San Francisco
Water Power Sewer
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APPENDIX D

2025 Conservation Tracking Model Summary

2025 URBAN WATER MANAGEMENT PLAN
for the City and County of San Francisco

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SFPUC Conservation Tracking Model

Water and Energy Savings Specifications for Conservation Program Measures

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Overview

The SFPUC Conservation Tracking Model is a tool developed to track conservation program activity, water savings, and costs and benefits for SFPUC's retail service area conservation programs. The model is a customized version of the Alliance for Water Efficiency's (AWE) Water Conservation Tracking Tool, an Excel-based water conservation tracking model with more than four hundred registered water utility users throughout North America. In 2014, the SFPUC customized the AWE Conservation Tracking Tool for its retail service area and began using it to forecast water savings from conservation measures.

The purpose of this Water and Energy Savings Specifications for Conservation Program Measures Technical Memorandum is to document the assumptions and methodologies used to estimate water savings for every measure in the SFPUC's Conservation Tracking Model and key updates made over time. This document reflects all measures with modeled water savings included in the Conservation Tracking Model, including measures the SFPUC implements now or plans to in the next five years, implemented in the past, and ones SFPUC has evaluated and not implemented and may or may not do so in the future. It does not reflect conservation measures the SFPUC provides or provided in the past that don't have established or sufficient water-savings methodologies.

History of SFPUC Conservation Forecast Modelling

The SFPUC developed its first model in 2004 to forecast both in-City retail water demands and water savings from conservation measures. The SFPUC used estimated conservation water savings generated by this model to develop its 2004 and 2011 conservation plans. The SFPUC migrated from using this combined demand/forecast model in 2014, and started using a separate econometric demand model originally developed by The Brattle Group to estimate retail demands and to the SFPUC Conservation Tracking Model to estimate water savings from conservation measures. Most recently, in 2025, the SFPUC updated its econometric demand model for its retail service area for use in preparing its 2025 Urban Water Management Plan and for providing updated demand estimates for its 2025 Retail Conservation Plan.

Model Structure

The Conservation Tracking Model is an Excel-based model with an extensive Visual Basic backend. Using the model requires completing Model Setup, Program Specification, and Annual Activity data input tasks. Each data input task is contained on a separate worksheet in the model.

Model Setup consists of providing the model with the baseline forecast of water demand, as well as other basic system information the model uses to calculate the costs and benefits of conservation programs. The baseline water demand forecast comes from the econometric demand models. Setup also includes providing the latest estimates of actual population, housing, and employment which are used to update the estimates of passive water savings to date.

Program Specification consists of parameterizing the conservation programs in the model. The model can hold up to 200 separate programs. Program parameters are grouped into five categories: water saving parameters, utility cost parameters, participant cost parameters, participant non water benefits parameters, and plumbing code parameters. The latter are used to specify interaction effects with plumbing codes to avoid double counting water savings jointly produced by plumbing codes and conservation programs. In terms of forecasting conservation program water savings, the most important parameters are the water savings parameters and the plumbing code interaction parameters.

Annual Activity is simply the number of units of activity that have been done (in the case of historical years) or are expected to be done (in the case of future years). The user enters historical and projected annual activity for each conservation program that was specified during the Program Specification step. For toilets, urinals, and clothes washers, the model includes fixture inventory modules to keep track of how many fixtures have been converted to efficient fixtures due to plumbing codes and conservation programs to ensure the user does not specify levels of fixture replacement that are physically infeasible.

Once the three data input tasks have been completed the model results can be reviewed. Model results are summarized into three categories: (1) program water savings, (2) retail water demand, and (3) costs and benefits.

- Program water savings are the projected annual water savings from each specified conservation program through 2050. Results can be grouped by program category and customer class or shown individually.

- Retail demand results summarize the baseline annual demand forecast with plumbing code and conservation program adjustments through 2050. It is grouped by customer class and shown separately for the in-city and suburban parts of SFPUC's retail service area. Results can be shown in MGD or acre-feet. Gross per capita and residential per capita water use are also reported.
- Costs and benefits of conservation are reported for the utility and program participant perspectives. Unit costs, net present value, and benefit-cost ratios can be reported for the totality of all programs, for individual program categories (e.g. toilet replacement programs), or for individual programs. In addition to financial benefits and costs, the model calculates expected reductions in associated energy use and greenhouse gas emissions.

Model inputs can be saved as scenarios. This allows the model to simultaneously hold more than one set of data inputs. For example, a user could specify scenarios for alternative baseline population and demand forecasts or for alternative levels of conservation program investment. There is no practical limit to the number of scenarios the model can hold.

Summary of Key Updates since 2015

2015 Updates
The conservation program savings presented in SFPUC's 2011 Conservation Plan were developed with the SFPUC's original Retail Demand Model not the Conservation Tracking Model. While the Conservation Tracking Model can be calibrated to replicate the 2011 estimates, the final estimates developed for the 2015 Conservation Plan, which were developed with the Conservation Tracking Model, were generally lower after 2020 than was presented in the 2011 Plan for three main reasons:

- The SFPUC undertook a review of the water saving estimates and assumptions and made several adjustments, including to savings estimates for clothes washers and toilets, both of which were lowered to account for new efficiency standards affecting the long-term savings potential of these programs.
- The 2015 Plan updated the end dates for toilet and clothes washer incentives due to high fixture saturation levels.

- The 2015 Plan focused mainly on the next five years, reflecting that beyond that horizon, there is much less certainty regarding what conservation programs SFPUC will find most beneficial and cost-effective to implement.

2020 Updates
In 2020, the SFPUC made the following changes to the model:

- Revised future participation levels for several measures to better reflect current trends.
- Added several new conservation measures.
- Adjusted the water savings assumptions of several existing measures.
- Updated the water savings module for clothes washer efficiency standards to align it with the approach used in Version 4 of the Alliance for Water Efficiency's Water Conservation Tracking Tool.
- Incorporated the City of San Francisco Planning Department's current population and housing estimates.
- Removed the calculation of plumbing code water savings for new development (post 2020) because they are already embedded in SFPUC's updated retail demand projections.

These updates were based on analysis of historical program participation, updated fixture saturation rates, and new empirical and other water-savings studies and data available since 2015. This document reflects the assumptions and specifications used in the SFPUC's Conservation Tracking Model for purposes of estimating water savings for the SFPUC's 2020 Retail Conservation plan.

2025 Updates
In 2025, the following updates to the model were made:

- Revised the toilet fixture saturation module to account for replacement of 1.6 gpf toilets with 1.28 gpf or less toilets by SFPUC toilet replacement programs.
- Updated savings assumptions of AMI leak alert measures to align with savings estimates reported in the February 2, 2024, technical memorandum: *Water Savings Assessment of SFPUC Leak Alert Programs*.
- Updated savings assumptions for HET replacement programs to account for replacement of existing toilets with HET toilets with flush ratings < 1.28 gpf.
- Added new programs to the model, including direct install and rebate programs to replace 1.6 gpf toilets with ultra-high-efficiency toilets with flush ratings of <= 1.0 gpf; and multi-family and non-residential landscape irrigation timer rebate programs.
- Incorporated into the model updated implementation costs provided by SFPUC for 39 programs.
- Incorporated projected annual implementation levels through 2050 provided by SFPUC for 38 programs.
- Incorporated the estimates of 2025 population, housing, and employment; estimates for 2020 population were revised.

2025 Population and Housing Estimates

SFPUC expects new construction to be built at code and generate no additional passive savings. All future passive savings will come from existing stock. As such, population and housing

estimates for 2025 were updated, as described below, and then held constant for the remainder of the planning horizon.

Population Estimate Update

Updated 2025 population of 842,027 was input based on Department of Finance E-5 Housing and Population Estimates (dated January 2025). Residential population in 2025 was updated from the same source. Additionally, the 2020 total population estimate of 941,269 provided by SF Planning was retroactively revised to 873,965 based on the 2020 estimated value from Department of Finance E-5 Housing and Population Estimates (dated January 2025).

The conservation model's original and updated population projections are shown in Table 1. As shown in this table, the population stops growing after 2025 to reflect no additional passive savings to be generated from future growth.

Table 1: Population Projection Update

	Total Population			Residential Population		
Year	2020 Model	2025 Model	% Difference	2020 Model	2025 Model	% Difference
2005	780,187	780,187	0.0%	756,678	756,678	0.0%
2010	805,235	805,235	0.0%	780,971	780,971	0.0%
2015	857,508	857,508	0.0%	831,995	831,995	0.0%
2020	941,269	873,965	-7.2%	913,031	840,986	-7.9%
2025	941,269	842,027	-10.5%	913,031	811,717	-11.1%
2030	941,269	842,027	-10.5%	913,031	811,717	-11.1%
2035	941,269	842,027	-10.5%	913,031	811,717	-11.1%
2040	941,269	842,027	-10.5%	913,031	811,717	-11.1%
2045	941,269	842,027	-10.5%	913,031	811,717	-11.1%
2050	941,269	842,027	-10.5%	913,031	811,717	-11.1%

Source: 2020 total population from San Francisco Planning Department, adjusted to residential population based on 3% group quarters (DOF E-5 and P-4)

Household Projection Update

Total housing units were sourced from San Francisco Planning's 2024 Housing Inventory. This value is assumed to be an estimate of total constructed housing units as opposed to occupied housing units.

Occupied single-family housing units in 2025 were set equal to the number of single-family residential accounts in the SFPUC's billing system as of June 2025. This includes the number of accounts with the service agreement type residential single family (RES-SWTR), regardless of dwelling unit count, and the service agreement type of residential combination service (COMBO-R) with 1 dwelling unit. Occupied single-family housing units for 2030 and beyond were kept the same as 2025.

Total 2025 housing units from the Planning Department were adjusted to estimate occupied housing units using a vacancy rate of 11.25%, which is an average of the last two estimates provided by the ACS 1-year estimates for the City of San Francisco from 2023 (11.03%) and 2024 (11.48%). Total occupied multi-family housing units in 2025 were estimated by subtracting the number of occupied single-family housing units in 2025 from the total 2025 occupied housing units.

Calculation of Plumbing Code Water Savings

The Conservation Tracking Model calculates the water savings associated with plumbing codes and appliance efficiency standards using models of fixture inventory coupled with usage assumptions. These savings are commonly referred to as passive water savings because they occur regardless of actions taken by the utility. The Tracking Model includes passive savings models for residential toilets, showerheads, and clothes washers, and non-residential toilets, urinals, hotel showerheads, and coin-op clothes washers.

It is important to emphasize that the passive savings estimates do not actually impact the model's estimates of final water demand. This is because the econometric demand model's baseline demand forecasts used in the Tracking Model are net of passive water savings. However, the econometric forecast does not generate an explicit forecast of passive water savings because the adjustment for passive savings is enacted through the model's trend term. Because SFPUC desired explicit estimates of passive water savings, modules for estimating these savings were included in the Conservation Tracking Model. These estimates are added to the econometric demand model's baseline forecast before it is used in the Conservation Tracking Model so that they can be represented explicitly in the Conservation Tracking Model. It is the econometric demand model's baseline forecast adjusted for passive savings that is entered on the conservation Model Setup worksheet. The adjusted baseline forecast is:[1]

Adjusted Baseline Forecast = Econometric Model Baseline Forecast + Passive Water Savings

The final demand forecast generated by the Conservation Tracking Model is then:

Final Demand Forecast = Adjusted Baseline Forecast – Passive Water Savings – Program Water Savings

This is also equal to:

Final Demand Forecast = Econometric Model Baseline Forecast – Program Water Savings

This means the only determinants of the final demand forecast are the Econometric Model Baseline Forecast and the forecast of programmatic water savings from future implementation of SFPUC conservation programs. While the passive savings forecast is useful because it provides an estimate of how much demand reduction can be ascribed to plumbing codes and appliance standards, it does not actually affect the final estimate of future demand.

[1] The passive water savings adjustment also includes water savings expected to be realized after 2015 from the historical implementation of SFPUC conservation programs prior to the start of the Econometric Model's baseline forecast. This is done to prevent the model from double counting these water savings.

Following are descriptions of how passive savings are calculated for each fixture/appliance category. The SFPUC Plumbing Fixture Population and Efficiency Saturation Estimates Technical Memorandum issued on January 13, 2014 and included in Appendix A of the 2015 Retail Conservation Plan and the updated saturation estimates memo dated August 19, 2019, and included in appendices of the 2020 Retail Conservation Plan provide more details on fixture population and saturation estimates.

Residential Toilets

The population of residential toilets is based on available estimates of actual single and multi-family housing units. These estimates are multiplied by the average number of toilets per dwelling unit, which are estimated from recent American Housing Survey data. The model uses an average of 2.22 and 1.26 toilets per dwelling unit for single and multi-family housing, respectively. Toilets installed in new housing constructed between 1991 and 2013 are assumed to be ULFT (1.6 gpf). Toilets installed in new housing constructed after 2013 are assumed to be HET (1.28 gpf). Toilets in existing housing constructed before 1991 are assumed to have an average flush volume of 3.5 gpf. Toilets in existing housing are assumed to be replaced at an annual rate of 3.1% per year. This is the average rate of residential toilet replacement reported in studies done by EBMUD and SCVWD. Existing toilets replaced between 1991 and 2013 are assumed to be replaced by ULFTs. Existing toilets replaced after 2013 are assumed to be replaced by HETs. Using this information, the model calculates the average flush volume for the inventory of new and existing toilets for each year between 1990 and 2064. Water savings per flush is calculated relative to the average flush volume in 1990. Average savings per flush is equal to the average flush volume in 1990 less the average flush volume in each year after 1990. Average savings per flush is multiplied by the estimated number of flushes per year to estimate annual water savings. The estimated number of flushes per year is equal to the residential population multiplied by the average daily per capita flush rate multiplied by 365. The residential population is derived from SFPUC's service area population forecasts. The average daily per capita flush rate of 4.8 is taken from the results for San Francisco reported in the 2011 California Single Family Water Efficiency Study.

Non-Residential Toilets

The population of non-residential toilets for the period 1990-2012 is taken from the Fixture Saturation Task Memo. The population of non-residential toilets for the period 2013-2064 is a linear extrapolation based on the forecast of service area population. The same assumptions used for residential toilets regarding flush volume of new toilets and replacement rate of existing toilets are used for non-residential toilets. The average flush volume of the toilet inventory and the water savings per flush relative to 1990 are calculated the same way as for residential toilets. Average savings per flush is multiplied by the estimated number of flushes per year to estimate annual water savings. Vickers (2001) estimates annual flushes by multiplying daily flushes by a 260-day work year. Male workers are assumed to flush toilets (as opposed to urinals) an average of one time per day while female workers are assumed to flush toilets an average of three times per day. Male workers are assumed to comprise 54% of the labor force, per City of San Francisco (2009). Total employment is taken from SFPUC's employment forecast.

Non-Residential Urinals

Based on an analysis of DBI data, the ratio of urinals to toilets is estimated to be 0.15. This ratio is applied to the estimated stock of non-residential toilets to estimate the stock of urinals. Urinals installed before 1992 are assumed to have an average flush volume of 2 gpf. Urinals installed between 1992 and 2013 are assumed to have an average flush volume of 1 gpd. Urinals installed in 2014 are assumed to have a flush volume of 0.5 gpf. Urinals installed after 2014 are assumed to have a flush volume of 0.125 gpf. Urinals are assumed to have the same replacement rate as toilets. The average

flush volume of the urinal inventory and the water savings per flush relative to 1990 are calculated the same way as for residential and commercial toilets. Average savings per flush is multiplied by the estimated number of flushes per year to estimate annual water savings. To calculate total flushes per year, male workers are assumed to have a daily flush rate of 2, per Vickers (2001). Male workers are assumed to comprise 54% of the labor force, per City of San Francisco (2009). Total employment is taken from SFPUC's employment estimate.

Residential Showerheads

The population of residential showerheads is based on available estimates of actual single and multi-family housing units. These forecasts are multiplied by the average number of showerheads per dwelling unit, which are estimated from recent American Housing Survey data. The model uses an average of 1.34 and 1.21 showerheads per dwelling unit for single and multi-family housing, respectively. Showerheads installed in new housing constructed before 2005 are assumed to have an average flow rate of 2.3 gpm. Showerheads installed in new housing constructed between 2005 and 2017 are assumed to have an average flow rate of 2.0 gpm. Showerheads installed after 2017 are assumed to have an average flow rate of 1.8 gpm. Showerheads in existing housing are assumed to be replaced at an annual rate of 12% per year, per the Alliance for Water Efficiency. Using this information, the model calculates the average showerhead flow rate for the inventory of new and existing showerheads for each year between 2005 and 2064. Average savings per minute is equal to the average flow rate in 2005 less the average flow rate in each year after 2005. Annual water savings is calculated as the product of the average flow rate and the annual number of minutes for showering. The annual number of minutes for showering is equal to the average number of shower events per household per day multiplied by the average shower duration in minutes multiplied by the number of households multiplied by 365. An average of 2 shower events per day and an average duration of 9 minutes per shower event are taken from the results for San Francisco from the 2011 California Single Family Water Efficiency Study.[2] The number of residential housing units is taken from SFPUC's housing forecast.

Hotel Showerheads

The population of hotel showerheads is based on an estimate of the total number of hotel rooms in San Francisco. The model assumes one showerhead per room. Showerheads installed before 2005 are assumed to have an average flow rate of 2.5 gpm. Showerheads installed between 2005 and 2017 are assumed to have an average flow rate of 2.2 gpm. Showerheads installed after 2017 are assumed to have an average flow rate of 1.8 gpm. Showerheads are assumed to be replaced at an annual rate of 12% per year, per the Alliance for Water Efficiency. Using this information, the model calculates the average showerhead flow rate for the inventory of new and existing showerheads for each year between 2005 and 2064. Average savings per minute is equal to the average flow rate in 2005 less the average flow rate in each year after 2005. Annual water savings is calculated as the product of the average flow rate and the annual number of minutes for showering. The annual number of minutes for showering is equal to the average number of shower events per occupied room per day multiplied by the average shower duration in minutes multiplied by the number of occupied rooms multiplied by 365. An average of 1.34 shower events per day per occupied room and an average duration of 10 minutes per shower event are taken from the AWWARF Commercial End Uses of Water Study. The average hotel occupancy rate is based on a review of various estimates published on the internet of hotel occupancy in San Francisco.

[2] The estimate of average number of shower events per day for San Francisco from this study is used directly in the single-family residential calculation. For the multi-family calculation, it is scaled by the ratio of multi-family to single-family persons per household to consider the lower density in multi-family housing.

Residential Clothes Washers

The stock of residential clothes washers is based on SFPUC's housing forecast and the average number of washers per dwelling unit. The average number of washers per dwelling unit is 0.937 for single-family and 0.41 for multi-family. The multi-family estimate includes both in-unit and common room washers. Existing washers are replaced at an annual rate of 9%, which is equivalent to assuming washers have an average useful life of 11 years, which is consistent with industry estimates. When a washer is replaced, it is replaced with either a conventional or high-efficiency (Energy Star) washer according to a forecast of market shares informed by market analyses done to support the setting of federal efficiency standards for washers. Water factors for new conventional and high-efficiency washers change over time in the model. Water factors for conventional washers are based on federal energy standards while water factors for high-efficiency washers are based on EPA Energy Star specifications. The average water factor for the stock of residential washers adjusts over the course of the forecast based upon the rate at which existing washers are replaced and new washers are added to the inventory. The model's accuracy in predicting water use by clothes washers is checked against water use benchmarks for 1997, 2007, and 2012 taken from residential end use studies. Washer utilization in single-family households is drawn from the San Francisco End Use of Water Study. Washer utilization in multi-family households scales down the single-family estimate to account for smaller average household size. Water savings are calculated relative to 2005 and are equal to the difference in water use assuming average washer efficiency in 2005 versus average washer efficiency in the forecast year.

Coin-op Clothes Washers

Estimates of passive water savings for coin-op clothes washers use the same methodology used for residential clothes washers. The natural replacement rate for coin-op washers is the average of estimates developed by the Alliance for Water Efficiency (11.1%) and the Department of Energy (13.3%). The stock of coin-op clothes washers is based on an internet search of coin-op washer facilities in San Francisco. The average number of washers per coin-op facility is taken from the Fixture Saturation Task Memo. The average number of loads per day is taken from a PG&E study of coin-op washer water and energy consumption. The water factors for new and replaced washers are based on existing federal efficiency regulations for commercial clothes washers.

Calculation of Programmatic Water Savings

The Conservation Tracking Model calculates the water savings associated with a program as the product of the estimated water savings per unit of activity and the amount of activity completed. These savings are commonly referred to as active water savings because they result from the utility's direct investment in conservation programs intended to reduce demand. In other words, the savings result from the utility's active pursuit of demand reduction.

In the Tracking Model, the user specifies a starting unit water savings for each program. The behavior and duration of the unit savings overtime can then be adjusted with the useful life, annual decay, and plumbing code interaction parameters. When the annual decay and plumbing code interaction parameters are both set to 0, annual savings is equal to the product of the initial unit savings and the amount of activity. Annual savings accrue until the measure's useful life is reached, after which annual savings are assumed to be zero. Thus given initial unit savings S_0, measure useful life u, and activity of A_s in year s, water savings in any year t ≥ s are:

$$S_t = A_s S_0 \; if \; t - s + 1 \leq u, 0 \; otherwise$$

When the annual decay parameter takes a value d in the range (0, 1], annual water savings in any year t ≥ s are:

$$S_t = A_s S_0 (1-d)^{t-s} \; if \; t-s+1 \leq u, 0 \; otherwise$$

When the plumbing code interaction parameter takes a value p in the range (0, 1] and the plumbing code is in effect for any year t ≥ v, annual water savings in any year t ≥ s are:

$$S_t = \begin{cases} A_s S_0 \; if \; u \geq t-s+1 \; and \; t < v \\ A_s (1-p)^{t-s} S_0 \; if \; t-s+1 \leq u \; and \; t \geq v \\ 0 \; if \; t-s+1 > u \end{cases}$$

When the plumbing code interaction parameter takes a value p in the range (0, 1], the plumbing code is in effect for any year t ≥ v, and the annual decay parameter takes a value d in the range (0, 1], annual water savings in any year t ≥ s are:

$$S_t = \begin{cases} A_s S_0 (1-d)^{t-s} \; if \; t-s+1 \leq u \; and \; t < v \\ A_s (1-p)^{t-s} S_0 (1-d)^{t-s} \; if \; t-s+1 \leq u \; and \; t \geq v \\ 0 \; if \; \; t-s+1 > u \end{cases}$$

The specification of these parameters are based on current state and federal plumbing codes and appliance standards and findings from empirical evaluations of conservation program performance, as compiled by the California Water Efficiency Partnership (CalWEP) and Alliance for Water Efficiency (AWE). The specific data sources and assumptions used to create the water savings and plumbing code specifications for each program are provided in the remainder of this document.

The model's toilet fixture inventory modules for single- and multi-family toilets also estimate water savings from the City's toilet retrofit-on-resale ordinance that started in 2009. These estimates rest on two simplifying assumptions: (1) 3.5+ gpf toilets are uniformly distributed across the housing stock and (2) each housing unit is equally likely to be put on the market for sale each year. Given these two assumptions, ROR toilet replacements in any year t ≥ 2009 are calculated as:

(Stock of 3.5+ gpf toilets at beginning of year – SFPUC toilet replacements) x housing resale rate

The model assumes ROR toilets are replaced with ULFTs prior to 2014 and HETs thereafter.

Program Water Savings Specifications

The remainder of this document presents the water savings specifications for each conservation measure included in the Conservation Tracking Model. Program specifications are grouped first by customer class and second by programs type.

Confidence in Estimates

The program water savings specifications utilize the best available information on water savings. Only measures with a sufficient level of confidence in the approach to estimating water-savings are included in the Tracking Model. The SFPUC implements a number of measures that are not included in the model that are likely to generate some water savings but for which there are insufficient empirical studies or standard engineering estimates to generate estimates with a reasonable level of confidence. For the measures included in the model there is a range of reliability of savings estimates. While all measures in the tool meet a base level of confidence, for established and widely deployed measures – e.g. toilet replacements -- there is strong empirical evidence on water savings from multiple empirical program evaluations. In other cases, less data is available or the program is so new that empirical performance data is limited or nonexistent. In these cases, the water savings estimates may be based on results of a single evaluation done elsewhere or they may be built up from utilization and flow rate assumptions – commonly referred to as engineering estimates.

A confidence score of 1, 2 and 3 is assigned to each program specification to indicate the level of confidence in the water savings specification. The confidence scores are subjective in the sense that they rely on professional judgement as to the quality and applicability of the data underlying the water savings specification.

Confidence Score	**Criteria**
1	Savings are based on well-designed empirical evaluations of program performance. The program is widely deployed by other water suppliers and water savings have been evaluated in multiple locations and contexts. Savings estimates are directly applicable or can reasonably be re-scaled to be applicable to SFPUC's service area.
2	Savings are based on simple empirics of program performance (e.g. a simple difference in means or difference-in-differences analysis). The program may not be widely deployed by other water suppliers and may not have been evaluated in multiple locations and contexts.
3	Empirical estimates of program performance are not available or are limited in their applicability to SFPUC's service area. Savings are based on engineering estimates relying on general assumptions about water use with and without the program intervention

Measure Summary Tables

The following tables summarize the measures in the model at the time of this update (August 2020). The tables provides:

- A brief description of each measure

- The unit savings estimate for the measure
- The basis for the estimate
- The expected annual water savings at the planned level of activity
- The confidence score for the water savings estimate

Link to Detailed Specifications
The measure IDs in the summary tables are hyperlinked to the measure's detailed specification. Ctr-clicking the specification ID will take the reader to the measure's detailed specification. Ctr-clicking the ID the detailed specification will take the reader back to the summary table.

Basis for Savings Estimates
The basis for the savings estimate is either:

Empirical Program Evaluations – the savings estimate is based on results from one or more empirical evaluations of water savings for similar programs. The empirical estimate may be adjusted to account for differences between the location(s) where the empirical evaluation was completed and SFPUC's service area. Such adjustments are explained in the measure's detailed specification.

Engineering Estimate – the savings estimate is based on assumptions about fixture/device utilization and the water-using properties of the existing and new fixture/device. Engineering estimates are generally less reliable than estimates based on empirical program evaluations.

Annual Savings Estimates
The annual savings estimates show the expected water savings from one year of planned annual activity. These savings would be expected to persist over the useful life of the measure. Savings for most measures are assumed to be stationary, meaning the model does not assume the savings will change significantly over its useful life. However, this assumption is not adopted for every measure. For example, the model assumes savings from surveys are not constant, but rather decrease with time. The estimates in the summary tables do not reflect these adjustments. Therefore, the estimates should be viewed as upper-bounds for measures whose savings are expected to decrease over time.

Single-Family Measures

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
S1	Mandatory CAP Audit	Free site evaluation required for single-family residents to participate in the SFPUC's Community Assistance Program (CAP) for discounted water and sewer rates. Identify inefficient plumbing fixtures and leaks and suggest improvements.	17.5 gpd	Empirical Program Evaluations	Savings assumed to decay by 20% per year	2
S2	WaterWise Evaluation	Free indoor and outdoor site consultation: review consumption history, check plumbing fixtures and irrigation system components for leaks, determine fixture flow rates, recommend improvements, identify fixtures eligible for replacement through rebate programs, and provide standard repair parts for faulty toilets and free water-saving devices and materials. Customized report of findings sent to customer after visit.	17.5 gpd	Empirical Program Evaluations	Savings assumed to decay by 20% per year	2
S3a	Leak Alerts	SFPUC uses its AMI data to flag accounts that trigger continuous usage thresholds and alerts customers if a leak is suspected. SFPUC provides alerted customers with information on how to check for and repair common leaks	0.56 gpd	Empirical Program Evaluations	Unit savings is per active Single-Family account	1
S3b	Custom Water Use Report	Report with customers' water use information, comparison of water to similar properties, and customized information on ways to save.	8.4 gpd	Empirical Program Evaluations	Multiple empirical evaluations have found home water reports reduce water use by 5-6%. The model assumes 5.5%.	1
S4	1.5 GPM Showerhead Distribution	Up to two free showerheads (as part of measure S2 or in-person pickup from SFPUC) per household.	6.8 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed	2

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
					in 2018. Assumes 54% installation rate	
S5	1.5 GPM Showerhead Direct Install	Provides free installation of 1.5 gpm showerheads to single family residents. WaterWise Evaluation (S2) is a pre-requisite to this measure.	12.6 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018	1
S6	HET Rebate	Cash rebates of up to $125 to replace old toilets (3.5 gpf or more) with approved HETs (1.28 gpf or less).	20.9 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Direct install savings reduced by 25% to account for rebates used to replace ULF toilets and program free-riders. Program replaced existing toilets rated >= 1.6 gpf with toilets rated <= 1.0 gpf.	2
S7	CAP Direct Install thru SFPUC Funding	Free installation of HETs (1.28 gpf) for single-family residents who are also CAP participants. Only 3.5 gpf toilets replaced except a small number of old, poorly performing 1.6s. **Pre-requisite:** Mandatory CAP Audits (Measure S1).	27.8 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Program replaced existing toilets rated >= 1.6 gpf	1

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
					with toilets rated <= 1.0 gpf.	
S8	HET Direct Install (Non-CAP)	Same as measure S7 but is open to single-family residents who are not a CAP participant. Program did not start until 2016	27.8 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Program replaced existing toilets rated >= 1.6 gpf with toilets rated <= 1.0 gpf.	1
S8b	HET Direct Install (Non-CAP, replacing 1.6 gpf toilets)	Same measure as S8 but targets replacement of 1.6 gpf toilets	6.7 gpd	Engineering Estimate	Estimate prepared by SFPUC Staff	3
S9	HET Voucher	A voucher issued to eligible residents to replace their older toilets with HETs.	20.9 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Direct install savings reduced by 25% to account for rebates used to replace ULF toilets and program free-riders. Program replaced existing toilets rated >= 1.6 gpf	2

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
					with toilets rated <= 1.0 gpf.	
S11	CEE Tier 3 Washer Rebate (IWF 4.0)	Up to $100 rebate from SFPUC and $50 rebate from PG&E for a combined $150 rebate for a washer with 4 IWF or lower.	10.2 gpd	Engineering Estimate	Engineering estimate based on limited data on clothes washer market shares	3
S12	Energy Star Most Efficient Washer Rebate (IWF 3.5)	Up to $100 rebate from SFPUC and $50 rebate from PG&E for a combined $150 rebate for a washer with 3.5 IWF or lower.	11.6 gpd	Engineering Estimate	Engineering estimate based on limited data on clothes washer market shares	3
S16a	Rain Barrel Discount (replaced by S16c)	Subsidy program (through a vendor) that discounts the purchase cost of rain barrel and provides training.	0.8 gpd	Engineering Estimate	60 gal capacity. Estimated with AWE Rain Barrel Harvest & Application Model	3
S16b	Rain Cistern Discount (replaced by S16d)	Subsidy program (through a vendor) that discounts the purchase cost of cisterns and provides training.	2.4 gpd	Engineering Estimate	205 gal capacity. Estimated with AWE Rain Barrel Harvest & Application Model	3
S16c	Rain Barrel Rebate	In-house administered rebate program with required proof of install.	0.8 gpd	Engineering Estimate	60 gal capacity. Estimated with AWE Rain Barrel Harvest & Application Model	3
S16d	Cistern Rebate	In-house administered rebate program with required proof of install.	2.4 gpd	Engineering Estimate	205 gal capacity. Estimated with AWE Rain Barrel Harvest & Application Model	3

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
S18	Weather-Based Irrigation Controller Rebate	Financial rebate towards purchase and installation of a weather-based irrigation controller that uses site specific data and adjusts the irrigation time depending on the local weather.	3.7 gpd	Empirical Program Evaluations	Estimate is based on review of empirical evaluations of WBIC savings in Southern and Northern CA	2
S20	Device Distribution	Various water-efficient fixtures: bathroom aerators (0.5/1.0/1.5 gpm), kitchen/bathroom laminar (1.5 gpm), kitchen aerators (1.5/2.2 gpm), utility aerators (1.5/2.0/2.2), pre-rinse spray nozzles, garden spray hose nozzles, toilet flappers, toilet fill valves, and soil moisture meters.	3.3 gpd	Engineering Estimate	Based on review of end use studies and engineering estimates of savings potential of aerators and other devices	3
S21	ULFT to Ultra-High-Efficiency Toilet Direct Install	Same as S8 but targeting replacement of 1.6 gpf toilets.	6.7 gpd	Engineering Estimate	Estimate prepared by SFPUC Staff	3
S22	ULFT to Ultra-High-Efficiency Toilet Rebate	Same as S6 but targeting replacement of 1.6 gpf toilets.	5.0 gpd	Engineering Estimate	Estimate prepared by SFPUC Staff	3

Multi-Family Measures

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
M1	WaterWise Direct Installation Evaluation	Free, required site evaluation for multi-family residents to participate in the SFPUC's HET/Urinal Direct Install Program). Identify inefficient plumbing fixtures and leaks and suggest improvements.	10.6 gpd	Empirical Program Evaluations	Equal to indoor savings for S1 and S2. Savings assumed to decay by 20% per year	2
M2	WaterWise Evaluation	Free site consultation: review consumption history, check toilets for leaks, determine fixture flow rates, recommend improvements, identify fixtures eligible for replacement through rebate programs, provide standard repair parts for faulty toilets and free water-saving devices and materials.	10.6 gpd	Empirical Program Evaluations	Equal to indoor savings for S1 and S2. Savings assumed to decay by 20% per year	2
M3a	Small Multi-Family Leak Alert	SFPUC uses its AMI data to flag 2-5 dwelling unit multi-family accounts that trigger continuous usage thresholds and alerts customers if a leak is suspected. SFPUC provides alerted customers with information on how to check for and repair common leaks	1.6 gpd	Empirical Program Evaluations	Unit savings applies to all Multi-Family customers with 2-5 dwelling units	1
M3b	Large Multi-Family Leak Alert	Same as M3a but targeting multi-family accounts with more than 5 units	0.0 gpd	Empirical Program Evaluations	Savings not statistically different from 0 in program evaluation	1
M4	Showerhead Distribution	Buildings with 10 or less units are limited to one showerhead per unit. These buildings can pick up showerheads at the customer service counter. Also includes buildings that receive showerheads that are not installed during a Water Wise Evaluation. Buildings with over 10 units must schedule a WaterWise Evaluation (measure M2) in order to receive the free devices	6.8 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Assumes 54% installation rate	2
M5	Showerhead Direct Install	Free installation of showerheads. **Pre-requisite:** WaterWise Direct Install Evaluations (Measure M1)	12.6 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit	1

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
					programs completed in 2018	
M6a M6b	HET Rebate	Cash rebates of up to $125 per tank-style HET or up to $300 per flushometer valve HET to replace a high-flow toilet (3.5 gpf or more).	30 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Direct install savings reduced by 25% to account for rebates used to replace ULF toilets and program free-riders. Program replaced existing toilets rated >= 1.6 gpf with toilets rated <= 1.0 gpf.	2
M7a M7b	HET Direct Install	Free installation of tank-style (T) or flushometer valve (F) HETs. **Pre-requisite:** WaterWise Direct Install Evaluation (Measure M1)	38.6 gpd 38.6 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Program replaced existing toilets rated >= 1.6 gpf with toilets rated <= 1.0 gpf.	1
M7c	HET Direct Install (replacing 1.6 gpf toilets)	Same as M7 but targeting replacement of 1.6 gpf toilets	9.3 gpd	Engineering Estimate	Estimate prepared by SFPUC Staff	3

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
M8	HET Voucher	A voucher issued to eligible residents to replace their older toilets with HETs	30 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Direct install savings reduced by 25% to account for rebates used to replace ULF toilets and program free-riders. Program replaced existing toilets rated >= 1.6 gpf with toilets rated <= 1.0 gpf.	2
M9	HET Install thru On-Bill Financing	Partner with third-party vendors to find customers with remaining savings opportunity, sell them the program, and conduct the installation. The customer pays for the program through savings received through their water bill.	38.6 gpd	Empirical Program Evaluations	Based on empirical evaluation of bathroom retrofit programs completed in 2018. Program replaced existing toilets rated >= 1.6 gpf with toilets rated <= 1.0 gpf.	1
M10	CEE Tier 3 Washer Rebate (IWF 4.0)	Rebate for coin-op, common area clothes washer with IWF of 4 or lower. (multi-family in-unit residential style washers are covered under SF measure)	126 gpd	Engineering Estimate	Engineering estimate based on limited data on clothes washer market shares	3

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
M17	Efficient Irrigation Timer Rebate	Financial rebate towards purchase and installation of a weather-based irrigation controller that uses site specific data and adjusts the irrigation time depending on the local weather.	3.7 gpd	Empirical Program Evaluations	Savings assumed to be same as single-family program (S18)	2
M20	Device Distribution	Various water-efficient fixtures: bathroom aerators (0.5/1.0/1.5 gpm), kitchen/bathroom laminar (1.5 gpm), kitchen aerators (1.5/2.2 gpm), utility aerators (1.5/2.0/2.2), pre-rinse spray nozzles, garden spray hose nozzles, toilet flappers, toilet fill valves, and soil moisture meters.	3.3 gpd	Engineering Estimate	Based on review of end use studies and engineering estimates of savings potential of aerators and other devices	3
M21	ULFT to Ultra-High-Efficiency Toilet Direct Install	Same as M7 but targeting replacement of 1.6 gpf toilets.	9.3 gpd	Engineering Estimate	Estimate prepared by SFPUC Staff	3
M22	ULFT to Ultra-High-Efficiency Toilet Rebate	Same as M6 but targeting replacement of 1.6 gpf toilets.	6.9 gpd	Engineering Estimate	Estimate prepared by SFPUC Staff	3

Non-Residential Measures

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
N1	WaterWise Evaluations for Commercial Buildings	Free site consultation: review consumption history, check toilets for leaks, determine fixture flow rates, recommend improvements, identify fixtures eligible for replacement through incentive programs, provide standard repair parts for faulty toilets and free water-saving devices and materials. Customized report of findings sent after visit.	215 gpd	Empirical Program Evaluations	Based on empirical evaluations of CII surveys done in Southern California in the 1990s	3
N2	Commercial Direct Install Audits	Free site consultation similar to measure N1. Required for commercial buildings that applied for direct install programs.	215 gpd	Empirical Program Evaluations	Based on empirical evaluations of CII surveys done in Southern California in the 1990s	3
N3a N3b N3c	Surveys – Hospitals, Hotels, Schools	Free site consultation for hospitals, hotels, and schools	4643 gpd 993 gpd 256 gpd	Empirical Program Evaluations	Based on empirical evaluations of CII surveys done in Southern California in the 1990s	3
N4	Surveys – Large Landscape by Contractors	Free landscape survey provided to eligible customers (0.5 acres or more of irrigated landscapes) under the Landscape Technical Assistance Program. Survey will evaluate the water delivery system to check for inefficiencies that lead to water losses, Surveyors will also determine the site's water budget by cataloguing plant type and will create site-specific recommendations and a cost estimate for improving irrigation efficiency.	161 gpd	Engineering Estimate	Unit savings per acre surveyed. Assumes 10% reduction in average landscape site water use of 1.8 AF/Acre	3

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
N5	Surveys – CII Facilities by Contractors	Free site consultation for other types of non-residential customers provided by third-party consultant or other funding sources.	5120 gpd	Engineering Estimate	SFPUC staff estimate of water savings from consultant audits	2
N6	Landscape Leak Alert	SFPUC uses its AMI data to flag landscape accounts that trigger continuous usage thresholds and alerts customers if a leak is suspected. SFPUC provides alerted customers with information on how to check for and repair common leaks	28.2 gpd	Empirical Program Evaluations		1
N7	1.5 GPM Showerhead Giveaway	Provides free, high-efficiency 1.5 gpm showerheads for San Francisco businesses.	5.6 gpd	Engineering Estimate	Based on review of hotel end use studies and engineering estimates of hotel showerhead savings potential. Assumes 54% installation rate	3
N8	1.5 GPM Showerhead Direct Install	Free installation of high-efficiency 1.5 gpm showerheads for San Francisco businesses. **Pre-requisite:** Direct Install Audit (Measure N2)	10.4 gpd	Engineering Estimate	Based on review of hotel end use studies and engineering estimates of hotel showerhead savings potential.	3
N9	Device Distribution	Various water-efficient fixtures: bathroom aerators (0.5/1.0/1.5 gpm), kitchen/bathroom laminar (1.5 gpm), kitchen aerators (1.5/2.2 gpm), utility aerators (1.5/2.0/2.2), pre-rinse spray nozzles, garden spray hose nozzles, toilet flappers, toilet fill valves, and soil moisture meters.	3.3 gpd	Engineering Estimate	Based on review of end use studies and engineering estimates of savings potential of aerators and other devices	3
N10a N10b	HET Rebate	Cash rebates of up to $125 per tank style toilet and up to $300 per flushometer valve toilet for replacing	28.4 gpd	Empirical Program Evaluations	Based on CUWCC CII Toilet Savings Study. Estimate scales-up	2

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
		high-flow toilets (3.5 gpf or more) with approved HET models (1.28 gpf or less).			ULFT savings to account for improved efficiency of HET	
N11a N11b N11c N11d N11e N11f	HET Rebate – Schools, Hotels, Muni	Cash rebates of up to $125 per tank style toilet and up to $300 per flushometer valve toilet for replacing high-flow toilets (3.5 gpf or more) with approved HET models (1.28 gpf or less).	20.6 gpd	Empirical Program Evaluations	Based on CUWCC CII Toilet Savings Study. Estimate scales-up ULFT savings to account for improved efficiency of HET	2
N12a N12b	HET Direct Install	Free installation of High-Efficiency Toilets for businesses in SF **Pre-requisite:** Direct Install Audit (Measure N2)	29 gpd	Empirical Program Evaluations	Based on CUWCC CII Toilet Savings Study. Estimate scales-up ULFT savings to account for improved efficiency of HET	2
N13	HET Direct Install – Schools, Hotels	Free installation of HETs for schools or hotels in SF. **Pre-requisite:** Direct Install Audit (Measure N2)	19.6 gpd	Empirical Program Evaluations	Based on CUWCC CII Toilet Savings Study. Estimate scales-up ULFT savings to account for improved efficiency of HET	2
N14	HET Voucher	A voucher for HET purchase.	28.4 gpd	Empirical Program Evaluations	Based on CUWCC CII Toilet Savings Study. Estimate scales-up ULFT savings to account for improved efficiency of HET	2

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
N15	HET Voucher – Schools, Hotels	Same as N14 but directed at schools and hotels	17.8 gpd	Empirical Program Evaluations	Based on CUWCC CII Toilet Savings Study. Estimate scales-up ULFT savings to account for improved efficiency of HET	2
N16	HET Install thru On-Bill Financing	Partner with third-party vendors to find customers with savings opportunity, sell them the program, and conduct the installation. The customer pays for the program through savings received through their water bill.	29 gpd	Empirical Program Evaluations	Based on CUWCC CII Toilet Savings Study. Estimate scales-up ULFT savings to account for improved efficiency of HET	2
N17a N17b	HEU Rebate	Cash rebates of up to $300 per urinal for eligible commercial businesses when high flow urinals (1.5 gpf or more) are replaced with High-Efficiency Urinal (HEU) models that are 0.125 gpf or less.	16.2 gpd	Empirical Program Evaluations	Based on CUWCC Urinal Savings Potential PBMP Study	3
N18	HEU Direct Install	A program for replacing 1.5 gallons per flush (gpf) high efficiency urinals with pint flush urinals.	16.2 gpd	Engineering Estimate	Based on CUWCC Urinal Savings Potential PBMP Study	3
N20	Energy Star Washer Rebate (IWF 4.5)	Measure has been discontinued. Cash rebates for commercial high-efficiency clothes washers with a water factor of 4.5 or below.	39 gpd	Engineering Estimate	Engineering estimate based on limited data on clothes washer market shares and coin-op washer utilization rates	3
N21	Energy Star Washer Rebate (IWF 4)	Cash rebates of up to $200 for commercial high-efficiency clothes washers with a water factor of 4.0 or below. For any business where 10 or more washers are being installed, a pre-purchase inspection must be scheduled.	45 gpd	Engineering Estimate	Engineering estimate based on limited data on clothes washer market shares and	3

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
					coin-op washer utilization rates	
N22a	Landscape Grants (pre 2020)	Under Landscape Grant Program, landscapes with over 0.5 acre of irrigated areas are eligible to receive funding to implement retrofits and install fixtures to facilitate water conservation.	179 gpd/acre	Empirical Program Evaluations	Based on SFPUC staff estimates of water savings for 11 large landscape grant projects	2
N22b	Landscape Grants (post 2020)	Under Landscape Grant Program, landscapes with 10,000 sf to 0.5 acre or more of irrigated areas are eligible to receive funding to implement retrofits and install fixtures to facilitate water conservation.	179 gpd/acre	Empirical Program Evaluations	Assumed same as N22a	2
N24	Equipment Retrofit Rebates - Unmetered/Estimated	Incentives to businesses to upgrade indoor equipment. Projects must achieve an annual water savings of 100 ccf or more to qualify. SFPUC will provide qualifying projects incentives of $0.50 per ccf over a 10-year lifespan up to 50% of the equipment costs. Program includes customized incentives as well as standard incentives for equipment with predictable water savings, such as water efficient ice machines, and connectionless food steamers.	2.0	Engineering Estimate	Annual activity entered in units of ccf/yr.	1
N25a	Custom Equipment Retrofit Rebates – Metered (Pre-2025)	Similar to Measure N24, but allows applicants to create customized project tailored toward their specific business needs and water use patterns.	2.0	Engineering Estimate	Annual activity entered in units of ccf/yr.	1
N25b	Custom Equipment Retrofit Rebates – Metered (2025+)	Same as N25a, but with larger incentive cost.	2.0	Engineering Estimate	Annual activity entered in units of ccf/yr.	1
N26	Non-Residential Leak Alert	SFPUC uses its AMI data to flag non-residential accounts that trigger continuous usage thresholds and alerts customers if a leak is suspected. SFPUC provides alerted customers with information on how to check for and repair common leaks	5.0 gpd	Empirical Program Evaluations		1

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Basis for Savings Estimate	Notes on Savings Estimate	Water Savings Estimate Confidence Score
N27	Kitchen Low Flow Spray Valves	Rebate or giveaway of high-efficiency kitchen spray valves used primarily by dishwashing stations	30 gpd	Empirical Program Evaluations	Based on multiple empirical evaluations of savings from kitchen spray-valve retrofits. Estimate assumes 50% installation/retention rate	1
N29	Efficient Irrigation Timer Rebate	Financial rebate towards purchase and installation of a weather-based irrigation controller that uses site specific data and adjusts the irrigation time depending on the local weather.	13.4 gpd	Empirical Program Evaluations	Lower-bound of 95% CI of average savings per station, per A&N Technical's 2011 WBIC savings evaluation. Lower-bound is used because of San Francisco's climate and lower landscape water use.	2
N30	ULFT to Ultra-High-Efficiency Toilet Rebate	Cash rebates to replace tank and flushometer style toilets and up to $300 per flushometer valve toilet. Similar to N10 but targets replacement of 1.6 gpf toilets	7.0 gpd	Engineering Estimate	Estimate prepared by SFPUC	3

Measures Applicable to All Customers

ID	Measure Name	Measure Description	Expected Unit Water Savings (GPD)	Notes on Savings Estimate	Water Savings Estimate Confidence Score
A3	Irrigation Customer Large Landscape Budget (Discontinued)	The SFPUC calculates how water use for irrigated landscape sites that received an irrigation or landscape grant or were required to comply with San Francisco's Water Efficient Irrigation Ordinance (WEIO) compares to the maximum allowable water use (MAWA) recommended for the plant types per state calculations. Staff are exploring how to potentially expand the program to all sites served by dedicated irrigation meters	357 gpd	Unit savings per acre surveyed. Assumes 10% reduction in average pre-grant water use of 4 AF/Acre for 9 large landscapes enrolled in SFPUC landscape grant program	3
A4a	Municipal Large Landscape Budget	This measure is for informational/educational monthly water budget reports sent to dedicated irrigation account customers. The monthly water budget report indicates how their water use for the previous month (and all prior months in the year) compares with the estimated amount allotted for their site based on the state MAWA calculation, divided by month and factoring in precipitation. Prior to 2025, the SFPUC provided these reports only to dedicated irrigation customers that had received an irrigation meter or landscape grant from the SFPUC.	48 gpd	Assumes 10% reduction in average pre-budget water use of 0.54 AF/Ac	3
A4b	Non-Municipal Large Landscape Budget	This measure is for informational/educational monthly water budget reports sent to dedicated irrigation account customers. The monthly water budget report indicates how their water use for the previous month (and all prior months in the year) compares with the estimated amount allotted for their site based on the state MAWA calculation, divided by month and factoring in precipitation. Prior to 2025, the SFPUC provided these reports only to dedicated irrigation customers that had received an irrigation meter or landscape grant from the SFPUC.	236	Assumes 10% reduction in average pre-budget water use of 2.64 AF/Ac	3

Measure Specifications

This section contains the water savings specification for each measure used in the conservation savings model. The specifications are grouped by customer class: (1) single-family, (2) multi-family, and (3) non-residential.

Single Family Measures

ID	Name	Class	Category
S1	Mandatory CAP Audit	Single Family	Audits & Reports

Water Savings: Average of savings from residential survey savings reported by Whitcomb (2000), A&N Technical Services (1994b), and Chesnutt, et al. (1995) is 33.9 gpd. Whitcomb (2000) reported 60% of savings are from outdoor uses and 40% are from indoor uses. Single family irrigation area in SFPUC retail service is approximately 34% of state average reported by DeOreo and Mayer (2010). Estimate based on combination of behavioral and fixture retrofits induced by survey recommendations. Savings from showerheads removed from indoor component to avoid double counting savings from S11 and S12. The 3 gpd estimate for showerheads assumes half the site visits get a direct install showerhead and half get a showerhead left for owner-installation, in which 50% are installed.

Water savings = (0.4 x 33.9 gpd – 3 gpd) + 0.6 x 0.34 x 33.9 gpd = 17.5 gpd (6,388 gpy)

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: 20%. Lower-end of decay rate range reported in CUWCC (2005).

Useful Life: 5 yrs. Based on typical useful life of survey savings reported in CUWCC (2005).

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year, 80% of outdoor savings occur in peak period. Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = 0.42 x (0.4 x 33.9 gpd – 3 gpd) + 0.8 x 0.6 x 0.34 x 33.9 gpd)/17.5 = 57%

Unit Sewer Savings: Sewer savings = 0.4 x 33.9 gpd – 3 gpd = 10.6 gpd (3,869 gpy)
Wastewater to water savings ratio = 0.606

Unit Electricity Savings: NA

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006), that hot water comprises 67% of shower/faucet flow - per DOE (2006) – that half of indoor water savings involve reductions in shower/faucet flow, and that indoor savings comprise 66% of total survey savings.

Gas savings = 0.0072 therms/gal x 0.67 x 0.5 x 0.66 = 0.0016 therms/gal

Confidence Score: 2

ID	Name	Class	Category
S2	WaterWise Evaluations	Single Family	Audits & Reports

All assumptions same as S1.

ID	Name	Class	Category
S3a	Leak Alerts	Single Family	Audits & Reports

Water Savings: Detailed empirical analysis of SFPUC's Single-Family Customer Leak Alert Program concluded:

- The Program reduced the mean duration of leak events lasting 72 or more hours by 32.6 hours, from 58 to 25.4 hours.
- The Program reduced the frequency of leak events lasting 72 or more hours from 0.194 to 0.113 leaks per meter-year.
- The Program reduced mean leakage volume from 437.1 to 233.7 gallons per meter-year, or by about 203 gallons per meter-year.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year.

Peak Period Savings Percent: We assume the same savings pattern as S1 and S2 – where outdoor savings comprise 34% of total savings and 80% of outdoor savings occur in the peak period.

Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = 0.42 x 0.66 + 0.8 x 0.34 = 55%

Unit Sewer Savings: We do not have data on how leakage is distributed between indoor and outdoor water uses. We assume the same distribution as indoor and outdoor water use.
Sewer savings = 0.66 x 203 gpy per meter = 134 gpy per meter
Wastewater to water savings ratio = 0.66

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
S3b	Custom Water Use Report	Single Family	Audits & Reports

Water Savings: Average water savings are 5.5% of single family daily use, per Mitchell and Chesnutt (2014). Multiple other empirical estimates of water use report savings have measured average saving rates of 4-6% (https://www.watersmart.com/resources/). Median single family water use in SFPUC's retail service area (circa 2005) is 153 gpd, per DeOreo and Mayer (2010a).

Water savings = 0.055 x 153 gpd = 8.4 gpd (3,066 gpy)

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year.

Peak Period Savings Percent: Evaluations of water use reports have not had sufficient data to detect seasonal effects (Mitchell and Chesnutt, 2014). For now we assume the same savings pattern as S1 and S2 – where outdoor savings comprise 34% of total savings and 80% of outdoor savings occur in the peak period.

Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = (0.42 x 0.66 x 8.4 gpd + 0.8 x 0.34 x 8.4 gpd) ÷ 8.4 = 55%

Unit Sewer Savings: Evaluations of water use reports have not had sufficient data to determine indoor and outdoor savings as a share of total (Mitchell and Chesnutt, 2014). For now we assume the same savings pattern as S1 and S2 – where indoor savings comprise 66% of total savings

Sewer savings = 0.606 x 8.4 gpd = 5.09 gpd (1,858 gpy)
Wastewater to water savings ratio = 0.606

Unit Electricity Savings: NA

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006), that hot water comprises 67% of shower/faucet flow - per DOE (2006) – that half of indoor water savings involve reductions in shower/faucet flow, and that indoor savings comprise 66% of total savings.

Gas savings = 0.0072 therms/gal x 0.67 x 0.5 x 0.66 = 0.0016 therms/gal

Confidence Score: 1

ID	Name	Class	Category
S4	1.5 GPM Showerheads Distributions	Single Family	HESH

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Mean savings for showerheads installed in single-family households was 12.6 gpd. Field studies of retrofit kit distributions in Irvine (A&N Technical Services 1992d) and Los Angeles (A&N Technical Services 1991) have found initial installation probabilities that range from 49% to 59%. We assume a 54% installation probability.

Water savings = 0.54 x 12.6 gpd = 6.8 gpd (2482 gpy)

Plumbing Code Savings: Zero. SB 407 mandates showerheads have a maximum capacity of 2.5 gpm. Currently, the average flow rate of showerheads in SFPUC's retail service area is 1.95, per DeOreo and Mayer (2010a).

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 8 yrs, per Alliance for Water Efficiency (2014).

Peak Period Savings Percent:
Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 6.8 gpd (2482 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006) and that hot water comprises 67% of shower/faucet flow - average of DOE (2006) and Aquacraft (1999). Gas savings = 0.0072 therms/gal x 0.67 = 0.0048 therms/gal

Confidence Score: 2

ID	Name	Class	Category
S5	1.5 GPM Showerheads Direct Install	Single Family	HESH

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Mean savings for showerheads installed in single-family households was 12.6 gpd (4599 gpy).

Unit Sewer Savings: Sewer savings = 12.6 gpd (4599 gpy)
Wastewater to water savings ratio = 1.000

All other assumptions same as S4.

Confidence Score: 1

ID	Name	Class	Category
S6	HET Rebates (Tank)	Single Family	HET

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Installed HETs had flush rates of 1.1 gpf or less. Mean savings for HETs installed in single-family households was 27.8 gpd (10147 gpy). Direct installation programs can more effectively screen out the replacement of ULF toilets than can rebate programs. Nearly all the toilets replaced in the direct installation programs evaluated by M.Cubed and A&N Technical Services were older non-ULFT toilets. Rebate programs may inadvertently issue rebates for the replacement of ULF toilets. To account for this possibility, mean daily savings estimated for the direct installation programs is reduced by 25%.

Water savings = 27.8 gpd x 0.75 = 20.9 gpd (7629 gpy)

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 25 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 20.9 gpd (7629 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
S7	CAP Direct Install thru SFPUC Funding	Single Family	HET

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Installed HETs had flush rates of 1.0 gpf or less. Mean savings for HETs installed in single-family households was 27.8 gpd (10147 gpy).

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 33 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 27.8 gpd (10147 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
S8	HET Direct Install (Non-Cap)	Single Family	HET

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Installed HETs had flush rates of 1.0 gpf or less. Mean savings for HETs installed in single-family households was 27.8 gpd (10147 gpy).

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 33 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 27.8 gpd (10147 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
S9	HET Vouchers	Single Family	HET

All assumptions same as S6.

ID	Name	Class	Category
S11	CEE Tier 3 Rebate (IWF 4.0)	Single Family	HEW

Water Savings: Assumes participant in market for washer. Without rebate, participant will purchase either top- or front-load washer. Current market share (circa 2012) of top-load washers is 52%, per DOE (2012). Current Energy Star market share (circa 2012) is 50%, per DOE (2012). Maximum allowed IWF for Energy Star washer after 2011 is 6. Maximum allowed IWF for non-Energy Star washer is 9.5, per National Appliance Standard. (National Appliance Standard changes in 2015 to 4.5 IWF for front-load and 8.0 IWF for top-load, and again in 2018 to 6.0 IWF for top-load). Average IWF of new washer is:

Avg IWF of New Washer Without Rebate = 0.5 x 6.0 + 0.5 x 9.5 = 7.75 (note this will overstate avg IWF after 2015 due to nat'l appl stdrd)

Average washer loads per day for single family households in SFPUC retail service area is 0.91, per DeOreo and Mayer (2010a). Average volume of new clothes washer is 3 cubic feet, per DOE (2012).

Water savings = (7.75 – 4.0) x 3 x 0.91 = 10.2 gpd (3,723 gpy)

Plumbing Code Savings: Effective Jan 1, 2015, appliance standard is 4.5 IWF for front-load and 8.0 IWF for top-load. Given current front- and top-load market shares and Energy Star market share, average IWF under appliance standard in 2015 is:

2015 Avg IWF under Nat'l Appl Std = 0.52 x (0.5 x 8.0 + 0.5 x 6.0) + 0.48 x 4.5 = 5.8

Effective Jan 1, 2018, appliance standard is 4.5 IWF for front-load and 6.0 for top-load. Average IWF under appliance standard in 2018 is:

2018 Avg IWF under Nat'l Appl Std = 0.52 x 6.0 + 0.48 x 4.5 = 5.3.

For modeling conservation program benefits, we use the average of these two water factors – 5.6 -- and start the standard in 2015. Plumbing code savings starting in 2015 are:

Plumbing code savings = (7.75 – 5.6) x 3 x 0.91 = 5.9 gpd (2,154)

Plumbing Code NRR: 7.1%. Based on average washer life of 14 years, per DOE (2012).

Annual Decay Rate: NA

Useful Life: 14 years, per DOE (2012)

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 10.2 gpd (3,723 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: 0.0036 KWh/gal. Based on high efficiency washer electricity savings reported in FEMP (2000).

Unit Gas Savings: 0.0035 therms/gal. Based on high efficiency washer gas savings reported in FEMP (2000).

Confidence Score: 3

ID	Name	Class	Category
S12	Energy Star Most Efficient (IWF 3.5) Washer Rebate	Single Family	HEW

Water Savings: See S11 for details.

Water savings = (7.75 – 3.5) x 3 x 0.91 = 11.6 gpd (4,234 gpy)

Unit Sewer Savings: Sewer savings = 11.6 gpd (4,234 gpy)
Wastewater to water savings ratio = 1.000

All other assumptions same as S11.

Confidence Score: 3

ID	Name	Class	Category
S16a, S16b S16c, S16d	Rain Barrels and Cisterns	Single Family, Multi Family, Non-Residential	Grants

Water Savings: Savings based on M.Cubed Rain Barrel Harvest & Application Model (rainbarrel_harvest_and_application_model.xlsx)

60 gal barrel = 302 gpy (assumes 100 sqft irr area)
205 gal cistern = 887 gpy (assumes 300 sqft irr area)

The rain barrel water savings model simulates rain barrel catchment, filling, and application of stored water using daily rainfall and ETO data for the period 2/5/2001 to 10/22/2014. Daily weather data are from the Union City CIMIS weather station. The 60 gallon barrel savings estimate assumes a catchment area of 1000 square feet, irrigation area of 100 square feet, and landscape crop water coefficient (KL) of 0.25. The 205 gallon cistern savings estimate assumes irrigation area is 300 square feet. The other model assumptions are the same. Daily application of stored water is equal to the lesser of daily irrigation requirement and stored water. Daily irrigation requirement in cubic feet is equal to irrigation area x KL x net ETO ÷ 12.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 15 years. Assumed

Peak Period Savings Percent: 24%. Calculated with M.Cubed Rain Barrel Harvest & Application Model for a 100 gal. barrel. Peak period savings % increases with barrel size, since more water can be stored for use in peak season.

Unit Sewer Savings: NA

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
S18	WBIC	Single Family	Grants

Water Savings: Several empirical program evaluations of WBIC performance have been completed since the early 2000s. A good summary of these studies can be found on the Cal WEP website. The following table summarizes findings from these studies.

Study	% Reduction in Outdoor Water Use	% Reduction in Total Household Water Use	Mean Reduction in Gal/Day	Sample Size
Orange County 2001	16-24%	7-10%	37-57	40 SF Homes
Orange County 2004	No estimate	10%	41	97 SF Homes
No & So Cal, 2009	7%	No estimate	58	1,987 SF Homes
Orange County 2010	10%	7%	37	899 SF Homes
Orange County 2011	No estimate	9%	49	70 SF Homes

The mean percentage reduction in outdoor water use estimated by these studies range from 7 to 24%. We are inclined to give more weight to the 2009 and 2010 studies that had large sample sizes. The mean percentage reduction in outdoor water use was 7-10%. We use the lower end of the range to be conservative.

Median single family water use in SFPUC's retail service area (circa 2005) is 153 gpd, per DeOreo and Mayer (2010a). On average, outdoor water use is assumed to be 34% of total water use. Expected WBIC savings are thus: 153 x 0.34 x 0.07 = 3.7 gpd or 1,351 gpy.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 10 years. Assumed

Peak Period Savings Percent: 100% of savings assumed to occur in peak season.

Unit Sewer Savings: NA

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
S20	Device Distribution	Single Family	Grants

Water Savings: Water savings are a quantity-weighted average of devices distributed by SFPUC. The devices, quantity weights, and annual savings are shown in the following table.

Devices	Annual Quantity	Savings (GPY)	
1.5 gpm bathroom aerator	8229	210	
1.0 gpm bathroom aerator	0	361	
0.5 gpm bathroom aerator	1537	511	
1.5 gpm kitchen laminar	0	210	
1.5 gpm bathroom laminar	0	210	
2.2 gpm kitchen aerator	265	0	
1.5 gpm kitchen aerator	4641	210	
1.5 utility aerator	54	210	
2.0 utility aerator	54	60	
2.2 utility aerator	16	0	
Garden spray hose nozzle	295	0	No reliable estimates
Toilet flapper	3603	1212	
Toilet fill valves	1819	1212	Assumed to be same as flapper savings
Soil moisture meter	7	0	No reliable estimates
Total	20520		
Weighted Avg Savings		491	

Annual savings for aerators are based on the following data and assumptions:

- Median SFR faucet use is 29 gpd (source: Aquacraft SFPUC End Use Study).
- An average of 4 faucets per household is assumed.
- Average use per faucet is 7.25 gpd. The calculation assumes uniform faucet usage, which while unlikely to be true is necessary given lack of data on faucet use.
- Aerators reduce free flowing faucet water consumption. It is assumed half of faucet use is for free flowing uses (e.g. brushing teeth or washing vegetables) and half is for fixed volume uses (e.g. filling pots or getting a drink of water). Free flowing faucet use is therefore 3.63 gpd.
- Average faucet flow is assumed to be 2.2 gpm. Therefore, faucets average 1.6 minutes of free flowing use per day.
- It is assumed half of distributed faucets are installed.

Given these assumptions, savings by aerator flow rate are:

Aerator flow rate (gpm)	Avg Use GPD	Potential Savings (GPD)	Install %	Actual Savings (GPD)	Actual Savings (GPY)
2.2	3.63	0.00	50%	0.00	0
2.0	3.30	0.33	50%	0.16	60
1.5	2.47	1.15	50%	0.58	210
1.0	1.65	1.98	50%	0.99	361
0.5	0.82	2.80	50%	1.40	511

Annual savings for flappers and fill valves are based on the following data and assumptions:

- Median SFR leakage rate is 8.3 gpd, per Aquacraft SFPUC End Use Study.
- According to 2004 CUWCC Toilet Flapper Study and 1999 Residential End Use Study most household water leaks can be attributed to toilets. It is assumed toilet leaks account for 80% of the median leakage rate, or 6.64 gpd.
- It is assumed replacing flapper or fill valves will eliminate toilet-related leakage.
- It is assumed half of distributed flappers and fill valves are installed.

Given these assumptions, water savings are 3.32 gpd, or 1212 gpy.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 5 years

Peak Period Savings Percent:

Unit Sewer Savings: Same as water savings

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
S21	ULFT to Ultra-High-Efficiency Toilet Direct Install	Single Family	HET

Water Savings: 6.7 gpd (2446 gpy). Engineering estimate prepared by SFPUC staff.

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 33 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 6.7 gpd (2466 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
S22	ULFT to Ultra-High-Efficiency Toilet Rebate	Single Family	HET

Water Savings: 5.0 gpd (1825 gpy). Engineering estimate prepared by SFPUC staff.

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 33 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 5.0 gpd (1825 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

Multi Family Measures

ID	Name	Class	Category
M1	WaterWise Direct Install Evaluations	Multi Family	Audits & Reports

Water Savings: Assumes same as indoor share of savings for S1 and S2

Water savings = 10.6 gpd (3,869 gpy)

Plumbing Code NRR: NA

Annual Decay Rate: 20%. Same as S1 and S2. Lower-end of decay rate range reported in CUWCC (2005).

Useful Life: 5 yrs. Same as S1 and S2. Based on typical useful life of survey savings reported in CUWCC (2005).

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 10.6 gpd (3,869 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006), that hot water comprises 67% of shower/faucet flow - per DOE (2006) – that half of indoor water savings involve reductions in shower/faucet flow, and that indoor savings comprise 100% of total survey savings.

Gas savings = 0.0072 therms/gal x 0.67 x 0.5 x 1.00 = 0.0024 therms/gal

Confidence Score: 2

ID	Name	Class	Category
M2	WaterWise Evaluations	Multi Family	Audits & Reports

All assumptions same as M1.

ID	Name	Class	Category
M3a	Small Multi-Family Leak Alert	Multi Family	Audits & Reports

Water Savings: Detailed empirical analysis of SFPUC's Multi-Family Customer Leak Alert Program concluded:

- The Program reduced the mean duration of leak events lasting 72 or more hours from 235.7 to 137.0 hours.
- The Program reduced the frequency of leak events lasting 72 or more hours from 0.656 to 0.453 leaks per meter-year.
- The Program reduced the mean leak volume from 1519 to 925.5 gallons per meter-year, or 593.5 gallons per meter-year (1.6 gpd).

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year.

Peak Period Savings Percent: We assume leaks are more or less distributed uniformly across the year.

Peak period runs from May 1 to Sep 30, representing 42% of days.

Unit Sewer Savings: We do not have data on how leakage is distributed between indoor and outdoor water uses. We assume multi-family water use is dominated by indoor water uses and so too are water savings from leak alerts.
Sewer savings = 0.9 x 593.5 gpy per meter = 534.2 gpy per meter
Wastewater to water savings ratio = 0.9

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
M3b	Large Multi-Family Leak Alert	Multi Family	Audits & Reports

Water Savings: A statistically significant reduction in mean leakage volume between the pre- program and program periods was not detected. Thus, we do not estimate any water savings for the large multi-family leak alert program.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year.

Peak Period Savings Percent: We assume leaks are more or less distributed uniformly across the year.

Peak period runs from May 1 to Sep 30, representing 42% of days.

Unit Sewer Savings: We do not have data on how leakage is distributed between indoor and outdoor water uses. We assume multi-family water use is dominated by indoor water uses and so too are water savings from leak alerts.
Sewer savings = 0.9 x 0 gpy per meter = 0 gpy per meter
Wastewater to water savings ratio = 0.9

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
M4	Showerheads Distributions	Multi Family	HESH

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Mean savings for showerheads installed in multi-family households was 12.6 gpd. Field studies of retrofit kit distributions in Irvine (A&N Technical Services 1992d) and Los Angeles (A&N Technical Services 1991) have found initial installation probabilities that range from 49% to 59%. We assume a 54% installation probability.

Water savings = 0.54 x 12.6 gpd = 6.8 gpd (2482 gpy)

Plumbing Code Savings: Zero. SB 407 mandates showerheads have a maximum capacity of 2.5 gpm. Currently, the average flow rate of showerheads in SFPUC's retail service area is 1.95, per DeOreo and Mayer (2010a).

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 8 yrs, per Alliance for Water Efficiency (2014).

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 6.8 gpd (2482 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006) and that hot water comprises 67% of shower/faucet flow - average of DOE (2006) and Aquacraft (). Gas savings = 0.0072 therms/gal x 0.67 = 0.0048 therms/gal

Confidence Score: 2

ID	Name	Class	Category
M5	Showerheads Direct Install	Multi Family	HESH

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Mean savings for showerheads installed in multi-family households was 12.6 gpd (4599 gpy).

Unit Sewer Savings: Sewer savings = 12.6 gpd (4599 gpy)

All other assumptions same as M4.

Confidence Score: 1

ID	Name	Class	Category
M6a	HET Rebate (Tank)	Multi Family	HET

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Installed HETs had flush rates of 1.0 gpf or less. Mean savings for HETs installed in multi-family households was 38.6 gpd (14089 gpy). Direct installation programs can more effectively screen out the replacement of ULF toilets than can rebate programs. Nearly all the toilets replaced in the direct installation programs evaluated by M.Cubed and A&N Technical Services were older non-ULFT toilets. Rebate programs may inadvertently issue rebates for the replacement of ULF toilets. To account for this possibility, mean daily savings estimated for the direct installation programs is reduced by 25%.

Water savings = 38.6 gpd x 0.75 = 30.0 gpd (10950 gpy)

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 30.0 gpd (10950 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
M6b	HET Rebate (Flushometer)	Multi Family	HET

All assumptions same as M6a.

ID	Name	Class	Category
M7a	HET Direct Install (Tank)	Multi Family	HET

Water Savings: M.Cubed and A&N Technical Services (2018a, 2018b) estimated toilet, showerhead, and aerator water savings from direct installation bathroom retrofit programs in Bakersfield, Torrance, and East Los Angeles targeting both single- and multi-family bathrooms. Installed HETs had flush rates of 1.0 gpf or less. Mean savings for HETs installed in multi-family households was 38.6 gpd (14089 gpy).

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 38.6 gpd (14089 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
M7b	HET Direct Install (Flushometer)	Multi Family	HET

All assumptions same as M7a.

ID	Name	Class	Category
M7c	ULFT to Ultra-High-Efficiency Toilet Direct Install	Multi Family	HET

Water Savings: 9.3 gpd (3395 gpy). Engineering estimate prepared by SFPUC staff.

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 33 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 9.3 gpd (3395 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
M8	HET Voucher	Multi Family	HET

All assumptions same as M6a.

ID	Name	Class	Category
M9	HET/Fixture Install thru On-Bill Financing	Multi Family	HET

All assumptions same as M7a.

ID	Name	Class	Category
M10	CEE Tier 3 Rebate (IWF 4.0)	Multi Family	HEW

Note that the model has separate measures for M10a and M10b that are distinguished only by differing rebate amounts provided through time.

Water Savings: Assumes rebates are for common area laundry rooms, not individual apartments. Without rebate, participant will purchase either top- or front-load washer. Current market share (circa 2012) of top-load washers is 52%, per DOE (2012). Current Energy Star market share (circa 2012) is 50%, per DOE (2012). Maximum allowed IWF for Energy Star washer after 2011 is 6. Maximum allowed IWF for non-Energy Star washer is 9.5, per National Appliance Standard. (National Appliance Standard changes in 2015 to 4.5 IWF for front-load and 8.0 IWF for top-load, and again in 2018 to 6.0 IWF for top-load). Average IWF of new washer is:

Avg IWF of New Washer Without Rebate = 0.5 x 6.0 + 0.5 x 9.5 = 7.75 (note this will overstate avg IWF after 2015 due to nat'l appl stdrd)

Average washer loads per day is 8.4, per M.Cubed (2014). Average volume of new clothes washer for common area use is assumed to be 4 cubic feet.

Water savings = (7.75 – 4.0) x 4 x 8.4 = 126 gpd (45,990 gpy) [Get energy star commercial list]

Plumbing Code Savings: Effective Jan 1, 2015, appliance standard is 4.5 IWF for front-load and 8.0 IWF for top-load. Given current front- and top-load market shares and Energy Star market share, average IWF under appliance standard in 2015 is:

2015 Avg IWF under Nat'l Appl Std = 0.52 x (0.5 x 8.0 + 0.5 x 6.0) + 0.48 x 4.5 = 5.8

Effective Jan 1, 2018, appliance standard is 4.5 IWF for front-load and 6.0 for top-load. Average IWF under appliance standard in 2018 is:

2018 Avg IWF under Nat'l Appl Std = 0.52 x 6.0 + 0.48 x 4.5 = 5.3.

For modeling conservation program benefits, we use the average of these two water factors – 5.6 -- and start the standard in 2015. Plumbing code savings starting in 2015 are:

Plumbing code savings = (7.75 – 5.6) x 4 x 8.4 = 72 gpd (26,280)

Plumbing Code NRR: 7.1%. Based on average washer life of 14 years, per DOE (2012).

Annual Decay Rate: NA

Useful Life: 14 years, per DOE (2012)

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 126 gpd (45,990 gpy)

Wastewater to water savings ratio = 1.000

Unit Electricity Savings: 0.0036 KWh/gal. Based on high efficiency washer electricity savings reported in FEMP (2000).

Unit Gas Savings: 0.0035 therms/gal. Based on high efficiency washer gas savings reported in FEMP (2000).

Confidence Score: 3

ID	Name	Class	Category
M17	Efficient Irrigation Timer Rebate	Multi Family	HET

All assumptions same as S18.

ID	Name	Class	Category
M20	Device Distribution	Multi Family	Grants

Water Savings: Water savings are a quantity-weighted average of devices distributed by SFPUC. The devices, quantity weights, and annual savings are shown in the following table.

Devices	Annual Quantity	Savings (GPY)	
1.5 gpm bathroom aerator	8229	210	
1.0 gpm bathroom aerator	0	361	
0.5 gpm bathroom aerator	1537	511	
1.5 gpm kitchen laminar	0	210	
1.5 gpm bathroom laminar	0	210	
2.2 gpm kitchen aerator	265	0	
1.5 gpm kitchen aerator	4641	210	
1.5 utility aerator	54	210	
2.0 utility aerator	54	60	
2.2 utility aerator	16	0	
Garden spray hose nozzle	295	0	No reliable estimates
Toilet flapper	3603	1212	
Toilet fill valves	1819	1212	Assumed to be same as flapper savings
Soil moisture meter	7	0	No reliable estimates
Total	20520		
Weighted Avg Savings		491	

Annual savings for aerators are based on the following data and assumptions:

- Median SFR faucet use is 29 gpd (source: Aquacraft SFPUC End Use Study).
- An average of 4 faucets per household is assumed.
- Average use per faucet is 7.25 gpd. The calculation assumes uniform faucet usage, which while unlikely to be true is necessary given lack of data on faucet use.
- Aerators reduce free flowing faucet water consumption. It is assumed half of faucet use is for free flowing uses (e.g. brushing teeth or washing vegetables) and half is for fixed volume uses (e.g. filling pots or getting a drink of water). Free flowing faucet use is therefore 3.63 gpd.
- Average faucet flow is assumed to be 2.2 gpm. Therefore, faucets average 1.6 minutes of free flowing use per day.
- It is assumed half of distributed faucets are installed.

Given these assumptions, savings by aerator flow rate are:

Aerator flow rate (gpm)	Avg Use GPD	Potential Savings (GPD)	Install %	Actual Savings (GPD)	Actual Savings (GPY)
2.2	3.63	0.00	50%	0.00	0
2.0	3.30	0.33	50%	0.16	60
1.5	2.47	1.15	50%	0.58	210
1.0	1.65	1.98	50%	0.99	361
0.5	0.82	2.80	50%	1.40	511

Annual savings for flappers and fill valves are based on the following data and assumptions:

- Median SFR leakage rate is 8.3 gpd, per Aquacraft SFPUC End Use Study.
- According to 2004 CUWCC Toilet Flapper Study and 1999 Residential End Use Study most household water leaks can be attributed to toilets. It is assumed toilet leaks account for 80% of the median leakage rate, or 6.64 gpd.
- It is assumed replacing flapper or fill valves will eliminate toilet-related leakage.
- It is assumed half of distributed flappers and fill valves are installed.

Given these assumptions, water savings are 3.32 gpd, or 1212 gpy.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 5 years

Peak Period Savings Percent:

Unit Sewer Savings: Same as water savings

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
M21	ULFT to Ultra-High-Efficiency Toilet Direct Install	Multi Family	HET

Water Savings: 9.3 gpd (3395 gpy). Engineering estimate prepared by SFPUC staff.

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 33 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 9.3 gpd (3395 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
M22	ULFT to Ultra-High-Efficiency Toilet Rebate	Multi Family	HET

Water Savings: 6.9 gpd (2519 gpy). Engineering estimate prepared by SFPUC staff.

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 33 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 6.9 gpd (2519 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

Non Residential Measures

ID	Name	Class	Category
N1	WaterWise Evaluations for Commercial Buildings	Non Residential	Audits & Reports

Water Savings: Assumes basic analyst or staff evaluations identify an average of 20% potential water savings per site, per CUWCC (2005). For calculating water savings, we assume 50% of potential savings are realized. Average realized water savings is therefore 10% of site use, which matches the assumption used by the SFPUC Retail Demand Model. Average water use per site (circa 2014) is 2,154 gpd, per SFPUC Retail Demand Model.

Water savings = 0.2 x 0.5 x 2,154 gpd = 215 gpd (78,475 gpy)

(NOTE: A higher estimate is warranted if SFPUC targets sites with higher than average use.)

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA. No savings persistence data reported in CUWCC (2005).

Useful Life: No savings persistence data reported in CUWCC (2005). We assume same average life as S1 – 5 years.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year, 80% of outdoor savings occur in peak period. Peak period runs from May 1 to Sep 30, representing 42% of days. Assumes 18% of savings are irrigation-related, per CUWCC (2005).

Peak % = (0.42 x 0.82 x 215 gpd + 0.8 x 0.18 x 215 gpd)/215 gpd = 49%

Unit Sewer Savings: Sewer savings = 0.82 x 215 gpd = 176 gpd (64,240 gpy)
Wastewater to water savings ratio = 0.820

Unit Electricity Savings: NA. No data on electricity savings

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006), that hot water comprises 67% of shower/faucet flow - per DOE (2006) – that one-quarter of indoor water savings involve reductions in shower/faucet flow, and that indoor savings comprise 82% of total survey savings. Gas savings = 0.0072 therms/gal x 0.67 x 0.25 x 0.82 = 0.001 therms/gal

Confidence Score: 3

ID	Name	Class	Category
N2	Commercial Direct Install Audits	Non Residential	Audits & Reports

All assumptions same as N1.

ID	Name	Class	Category
N3a,N3b,N3c	Surveys – Hospitals, Hotels, Schools	Non Residential	Audits & Reports

Water Savings: Number of sites and average daily use per site (circa 2013) shown in table are taken from the SFPUC Retail Demand Model.

Category	Number of Sites	Average Daily Use (gpd)
Hospitals	28	46,429
Hotels	421	9,929
Schools	297	2,559
Wtd Avg		8,365

Assumes basic analyst or staff evaluations identify an average of 20% potential water savings per site, per CUWCC (2005). For calculating water savings, we assume 50% of potential savings are realized. Average realized water savings is therefore 10% of site use, which matches the assumption used by the SFPUC Retail Demand Model. Average water use per site is 8,365 gpd, per above table.

Water savings wtd average = 0.2 x 0.5 x 8,365 gpd = 837 gpd (305,505 gpy)
Hospitals = 0.2 x 0.5 x 46,429 gpd = 4643 gpd (1,694,695 gpy)
Hotels = 0.2 x 0.5 x 9,929 gpd = 993 gpd (362,445 gpy)
Schools = 0.2 x 0.5 x 2,559 gpd = 256 gpd (93,440 gpy)

(NOTE: A higher estimate is warranted if SFPUC targets sites with higher than average use.)

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA. No savings persistence data reported in CUWCC (2005).

Useful Life: No savings persistence data reported in CUWCC (2005). We assume same average life as S1 – 5 years.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year, 80% of outdoor savings occur in peak period. Peak period runs from May 1 to Sep 30, representing 42% of days. Assumes 18% of savings are irrigation-related, per CUWCC (2005).

Peak % = (0.42 x 0.82 x 837 gpd + 0.8 x 0.18 x 837 gpd)/837 gpd = 49%

Unit Sewer Savings: Sewer savings = 0.82 x 837 gpd = 686 gpd (250,390 gpy)
Hospitals = 3,807 gpd (1,389,555 gpy)
Hotels = 814 gpd (297,110 gpy)
Schools = 210 gpd (76,650 gpy)
Wastewater to water savings ratio = 0.820

Unit Electricity Savings: NA. No data on electricity savings

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006), that hot water comprises 67% of shower/faucet flow - per DOE (2006) – that 50% of indoor water savings involve reductions in shower/faucet flow, and that indoor savings comprise 82% of total survey savings. Gas savings = 0.0072 therms/gal x 0.67 x 0.5 x 0.82 = 0.002 therms/gal

Confidence Score: 3

ID	Name	Class	Category
N4	Surveys – Large Landscape by Contractors	Non Residential	Audits & Reports

Water Savings: Per SFPUC Retail Demand Model, average use per site is 1.8 af/acre. Average water savings is 10%, also per SFPUC Retail Demand Model.

Water savings per acre = 0.1 x 1.8 x 325,851/365 = 161 gpd (58,765 gpy)

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA. No savings persistence data reported in CUWCC (2005).

Useful Life: No savings persistence data reported in CUWCC (2005). We assume same average life as S1 – 5 years. Same assumption used in SFPUC Retail Demand Model.

Peak Period Savings Percent: Assumes 80% of outdoor savings occur in peak period. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 80%

Unit Sewer Savings: NA

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
N5	Surveys – CII Facilities by Contractors	Non Residential	Audits & Reports

Water Savings: SFPUC estimates consultant audits save from 2,450 to 7,790 gpd. Model assumes midpoint of range – 5,120 gpd.

Water savings = 0.5 x (2,450 gpd + 7,790 gpd) = 5,120 gpd (1,868,800 gpy)

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA. No savings persistence data reported in CUWCC (2005).

Useful Life: No savings persistence data reported in CUWCC (2005). We assume same average life as S1 – 5 years. Same assumption used in SFPUC Retail Demand Model.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year, 80% of outdoor savings occur in peak period. Peak period runs from May 1 to Sep 30, representing 42% of days. Assumes 23% of savings are irrigation-related, per CUWCC (2005).

Peak % = (0.42 x 0.77 x 5120 gpd + 0.8 x 0.23 x 5120 gpd)/5120 gpd = 51%

Unit Sewer Savings: Sewer savings = 0.77 x 5120 gpd = 3,942 gpd (1,438,830 gpy)

Unit Electricity Savings: NA. No data on electricity savings

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006), that hot water comprises 67% of shower/faucet flow - per DOE (2006) – that one-quarter of indoor water savings involve reductions in shower/faucet flow, and that indoor savings comprise 82% of total survey savings. Gas savings = 0.0072 therms/gal x 0.67 x 0.25 x 0.77 = 0.0009 therms/gal

Confidence Score: 2

ID	Name	Class	Category
N6	Landscape Leak Alerts	Non Residential	Audits & Reports

Water Savings: Detailed empirical analysis of SFPUC's Landscape Customer Leak Alert Program concluded:

- The Program reduced the mean duration of leak events lasting 72 or more hours from 598.2 to 434.1 hours.
- The Program reduced the frequency of leak events lasting 72 or more hours from 1.048 to 0.840 leaks per meter-year.
- The Program reduced the mean leak volume by 10311 gallons per meter-year (28.2 gpd).

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year.

Peak Period Savings Percent: We assume leaks are more or less distributed uniformly across the year.

Peak period runs from May 1 to Sep 30, representing 42% of days.

Unit Sewer Savings: Outdoor water use only

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
N7	1.5 GPM Showerhead Giveaway	Non Residential	HESH

Water Savings: Water savings estimate assumes program targets lodging establishments where shower water use comprises a significant proportion of total facility water use. Hotel shower water use from data logging done for the 2000 AWWARF CII End Uses of Water Study are summarized in the following table.

Shower Water Use Estimates from AWWARF CII End Uses of Water Study, 2000

Hotel Location	Water Use gpy/showerhead	Implied Utilization Rate minutes/day	Retrofit Water Use gpy/showerhead	Savings gpy/showerhead	% Hot
Irvine	10,203	13	6,957	3,246	71%
Phoenix	13,724	17	9,357	4,367	28%
San Diego	12,446	15	8,486	3,960	
Santa Monica	11,182	14	7,624	3,558	
Average	11,889	15	8,106	3,783	50%

Mean flow rate (gpm)	2.2
Retrofit flow rate (gpm)	1.5

We assume installed showerheads will have a mean savings rate of 3,800 gpy. Field studies of retrofit kit giveaway programs in Irvine (A&N Technical Services 1992d) and Los Angeles (A&N Technical Services 1991) found initial installation probabilities that ranged from 49% to 59%. We assume a 54% installation probability.

Giveaway showerhead savings = 3,800 gpy/showerhead x 0.54 = 2,052 gpy/showerhead

Plumbing Code Savings: Zero. SB 407 mandates showerheads have a maximum capacity of 2.5 gpm. It is assumed the flow rating of replaced showerheads will be 2.5 gpm or less

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 8 yrs, per Alliance for Water Efficiency (2014).

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 2,052 gpy
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006) and that hot water comprises 50% of shower flow per above table. Gas savings = 0.0072 therms/gal x 0.5 = 0.0036therms/gal

Confidence Score: 3

ID	Name	Class	Category
N8	1.5 GPM Showerhead Direct Install	Non Residential	HESH

Water Savings: Water savings estimate assumes program targets lodging establishments where shower water use comprises a significant proportion of total facility water use. Hotel shower water use from data logging done for the 2000 AWWARF CII End Uses of Water Study are summarized in the following table.

Shower Water Use Estimates from AWWARF CII End Uses of Water Study, 2000

Hotel Location	Water Use gpy/showerhead	Implied Utilization Rate minutes/day	Retrofit Water Use gpy/showerhead	Savings gpy/showerhead	% Hot
Irvine	10,203	13	6,957	3,246	71%
Phoenix	13,724	17	9,357	4,367	28%
San Diego	12,446	15	8,486	3,960	
Santa Monica	11,182	14	7,624	3,558	
Average	11,889	15	8,106	3,783	50%

Assumed Mean flow rate (gpm)	2.2
Retrofit flow rate (gpm)	1.5

We assume installed showerheads will have a mean savings rate of 3,800 gpy/showerhead installed.

Plumbing Code Savings: Zero. SB 407 mandates showerheads have a maximum capacity of 2.5 gpm. It is assumed the flow rating of replaced showerheads will be 2.5 gpm or less

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 8 yrs, per Alliance for Water Efficiency (2014).

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 3,800 gpy
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: Assumes energy requirement of 0.0072 therms/gal for hot water heating, per DOE (2006) and that hot water comprises 50% of shower flow per above table. Gas savings = 0.0072 therms/gal x 0.5 = 0.0036therms/gal

Confidence Score: 3

ID	Name	Class	Category
N9	Device Distribution	Non Residential	Grants

Water Savings: Water savings are a quantity-weighted average of devices distributed by SFPUC. The devices, quantity weights, and annual savings are shown in the following table.

Devices	Annual Quantity	Savings (GPY)	
1.5 gpm bathroom aerator	8229	210	
1.0 gpm bathroom aerator	0	361	
0.5 gpm bathroom aerator	1537	511	
1.5 gpm kitchen laminar	0	210	
1.5 gpm bathroom laminar	0	210	
2.2 gpm kitchen aerator	265	0	
1.5 gpm kitchen aerator	4641	210	
1.5 utility aerator	54	210	
2.0 utility aerator	54	60	
2.2 utility aerator	16	0	
Garden spray hose nozzle	295	0	No reliable estimates
Toilet flapper	3603	1212	
Toilet fill valves	1819	1212	Assumed to be same as flapper savings
Soil moisture meter	7	0	No reliable estimates
Total	20520		
Weighted Avg Savings		491	

Annual savings for aerators are based on the following data and assumptions:

- Median SFR faucet use is 29 gpd (source: Aquacraft SFPUC End Use Study).
- An average of 4 faucets per household is assumed.
- Average use per faucet is 7.25 gpd. The calculation assumes uniform faucet usage, which while unlikely to be true is necessary given lack of data on faucet use.
- Aerators reduce free flowing faucet water consumption. It is assumed half of faucet use is for free flowing uses (e.g. brushing teeth or washing vegetables) and half is for fixed volume uses (e.g. filling pots or getting a drink of water). Free flowing faucet use is therefore 3.63 gpd.
- Average faucet flow is assumed to be 2.2 gpm. Therefore, faucets average 1.6 minutes of free flowing use per day.
- It is assumed half of distributed faucets are installed.

Given these assumptions, savings by aerator flow rate are:

Aerator flow rate (gpm)	Avg Use GPD	Potential Savings (GPD)	Install %	Actual Savings (GPD)	Actual Savings (GPY)
2.2	3.63	0.00	50%	0.00	0
2.0	3.30	0.33	50%	0.16	60
1.5	2.47	1.15	50%	0.58	210
1.0	1.65	1.98	50%	0.99	361

0.5	0.82	2.80	50%	1.40	511

Annual savings for flappers and fill valves are based on the following data and assumptions:

- Median SFR leakage rate is 8.3 gpd, per Aquacraft SFPUC End Use Study.
- According to 2004 CUWCC Toilet Flapper Study and 1999 Residential End Use Study most household water leaks can be attributed to toilets. It is assumed toilet leaks account for 80% of the median leakage rate, or 6.64 gpd.
- It is assumed replacing flapper or fill valves will eliminate toilet-related leakage.
- It is assumed half of distributed flappers and fill valves are installed.

Given these assumptions, water savings are 3.32 gpd, or 1212 gpy.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 5 years

Peak Period Savings Percent:

Unit Sewer Savings: Same as water savings

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
N10a	HET Rebates (Tank) - CII	Non Residential	HET

Water Savings: Savings based on CUWCC CII Toilet Savings Study (2001). Assume 10% of rebates replace ULFTs
Water savings = 0.9 x 1.15 x 25 gpd + 0.1 x 25 gpd = 28.4 gpd (10,366 gpy)

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent:
Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = 42%

Unit Sewer Savings: Sewer savings = same as water savings
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
N10b	HET Rebates (Flushometer) - CII	Non Residential	HET

Water Savings: Savings based on CUWCC CII Toilet Savings Study (2001). Assume 10% of rebates replace ULFTs
Water savings = 0.9 x 1.15 x 25 gpd + 0.1 x 25 gpd = 28.4 gpd (10,366 gpy)

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent:
Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = 42%

Unit Sewer Savings: Sewer savings = same as water savings
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
N11a,N11b,N11c	HET Rebates Schools, Hotels, Muni (Tank)	Non Residential	HET

Water Savings: Assumes program targets non-ULF toilets. CUWCC (2001) estimated replacing non-ULF toilets with ULF toilets in schools, hotels, and government facilities resulted in average daily savings shown in the table.

Category	Avg Savings Per ULF Toilet (gpd)	Imputed Flushes/Day
Schools	18	8.4
Hotels	16	7.4
Government	25	11.6
Avg Savings	20	9.3

Note: GPD savings from CUWCC (2001). Imputed flushes/day assumes avg of replaced toilet was 3.75 gpf

Assume 10% of rebates replace ULFTs
Schools: [0.1(1.6-1.28)+0.9(3.75-1.28)] x 8.4 = 18.9 gpd (6,914)
Hotels: [0.1(1.6-1.28)+0.9(3.75-1.28)] x 7.4 = 16.7 gpd (6,096)
Gov: [0.1(1.6-1.28)+0.9(3.75-1.28)] x 11.6 = 26.2 gpd (9,563)

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent:
Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = 42%

Unit Sewer Savings: Sewer savings = same as water savings
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
N11d,N11e,N11f	HET Rebates Schools, Hotels, Muni (Flushometer)	Non Residential	HET

All assumptions same as N11a, N11b, N11c.

ID	Name	Class	Category
N12a	HET Direct Install (Tank) - CII	Non Residential	HET

Water Savings: Assumes program targets non-ULF toilets. CUWCC (2001) estimated replacing non-ULF toilets with ULF toilets resulted in average daily savings of 25 gpd. Assuming non-ULF toilets have an average flush volume of 3.75, the HE toilet would save approximately 15% more than a ULF toilet.

Water savings = 1.15 x 25 gpd = 29 gpd (10,585 gpy)

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent:
Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = 42%

Unit Sewer Savings: Sewer savings = 29 gpd (10,585 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
N12b	HET Direct Install (Flushometer) - CII	Non Residential	HET

All assumptions same as N12a.

ID	Name	Class	Category
N13	HET Direct Install School/Hotel	Non Residential	HET

Water Savings: Assumes program targets non-ULF toilets. CUWCC (2001) estimated replacing non-ULF toilets with ULF toilets in schools and hotels resulted in average daily savings shown in the table.

Category	Avg Savings Per ULF Toilet (gpd)	Imputed Flushes/Day
Schools	18	8.4
Hotels	16	7.4
Avg Savings	17	7.9

Note: GPD savings from CUWCC (2001). Imputed flushes/day assumes avg of replaced toilet was 3.75 gpf

It is assumed direct install toilets would only replace non-ULF. Assuming non-ULF toilets have an average flush volume of 3.75, the HE toilet would save approximately 15% more than a ULF toilet.

Water savings = 1.15 x 17 gpd = 19.6 gpd (7,154 gpy)

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent:
Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = 42%

Unit Sewer Savings: Sewer savings = same as water savings
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
N14	CII HET Voucher	Non Residential	HET

All assumptions same a N10

ID	Name	Class	Category
N15	HET Voucher School/Hotel	Non Residential	HET

Water Savings: Assumes 90% of vouchers go to non-ULF and 10% go to ULF toilets. CUWCC (2001) estimated replacing non-ULF toilets with ULF toilets in schools and hotels resulted in average daily savings shown in the table.

Category	Avg Savings Per ULF Toilet (gpd)	Imputed Flushes/Day
Schools	18	8.4
Hotels	16	7.4
Avg Savings	17	7.9

Note: GPD savings from CUWCC (2001). Imputed flushes/day assumes avg of replaced toilet was 3.75 gpf

Savings = [0.1 x (1.6 – 1.28) + 0.9 x (3.75 – 1.28)] x 7.9 = 17.8 gpd (6,497 gpy)

Comparison to Retail Demand Model (RDM) Estimate: this measure is not in the RDM.

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent:
Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days.

Peak % = 42%

Unit Sewer Savings: Sewer savings = same as water savings
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
N16	HET/Fixture Install thru On-Bill Financing	Non Residential	HET

All assumptions same as N12a

ID	Name	Class	Category
N17a, N17b	HEU Rebate - CII	Non Residential	HEU

Water Savings: From Koeller & Company (2005). Urinals in CA used an estimated 28,000 AFY in 2005. Average flush rate is 2 times per day per male employee. Total employment in 2005 is 16.8 million, 55% male. Average flush volume = 28000 x 325851/[2 x 16.8 x 10^6 x 0.55 x 365) = 1.35 gpf

25 x 10^6 gal/day / 1.35 gal/flush = 18.5 x 10^6 flushes/day

18.5 x 10^6 flushes/day / 1.4 x 10^6 urinals (circa 2005) = 13.2 flushes/urinal/day

0.5 gpf: (1.35-.5) x 13.2 flush/day = 11.2 gpd (4,088 gpy)
0.25 gpf: (1.35-.25) x 13.2 flush/day = 14.5 gpd (5,293 gpy)
0.125 gpf: (1.35-.125) x 13.2 flush/day = 16.2 gpd (5,913 gpy)

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Same as water savings
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
N18	HEU Direct Install - CII	Non Residential	HEU

All assumptions same as N17.

ID	Name	Class	Category
N20	Energy Star Washer Rebates (IWF 4.5)	Non Residential	HEW

Water Savings: Assumes rebates are for common area laundry rooms, not individual apartments. Without rebate, participant will purchase either top- or front-load washer. Current market share (circa 2012) of top-load washers is 52%, per DOE (2012). Current Energy Star market share (circa 2012) is 50%, per DOE (2012). Maximum allowed IWF for Energy Star washer after 2011 is 6. Maximum allowed IWF for non-Energy Star washer is 9.5, per National Appliance Standard. (National Appliance Standard changes in 2015 to 4.5 IWF for front-load and 8.0 IWF for top-load, and again in 2018 to 6.0 IWF for top-load). Average IWF of new washer is:

Avg IWF of New Washer Without Rebate = 0.5 x 6.0 + 0.5 x 9.5 = 7.75 (note this will overstate avg IWF after 2015 due to nat'l appl stdrd)

Average loads per day for machines with load capacity under 25 pounds is 3, per Sutter and Pope (2006). Average washer volume is assumed to be 4 cubic feet.

Water savings = (7.75 – 4.5) x 4 x 3 = 39 gpd (14,235 gpy)

Plumbing Code Savings: Effective Jan 1, 2015, appliance standard is 4.5 IWF for front-load and 8.0 IWF for top-load. Given current front- and top-load market shares and Energy Star market share, average IWF under appliance standard in 2015 is:

2015 Avg IWF under Nat'l Appl Std = 0.52 x (0.5 x 8.0 + 0.5 x 6.0) + 0.48 x 4.5 = 5.8

Effective Jan 1, 2018, appliance standard is 4.5 IWF for front-load and 6.0 for top-load. Average IWF under appliance standard in 2018 is:

2018 Avg IWF under Nat'l Appl Std = 0.52 x 6.0 + 0.48 x 4.5 = 5.3.

For modeling conservation program benefits, we use the average of these two water factors – 5.6 -- and start the standard in 2015. Plumbing code savings starting in 2015 are:

Plumbing code savings = (7.75 – 5.6) x 4 x 3 = 26 gpd (9,490)

Plumbing Code NRR: 12.2%, average of the turnover rates assumed by AWE (11.1%) and DOE (13.3%) for commercial washers.

Annual Decay Rate: NA

Useful Life: 14 years, per DOE (2012)

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 39 gpd (14,235 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: 0.0036 KWh/gal. Based on high efficiency washer electricity savings reported in FEMP (2000).

Unit Gas Savings: 0.0035 therms/gal. Based on high efficiency washer gas savings reported in FEMP (2000).

Confidence Score: 3

ID	Name	Class	Category
N21	Energy Star Washer Rebates (IWF 4)	Non Residential	HEW

Note that the model has separate measures for N21a and N21b that are distinguished only by differing rebate amounts provided through time.

Water Savings: Assumes rebates are for common area laundry rooms, not individual apartments. Without rebate, participant will purchase either top- or front-load washer. Current market share (circa 2012) of top-load washers is 52%, per DOE (2012). Current Energy Star market share (circa 2012) is 50%, per DOE (2012). Maximum allowed IWF for Energy Star washer after 2011 is 6. Maximum allowed IWF for non-Energy Star washer is 9.5, per National Appliance Standard. (National Appliance Standard changes in 2015 to 4.5 IWF for front-load and 8.0 IWF for top-load, and again in 2018 to 6.0 IWF for top-load). Average IWF of new washer is:

Avg IWF of New Washer Without Rebate = 0.5 x 6.0 + 0.5 x 9.5 = 7.75 (note this will overstate avg IWF after 2015 due to nat'l appl stdrd)

Average loads per day for machines with load capacity under 25 pounds is 3, per Sutter and Pope (2006). Average washer volume is assumed to be 4 cubic feet.

Water savings = (7.75 – 4.0) x 4 x 3 = 45 gpd (16,425 gpy)

Plumbing Code Savings: Effective Jan 1, 2015, appliance standard is 4.5 IWF for front-load and 8.0 IWF for top-load. Given current front- and top-load market shares and Energy Star market share, average IWF under appliance standard in 2015 is:

2015 Avg IWF under Nat'l Appl Std = 0.52 x (0.5 x 8.0 + 0.5 x 6.0) + 0.48 x 4.5 = 5.8

Effective Jan 1, 2018, appliance standard is 4.5 IWF for front-load and 6.0 for top-load. Average IWF under appliance standard in 2018 is:

2018 Avg IWF under Nat'l Appl Std = 0.52 x 6.0 + 0.48 x 4.5 = 5.3.

For modeling conservation program benefits, we use the average of these two water factors – 5.6 -- and start the standard in 2015. Plumbing code savings starting in 2015 are:

Plumbing code savings = (7.75 – 5.6) x 4 x 3 = 26 gpd (9,490)

Plumbing Code NRR: 12.2%, average of the turnover rates assumed by AWE (11.1%) and DOE (13.3%) for commercial washers.

Annual Decay Rate: NA

Useful Life: 14 years, per DOE (2012)

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 45 gpd (16,425 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: 0.0036 KWh/gal. Based on high efficiency washer electricity savings reported in FEMP (2000).

Unit Gas Savings: 0.0035 therms/gal. Based on high efficiency washer gas savings reported in FEMP (2000).

Confidence Score: 3

ID	Name	Class	Category
N22	Landscape Grants	Non Residential	Grants

Water Savings: Average savings for previous grant projects (implemented 2011-2019) is shown in the following table based on calculations performed by SFPUC. The pre-grant average water use per acre is 1.6 AFY/Acre and the average water savings per acre is 0.2 AFY/Acre (11%), or 65,170 gpy (179 gpd).

Project Name	Project Size (acres)	Pre-Grant Use (mgy)	Projected Savings (mgy)	Projected Savings (%)	Observed Savings (mgy)[1]	Observed Savings (%)[1]
Balboa Park Water Conservation Project	17.3	15.4	1.5	10%	-1.24	-8%
Fort Mason Water Conservation Irrigation Upgrades	12.3	25.8	4.6	18%	7.5	29%
Sunset Blvd. Landscape Irrigation Retrofit	3.5	16.7	13.8	83%	N/A	N/A
Jefferson Square Park Water Conservation Project	5.1	6.0	1.7	28%	0.52	9%
Alta Plaza Park Water Conservation Project	4.0	9.7	3.8	39%	-0.65	-7%
Laguna Honda Hospital Water Conservation Project	2.5	2.9	0.96	33%	N/A	N/A
Moscone Recreation Center	6.2	8.8	2.7	30%	-0.36	-4%
Alamo Square Park	9.4	8.8	1.4	16%	2.41	27%
Sunol Glen Elementary School	1.7	2.56	1.17	46%	0.03	1%
Washington Square Park	1.5	3.0	1.7	60%	X	X
Forest Hill Station	0.7	1.13	0.44	39%	0.0	0%

[1] Based on simple comparison of billed consumption before and after project installation, with no controls for factors like weather, price, or drought restrictions.

Program N22a (Landscape Grants Pre2020) in the Tracking Model reflects landscapes with over 0.5 acre of irrigated area that were installed before 2020.

Program N22b (Landscape Grants Post 2020) in the Tracking Model reflects landscapes of 10,000 sf to 0.5 ac or more of irrigated area. Only one project of 10,000 sq ft has been completed between 2020-2025 (Lombard Street in May 2023). The Filoli Center Irrigation System Update Project is 845,000 sq ft (19.4 ac) and begins construction in 2025. Water savings are assumed to be the same as those estimated for N22a projects until updated savings estimates can be calculated from newly installed projects.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA. No savings persistence data reported in CUWCC (2005).

Useful Life: SFPUC program assumption is 20 years.

Peak Period Savings Percent: Assumes 80% of outdoor savings occur in peak period. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 80%

Unit Sewer Savings: NA

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
N24	Equipment Retrofit Rebates	Non Residential	Grants

Water Savings: Water savings are 1 CCF/Yr (748 gpy) because the savings are entered directly as CCF/Yr in the Annual Activity.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 10 years

Peak Period Savings Percent: 42%

Unit Sewer Savings: Same as water savings
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
N25	Custom Equipment Retrofit Rebates	Non Residential	Grants

All assumptions same as N24
N25a and N25b are only distinguished by the unit cost for each program.

ID	Name	Class	Category
N26	Non-Residential Leak Alerts	Non Residential	Audits & Reports

Water Savings: Detailed empirical analysis of SFPUC's Landscape Customer Leak Alert Program concluded:

- The Program reduced the mean duration of leak events lasting 72 or more hours from 495.6 to 438.4 hours.
- The Program did not reduce leak frequency.
- The Program reduced the mean leak volume by 1841.7 gallons per meter-year (5.0 gpd).

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year.

Peak Period Savings Percent: We assume leaks are more or less distributed uniformly across the year.

Peak period runs from May 1 to Sep 30, representing 42% of days.

Unit Sewer Savings: We do not have data on how leakage is distributed between indoor and outdoor water uses. We assume non-residential water use is dominated by indoor water uses and so too are water savings from leak alerts.
Sewer savings = 0.9 x 1841.7 gpy per meter = 1657.5 gpy per meter
Wastewater to water savings ratio = 0.9

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 1

ID	Name	Class	Category
N27	Kitchen Low Flow Spray Valves	Non Residential	Grants

All assumptions taken directly from the SFPUC Retail Demand Model. The SFPUC Retail Demand Model used a daily water savings estimate of 30 gpd (10,950 gpy) and fixture useful life of 10 years. The estimate is based on empirical estimates of daily savings (60 gpd) and a 50% installation and retention rate.

Confidence Score: 1

ID	Name	Class	Category
N29	Efficient Irrigation Timer Rebate	Non-Residential	Grants

Water Savings: 13.4 gpd or 4891 gpy. This is the lower-bound of 95% CI of average savings per station, per A&N Technical's 2011 WBIC savings evaluation. Lower-bound is used because of San Francisco's climate and lower landscape water use.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 10 years. Assumed

Peak Period Savings Percent: 100% of savings assumed to occur in peak season.

Unit Sewer Savings: NA

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 2

ID	Name	Class	Category
N30	ULFT to Ultra-High-Efficiency Toilet Rebate	Non-Residential	HET

Water Savings: 7.0 gpd (2540 gpy). Engineering estimate prepared by SFPUC staff.

Plumbing Code Savings: Effective Jan 1, 2014, same as water savings

Plumbing Code NRR: 3% per M.Cubed (2014)

Annual Decay Rate: NA. Leakage and double flushing assumed no worse than toilets replaced.

Useful Life: NA. Plumbing code ensures toilet cannot revert to lower efficiency. Period of savings attributed to program does not exceed useful life of toilet. On average savings are counted for 33 years, the average useful life of the toilet.

Peak Period Savings Percent: Assumes indoor savings evenly distributed through year. Peak period runs from May 1 to Sep 30, representing 42% of days. Peak % = 42%

Unit Sewer Savings: Sewer savings = 7.0 gpd (2540 gpy)
Wastewater to water savings ratio = 1.000

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
A3	Irrigation Customer Landscape Budgets	Non Residential	Audits & Reports

Water Savings: Many water suppliers have adopted water budgets for their large landscapes, which provides an effective way for both managing and evaluating large landscape programs. Landscape budgets are a form of customer education/information designed to help customers irrigate landscape efficiently. The effectiveness of this intervention can vary significantly depending on existing water use practices, types of landscapes subject to budgets, types of customers receiving budgets, cost of water, etc. There have been several empirical evaluations of landscape budget performance. Cal WEP provides a good summary of these studies.

The impact of landscape education on compliance with water budgets was evaluated in Orange County, California in a 2004 study. The education component was targeted at landscape contractors and property managers at home-owner associations (HOAs). The results were based on the experience of 47 HOAs that had participated in the program up to that point. The impact evaluation concluded that early participants in the program reduced their water demand by 9%, later participants by 20% (the difference between early and later participants was not explained).

Several studies are available that examine the impact of budget-based rates on large landscape water use. An early study, published in 1997 showed that tiered rates tied to landscape water budgets can reduce irrigation demand by about 20-25%.

Cal WEP compiled data from 12 Bay Area retailers on actual water use versus budget for a sample of large landscapes. On average, actual use exceeded budgeted use by 33%. Cal WEP also compared budget exceedence by type of customer. It found budget exceedence was greatest for HOAs and commercial properties (excluding gold courses) and lowest for parks and schools. The average exceedence for HOAs and commercial was 23% and 34%, respectively; for parks and schools it was 10% and 5%, respectively.

This measure assumes budgets would reduce large landscape water use by 10%, on average. This is at the lower-end of the savings range from empirical studies and significantly less than the average budget exceedence for the sample of 12 Bay Area water agencies. A conservative savings assumption is deemed appropriate because:

- Parks and schools, which tend to have lower budge exceedence, comprise most of the large landscape area in SFPUC's retail service area.
- SFPUC's high retail water rates already discourage wasteful irrigation and landscape water use.
- SFPUC's cool summer climate results in lower irrigation application rates relative to other parts of California with dryer, hotter summer climates.

The average pre-grant irrigation application rate at large landscape sites participating in SFPUC's large landscape grant program is 4 AF/acre (see N22).

Savings = 4 AF/acre x 0.1 = 0.4 AF/acre (130,340 gpy/acre)

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year

Peak Period Savings Percent: 100%

Unit Sewer Savings: 0

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
A4a	Municipal Large Landscape Budget	Non Residential	Audits & Reports

Water Savings: Assumes 10% reduction in average pre-budget water use of 0.54 AF/Ac. See further detail in Measure A3.
Savings = 0.54 AF/acre x 0.1 = 0.054 AF/acre (17,596 gpy/acre; 48 gpd/acre)

SFPUC analyzed 2020 satellite imagery for all parcels associated with dedicated irrigation meters and identified the area of irrigable, irrigated landscape cover served by each meter and parcel. Based on calendar year 2024 billed consumption, the average pre-budget water use for municipal irrigation accounts was 0.54 AF/ac, based on 867 acres of irrigable, irrigated municipal landscape served by dedicated irrigation meters that are slated to receive regular water budget reports starting in late 2025.

Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year

Peak Period Savings Percent: 100%

Unit Sewer Savings: 0

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

ID	Name	Class	Category
A4b	Non-Municipal Large Landscape Budget	Non Residential	Audits & Reports

Water Savings: Assumes 10% reduction in average pre-budget water use of 2.64 AF/Ac. See further detail in Measure A3.

Savings = 2.64 AF/acre x 0.1 = 0.264 AF/acre (86,025 gpy/acre; 236 gpd/acre)

SFPUC analyzed 2020 satellite imagery for all parcels associated with dedicated irrigation meters and identified the area of irrigable, irrigated landscape cover served by each meter and parcel. Based on calendar year 2024 billed consumption, the average pre-budget water use for non-municipal irrigation accounts was 2.64 AF/ac, based on 173 acres of irrigable, irrigated non-municipal landscape served by dedicated irrigation meters that are slated to receive regular water budget reports starting in late 2025.
Plumbing Code Savings: NA

Plumbing Code NRR: NA

Annual Decay Rate: NA

Useful Life: 1 year

Peak Period Savings Percent: 100%

Unit Sewer Savings: 0

Unit Electricity Savings: NA

Unit Gas Savings: NA

Confidence Score: 3

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