	$1,104

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Internal Leakage	25.0%	34.2
SF Internal Leakage	25.0%	15.1
COM Internal Leakage	25.0%	65.8
HOT Internal Leakage	25.0%	452.5
RES Internal Leakage	25.0%	125.1
MAN Internal Leakage	25.0%	562.1
MF External Leakage	25.0%	2.1
SF External Leakage	25.0%	3.3
COM External Leakage	25.0%	9.8
HOT External Leakage	25.0%	98.1
RES External Leakage	25.0%	13.5
MAN External Leakage	25.0%	123.8
LAN External Leakage	25.0%	53.9

Targets

Target Method: Percentage

% of Accts Targeted / yr	10.000%
Only Effects New Accts	☐

Costs

View: Utility Detail

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$105,738	$26,435	$132,173
2021	$108,065	$27,016	$135,082
2022	$110,443	$27,611	$138,053
2023	$112,871	$28,218	$141,089
2024	$115,355	$28,839	$144,193
2025	$117,893	$29,473	$147,367
2026	$120,487	$30,122	$150,608
2027	$123,137	$30,784	$153,921
2028	$125,847	$31,462	$157,308
2029	$128,615	$32,154	$160,769
2030	$0	$0	$0
2031	$0	$0	$0
2032	$0	$0	$0
2033	$0	$0	$0
2034	$0	$0	$0
2035	$0	$0	$0
2036	$0	$0	$0
2037	$0	$0	$0
2038	$0	$0	$0
2039	$0	$0	$0
2040	$0	$0	$0

Targets

View: Accounts

	MF	SF	COM	HOT	RES	MAN	LAN	Total
2018	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0
2020	307	1,603	144	10	14	4	34	2,115
2021	314	1,638	147	10	14	4	34	2,161
2022	321	1,674	151	10	14	4	35	2,209
2023	328	1,711	154	10	15	4	36	2,257
2024	335	1,748	157	10	15	4	37	2,307
2025	342	1,787	161	11	15	5	37	2,358
2026	350	1,826	164	11	16	5	38	2,410
2027	358	1,866	168	11	16	5	39	2,463
2028	365	1,907	172	11	16	5	40	2,517
2029	374	1,949	175	12	17	5	41	2,572
2030	0	0	0	0	0	0	0	0
2031	0	0	0	0	0	0	0	0
2032	0	0	0	0	0	0	0	0
2033	0	0	0	0	0	0	0	0
2034	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0	0

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.015819
2021	0.031987
2022	0.048510
2023	0.065396
2024	0.082654
2025	0.100292
2026	0.118318
2027	0.136740
2028	0.155567
2029	0.174809
2030	0.174809
2031	0.174809
2032	0.174809
2033	0.174809
2034	0.174809
2035	0.174809
2036	0.174809
2037	0.174809
2038	0.174809
2039	0.174809
2040	0.174809

Water Rates (Pricing)

Overview	
Name	Water Rates (Pricing)
Abbr	Rates
Category	Default
Measure Type	Pricing Measure

Customer Class	
Customer Class	Single Family

Time Period	
First Year	2018

Description

Rates must meet Utility costs, but some features can improve customer accountability by better imposing cost impacts for high water usage. Conservation oriented rate structures generally collect less than 30% of water revenue through base charges. This measure would be informed by existing rate structures. Additional conservation is possible through pricing changes that modify behavior; this assumes fixture and appliance or outdooring watering have water savings accounted for in the hardware equipment changes documented in other measures. This measure requires regular rate studies. Assumes average annual price increase for modeling time period through year 2040. Measure converts price increases to real price increases net of inflation; annual increase must be above user set threshold (such as assuming a 2% inflation) to trigger a demand reduction.

Comments

> Current measure.
> Annual rate increase based on FY14-FY17 average was 4%. 2016 rate study proposed 4.4% increase annually through 2040.
> COF has water budget based rates already for SF.
> Assumptions 2% inflation based on Wanda Noffz email 2/4/19 (personnel increase) and 4.4% rate increase based on recent rate increases. An econometric pricing analysis may be conducted.
> A conservative industry estimate for 5-year rate studies and price elasticities are assumed.
> The pricing measure only addresses SF customers.
> Assume upcoming 4.4% increase will continue to 2040. This is a conservative assumption, other utilities have done higher increases.

Planned Rate Increases

Add Rate Increase

Change Year	Price Incr (%)	Price Incr Adjusting for Inflation	
2018	4.4%	2.4%	Delete
2019	4.4%	2.4%	Delete
2020	4.4%	2.4%	Delete
2021	4.4%	2.4%	Delete
2022	4.4%	2.4%	Delete
2023	4.4%	2.4%	Delete
2024	4.4%	2.4%	Delete
2025	4.4%	2.4%	Delete
2026	4.4%	2.4%	Delete
2027	4.4%	2.4%	Delete
2028	4.4%	2.4%	Delete
2029	4.4%	2.4%	Delete
2030	4.4%	2.4%	Delete
2031	4.4%	2.4%	Delete
2032	4.4%	2.4%	Delete
2033	4.4%	2.4%	Delete
2034	4.4%	2.4%	Delete
2035	4.4%	2.4%	Delete
2036	4.4%	2.4%	Delete
2037	4.4%	2.4%	Delete
2038	4.4%	2.4%	Delete
2039	4.4%	2.4%	Delete
2040	4.4%	2.4%	Delete

Results

Average Water Savings (mgd)	
0.276614	
Lifetime Savings - Present Value ($)	
Utility	$413,113
Community	$413,113
Lifetime Costs - Present Value ($)	
Utility	$367,242
Community	$367,242
Benefit to Cost Ratio	
Utility	1.12
Community	1.12
Cost of Savings per Unit Volume ($/mg)	
Utility	$158

Price Elasticity

Overall	Indoor	Outdoor
-0.30	-0.10	-0.79

Utility Costs

Rate Study Cost	$75,000
Rate Study Frequency (every # yrs)	5
First Year of Rate Study	2021
Annual Maintenance Cost	$10,000

Consumer Price Index

First Year Index	100.0
Annual Increase	2%

Costs

	Utility	Customer	Total (Community)
2018	$10,000	$0	$10,000
2019	$10,000	$0	$10,000
2020	$10,000	$0	$10,000
2021	$85,000	$0	$85,000
2022	$10,000	$0	$10,000
2023	$10,000	$0	$10,000
2024	$10,000	$0	$10,000
2025	$10,000	$0	$10,000
2026	$85,000	$0	$85,000
2027	$10,000	$0	$10,000
2028	$10,000	$0	$10,000
2029	$10,000	$0	$10,000
2030	$10,000	$0	$10,000
2031	$85,000	$0	$85,000
2032	$10,000	$0	$10,000
2033	$10,000	$0	$10,000
2034	$10,000	$0	$10,000
2035	$10,000	$0	$10,000
2036	$85,000	$0	$85,000
2037	$10,000	$0	$10,000
2038	$10,000	$0	$10,000
2039	$10,000	$0	$10,000
2040	$10,000	$0	$10,000

Projected Price Index

	Price Index	Cumulative Index Increase
2018	100.0	0%
2019	102.0	2%
2020	104.0	4%
2021	106.1	6%
2022	108.2	8%
2023	110.4	10%
2024	112.6	13%
2025	114.9	15%
2026	117.2	17%
2027	119.5	20%
2028	121.9	22%
2029	124.3	24%
2030	126.8	27%
2031	129.4	29%
2032	131.9	32%
2033	134.6	35%
2034	137.3	37%
2035	140.0	40%
2036	142.8	43%
2037	145.7	46%
2038	148.6	49%
2039	151.6	52%
2040	154.6	55%

Water Savings

	Total Savings (mgd)
2018	0.020292
2019	0.040924
2020	0.061892
2021	0.083203
2022	0.104866
2023	0.126891
2024	0.149287
2025	0.172063
2026	0.195228
2027	0.218791
2028	0.242764
2029	0.267155
2030	0.291974
2031	0.317231
2032	0.342937
2033	0.369104
2034	0.395743
2035	0.422865
2036	0.450483
2037	0.478609
2038	0.507253
2039	0.536429
2040	0.566148

Outdoor Water Budgeting

Overview	
Name	Outdoor Water Budgeting
Abbr	WaterBudget
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2040
Measure Length	21

Measure Life	
Permanent	☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$740.00	$2,000.00	1
COM	$740.00	$2,000.00	1
HOT	$740.00	$2,000.00	1
LAN	$740.00	$2,000.00	1

Administration Costs

Method: Fixed

Annual Admin Costs	$7,000

Description

Provide irrigation assessment and water budgeting for large scale irrigation users.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☐	☑	☑	☐	☐	☐	☑	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐		☐	☐					
Urinals			☐	☐					
Lavatory Faucets	☐		☐	☐					
Showers	☐		☐	☐					
Dishwashers	☐		☐	☐					
Clothes Washers	☐		☐	☐					
Process			☐						
Kitchen Spray Rinse			☐	☐					
Internal Leakage	☐		☐	☐					
Baths	☐			☐					
Other	☐		☐	☐					
Irrigation	☑		☑	☑				☑	
Pools	☐			☐					
Wash Down	☐			☐					
Cooling			☐	☐					
Car Washing	☐								
External Leakage	☐		☐	☐				☐	
Outdoor									
Non-Lavatory/Kitchen Faucets	☐		☐	☐					

Comments

> Estimated based on COF investing in software like Waterfluence at $74 per site. Admin costs calculated based on direct cost tab. Assume about $11 per site for incidental annual expenses. Assuming a five-year investment per site, unit cost is set at $1,480 per 20 year site monitoring fee - halved to account for accounts coming online later.
> Admin represents $5K for staff time and an annual service fee of $2,000.
> Savings is estimated based on past experience with other Cities.

Results

Units: MG

Average Water Savings (mgd)	
	0.030084
Lifetime Savings - Present Value ($)	
Utility	$354,262
Community	$354,262
Lifetime Costs - Present Value ($)	
Utility	$302,675
Community	$858,042
Benefit to Cost Ratio	
Utility	1.17
Community	0.41
Cost of Savings per Unit Volume ($/mg)	
Utility	$1,198

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Irrigation	30.0%	25.2
COM Irrigation	30.0%	120.2
HOT Irrigation	30.0%	1,135.0
LAN Irrigation	30.0%	716.5

Targets

Target Method: Count

# of Accts Targeted / yr	5

Costs

View: Utility Detail

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$14,800	$7,000	$21,800
2021	$14,800	$7,000	$21,800
2022	$14,800	$7,000	$21,800
2023	$14,800	$7,000	$21,800
2024	$14,800	$7,000	$21,800
2025	$14,800	$7,000	$21,800
2026	$14,800	$7,000	$21,800
2027	$14,800	$7,000	$21,800
2028	$14,800	$7,000	$21,800
2029	$14,800	$7,000	$21,800
2030	$14,800	$7,000	$21,800
2031	$14,800	$7,000	$21,800
2032	$14,800	$7,000	$21,800
2033	$14,800	$7,000	$21,800
2034	$14,800	$7,000	$21,800
2035	$14,800	$7,000	$21,800
2036	$14,800	$7,000	$21,800
2037	$14,800	$7,000	$21,800
2038	$14,800	$7,000	$21,800
2039	$14,800	$7,000	$21,800
2040	$14,800	$7,000	$21,800

Targets

View: Accounts

	MF	COM	HOT	LAN	Total
2018	0	0	0	0	0
2019	0	0	0	0	0
2020	5	5	5	5	20
2021	5	5	5	5	20
2022	5	5	5	5	20
2023	5	5	5	5	20
2024	5	5	5	5	20
2025	5	5	5	5	20
2026	5	5	5	5	20
2027	5	5	5	5	20
2028	5	5	5	5	20
2029	5	5	5	5	20
2030	5	5	5	5	20
2031	5	5	5	5	20
2032	5	5	5	5	20
2033	5	5	5	5	20
2034	5	5	5	5	20
2035	5	5	5	5	20
2036	5	5	5	5	20
2037	5	5	5	5	20
2038	5	5	5	5	20
2039	5	5	5	5	20
2040	5	5	5	5	20

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.002995
2021	0.005991
2022	0.008986
2023	0.011982
2024	0.014977
2025	0.017973
2026	0.020968
2027	0.023963
2028	0.026959
2029	0.029954
2030	0.032950
2031	0.035945
2032	0.038940
2033	0.041936
2034	0.044931
2035	0.047927
2036	0.050922
2037	0.053918
2038	0.056913
2039	0.059908
2040	0.062904

Water Efficient Landscape Rebate

Overview	
Name	Water Efficient Landscape Reba
Abbr	LWL
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2018
Last Year	2040
Measure Length	23

Measure Life	
Permanent	☐
Years	15
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$1,500.00	$8,500.00	1
SF	$1,500.00	$3,500.00	1
COM	$1,500.00	$8,500.00	1

Administration Costs

Method: Fixed

Annual Admin Costs	$5,000

Description

Landscape irrigation can be a significant chunk of a customer's water bill during the summer. By removing a grass lawn and switching to a mix of low-water-use plants, mulch, and rainwater gardens, customers can save water, beautify the landscape, retain water that would otherwise run into storm-drains, create important pollinator habitat and save money. City of Flagstaff water customers can contact the Water Conservation office to join the Low Water Landscape Program and schedule a FREE pre-removal (i.e. when grass lawn is still intact) inspection of their site to find out if they may qualify for a low water landscape rebate.
> At least 50% of the converted lawn must be replaced with low water use plants, which are also ideally native.
> Rock-cover should be kept to 20% of ground cover. The use of wood chip mulch for water retention on the landscape in encouraged.
> If irrigation is installed, it must be a drip irrigation system, ideally with a timed controller. No spray irrigation is allowed.
> No fountains or other water features may exist on the property
> Applicants must submit a post-lawn removal water consumption calculation estimating the water savings during the establishment period of the plants and the post-establishment period.
> Applicants must submit a site design and a plant list, showing the location of each plant on the site.
> Applicant must agree to do an indoor water checkup with Water Conservation Staff at some point during the process.
> Only one low water landscape rebate is allowed per residential site. Large commercial sites may submit up to three (3) rebates if they need to remove the lawn in stages.

Customer Classes

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
	☑	☑	☑	☐	☐	☐	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐	☐						
Urinals			☐						
Lavatory Faucets	☐	☐	☐						
Showers	☐	☐	☐						
Dishwashers	☐	☐	☐						
Clothes Washers	☐	☐	☐						
Process			☐						
Kitchen Spray Rinse			☐						
Internal Leakage	☐	☐	☐						
Baths	☐	☐							
Other	☐	☐	☐						
Irrigation	☑	☑	☑						
Pools	☐	☐							
Wash Down	☐	☐							
Cooling			☐						
Car Washing	☐	☐							
External Leakage	☑	☑	☑						
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐	☐						

Comments

> Rebate: $0.25/sq. ft.
> Recent participation is 1 per year. Historically approx. 5,650 sq. ft removed per account. Mostly HOA and COM accounts.
> Current rebate program starts July 1, 2018, and ends on June 30, 2019. Applications are processed on a first-received, first-served basis until funds are depleted.
> All customers eligible.
> Find cost basis on black-tabbed worksheet "2019 Measure Cost Basis "

Results

Units: MG

Average Water Savings (mgd)	
0.001435	
Lifetime Savings - Present Value ($)	
Utility	$17,534
Community	$17,534
Lifetime Costs - Present Value ($)	
Utility	$224,140
Community	$668,344
Benefit to Cost Ratio	
Utility	0.08
Community	0.03
Cost of Savings per Unit Volume ($/mg)	
Utility	$18,595

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Irrigation	50.0%	25.2
SF Irrigation	50.0%	39.4
COM Irrigation	50.0%	120.2
MF External Leakage	50.0%	2.1
SF External Leakage	50.0%	3.3
COM External Leakage	50.0%	9.8

Targets

Target Method: Percentage

% of Accts Targeted / yr	0.025%
Only Effects New Accts	☐

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$7,374	$5,000	$12,374
2019	$7,536	$5,000	$12,536
2020	$7,702	$5,000	$12,702
2021	$7,872	$5,000	$12,872
2022	$8,045	$5,000	$13,045
2023	$8,222	$5,000	$13,222
2024	$8,402	$5,000	$13,402
2025	$8,587	$5,000	$13,587
2026	$8,776	$5,000	$13,776
2027	$8,969	$5,000	$13,969
2028	$9,167	$5,000	$14,167
2029	$9,368	$5,000	$14,368
2030	$9,574	$5,000	$14,574
2031	$9,785	$5,000	$14,785
2032	$10,000	$5,000	$15,000
2033	$10,220	$5,000	$15,220
2034	$10,445	$5,000	$15,445
2035	$10,675	$5,000	$15,675
2036	$10,910	$5,000	$15,910
2037	$11,150	$5,000	$16,150
2038	$11,395	$5,000	$16,395
2039	$11,646	$5,000	$16,646
2040	$11,902	$5,000	$16,902

Targets

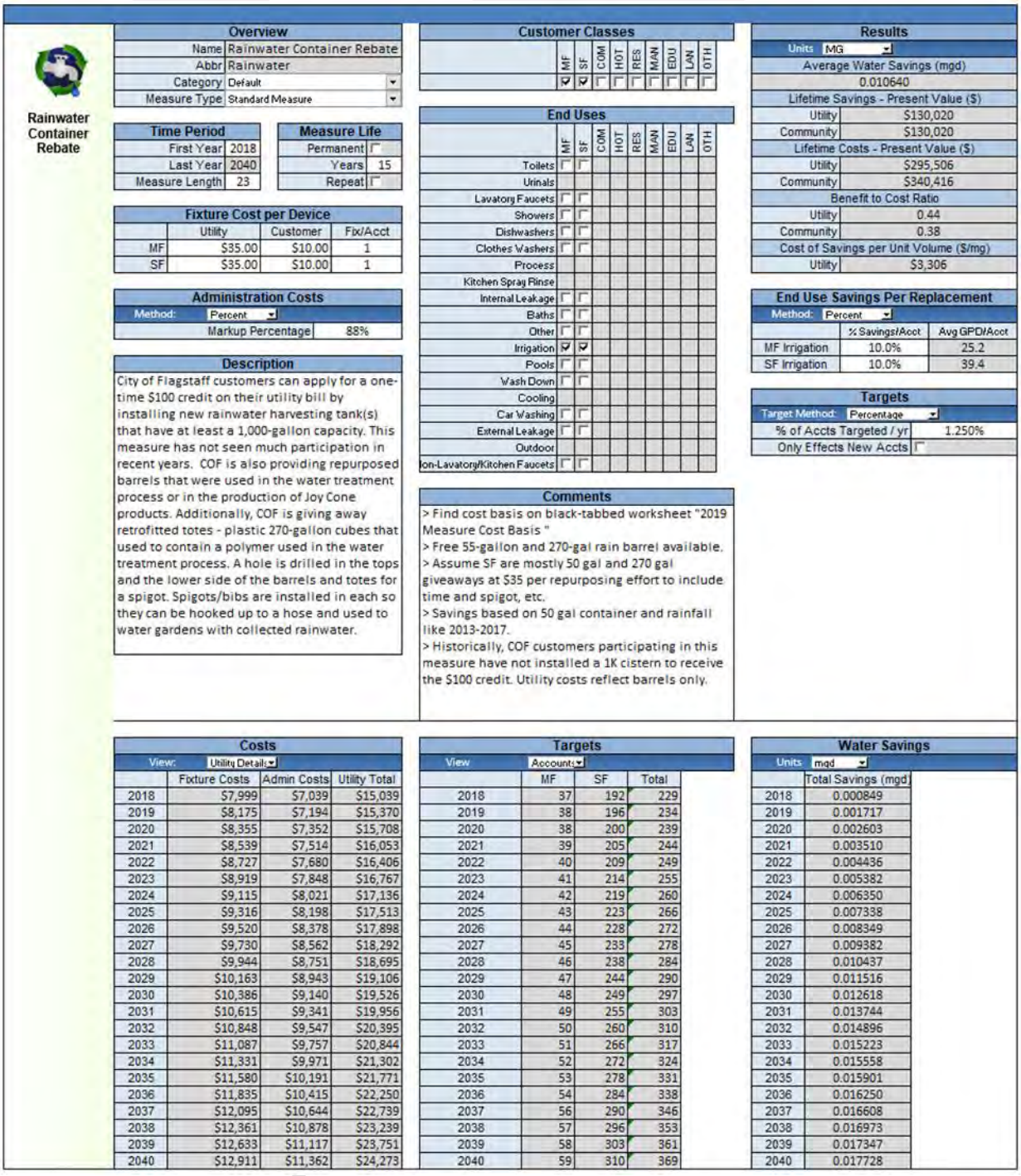
View: Accounts

	MF	SF	COM	Total
2018	1	4	0	5
2019	1	4	0	5
2020	1	4	0	5
2021	1	4	0	5
2022	1	4	0	5
2023	1	4	0	5
2024	1	4	0	6
2025	1	4	0	6
2026	1	5	0	6
2027	1	5	0	6
2028	1	5	0	6
2029	1	5	0	6
2030	1	5	0	6
2031	1	5	0	7
2032	1	5	0	7
2033	1	5	0	7
2034	1	5	0	7
2035	1	6	0	7
2036	1	6	1	7
2037	1	6	1	7
2038	1	6	1	8
2039	1	6	1	8
2040	1	6	1	8

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000114
2019	0.000231
2020	0.000351
2021	0.000473
2022	0.000598
2023	0.000726
2024	0.000856
2025	0.000990
2026	0.001126
2027	0.001265
2028	0.001407
2029	0.001553
2030	0.001702
2031	0.001853
2032	0.002009
2033	0.002053
2034	0.002098
2035	0.002144
2036	0.002191
2037	0.002240
2038	0.002289
2039	0.002339
2040	0.002391



Rainwater Container Rebate

Overview	
Name	Rainwater Container Rebate
Abbr	Rainwater
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2018
Last Year	2040
Measure Length	23

Measure Life		
Permanent	☐	
Years		15
Repeat	☐	

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$35.00	$10.00	1
SF	$35.00	$10.00	1

Administration Costs

Method: Percent

Markup Percentage	88%

Description

City of Flagstaff customers can apply for a one-time $100 credit on their utility bill by installing new rainwater harvesting tank(s) that have at least a 1,000-gallon capacity. This measure has not seen much participation in recent years. COF is also providing repurposed barrels that were used in the water treatment process or in the production of Joy Cone products. Additionally, COF is giving away retrofitted totes - plastic 270-gallon cubes that used to contain a polymer used in the water treatment process. A hole is drilled in the tops and the lower side of the barrels and totes for a spigot. Spigots/bibs are installed in each so they can be hooked up to a hose and used to water gardens with collected rainwater.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐							
Urinals									
Lavatory Faucets	☐	☐							
Showers	☐	☐							
Dishwashers	☐	☐							
Clothes Washers	☐	☐							
Process									
Kitchen Spray Rinse									
Internal Leakage	☐	☐							
Baths	☐	☐							
Other	☐	☐							
Irrigation	☑	☑							
Pools	☐	☐							
Wash Down	☐	☐							
Cooling									
Car Washing	☐	☐							
External Leakage	☐	☐							
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐							

Comments

> Find cost basis on black-tabbed worksheet "2019 Measure Cost Basis "
> Free 55-gallon and 270-gal rain barrel available.
> Assume SF are mostly 50 gal and 270 gal giveaways at $35 per repurposing effort to include time and spigot, etc.
> Savings based on 50 gal container and rainfall like 2013-2017.
> Historically, COF customers participating in this measure have not installed a 1K cistern to receive the $100 credit. Utility costs reflect barrels only.

Results

Units: MG

Average Water Savings (mgd)	
	0.010640
Lifetime Savings - Present Value ($)	
Utility	$130,020
Community	$130,020
Lifetime Costs - Present Value ($)	
Utility	$295,506
Community	$340,416
Benefit to Cost Ratio	
Utility	0.44
Community	0.38
Cost of Savings per Unit Volume ($/mg)	
Utility	$3,306

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Irrigation	10.0%	25.2
SF Irrigation	10.0%	39.4

Targets

Target Method: Percentage

% of Accts Targeted / yr	1.250%
Only Effects New Accts	☐

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$7,999	$7,039	$15,039
2019	$8,175	$7,194	$15,370
2020	$8,355	$7,352	$15,708
2021	$8,539	$7,514	$16,053
2022	$8,727	$7,680	$16,406
2023	$8,919	$7,848	$16,767
2024	$9,115	$8,021	$17,136
2025	$9,316	$8,198	$17,513
2026	$9,520	$8,378	$17,898
2027	$9,730	$8,562	$18,292
2028	$9,944	$8,751	$18,695
2029	$10,163	$8,943	$19,106
2030	$10,386	$9,140	$19,526
2031	$10,615	$9,341	$19,956
2032	$10,848	$9,547	$20,395
2033	$11,087	$9,757	$20,844
2034	$11,331	$9,971	$21,302
2035	$11,580	$10,191	$21,771
2036	$11,835	$10,415	$22,250
2037	$12,095	$10,644	$22,739
2038	$12,361	$10,878	$23,239
2039	$12,633	$11,117	$23,751
2040	$12,911	$11,362	$24,273

Targets

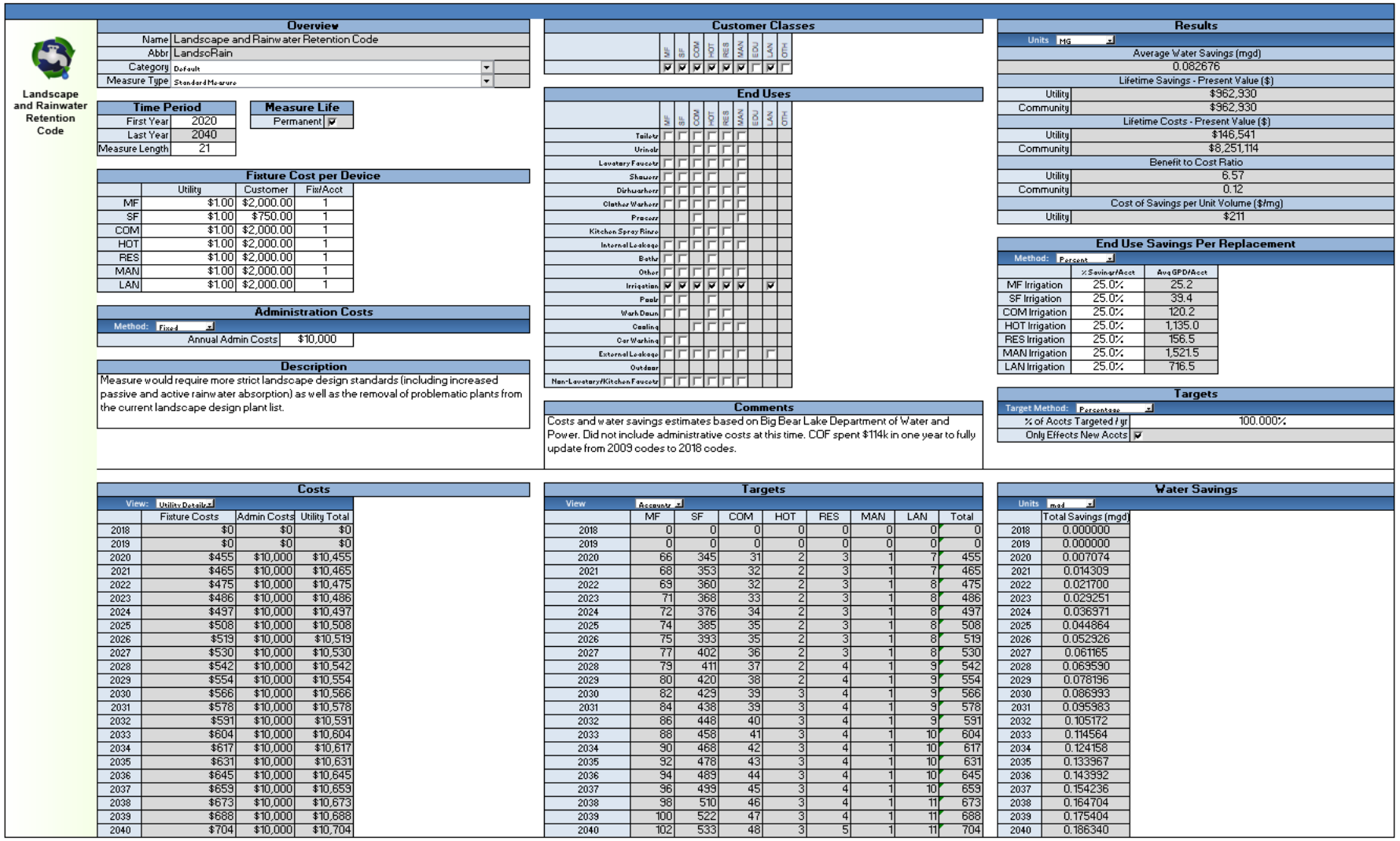
View: Accounts

	MF	SF	Total
2018	37	192	229
2019	38	196	234
2020	38	200	239
2021	39	205	244
2022	40	209	249
2023	41	214	255
2024	42	219	260
2025	43	223	266
2026	44	228	272
2027	45	233	278
2028	46	238	284
2029	47	244	290
2030	48	249	297
2031	49	255	303
2032	50	260	310
2033	51	266	317
2034	52	272	324
2035	53	278	331
2036	54	284	338
2037	56	290	346
2038	57	296	353
2039	58	303	361
2040	59	310	369

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000849
2019	0.001717
2020	0.002603
2021	0.003510
2022	0.004436
2023	0.005382
2024	0.006350
2025	0.007338
2026	0.008349
2027	0.009382
2028	0.010437
2029	0.011516
2030	0.012618
2031	0.013744
2032	0.014896
2033	0.015223
2034	0.015558
2035	0.015901
2036	0.016250
2037	0.016608
2038	0.016973
2039	0.017347
2040	0.017728



Landscape and Rainwater Retention Code

Overview

Name	Landscape and Rainwater Retention Code
Abbr	LandscRain
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2020
Last Year	2040
Measure Length	21

Measure Life

Permanent ☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$1.00	$2,000.00	1
SF	$1.00	$750.00	1
COM	$1.00	$2,000.00	1
HOT	$1.00	$2,000.00	1
RES	$1.00	$2,000.00	1
MAN	$1.00	$2,000.00	1
LAN	$1.00	$2,000.00	1

Administration Costs

Method: Fixed

Annual Admin Costs	$10,000

Description

Measure would require more strict landscape design standards (including increased passive and active rainwater absorption) as well as the removal of problematic plants from the current landscape design plant list.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☑	☑	☑	☑	☑	☐	☑	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐	☐	☐	☐	☐			
Urinals			☐	☐	☐	☐			
Lavatory Faucets	☐	☐	☐	☐	☐	☐			
Showers	☐	☐	☐	☐		☐			
Dishwashers	☐	☐	☐	☐	☐	☐			
Clothes Washers	☐	☐	☐	☐	☐	☐			
Process			☐			☐			
Kitchen Spray Rinse			☐	☐	☐				
Internal Leakage	☐	☐	☐	☐	☐	☐			
Baths	☐	☐			☐				
Other	☐	☐	☐	☐	☐	☐			
Irrigation	☑	☑	☑	☑	☑	☑		☑	
Pools	☐	☐			☐				
Wash Down	☐	☐			☐	☐			
Cooling			☐	☐	☐	☐			
Car Washing	☐	☐							
External Leakage	☐	☐	☐	☐	☐	☐		☐	
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐	☐	☐	☐	☐			

Comments

Costs and water savings estimates based on Big Bear Lake Department of Water and Power. Did not include administrative costs at this time. COF spent $114k in one year to fully update from 2009 codes to 2018 codes.

Results

Units: MG

Average Water Savings (mgd)	
	0.082676
Lifetime Savings - Present Value ($)	
Utility	$962,930
Community	$962,930
Lifetime Costs - Present Value ($)	
Utility	$146,541
Community	$8,251,114
Benefit to Cost Ratio	
Utility	6.57
Community	0.12
Cost of Savings per Unit Volume ($/mg)	
Utility	$211

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Irrigation	25.0%	25.2
SF Irrigation	25.0%	39.4
COM Irrigation	25.0%	120.2
HOT Irrigation	25.0%	1,135.0
RES Irrigation	25.0%	156.5
MAN Irrigation	25.0%	1,521.5
LAN Irrigation	25.0%	716.5

Targets

Target Method: Percentage

% of Accts Targeted / yr	100.000%
Only Effects New Accts	☑

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$455	$10,000	$10,455
2021	$465	$10,000	$10,465
2022	$475	$10,000	$10,475
2023	$486	$10,000	$10,486
2024	$497	$10,000	$10,497
2025	$508	$10,000	$10,508
2026	$519	$10,000	$10,519
2027	$530	$10,000	$10,530
2028	$542	$10,000	$10,542
2029	$554	$10,000	$10,554
2030	$566	$10,000	$10,566
2031	$578	$10,000	$10,578
2032	$591	$10,000	$10,591
2033	$604	$10,000	$10,604
2034	$617	$10,000	$10,617
2035	$631	$10,000	$10,631
2036	$645	$10,000	$10,645
2037	$659	$10,000	$10,659
2038	$673	$10,000	$10,673
2039	$688	$10,000	$10,688
2040	$704	$10,000	$10,704

Targets

View: Accounts

	MF	SF	COM	HOT	RES	MAN	LAN	Total
2018	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0
2020	66	345	31	2	3	1	7	455
2021	68	353	32	2	3	1	7	465
2022	69	360	32	2	3	1	8	475
2023	71	368	33	2	3	1	8	486
2024	72	376	34	2	3	1	8	497
2025	74	385	35	2	3	1	8	508
2026	75	393	35	2	3	1	8	519
2027	77	402	36	2	3	1	8	530
2028	79	411	37	2	4	1	9	542
2029	80	420	38	2	4	1	9	554
2030	82	429	39	3	4	1	9	566
2031	84	438	39	3	4	1	9	578
2032	86	448	40	3	4	1	9	591
2033	88	458	41	3	4	1	10	604
2034	90	468	42	3	4	1	10	617
2035	92	478	43	3	4	1	10	631
2036	94	489	44	3	4	1	10	645
2037	96	499	45	3	4	1	10	659
2038	98	510	46	3	4	1	11	673
2039	100	522	47	3	4	1	11	688
2040	102	533	48	3	5	1	11	704

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.007074
2021	0.014309
2022	0.021700
2023	0.029251
2024	0.036971
2025	0.044864
2026	0.052926
2027	0.061165
2028	0.069590
2029	0.078196
2030	0.086993
2031	0.095983
2032	0.105172
2033	0.114564
2034	0.124158
2035	0.133967
2036	0.143992
2037	0.154236
2038	0.164704
2039	0.175404
2040	0.186340

Commercial Rebates and Checkups

Overview

Name	Commercial Rebates and Checkups
Abbr	ComReb
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2018
Last Year	2040
Measure Length	23

Measure Life

Permanent ☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$5,000.00	$5,000.00	2
COM	$5,000.00	$5,250.00	2
HOT	$5,000.00	$5,250.00	1
RES	$1,000.00	$5,250.00	1

Administration Costs

Method: Fixed

Annual Admin Costs	$7,500

Description

Measure to provide rebates and/or checkups for commercial customers. Rebates include a standard list of water efficient equipment such as aerators, showerheads, spray valves, and toilets. Custom options could include x-ray machines, icemakers, air-cooled ice machines, steamers, washers, efficient dishwashers, replace once through cooling, and/or adding a conductivity controller on cooling towers.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☐	☑	☑	☑	☐	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☑		☑	☑	☑				
Urinals			☑	☑	☑				
Lavatory Faucets	☑		☑	☑	☑				
Showers	☑		☑	☑					
Dishwashers	☑		☑	☑	☑				
Clothes Washers	☑		☑	☑	☑				
Process			☑						
Kitchen Spray Rinse			☑	☑	☑				
Internal Leakage	☑		☑	☑	☑				
Baths	☑			☑					
Other	☑		☑	☑	☑				
Irrigation	☑		☑	☑	☑				
Pools	☑			☑					
Wash Down	☑			☑	☑				
Cooling			☑	☑	☑				
Car Washing	☑								
External Leakage	☑		☑	☑	☑				
Outdoor									
Non-Lavatory/Kitchen Faucets	☑		☑	☑	☑				

Comments

> Find cost basis on black-tabbed worksheet "2019 Measure Cost Basis"
> Savings is targeting 20% overall savings per account use.
> Assume 40% savings for a 1.6 to a 1.0 gpf toilet replacement for each property for each account. Assume 0.5 to .125 gpf urinal retrofit per account per site, showerheads assume 2.5 down to 1.8 gpm WaterSense, MF toilets assume 1.6 to 1.0 toilet gpf, assume 25% for all other uses.

Results

Units: MG

Average Water Savings (mgd)	
	0.057477
Lifetime Savings - Present Value ($)	
Utility	$805,170
Community	$1,202,738
Lifetime Costs - Present Value ($)	
Utility	$800,476
Community	$1,619,986
Benefit to Cost Ratio	
Utility	1.01
Community	0.74
Cost of Savings per Unit Volume ($/mg)	
Utility	$1,658

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
COM Toilets	40.0%	149.3
HOT Toilets	40.0%	1,181.6
RES Toilets	40.0%	250.2
COM Urinals	75.0%	39.5
HOT Urinals	75.0%	301.7
RES Urinals	75.0%	75.0
COM Lavatory Faucets	20.0%	49.7
HOT Lavatory Faucets	20.0%	380.1
RES Lavatory Faucets	20.0%	125.1
COM Showers	25.0%	59.2
HOT Showers	25.0%	905.1
COM Dishwashers	20.0%	39.5
HOT Dishwashers	20.0%	301.7
RES Dishwashers	20.0%	125.1
COM Clothes Washers	20.0%	98.7
HOT Clothes Washers	20.0%	754.2
RES Clothes Washers	20.0%	187.6
COM Process	20.0%	65.8
COM Kitchen Spray Rinse	20.0%	32.9
HOT Kitchen Spray Rinse	20.0%	251.4
RES Kitchen Spray Rinse	20.0%	35.1
COM Internal Leakage	20.0%	65.8
HOT Internal Leakage	20.0%	452.5
RES Internal Leakage	20.0%	125.1
HOT Baths	20.0%	130.7
COM Other	20.0%	15.1
HOT Other	20.0%	45.3
RES Other	20.0%	75.0
COM Irrigation	20.0%	120.2
HOT Irrigation	20.0%	1,135.0
RES Irrigation	20.0%	156.5
HOT Pools	20.0%	42.0
HOT Wash Down	20.0%	28.0
RES Wash Down	20.0%	9.7
COM Cooling	20.0%	9.8
HOT Cooling	20.0%	98.1
RES Cooling	20.0%	13.5
COM External Leakage	20.0%	9.8
HOT External Leakage	20.0%	98.1
RES External Leakage	20.0%	13.5
COM Non-Lavatory/Kitchen Faucets	20.0%	42.4
HOT Non-Lavatory/Kitchen Faucets	20.0%	323.8
RES Non-Lavatory/Kitchen Faucets	20.0%	193.1
MF Toilets	40.0%	102.6
MF Lavatory Faucets	25.0%	25.7
MF Showers	25.0%	124.0
MF Dishwashers	25.0%	4.3
MF Clothes Washers	25.0%	72.7
MF Internal Leakage	25.0%	34.2
MF Baths	25.0%	8.6
MF Other	25.0%	8.6
MF Irrigation	25.0%	25.2
MF Pools	25.0%	0.6
MF Wash Down	25.0%	1.2
MF Car Washing	25.0%	1.2
MF External Leakage	25.0%	2.1
MF Non-Lavatory/Kitchen Faucets	25.0%	47.0

Targets

Target Method: Detailed

Enter Annual Targets Below

Costs

View: Utility Detail

	Fixture Costs	Admin Costs	Utility Total
2018	$20,000	$7,500	$27,500
2019	$20,000	$7,500	$27,500
2020	$36,000	$7,500	$43,500
2021	$47,000	$7,500	$54,500
2022	$47,000	$7,500	$54,500
2023	$47,000	$7,500	$54,500
2024	$47,000	$7,500	$54,500
2025	$47,000	$7,500	$54,500
2026	$47,000	$7,500	$54,500
2027	$47,000	$7,500	$54,500
2028	$47,000	$7,500	$54,500
2029	$47,000	$7,500	$54,500
2030	$47,000	$7,500	$54,500
2031	$47,000	$7,500	$54,500
2032	$47,000	$7,500	$54,500
2033	$47,000	$7,500	$54,500
2034	$47,000	$7,500	$54,500
2035	$47,000	$7,500	$54,500
2036	$47,000	$7,500	$54,500
2037	$47,000	$7,500	$54,500
2038	$47,000	$7,500	$54,500
2039	$47,000	$7,500	$54,500
2040	$47,000	$7,500	$54,500

Targets

View: Accounts

	MF	COM	HOT	RES	Total
2018	2	0	0	0	2
2019	2	0	0	0	2
2020	1	1	3	1	6
2021	1	2	3	2	8
2022	1	2	3	2	8
2023	1	2	3	2	8
2024	1	2	3	2	8
2025	1	2	3	2	8
2026	1	2	3	2	8
2027	1	2	3	2	8
2028	1	2	3	2	8
2029	1	2	3	2	8
2030	1	2	3	2	8
2031	1	2	3	2	8
2032	1	2	3	2	8
2033	1	2	3	2	8
2034	1	2	3	2	8
2035	1	2	3	2	8
2036	1	2	3	2	8
2037	1	2	3	2	8
2038	1	2	3	2	8
2039	1	2	3	2	8
2040	1	2	3	2	8

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000260
2019	0.000514
2020	0.006319
2021	0.012600
2022	0.018767
2023	0.024822
2024	0.030766
2025	0.036602
2026	0.042332
2027	0.047966
2028	0.053510
2029	0.058969
2030	0.064346
2031	0.069646
2032	0.074873
2033	0.080031
2034	0.085125
2035	0.090156
2036	0.095128
2037	0.100048
2038	0.104919
2039	0.109744
2040	0.114526

School Retrofits

Overview	
Name	School Retrofits
Abbr	SchoolRetro
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2040
Measure Length	21

Measure Life	
Permanent	☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
COM	$10,000.00	$0.00	1
EDU	$10,000.00	$10,000.00	1

Administration Costs

Method: Percent

Markup Percentage	25%

Description

Provide WaterSense fixtures for one K-12 school and one higher education building annually. There is no financial match required by K-12 schools, but for higher education facilities, a match is required.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☐	☐	☑	☐	☐	☐	☑	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets			☑				☑		
Urinals			☑				☑		
Lavatory Faucets			☑				☑		
Showers			☐				☑		
Dishwashers			☑				☑		
Clothes Washers			☐				☐		
Process			☐						
itchen Spray Rinse			☑				☑		
Internal Leakage			☑				☑		
Baths									
Other			☐				☐		
Irrigation			☑				☑		
Pools							☐		
Wash Down							☐		
Cooling			☑				☑		
Car Washing									
External Leakage			☑				☑		
Outdoor									
ry/Kitchen Faucets			☑				☑		

Comments

Costs and savings based on Big Bear Lake Dept. of Water and Power.
> Overall, COF will invest $10K per year in higher education facilities to achieve an overall 10% reduction per water so approximately 0.5% per year.

Results

Units: MG

Average Water Savings (mgd)	
0.023893	
Lifetime Savings - Present Value ($)	
Utility	$319,974
Community	$456,520
Lifetime Costs - Present Value ($)	
Utility	$347,104
Community	$485,946
Benefit to Cost Ratio	
Utility	0.92
Community	0.94
Cost of Savings per Unit Volume ($/mg)	
Utility	$1,729

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
COM Toilets	15.0%	149.3
EDU Toilets	0.5%	73,279.9
COM Urinals	15.0%	39.5
EDU Urinals	0.5%	21,984.0
M Lavatory Fauc	15.0%	49.7
U Lavatory Fauc	0.5%	27,699.8
EDU Showers	0.5%	65,951.9
OM Dishwasher	15.0%	39.5
DU Dishwasher	0.5%	21,984.0
Kitchen Spray R	15.0%	32.9
Kitchen Spray R	0.5%	18,320.0
M Internal Leaka	15.0%	65.8
U Internal Leaka	0.5%	36,639.9
COM Irrigation	15.0%	120.2
EDU Irrigation	0.5%	146,166.9
COM Cooling	15.0%	9.8
EDU Cooling	0.5%	12,631.7
M External Leaka	15.0%	9.8
U External Leaka	0.5%	12,631.7
-Lavatory/Kitche	15.0%	42.4
-Lavatory/Kitche	0.5%	23,596.1

Targets

Target Method: Detailed

Enter Annual Targets Below

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Util Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$20,000	$5,000	$25,000
2021	$20,000	$5,000	$25,000
2022	$20,000	$5,000	$25,000
2023	$20,000	$5,000	$25,000
2024	$20,000	$5,000	$25,000
2025	$20,000	$5,000	$25,000
2026	$20,000	$5,000	$25,000
2027	$20,000	$5,000	$25,000
2028	$20,000	$5,000	$25,000
2029	$20,000	$5,000	$25,000
2030	$20,000	$5,000	$25,000
2031	$20,000	$5,000	$25,000
2032	$20,000	$5,000	$25,000
2033	$20,000	$5,000	$25,000
2034	$20,000	$5,000	$25,000
2035	$20,000	$5,000	$25,000
2036	$20,000	$5,000	$25,000
2037	$20,000	$5,000	$25,000
2038	$20,000	$5,000	$25,000
2039	$20,000	$5,000	$25,000
2040	$20,000	$5,000	$25,000

Targets

View: Accounts

	COM	EDU	Total
2018	0	0	0
2019	0	0	0
2020	1	1	2
2021	1	1	2
2022	1	1	2
2023	1	1	2
2024	1	1	2
2025	1	1	2
2026	1	1	2
2027	1	1	2
2028	1	1	2
2029	1	1	2
2030	1	1	2
2031	1	1	2
2032	1	1	2
2033	1	1	2
2034	1	1	2
2035	1	1	2
2036	1	1	2
2037	1	1	2
2038	1	1	2
2039	1	1	2
2040	1	1	2

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.002387
2021	0.004772
2022	0.007156
2023	0.009539
2024	0.011921
2025	0.014301
2026	0.016680
2027	0.019058
2028	0.021435
2029	0.023811
2030	0.026185
2031	0.028560
2032	0.030933
2033	0.033305
2034	0.035677
2035	0.038048
2036	0.040418
2037	0.042788
2038	0.045157
2039	0.047525
2040	0.049893

Government Building Retrofits

Overview	
Name	Government Building Retrofits
Abbr	GovtBuild
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2040
Measure Length	21

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
COM	$10,000.00	$1,000.00	1

Administration Costs	
Method:	Percent
Markup Percentage	5%

Description

Government buildings retrofit - this measure would bring all buildings owned by City of Flagstaff up to WaterSense specifications, including housing authority (section 8).

Customer Classes									
	MF	SF	COM	HOT	RES	MAN	EDU	LAN	GTH
	☐	☐	☑	☐	☐	☐	☐	☐	☐

End Uses	MF	SF	COM	HOT	RES	MAN	EDU	LAN	GTH
Toilets			☑						
Urinals			☑						
Lavatory Faucets			☑						
Showers			☑						
Dishwashers			☑						
Clothes Washers			☑						
Process			☐						
Kitchen Spray Rinse			☐						
Internal Leakage			☑						
Baths									
Other			☐						
Irrigation			☑						
Pools									
Wash Down									
Cooling			☐						
Car Washing									
External Leakage			☑						
Outdoor									
Non-Lavatory/Kitchen Faucets			☑						

Comments

Potential measure. Assumed utility would fully cover cost of retrofits (i.e. would not bill other departments for fixtures, only installation up to $10,000 in expenses). Assumed Water Conservation would budget $10k annually to retrofit one building at a time.

Results	
Units	MG
Average Water Savings (mgd)	
0.001917	
Lifetime Savings - Present Value ($)	
Utility	$26,414
Community	$37,725
Lifetime Costs - Present Value ($)	
Utility	$141,081
Community	$154,517
Benefit to Cost Ratio	
Utility	0.19
Community	0.24
Cost of Savings per Unit Volume ($/mg)	
Utility	$8,761

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
COM Toilets	40.0%	149.3
COM Urinals	40.0%	39.5
COM Lavatory Faucets	20.0%	49.7
COM Showers	20.0%	59.2
COM Dishwashers	20.0%	39.5
COM Clothes Washers	40.0%	98.7
COM Internal Leakage	20.0%	65.8
COM Irrigation	40.0%	120.2
COM External Leakage	20.0%	9.8
COM Non-Lavatory/Kitchen Faucets	20.0%	42.4

Targets	
Target Method:	Detailed
Enter Annual Targets Below	

Costs			
View:	Utility Details		
	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$10,000	$500	$10,500
2021	$10,000	$500	$10,500
2022	$10,000	$500	$10,500
2023	$10,000	$500	$10,500
2024	$10,000	$500	$10,500
2025	$10,000	$500	$10,500
2026	$10,000	$500	$10,500
2027	$10,000	$500	$10,500
2028	$10,000	$500	$10,500
2029	$10,000	$500	$10,500
2030	$10,000	$500	$10,500
2031	$10,000	$500	$10,500
2032	$10,000	$500	$10,500
2033	$10,000	$500	$10,500
2034	$10,000	$500	$10,500
2035	$10,000	$500	$10,500
2036	$10,000	$500	$10,500
2037	$10,000	$500	$10,500
2038	$10,000	$500	$10,500
2039	$10,000	$500	$10,500
2040	$0	$0	$0

Targets		
View	Accounts	
	COM	Total
2018	0	0
2019	0	0
2020	1	1
2021	1	1
2022	1	1
2023	1	1
2024	1	1
2025	1	1
2026	1	1
2027	1	1
2028	1	1
2029	1	1
2030	1	1
2031	1	1
2032	1	1
2033	1	1
2034	1	1
2035	1	1
2036	1	1
2037	1	1
2038	1	1
2039	1	1
2040	0	0

Water Savings	
Units	mgd
	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.000213
2021	0.000421
2022	0.000626
2023	0.000828
2024	0.001026
2025	0.001221
2026	0.001413
2027	0.001602
2028	0.001788
2029	0.001971
2030	0.002152
2031	0.002331
2032	0.002507
2033	0.002681
2034	0.002853
2035	0.003024
2036	0.003192
2037	0.003359
2038	0.003524
2039	0.003688
2040	0.003667

Residential Indoor Water Checkup

Overview	
Name	Residential Indoor Water Checku
Abbr	ResCheck
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2018
Last Year	2040
Measure Length	23

Measure Life	
Permanent	☐
Years	5
Repeat	☐

Fixture Cost per Device	Utility	Customer	Fix/Acct
SF	$6.00	$30.00	1

Administration Costs	
Method:	Percent
Markup Percentage	630%

Description

Customers can call or email to schedule a free in-home water check up. COF will assess fixtures for leaks, and tell how much water each fixture uses per minute. COF also offers free fixture replacements: water efficient aerators for sinks, water efficient showerheads, and advice about toilet retrofits.

Customer Classes

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
	☐	☑	☐	☐	☐	☐	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets		☑							
Urinals									
Lavatory Faucets		☑							
Showers		☑							
Dishwashers		☑							
Clothes Washers		☑							
Process									
Kitchen Spray Rinse									
Internal Leakage		☑							
Baths		☑							
Other		☑							
Irrigation		☐							
Pools		☐							
Wash Down		☐							
Cooling									
Car Washing		☐							
External Leakage		☐							
Outdoor									
Non-Lavatory/Kitchen Faucets		☑							

Comments

> Find cost basis on black-tabbed worksheet "2019 Measure Cost Basis "
> Assume surveys identify and reduce leaks (primarily in toilets).
> In the future, this measure could include or become an online self-audit/screening measure to identify if a site visit is warranted.
> Utility direct cost per visit is minimal (typically give away 1-2 aerators and maybe a showerhead, and therefore covered in efficient fixture giveaway measure. Majority of cost is administrative (hourly pay for personnel).
> Customer cost represents average cost to implement survey suggestions.
> Assume all surveyed accounts receive 1.5 gpm showerhead and 1.0 gpm bathroom aerators; and 50% are installed. Assume 2.5 gpm showerheads and 2.2 gpm aerators are being replaced.
>Targeted accounts annually based on past annual surveys completed (year 2018).

Results

Units	MG
Average Water Savings (mgd)	
0.003835	
Lifetime Savings - Present Value ($)	
Utility	$61,215
Community	$126,289
Lifetime Costs - Present Value ($)	
Utility	$33,015
Community	$55,628
Benefit to Cost Ratio	
Utility	1.85
Community	2.27
Cost of Savings per Unit Volume ($/mg)	
Utility	$1,025

End Use Savings Per Replacement

Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Toilets	5.0%	23.2
SF Lavatory Faucets	30.0%	8.1
SF Showers	20.0%	25.7
SF Dishwashers	5.0%	2.3
SF Clothes Washers	5.0%	19.1
SF Internal Leakage	50.0%	15.1
SF Baths	5.0%	3.5
SF Other	5.0%	3.8
SF Non-Lavatory/Kitchen Faucets	5.0%	15.1

Targets

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

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$230	$1,450	$1,680
2019	$235	$1,482	$1,717
2020	$240	$1,515	$1,755
2021	$246	$1,548	$1,794
2022	$251	$1,582	$1,833
2023	$257	$1,617	$1,873
2024	$262	$1,652	$1,915
2025	$268	$1,689	$1,957
2026	$274	$1,726	$2,000
2027	$280	$1,764	$2,044
2028	$286	$1,803	$2,089
2029	$292	$1,842	$2,135
2030	$299	$1,883	$2,182
2031	$305	$1,924	$2,230
2032	$312	$1,966	$2,279
2033	$319	$2,010	$2,329
2034	$326	$2,054	$2,380
2035	$333	$2,099	$2,432
2036	$341	$2,145	$2,486
2037	$348	$2,192	$2,541
2038	$356	$2,241	$2,596
2039	$363	$2,290	$2,654
2040	$371	$2,340	$2,712

Targets

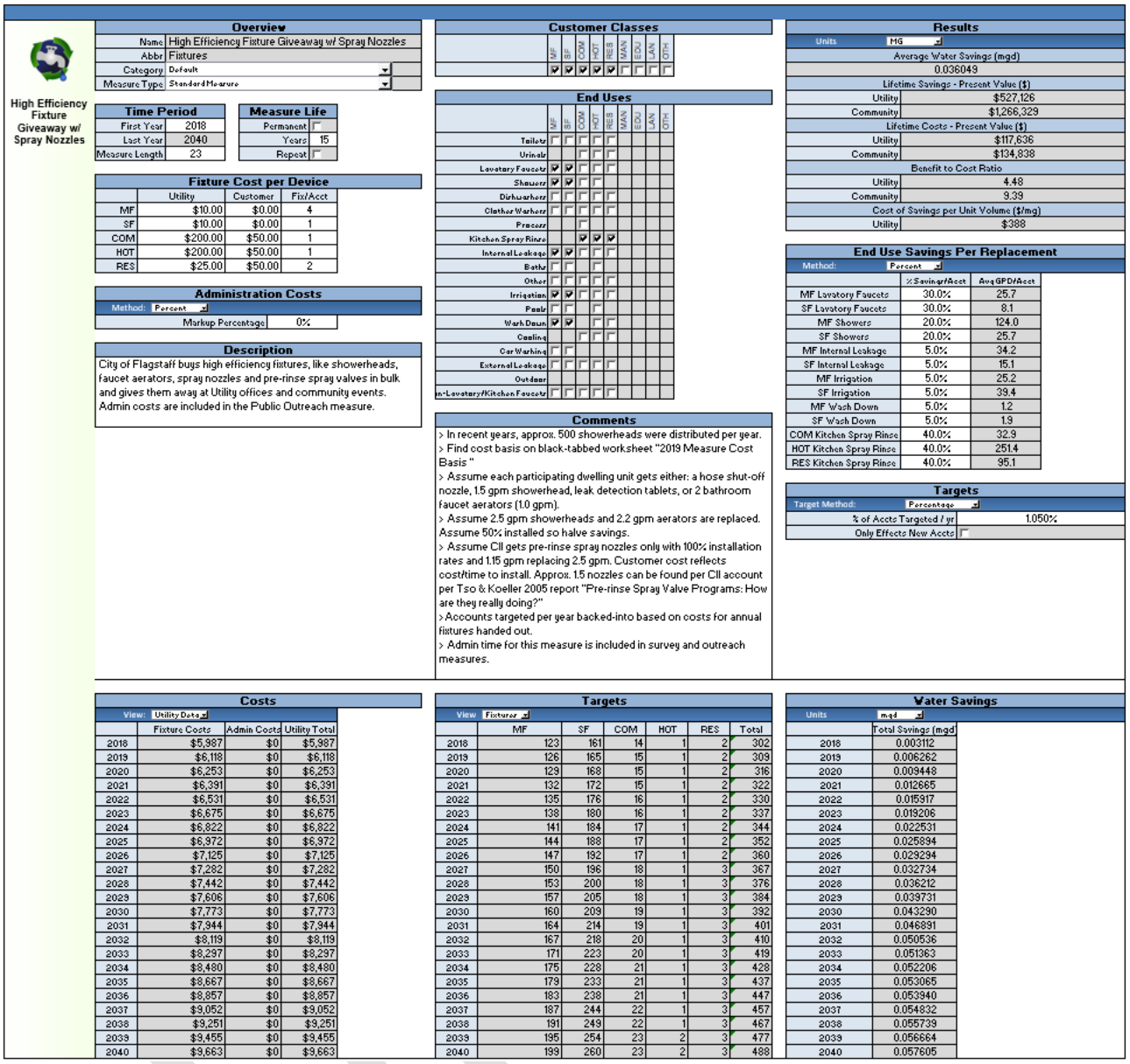
View: Accounts

	SF	Total
2018	38	38
2019	39	39
2020	40	40
2021	41	41
2022	42	42
2023	43	43
2024	44	44
2025	45	45
2026	46	46
2027	47	47
2028	48	48
2029	49	49
2030	50	50
2031	51	51
2032	52	52
2033	53	53
2034	54	54
2035	56	56
2036	57	57
2037	58	58
2038	59	59
2039	61	61
2040	62	62

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000709
2019	0.001426
2020	0.002152
2021	0.002887
2022	0.003631
2023	0.003693
2024	0.003756
2025	0.003821
2026	0.003888
2027	0.003955
2028	0.004025
2029	0.004095
2030	0.004167
2031	0.004241
2032	0.004316
2033	0.004393
2034	0.004471
2035	0.004552
2036	0.004634
2037	0.004718
2038	0.004803
2039	0.004891
2040	0.004980



High Efficiency Fixture Giveaway w/ Spray Nozzles

Overview

Name	High Efficiency Fixture Giveaway w/ Spray Nozzles
Abbr	Fixtures
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2018
Last Year	2040
Measure Length	23

Measure Life

Permanent	☐
Years	15
Repeat	☐

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$10.00	$0.00	4
SF	$10.00	$0.00	1
COM	$200.00	$50.00	1
HOT	$200.00	$50.00	1
RES	$25.00	$50.00	2

Administration Costs

Method: Percent

Markup Percentage	0%

Description

City of Flagstaff buys high efficiency fixtures, like showerheads, faucet aerators, spray nozzles and pre-rinse spray valves in bulk and gives them away at Utility offices and community events. Admin costs are included in the Public Outreach measure.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☑	☑	☑	☑	☐	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐	☐	☐	☐				
Urinals			☐	☐	☐				
Lavatory Faucets	☑	☑	☐	☐	☐				
Showers	☑	☑	☐						
Dishwashers	☐	☐	☐	☐	☐				
Clothes Washers	☐	☐	☐	☐	☐				
Faucets			☐						
Kitchen Spray Rinse			☑	☑	☑				
Internal Leakage	☑	☑	☐	☐	☐				
Baths	☐	☐		☐					
Other	☐	☐	☐	☐	☐				
Irrigation	☑	☑	☐	☐	☐				
Pools	☐	☐		☐					
Wash Down	☑	☑		☐	☐				
Cooling			☐	☐	☐				
Car Washing	☐	☐							
External Leakage	☐	☐	☐	☐	☐				
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐	☐	☐	☐				

Comments

> In recent years, approx. 500 showerheads were distributed per year.
> Find cost basis on black-tabbed worksheet "2019 Measure Cost Basis "
> Assume each participating dwelling unit gets either: a hose shut-off nozzle, 1.5 gpm showerhead, leak detection tablets, or 2 bathroom faucet aerators (1.0 gpm).
> Assume 2.5 gpm showerheads and 2.2 gpm aerators are replaced. Assume 50% installed so halve savings.
> Assume CII gets pre-rinse spray nozzles only with 100% installation rates and 1.15 gpm replacing 2.5 gpm. Customer cost reflects cost/time to install. Approx. 1.5 nozzles can be found per CII account per Tso & Koeller 2005 report "Pre-rinse Spray Valve Programs: How are they really doing?"
>Accounts targeted per year backed-into based on costs for annual fixtures handed out.
> Admin time for this measure is included in survey and outreach measures.

Results

Units: MG

Average Water Savings (mgd)	
	0.036049
Lifetime Savings - Present Value ($)	
Utility	$527,126
Community	$1,266,329
Lifetime Costs - Present Value ($)	
Utility	$117,636
Community	$134,838
Benefit to Cost Ratio	
Utility	4.48
Community	9.39
Cost of Savings per Unit Volume ($/mg)	
Utility	$388

End Use Savings Per Replacement

Method: Percent

	%Savings/Acct	Avg GPD/Acct
MF Lavatory Faucets	30.0%	25.7
SF Lavatory Faucets	30.0%	8.1
MF Showers	20.0%	124.0
SF Showers	20.0%	25.7
MF Internal Leakage	5.0%	34.2
SF Internal Leakage	5.0%	15.1
MF Irrigation	5.0%	25.2
SF Irrigation	5.0%	39.4
MF Wash Down	5.0%	1.2
SF Wash Down	5.0%	1.9
COM Kitchen Spray Rinse	40.0%	32.9
HOT Kitchen Spray Rinse	40.0%	251.4
RES Kitchen Spray Rinse	40.0%	95.1

Targets

Target Method: Percentage

% of Accts Targeted / yr	1.050%
Only Effects New Accts	☐

Costs

View: Utility Data

	Fixture Costs	Admin Costs	Utility Total
2018	$5,987	$0	$5,987
2019	$6,118	$0	$6,118
2020	$6,253	$0	$6,253
2021	$6,391	$0	$6,391
2022	$6,531	$0	$6,531
2023	$6,675	$0	$6,675
2024	$6,822	$0	$6,822
2025	$6,972	$0	$6,972
2026	$7,125	$0	$7,125
2027	$7,282	$0	$7,282
2028	$7,442	$0	$7,442
2029	$7,606	$0	$7,606
2030	$7,773	$0	$7,773
2031	$7,944	$0	$7,944
2032	$8,119	$0	$8,119
2033	$8,297	$0	$8,297
2034	$8,480	$0	$8,480
2035	$8,667	$0	$8,667
2036	$8,857	$0	$8,857
2037	$9,052	$0	$9,052
2038	$9,251	$0	$9,251
2039	$9,455	$0	$9,455
2040	$9,663	$0	$9,663

Targets

View: Fixtures

	MF	SF	COM	HOT	RES	Total
2018	123	161	14	1	2	302
2019	126	165	15	1	2	309
2020	129	168	15	1	2	316
2021	132	172	15	1	2	322
2022	135	176	16	1	2	330
2023	138	180	16	1	2	337
2024	141	184	17	1	2	344
2025	144	188	17	1	2	352
2026	147	192	17	1	2	360
2027	150	196	18	1	3	367
2028	153	200	18	1	3	376
2029	157	205	18	1	3	384
2030	160	209	19	1	3	392
2031	164	214	19	1	3	401
2032	167	218	20	1	3	410
2033	171	223	20	1	3	419
2034	175	228	21	1	3	428
2035	179	233	21	1	3	437
2036	183	238	21	1	3	447
2037	187	244	22	1	3	457
2038	191	249	22	1	3	467
2039	195	254	23	2	3	477
2040	199	260	23	2	3	488

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.003112
2019	0.006262
2020	0.009448
2021	0.012665
2022	0.015917
2023	0.019206
2024	0.022531
2025	0.025894
2026	0.029294
2027	0.032734
2028	0.036212
2029	0.039731
2030	0.043290
2031	0.046891
2032	0.050536
2033	0.051363
2034	0.052206
2035	0.053065
2036	0.053940
2037	0.054832
2038	0.055739
2039	0.056664
2040	0.057605

High Efficiency Toilet Rebate (Current)

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

Time Period	
First Year	2018
Last Year	2019
Measure Length	2

Measure Life	
Permanent	☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$69.25	$200.00	4
SF	$69.25	$200.00	2

Administration Costs

Method: Percent

Markup Percentage	50%

Description

Provide a rebate for the installation of a high efficiency toilet (HET). HETs are toilets flushing 1.28 gpf or less. Single-flush toilets must use 1.28 gallons or less per flush; dual-flush toilets can use 1.0/1.1 to 1.6 gallons per flush. All devices must be EPA WaterSense® labeled. Toilets must have been purchased on or after June 1, 2016. New toilets must replace an existing toilet; and only homes built before 2009 (as noted in the Coconino County Assessor's parcel database) are eligible since the City code required high-efficiency toilets after that date. Commercial sites built before 2011 are also eligible.
> Replace 5 gallon/flush (gpf) toilet (pre-1980) with 1.28 gpf toilet. Rebate: $100.
> Replace 3.5 gpf toilet (1981-1994) with 1.28 gpf. Rebate: $75.
> Replace 1.6 gpf toilet (1995-2008) with 1.28 gpf. Rebate: $25.

> FY20 pilot proposal: all toilets = $50, if code 1.28 gpf is exceeded, an additional $50 is offered - COF will provide advice on toilet MAP scores and advise re: liability on plumbing.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☑	☑							
Urinals									
Lavatory Faucets	☐	☐							
Showers	☐	☐							
Dishwashers	☐	☐							
Clothes Washers	☐	☐							
Process									
Kitchen Spray Rinse									
Internal Leakage	☐	☐							
Baths	☐	☐							
Other	☐	☐							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Cooling									
Car Washing	☐	☐							
External Leakage	☐	☐							
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐							

Comments

> Current measure
> Find cost (including admin) basis on black-tabbed worksheet "2019 Measure Cost Basis"
> Targets based on FY15-FY17 participation per account type. In FY 2017: 136 SF, 1 COM, and 4 MF toilets were rebated.
>Three year average rebate amount for replaced toilets = average utility cost of $68 per fixture
> Costs and savings based on the last three years include 1.28 gpf toilets are replacing: 25% 5 gpf, 51% 3.5 gpf, 24% 1.6 gpf.
> Admin percentage is based on recent staff time.

Results

Units: MG

Average Water Savings (mgd)	
0.001646	
Lifetime Savings - Present Value ($)	
Utility	$28,194
Community	$28,194
Lifetime Costs - Present Value ($)	
Utility	$29,165
Community	$85,318
Benefit to Cost Ratio	
Utility	0.97
Community	0.33
Cost of Savings per Unit Volume ($/mg)	
Utility	$2,109

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Toilets	55.7%	102.6
SF Toilets	55.7%	23.2

Targets

Target Method: Detailed

Enter Annual Targets Below

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$9,695	$4,848	$14,543
2019	$10,111	$5,055	$15,166
2020	$0	$0	$0
2021	$0	$0	$0
2022	$0	$0	$0
2023	$0	$0	$0
2024	$0	$0	$0
2025	$0	$0	$0
2026	$0	$0	$0
2027	$0	$0	$0
2028	$0	$0	$0
2029	$0	$0	$0
2030	$0	$0	$0
2031	$0	$0	$0
2032	$0	$0	$0
2033	$0	$0	$0
2034	$0	$0	$0
2035	$0	$0	$0
2036	$0	$0	$0
2037	$0	$0	$0
2038	$0	$0	$0
2039	$0	$0	$0
2040	$0	$0	$0

Targets

View: Accounts

	MF	SF	Total
2018	1	68	69
2019	2	69	71
2020	0	0	0
2021	0	0	0
2022	0	0	0
2023	0	0	0
2024	0	0	0
2025	0	0	0
2026	0	0	0
2027	0	0	0
2028	0	0	0
2029	0	0	0
2030	0	0	0
2031	0	0	0
2032	0	0	0
2033	0	0	0
2034	0	0	0
2035	0	0	0
2036	0	0	0
2037	0	0	0
2038	0	0	0
2039	0	0	0
2040	0	0	0

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000936
2019	0.001916
2020	0.001890
2021	0.001864
2022	0.001839
2023	0.001814
2024	0.001790
2025	0.001767
2026	0.001744
2027	0.001722
2028	0.001700
2029	0.001678
2030	0.001658
2031	0.001637
2032	0.001617
2033	0.001598
2034	0.001579
2035	0.001561
2036	0.001543
2037	0.001526
2038	0.001509
2039	0.001492
2040	0.001476

High Efficiency Toilet Rebate (New)

Overview	
Name	High Efficiency Toilet Rebate (New)
Abbr	ToiletsNew
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2040
Measure Length	21

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
MF	$75.00	$200.00	1
SF	$75.00	$200.00	1

Administration Costs	
Method:	Percent
Markup Percentage	25%

Description

Provide a rebate for the installation of a ultra-high efficiency toilet (UHET). UHETs are toilets flushing 1.0 gpf or less. All devices must be EPA WaterSense® labeled. Toilets must have been purchased on or after June 1, 2016. New toilets must replace an existing toilet; and only homes built before 2009 (as noted in the Coconino County Assessor's parcel database) are eligible since the City code required high-efficiency toilets after that date. Commercial sites built before 2011 are also eligible. All eligible toilets can receive a $100 rebate. COF will provide advice on toilet MAP scores and advise re: liability on plumbing.

Customer Classes	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☑	☑							
Urinals									
Lavatory Faucets	☐	☐							
Showers	☐	☐							
Dishwashers	☐	☐							
Clothes Washers	☐	☐							
Process									
Kitchen Spray Rinse									
Internal Leakage	☐	☐							
Baths	☐	☐							
Other	☐	☐							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Cooling									
Car Washing	☐	☐							
External Leakage	☐	☐							
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐							

Comments

> New measure
> Find cost (including admin) basis on black-tabbed worksheet "2019 Measure Cost Basis"
> Targets based on FY15-FY17 recent participation per account type. In FY 2017: 136 SF, 1 COM, and 4 MF toilets were rebated.
> Savings based on the last three years include the following types of toilets being replaced by <1.0 gpf: 25% 5 gpf, 51% 3.5 gpf, 24% 1.6 gpf.
> Admin percentage is based on recent staff time spent.

Results	
Units	MG
Average Water Savings (mgd)	0.016282
Lifetime Savings - Present Value ($)	
Utility	$230,905
Community	$230,905
Lifetime Costs - Present Value ($)	
Utility	$117,602
Community	$368,485
Benefit to Cost Ratio	
Utility	1.96
Community	0.63
Cost of Savings per Unit Volume ($/mg)	
Utility	$860

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
MF Toilets	72.3%	102.6
SF Toilets	72.3%	23.2

Targets	
Target Method:	Detailed
Enter Annual Targets Below	

Costs — View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$5,475	$1,369	$6,844
2021	$5,625	$1,406	$7,031
2022	$5,775	$1,444	$7,219
2023	$5,925	$1,481	$7,406
2024	$6,075	$1,519	$7,594
2025	$6,225	$1,556	$7,781
2026	$6,375	$1,594	$7,969
2027	$6,525	$1,631	$8,156
2028	$6,675	$1,669	$8,344
2029	$6,825	$1,706	$8,531
2030	$6,975	$1,744	$8,719
2031	$7,125	$1,781	$8,906
2032	$7,275	$1,819	$9,094
2033	$7,425	$1,856	$9,281
2034	$7,575	$1,894	$9,469
2035	$7,725	$1,931	$9,656
2036	$7,875	$1,969	$9,844
2037	$8,025	$2,006	$10,031
2038	$8,175	$2,044	$10,219
2039	$8,325	$2,081	$10,406
2040	$8,475	$2,119	$10,594

Targets — View: Accounts

	MF	SF	Total
2018	0	0	0
2019	0	0	0
2020	3	70	73
2021	4	71	75
2022	5	72	77
2023	6	73	79
2024	7	74	81
2025	8	75	83
2026	9	76	85
2027	10	77	87
2028	11	78	89
2029	12	79	91
2030	13	80	93
2031	14	81	95
2032	15	82	97
2033	16	83	99
2034	17	84	101
2035	18	85	103
2036	19	86	105
2037	20	87	107
2038	21	88	109
2039	22	89	111
2040	23	90	113

Water Savings — Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.001358
2021	0.002765
2022	0.004218
2023	0.005716
2024	0.007256
2025	0.008836
2026	0.010454
2027	0.012108
2028	0.013796
2029	0.015517
2030	0.017269
2031	0.019049
2032	0.020860
2033	0.022699
2034	0.024565
2035	0.026458
2036	0.028377
2037	0.030321
2038	0.032289
2039	0.034280
2040	0.036294

Hot Water Recirculation Code

Overview	
Name	Hot Water Recirculation Code
Abbr	HotRecircCode
Category	Default Plumbing Code
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2040
Measure Length	21

Measure Life	
Permanent	☑

Fixture Cost per Device	Utility	Customer	Fix/Acct
MF	$0.01	$500.00	3
SF	$0.01	$500.00	1

Administration Costs	
Method:	Fixed
Annual Admin Costs	$500

Description

The 2018 International Building Code (IBC) requires hot water recirculation on all new development.

Customer Classes	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐							
Urinals									
Lavatory Faucets	☑	☑							
Showers	☑	☑							
Dishwashers	☑	☑							
Clothes Washers	☑	☑							
Process									
Kitchen Spray Rinse									
Internal Leakage	☐	☐							
Baths	☐	☐							
Other	☐	☐							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Cooling									
Car Washing	☐	☐							
External Leakage	☐	☐							
Outdoor									
Non-Lavatory/Kitchen Faucets	☑	☑							

Comments

> Water savings based on Jim Lutz paper and information from Gary Klein and David Grieshop. See spreadsheet titled "Hot Water On Demand Water Savings Estimate_2013" 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 SF indoor water use this results in an equivalent savings of approximately 7-8 gpd/acct savings (7.06 gpd) or approx. 14.5% on shower and faucet end uses. More information for example system by ACT on www.gothotwater.com.

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

> Utility costs represent time to monitor implementation.

Results	
Units	MG
Average Water Savings (mgd)	
	0.062919
Lifetime Savings - Present Value ($)	
Utility	$898,226
Community	$2,284,515
Lifetime Costs - Present Value ($)	
Utility	$7,034
Community	$4,601,172
Benefit to Cost Ratio	
Utility	127.70
Community	0.50
Cost of Savings per Unit Volume ($/mg)	
Utility	$13

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
SF Lavatory Faucets	14.5%	8.1
SF Showers	14.5%	25.7
SF Dishwashers	14.5%	2.3
SF Clothes Washers	14.5%	19.1
SF Non-Lavatory/Kitchen Faucet	14.5%	15.1
MF Lavatory Faucets	14.5%	25.7
MF Showers	14.5%	124.0
MF Dishwashers	14.5%	4.3
MF Clothes Washers	14.5%	72.7
MF Non-Lavatory/Kitchen Faucet	14.5%	47.0

Targets	
Target Method:	Percentage
% of Accts Targeted / yr	100.000%
Only Effects New Accts	☑

Costs — View: Utility Details

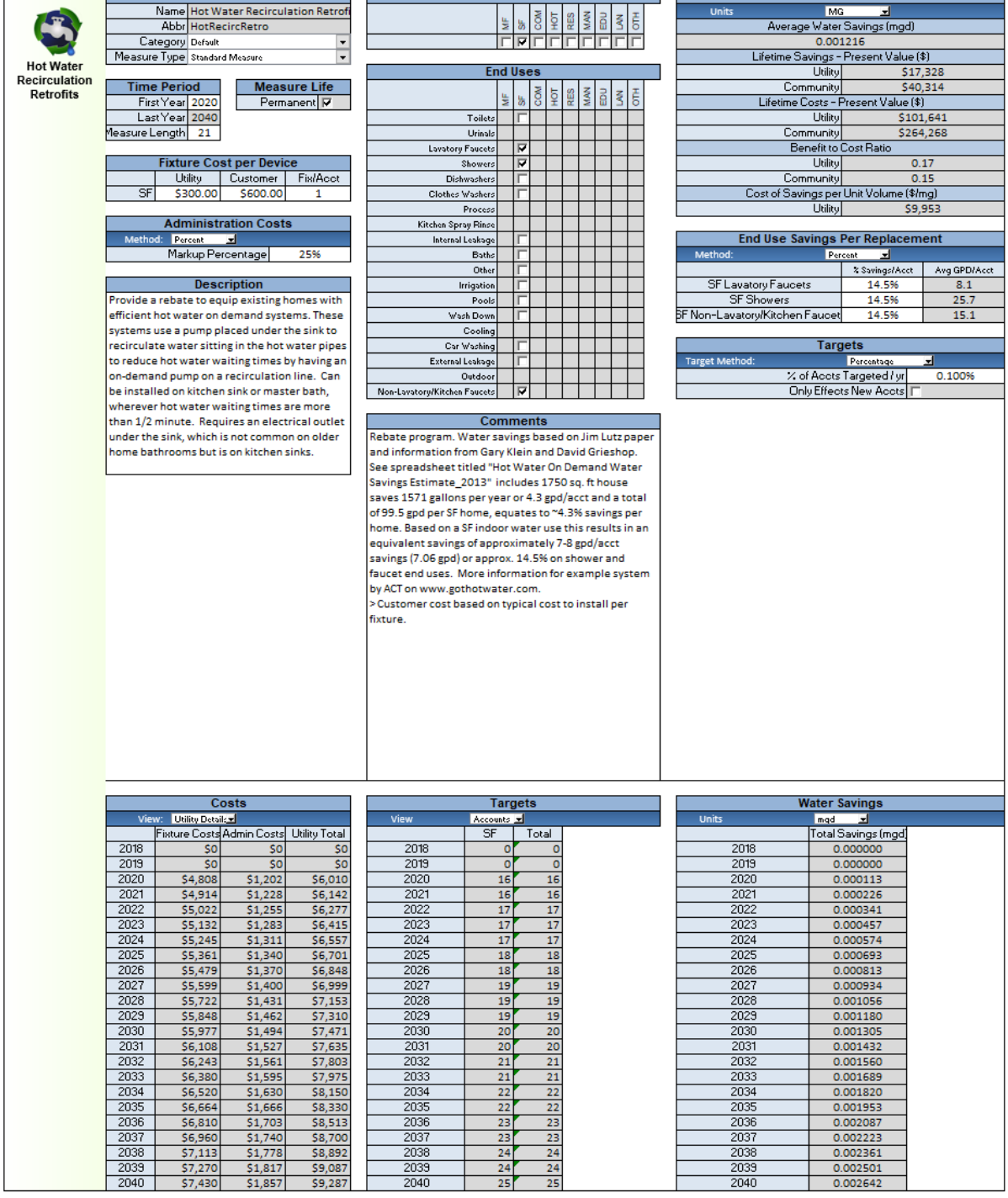
	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$5	$500	$505
2021	$6	$500	$506
2022	$6	$500	$506
2023	$6	$500	$506
2024	$6	$500	$506
2025	$6	$500	$506
2026	$6	$500	$506
2027	$6	$500	$506
2028	$6	$500	$506
2029	$7	$500	$507
2030	$7	$500	$507
2031	$7	$500	$507
2032	$7	$500	$507
2033	$7	$500	$507
2034	$7	$500	$507
2035	$8	$500	$508
2036	$8	$500	$508
2037	$8	$500	$508
2038	$8	$500	$508
2039	$8	$500	$508
2040	$8	$500	$508

Targets — View: Accounts

	MF	SF	Total
2018	0	0	0
2019	0	0	0
2020	66	345	411
2021	68	353	420
2022	69	360	429
2023	71	368	439
2024	72	376	448
2025	74	385	459
2026	75	393	468
2027	77	402	479
2028	79	411	489
2029	80	420	500
2030	82	429	511
2031	84	438	522
2032	86	448	534
2033	88	458	546
2034	90	468	557
2035	92	478	570
2036	94	489	582
2037	96	499	595
2038	98	510	608
2039	100	522	622
2040	102	533	635

Water Savings — Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.006013
2021	0.012041
2022	0.018084
2023	0.024152
2024	0.030253
2025	0.036393
2026	0.042571
2027	0.048793
2028	0.055068
2029	0.061391
2030	0.067769
2031	0.074203
2032	0.080710
2033	0.087294
2034	0.093954
2035	0.100700
2036	0.107531
2037	0.114449
2038	0.121457
2039	0.128560
2040	0.135758



Hot Water Recirculation Retrofits

Overview

Name	Hot Water Recirculation Retrofi
Abbr	HotRecircRetro
Category	Default
Measure Type	Standard Measure

Time Period

First Year	2020
Last Year	2040
Measure Length	21

Measure Life

Permanent ☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
SF	$300.00	$600.00	1

Administration Costs

Method: Percent

Markup Percentage	25%

Description

Provide a rebate to equip existing homes with efficient hot water on demand systems. These systems use a pump placed under the sink to recirculate 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

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
	☐	☑	☐	☐	☐	☐	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets		☐							
Urinals									
Lavatory Faucets		☑							
Showers		☑							
Dishwashers		☐							
Clothes Washers		☐							
Process									
Kitchen Spray Rinse									
Internal Leakage		☐							
Baths		☐							
Other		☐							
Irrigation		☐							
Pools		☐							
Wash Down		☐							
Cooling									
Car Washing		☐							
External Leakage		☐							
Outdoor									
Non-Lavatory/Kitchen Faucets		☑							

Comments

Rebate program. Water savings based on Jim Lutz paper and information from Gary Klein and David Grieshop. See spreadsheet titled "Hot Water On Demand Water Savings Estimate_2013" 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 SF indoor water use this results in an equivalent savings of approximately 7-8 gpd/acct savings (7.06 gpd) or approx. 14.5% on shower and faucet end uses. More information for example system by ACT on www.gothotwater.com.
> Customer cost based on typical cost to install per fixture.

Results

Units: MG

Average Water Savings (mgd)	
0.001216	
Lifetime Savings - Present Value ($)	
Utility	$17,328
Community	$40,314
Lifetime Costs - Present Value ($)	
Utility	$101,641
Community	$264,268
Benefit to Cost Ratio	
Utility	0.17
Community	0.15
Cost of Savings per Unit Volume ($/mg)	
Utility	$9,953

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
SF Lavatory Faucets	14.5%	8.1
SF Showers	14.5%	25.7
SF Non-Lavatory/Kitchen Faucet	14.5%	15.1

Targets

Target Method: Percentage

% of Accts Targeted / yr	0.100%
Only Effects New Accts	☐

Costs

View: Utility Detail

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$4,808	$1,202	$6,010
2021	$4,914	$1,228	$6,142
2022	$5,022	$1,255	$6,277
2023	$5,132	$1,283	$6,415
2024	$5,245	$1,311	$6,557
2025	$5,361	$1,340	$6,701
2026	$5,479	$1,370	$6,848
2027	$5,599	$1,400	$6,999
2028	$5,722	$1,431	$7,153
2029	$5,848	$1,462	$7,310
2030	$5,977	$1,494	$7,471
2031	$6,108	$1,527	$7,635
2032	$6,243	$1,561	$7,803
2033	$6,380	$1,595	$7,975
2034	$6,520	$1,630	$8,150
2035	$6,664	$1,666	$8,330
2036	$6,810	$1,703	$8,513
2037	$6,960	$1,740	$8,700
2038	$7,113	$1,778	$8,892
2039	$7,270	$1,817	$9,087
2040	$7,430	$1,857	$9,287

Targets

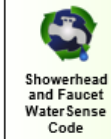
View: Accounts

	SF	Total
2018	0	0
2019	0	0
2020	16	16
2021	16	16
2022	17	17
2023	17	17
2024	17	17
2025	18	18
2026	18	18
2027	19	19
2028	19	19
2029	19	19
2030	20	20
2031	20	20
2032	21	21
2033	21	21
2034	22	22
2035	22	22
2036	23	23
2037	23	23
2038	24	24
2039	24	24
2040	25	25

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.000113
2021	0.000226
2022	0.000341
2023	0.000457
2024	0.000574
2025	0.000693
2026	0.000813
2027	0.000934
2028	0.001056
2029	0.001180
2030	0.001305
2031	0.001432
2032	0.001560
2033	0.001689
2034	0.001820
2035	0.001953
2036	0.002087
2037	0.002223
2038	0.002361
2039	0.002501
2040	0.002642



Showerhead and Faucet WaterSense Code

Overview	
Name	Showerhead and Faucet WaterSense Code
Abbr	ShowFauc
Category	Default Plumbing Code
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2040
Measure Length	21

Measure Life	
Permanent	☑

Fixture Cost per Device

	Utility	Customer	Fix/Acct
MF	$1.00	$10.00	20
SF	$1.00	$10.00	4
COM	$1.00	$10.00	20
HOT	$1.00	$10.00	50
RES	$1.00	$10.00	5
MAN	$1.00	$10.00	20

Administration Costs

Method: Fixed

Annual Admin Costs	$10,000

Description

Future code change to require all fixtures in new development meet WaterSense specifications. Recommended in concert with a conservation plan review.

Customer Classes

MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
☑	☑	☑	☑	☑	☑	☐	☐	☐

End Uses

	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐	☐	☐	☐	☐			
Urinals			☐	☐	☐				
Lavatory Faucets	☑	☑	☑	☑	☑	☑			
Showers	☑	☑	☑	☑		☑			
Dishwashers	☐	☐	☐	☐	☐	☐			
Clothes Washers	☐	☐	☐	☐	☐	☐			
Process			☐			☐			
Kitchen Spray Rinse			☐	☐	☐				
Internal Leakage	☐	☐	☐	☐	☐	☐			
Baths	☐	☐		☐					
Other	☐	☐	☐	☐	☐	☐			
Irrigation	☐	☐	☐	☐	☐	☐			
Pools	☐	☐		☐					
Wash Down	☐	☐		☐	☐				
Cooling			☐	☐	☐	☐			
Car Washing	☐	☐							
External Leakage	☐	☐	☐	☐	☐	☐			
Outdoor									
Non-Lavatory/Kitchen Faucets	☑	☑	☑	☑	☑	☑			

Comments

Savings based on code changing from 2.2 to 1.8 for kitchen, 2.2 to 1.5 for residential lavatory, and 2.5 to 2.0 for showerheads. Recommend in concert with conservation plan review.
Utility costs include increased code enforcement. Approximately $5k annually (via COF Building Official)

Results

Units: MG

Average Water Savings (mgd)	
	0.094324
Lifetime Savings - Present Value ($)	
Utility	$1,342,491
Community	$2,874,957
Lifetime Costs - Present Value ($)	
Utility	$197,309
Community	$781,980
Benefit to Cost Ratio	
Utility	6.80
Community	3.68
Cost of Savings per Unit Volume ($/mg)	
Utility	$249

End Use Savings Per Replacement

Method: Percent

	% Savings/Acct	Avg GPD/Acct
MF Lavatory Faucets	31.8%	25.7
SF Lavatory Faucets	31.8%	8.1
HOT Lavatory Faucets	31.8%	380.1
MF Showers	20.0%	124.0
SF Showers	20.0%	25.7
HOT Showers	20.0%	905.1
MF Non-Lavatory/Kitchen Faucet	18.2%	47.0
SF Non-Lavatory/Kitchen Faucets	18.2%	15.1
HOT Non-Lavatory/Kitchen Fauce	18.2%	323.8
COM Lavatory Faucets	31.8%	49.7
RES Lavatory Faucets	31.8%	125.1
MAN Lavatory Faucets	31.8%	425.0
COM Showers	20.0%	59.2
MAN Showers	20.0%	168.6
COM Non-Lavatory/Kitchen Fauce	18.2%	42.4
RES Non-Lavatory/Kitchen Faucet	18.2%	193.1
MAN Non-Lavatory/Kitchen Fauce	18.2%	362.0

Targets

Target Method: Percentage

% of Accts Targeted / yr	100.000%
Only Effects New Accts	☑

Costs

View: Utility Detail

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$3,456	$10,000	$13,456
2021	$3,534	$10,000	$13,534
2022	$3,611	$10,000	$13,611
2023	$3,689	$10,000	$13,689
2024	$3,772	$10,000	$13,772
2025	$3,856	$10,000	$13,856
2026	$3,939	$10,000	$13,939
2027	$4,025	$10,000	$14,025
2028	$4,116	$10,000	$14,116
2029	$4,205	$10,000	$14,205
2030	$4,297	$10,000	$14,297
2031	$4,392	$10,000	$14,392
2032	$4,489	$10,000	$14,489
2033	$4,588	$10,000	$14,588
2034	$4,687	$10,000	$14,687
2035	$4,792	$10,000	$14,792
2036	$4,897	$10,000	$14,897
2037	$5,005	$10,000	$15,005
2038	$5,114	$10,000	$15,114
2039	$5,227	$10,000	$15,227
2040	$5,343	$10,000	$15,343

Targets

View: Accounts

	MF	SF	COM	HOT	RES	MAN	Total
2018	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0
2020	66	345	31	2	3	1	448
2021	68	353	32	2	3	1	458
2022	69	360	32	2	3	1	468
2023	71	368	33	2	3	1	478
2024	72	376	34	2	3	1	489
2025	74	385	35	2	3	1	500
2026	75	393	35	2	3	1	510
2027	77	402	36	2	3	1	522
2028	79	411	37	2	4	1	533
2029	80	420	38	2	4	1	545
2030	82	429	39	3	4	1	557
2031	84	438	39	3	4	1	569
2032	86	448	40	3	4	1	582
2033	88	458	41	3	4	1	595
2034	90	468	42	3	4	1	607
2035	92	478	43	3	4	1	621
2036	94	489	44	3	4	1	635
2037	96	499	45	3	4	1	649
2038	98	510	46	3	4	1	663
2039	100	522	47	3	4	1	677
2040	102	533	48	3	5	1	692

Water Savings

Units: mgd

	Total Savings (mgd
2018	0.000000
2019	0.000000
2020	0.008550
2021	0.017220
2022	0.026002
2023	0.034899
2024	0.043920
2025	0.053068
2026	0.062336
2027	0.071732
2028	0.081263
2029	0.090923
2030	0.100719
2031	0.110653
2032	0.120734
2033	0.130965
2034	0.141344
2035	0.151884
2036	0.162584
2037	0.173447
2038	0.184474
2039	0.195674
2040	0.207050

Leak Assistance

Overview	
Name	Leak Assistance
Abbr	LeakAssist
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2040
Measure Length	21

Measure Life	
Permanent	☐
Years	10
Repeat	☑

Fixture Cost per Device	Utility	Customer	Fix/Acct
MF	$200.00	$0.00	2
SF	$200.00	$0.00	1

Administration Costs	
Method:	Percent
Markup Percentage	100%

Description

Leak assistance for qualifying low income customers. Only owner occupied residences/accounts are eligible. Would partner with plumbers to fix basic leaks at a flat rate.

Customer Classes	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
	☑	☑	☐	☐	☐	☐	☐	☐	☐

End Uses	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☐	☐							
Urinals									
Lavatory Faucets	☐	☐							
Showers	☐	☐							
Dishwashers	☐	☐							
Clothes Washers	☐	☐							
Process									
Kitchen Spray Rinse									
Internal Leakage	☑	☑							
Baths	☐	☐							
Other	☐	☐							
Irrigation	☐	☐							
Pools	☐	☐							
Wash Down	☐	☐							
Cooling									
Car Washing	☐	☐							
External Leakage	☑	☑							
Outdoor									
Non-Lavatory/Kitchen Faucets	☐	☐							

Comments

> Assume 1 leak per SF, 2 leaks per MF (typically duplex owners), as these programs typically are for owner-occupied residences
> Might model after SAWS Plumbers for People.

Results	
Units	MG
Average Water Savings (mgd)	
	0.001594
Lifetime Savings - Present Value ($)	
Utility	$23,279
Community	$37,446
Lifetime Costs - Present Value ($)	
Utility	$134,770
Community	$134,770
Benefit to Cost Ratio	
Utility	0.17
Community	0.28
Cost of Savings per Unit Volume ($/mg)	
Utility	$10,066

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
MF Internal Leakage	50.0%	34.2
SF Internal Leakage	50.0%	15.1
MF External Leakage	50.0%	2.1
SF External Leakage	50.0%	3.3

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

Costs

View: Utility Details

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$4,434	$4,434	$8,867
2021	$4,531	$4,531	$9,062
2022	$4,631	$4,631	$9,262
2023	$4,733	$4,733	$9,465
2024	$4,837	$4,837	$9,674
2025	$4,943	$4,943	$9,887
2026	$5,052	$5,052	$10,104
2027	$5,163	$5,163	$10,326
2028	$5,277	$5,277	$10,554
2029	$5,393	$5,393	$10,786
2030	$4,434	$4,434	$8,867
2031	$4,531	$4,531	$9,062
2032	$4,631	$4,631	$9,262
2033	$4,733	$4,733	$9,465
2034	$4,837	$4,837	$9,674
2035	$4,943	$4,943	$9,887
2036	$5,052	$5,052	$10,104
2037	$5,163	$5,163	$10,326
2038	$5,277	$5,277	$10,554
2039	$5,393	$5,393	$10,786
2040	$4,434	$4,434	$8,867

Targets

View: Accounts

	MF	SF	Total
2018	0	0	0
2019	0	0	0
2020	3	16	19
2021	3	16	20
2022	3	17	20
2023	3	17	20
2024	3	17	21
2025	3	18	21
2026	3	18	22
2027	4	19	22
2028	4	19	23
2029	4	19	23
2030	3	16	19
2031	3	16	20
2032	3	17	20
2033	3	17	20
2034	3	17	21
2035	3	18	21
2036	3	18	22
2037	4	19	22
2038	4	19	23
2039	4	19	23
2040	3	16	19

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.000203
2021	0.000411
2022	0.000623
2023	0.000840
2024	0.001062
2025	0.001289
2026	0.001520
2027	0.001757
2028	0.001999
2029	0.002246
2030	0.002246
2031	0.002246
2032	0.002246
2033	0.002246
2034	0.002246
2035	0.002246
2036	0.002246
2037	0.002246
2038	0.002246
2039	0.002246
2040	0.002246

Submetering

Overview	
Name	Submetering
Abbr	Submeters
Category	Default
Measure Type	Standard Measure

Time Period	
First Year	2020
Last Year	2039
Measure Length	20

Measure Life	
Permanent	☑

Fixture Cost per Device			
	Utility	Customer	Fix/Acct
MF	$100.00	$100.00	110
COM	$100.00	$100.00	10

Administration Costs	
Method:	Percent
Markup Percentage	5%

Description

Provide submeters (point leak detection devices like Flume offers) for all apartments in an apartment complex or all businesses in a strip mall.

Customer Classes	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
	☑	☐	☑	☐	☐	☐	☐	☐	☐

End Uses	MF	SF	COM	HOT	RES	MAN	EDU	LAN	OTH
Toilets	☑		☑						
Urinals			☑						
Lavatory Faucets	☑		☑						
Showers	☑		☑						
Dishwashers	☑		☑						
Clothes Washers	☑		☑						
Process			☐						
Kitchen Spray Rinse			☑						
Internal Leakage	☑		☑						
Baths	☐								
Other	☐		☐						
Irrigation	☑		☑						
Pools	☐								
Wash Down	☐								
Cooling			☐						
Car Washing	☐								
External Leakage	☑		☑						
Outdoor									
Non-Lavatory/Kitchen Faucets	☑		☑						

Comments

Savings based on estimated metering retrofit projects and education measure estimated savings. Leak savings are higher since submetering should make leaks easier to identify and locate. Costs based on Flume retail rates. Markup percentage is based on estimated installation.

Flume devices retail at $200.
> Restaurant accounts have already received a "submeter". Some restaurants may be included in commercial account strip malls.

Results	
Units	MG
Average Water Savings (mgd)	
0.001541	
Lifetime Savings - Present Value ($)	
Utility	$21,643
Community	$38,096
Lifetime Costs - Present Value ($)	
Utility	$169,297
Community	$330,532
Benefit to Cost Ratio	
Utility	0.13
Community	0.12
Cost of Savings per Unit Volume ($/mg)	
Utility	$13,077

End Use Savings Per Replacement		
Method:	Percent	
	% Savings/Acct	Avg GPD/Acct
MF Toilets	15.0%	102.6
COM Toilets	15.0%	149.3
COM Urinals	15.0%	39.5
MF Lavatory Faucets	15.0%	25.7
COM Lavatory Faucets	15.0%	49.7
MF Showers	15.0%	124.0
COM Showers	15.0%	59.2
MF Dishwashers	15.0%	4.3
COM Dishwashers	15.0%	39.5
MF Clothes Washers	15.0%	72.7
COM Clothes Washers	15.0%	98.7
COM Kitchen Spray Rinse	15.0%	32.9
MF Internal Leakage	15.0%	34.2
COM Internal Leakage	15.0%	65.8
MF Irrigation	15.0%	25.2
COM Irrigation	15.0%	120.2
MF External Leakage	15.0%	2.1
COM External Leakage	15.0%	9.8
MF Non-Lavatory/Kitchen Faucets	15.0%	47.0
COM Non-Lavatory/Kitchen Faucet	15.0%	42.4

Targets	
Target Method:	Count
# of Accts Targeted / yr	1

Costs

View: Utility Detail

	Fixture Costs	Admin Costs	Utility Total
2018	$0	$0	$0
2019	$0	$0	$0
2020	$12,000	$600	$12,600
2021	$12,000	$600	$12,600
2022	$12,000	$600	$12,600
2023	$12,000	$600	$12,600
2024	$12,000	$600	$12,600
2025	$12,000	$600	$12,600
2026	$12,000	$600	$12,600
2027	$12,000	$600	$12,600
2028	$12,000	$600	$12,600
2029	$12,000	$600	$12,600
2030	$12,000	$600	$12,600
2031	$12,000	$600	$12,600
2032	$12,000	$600	$12,600
2033	$12,000	$600	$12,600
2034	$12,000	$600	$12,600
2035	$12,000	$600	$12,600
2036	$12,000	$600	$12,600
2037	$12,000	$600	$12,600
2038	$12,000	$600	$12,600
2039	$12,000	$600	$12,600
2040	$0	$0	$0

Targets

View: Accounts

	MF	COM	Total
2018	0	0	0
2019	0	0	0
2020	1	1	2
2021	1	1	2
2022	1	1	2
2023	1	1	2
2024	1	1	2
2025	1	1	2
2026	1	1	2
2027	1	1	2
2028	1	1	2
2029	1	1	2
2030	1	1	2
2031	1	1	2
2032	1	1	2
2033	1	1	2
2034	1	1	2
2035	1	1	2
2036	1	1	2
2037	1	1	2
2038	1	1	2
2039	1	1	2
2040	0	0	0

Water Savings

Units: mgd

	Total Savings (mgd)
2018	0.000000
2019	0.000000
2020	0.000169
2021	0.000335
2022	0.000499
2023	0.000660
2024	0.000818
2025	0.000975
2026	0.001129
2027	0.001281
2028	0.001431
2029	0.001580
2030	0.001726
2031	0.001871
2032	0.002014
2033	0.002156
2034	0.002296
2035	0.002435
2036	0.002573
2037	0.002709
2038	0.002845
2039	0.002979
2040	0.002964