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Appendix G – DSS Model Update and Demand Analysis

Technical Memorandum - FINAL

Date: May 26, 2021

To: Ray Dienzo and Melissa Bland, Cambria Community Services District

From: Lisa Maddaus, Maddaus Water Management Inc.

Title: Summary of DSS Modeling Demand Analysis Update for 2020 UWMP

1. INTRODUCTION

Cambria Community Services District (Cambria) worked dynamically with Maddaus Water Management (MWM) to update Cambria's Least Cost Planning Decision Support System Model (DSS Model) from the prior 2016 version of the model. This effort included MWM providing Cambria staff with DSS Model training video modules and holding virtual meetings to ensure a comprehensive update. For this effort, MWM's role focused more on design support and peer review. The updates to the 2016 DSS Model and demand analysis are intended to support Cambria's 2020 Urban Water Management Plan (UWMP) development. This memo presents inputs and results from the demand analysis completed in March 2021.

In support of the 2021 effort, MWM provided a data workbook and an updated DSS Model containing refined software code so Cambria staff could update both with new data. MWM worked collaboratively with Cambria to refine model inputs and design features in the DSS Model. A revised demand projection scenario was implemented to investigate potential rebound activity and climate change adjustments from the recent drought, recession, and COVID-19 pandemic.

The results of this demand analysis support the efforts by Cambria and Water Systems Consulting, Inc. (WSC) in the development of the 2020 Cambria UWMP. The output of the DSS Model analysis has provided that data needed for the required 2020 UWMP Chapter 4 demand forecast data tables, as well as a foundation for the supply and demand comparison under various water year types scenarios in the water supply reliability analysis.

2. BACKGROUND

This effort is a continuation of past collaboration between Cambria and MWM. In 2016, MWM provided services to assist Cambria with the completion of an Environmental Impact Report (EIR). Services included a review of Cambria's historical demands, historical conservation activity including local plumbing codes, and the collaborative development of projected water use and demand management measures. This involved creating an update to Cambria's DSS Model previously used for the Water Use Efficiency Plan. Also conducted was a detailed review of Cambria's population and employment status as well as local codes and ordinances. Using the 2016 DSS Model, MWM produced Cambria's 2015 UWMP, completing the project in December 2016. The intent of the UWMP was to provide the California Department of Water Resources (DWR) and the public with information on present and future water supply sources and demands and to provide an assessment of Cambria's water resource needs. UWMPs provide water supply planning for a 20-year planning period in 5-year increments; identify and quantify adequate water supplies for existing and future demands during normal, dry and drought years; and assure efficient use of urban water supplies.

In 2013, MWM assisted Cambria with its long-standing water conservation program by developing scenarios for maximizing future water conservation in the community. This was done using the 2012 version of the DSS Model software.

The analysis of conservation measures and programs was then documented in the Water Use Efficiency Plan. The evaluation included measures directed at existing accounts and new development measures to help ensure new residential and business customers would be more water efficient. Three programs were developed to evaluate the net effect of running multiple measures together over time. From that analysis, a recommended conservation program was selected by the Cambria Board of Directors in January 2013 to be in concert with Cambria's goals. The work effort included MWM's direction of Cambria staff to perform an assessment of remaining conservation potential for large customers. MWM also prepared a supplemental technical analysis using San Luis Obispo County assessor data of water use by property size and other demographic data. This supported an update to Cambria Municipal Code for its retrofit points system for approval of new developments.

3. DSS MODELING APPROACH AND INPUTS

Updates to Cambria's DSS Model included additional consumption, production, population, and jobs data as well as passive saving analysis input changes. The DSS Model analysis demand forecast development methodology can be found in Appendix A; the passive savings basis can be found in Appendix B.

3.1 Data Collection

Utilizing utility billing records, monthly production, customer category consumption, and customer category accounts through December 2020 were updated by Cambria staff in the data collection section of the DSS Model. This 2021 modeling effort also used updated values for cost of water, water system audit results, and historical active conservation activity, interventions, rebates, and/or giveaways through 2020 for toilets, urinals, showerheads, faucet aerators, and clothes washers.

3.2 Growth Projections

This DSS Model demand analysis update used various growth projection parameters for Cambria's customer categories, the basis of which are defined below.

Population

Service area historical population was reviewed and determined to remain consistent with the previous 2015/2016 effort, where population was held constant at 6,032 people based on the 2010 Census. The Cambria service area still currently has a building moratorium, where no growth occurs beyond properties approved by the California Coastal Commission. As a result, though typically a valuable resource, the population projection estimates available through the US Census American Community Survey (ACS) were not accurately representative of the Cambria service area. The two areas of evidence for this were actual water consumption and the number of zero-read months where an account showed no water use. The ACS data showed that the Cambria population was trending downward; however, the actual water consumption in the service area was increasing while the number of zero-reads were decreasing. This water use and account trend did not imply a reduction in population; therefore, the ACS population estimates for Cambria were assumed to not accurately represent the service area.

Cambria's baseline population of 6,032 from the 2010 Census was verified against number of current occupied single family, multifamily, and vacation rental units. Single family (SF) population was calculated using total number of occupied single family units and the 2010 Census[1] average household size of 2.18. Approximately 60% of the single family units in the service area are occupied per the ACS DP04 2019 5-year estimates. The multifamily (MF) population was calculated using the total number of occupied multifamily units' times the ACS renter household size of 2.36.

[1] https://data.census.gov/cedsci/

Cambria's "Vacation Rental" population was determined by using total number of occupied vacation rental units times a household size of 4.44, which was derived using AirDNA[2] occupancy rates and average number of guests. Per AirDNA, it is assumed that 74% of vacation rental accounts are occupied. Future population projections were held constant until 2025 due to the current moratorium and no planned growth until 2026.

Currently in the Cambria service area, there is a goal of 4,650 residential connections based on the Buildout Reduction Program, part of the Cambria's 2008 Water Master Plan. Since the current waitlist for single family accounts is at 661, this analysis assumes account growth in the single family (SF) customer category only and that multifamily (MF) accounts will increase negligibly. In order to not exceed the residential unit cap, single family account growth was conducted by growing SF accounts 1% each year from 2026 to 2042, 0.5% in 2043, and 0% (no growth) after 2043. This approach yielded 4,650 total residential units for single family, multifamily, and vacation rentals in 2043 and remaining constant thereafter. It was assumed that there are 2.6 units per multifamily account based on ACS number of housing units and actual 2020 multifamily accounts per Cambria billing data. This approach yields a modest population growth estimated at 849 persons between 2026-2043 only, assumed to be in single family dwellings. For this analysis, single family accounts are growing at the same rate as single family population. Multifamily and vacation rental accounts are assumed to remained constant with no growth, as the population for those categories is not expected to change significantly.

Employment

Historical employment was based on the Economic Census of the United States with an estimated 1,250 jobs in 2012 and 1,500 in 2017. Historical jobs were estimated to remain static after 2017. For employment projections, it was assumed that, like population, employment would remain static through 2026. Therefore, the 2017 employment estimate of 1,500 (from the 2017 Economic Census) was held constant through 2025 then, like single family population, grew at 1% until 2042 with a 0.5% growth increase in 2043. Afterwards, it was estimated that employment would remain static through the model analysis period (2045). This employment estimate assumes approximately 15-18 new employees each year from 2026-2043, capping off at approximately 1,800 employees in 2043.

Commercial account growth in Cambria is estimated to grow at the rate of employment growth. There is no account growth assumed for Cambria's "Other" customer category which includes internal, non-revenue bearing accounts.

3.3 Water Loss

The DSS Model analysis included non-revenue water (NRW) in its demand calculations. A user input of 10.8% water loss from the 2019 AWWA Water Loss Workbook was used. An estimate of 9.3% was used in the 2015 UWMP effort.

3.4 Climate Change

An external climate change growth rate estimate was applied to the Cambria annual water demand projections with passive savings. Customer category demands were increased by 2.38% by 2050 to capture the effect of climate change. This bump was feathered in linearly starting with a zero increase then rising to 2.38% by 2050. This climate change increase was not applied to the NRW volume. The factor is based on changes in temperature and precipitation from CalAdapt,[3] which is based on analysis from California's Fourth Climate Change Assessment. Estimates were for the grid overlaying the Central Coast region originally prepared for the City of Santa Barbara and based on specific years (2020-2050). This analysis was based on an average of 10 climate models, and representative concentration pathways (RCP) 8.5, which assumed "business as usual" (i.e., emissions continue to rise strongly through 2050 and plateau around 2100). This resulted in a

[2] As of February 24, 2021, the average occupancy rate was 74% and average number of guests was 6. https://www.airdna.co/vacation-rental-data/app/us/california/cambria/overview

[3] https://cal-adapt.org/tools/annual-averages/

projected maximum temperature increase from 70.1°F (historical average) to 72.8°F in 2050 and an increase in precipitation from an average historical of 17.3 inches per year to 19.1 inches per year.[4]

3.5 Plumbing Codes and Passive Savings

An update to the plumbing code inputs section of the DSS Model for this passive savings analysis incorporated updates to the following:

- Age of housing profile
- Historical conversation measure implementation activity
- Cambria Municipal Code

More information on plumbing code and passive savings can be found in Appendix B.

4. MODEL ANALYSIS FINDINGS

The following tables and charts present Cambria historical and projected population and potable demands. The demands include passive savings and climate change.

Table 1. Estimated Cambria Population and Potable Water Demands

<table>
<tr><th></th><th>2020 (Actual)</th><th>2025</th><th>2030</th><th>2035</th><th>2040</th><th>2045</th></tr>
<tr><td>Population</td><td>6,032</td><td>6,000</td><td>6,300</td><td>6,500</td><td>6,800</td><td>6,900</td></tr>
<tr><td>Demands with NO Passive Savings (AFY)</td><td rowspan="3">540</td><td>600</td><td>630</td><td>660</td><td>690</td><td>700</td></tr>
<tr><td>Demands with Passive Savings (AFY)</td><td>580</td><td>590</td><td>610</td><td>630</td><td>630</td></tr>
<tr><td>Demands with Passive Savings AND Climate Change (AFY)</td><td>590</td><td>600</td><td>620</td><td>640</td><td>650</td></tr>
</table>

Note: Population values have been rounded to the nearest 100 people, demand to the nearest 10 AFY.

[4] City of Santa Barbara Water Vision Santa Barbara Demands Projections Basis Technical Memorandum, dated September, 24, 2020.

Figure 1. Historical and Projected Cambria Potable Demands

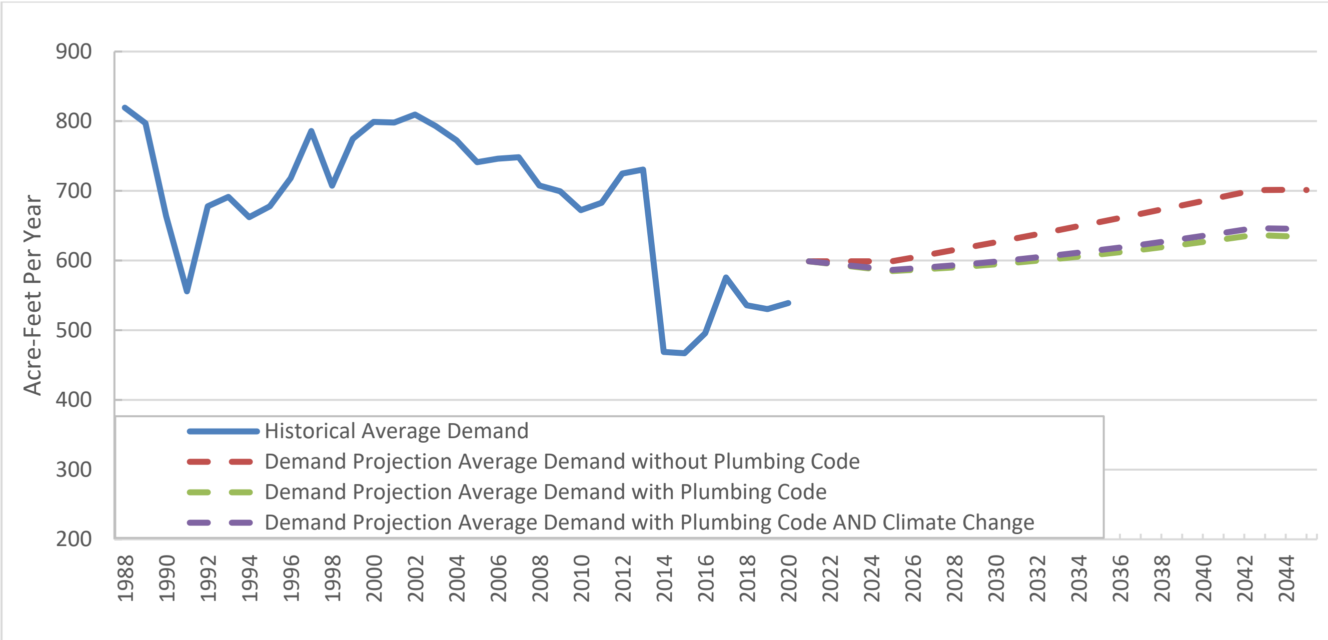
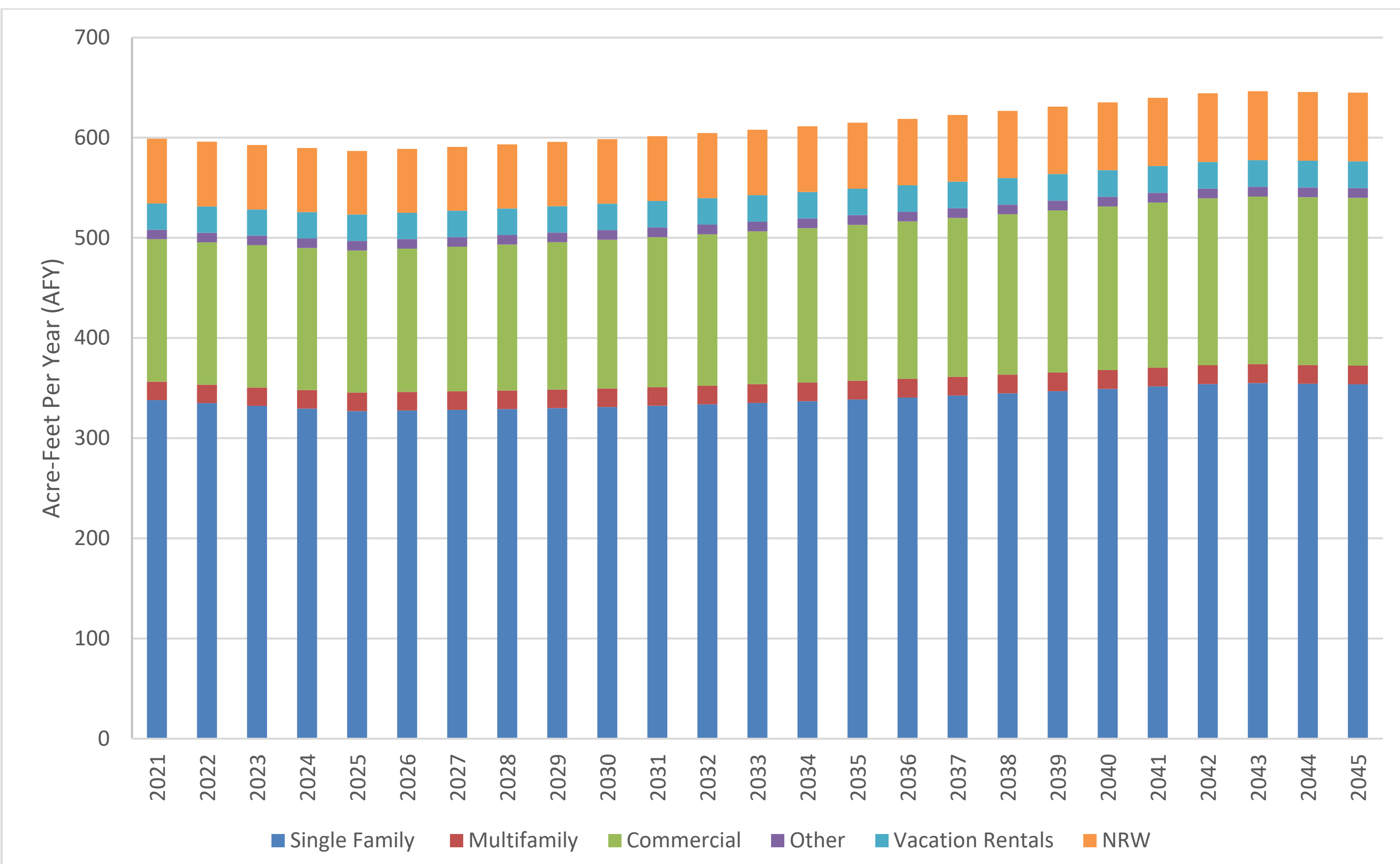
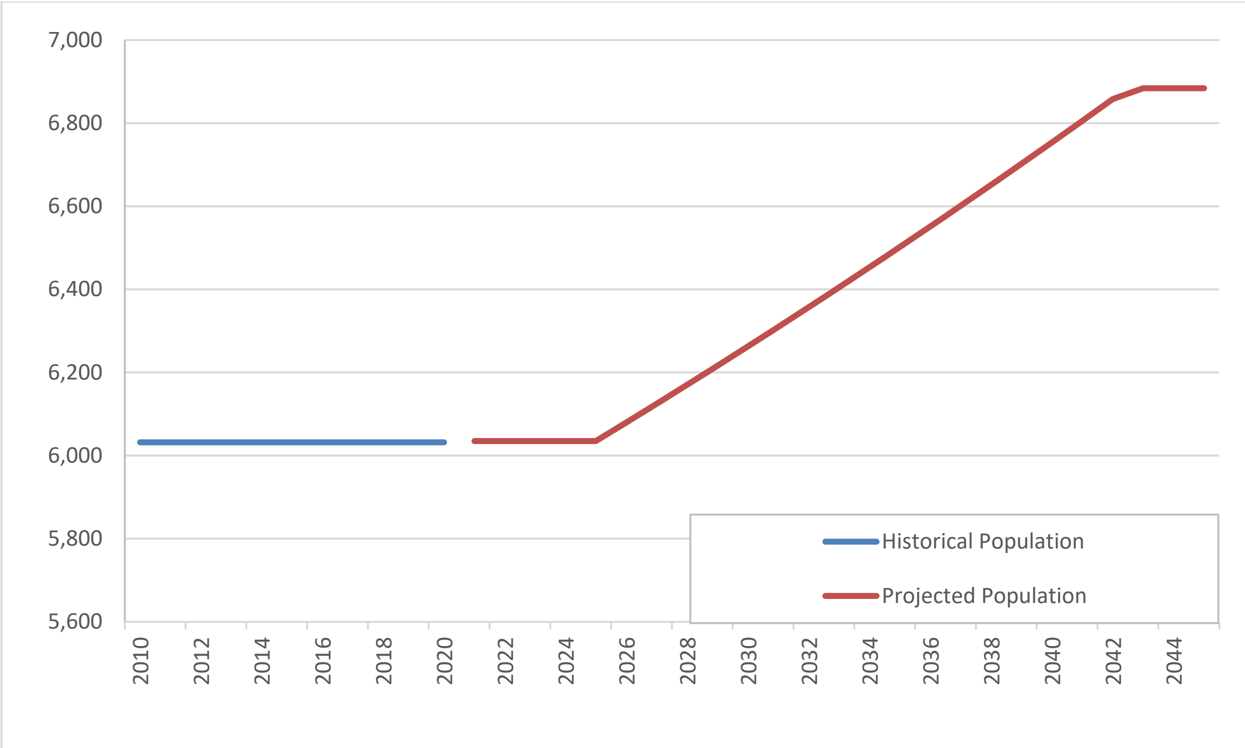


Figure 2. Projected Cambria Potable Demand by Customer Category with Plumbing Code and Climate Change



Note: Demands include plumbing code and climate change

Figure 3. Cambria Historical and Projected Population



5. UWMP TABLES

The following tables are provided for the 2020 UWMP and were informed by this DSS Model analysis effort. Tables are based on the DWR UWMP Draft Guidebook dated September 3, 2020. All demands presented include passive savings.

Table 2 (DWR Table 3-1) presents current and projected population.

Table 2. (DWR Table 3-1) Population – Current and Projected Estimates

Submittal Table 3-1 Retail: Population - Current and Projected						
Population Served	2020	2025	2030	2035	2040	2045
	6,032	6,000	6,300	6,500	6,800	6,900
NOTES: Population values have been rounded to the nearest 100 people. Due to a building moratorium in Cambria, there was no population growth between 2010 and 2020. Cambria population growth is expected to start in 2026. From 2026-2043 a population growth rate of approximately 1% per year for single family only is projected, until a maximum of 4,650 total residential units is met. Residential units include vacation rentals, multifamily, and single family units. For example, 2025 population is based on 2,048 occupied SF housing units x 2.18 average household size (HHS) based on 2010 census + 347 occupied multifamily housing units x 2.36 average HHS for renter-occupied units per American Community Survey + 169 occupied vacation rental units x 4.44 estimated HHS for vacation rentals per AIRDNA metrics of 6 guests x 74% occupancy rate.						

Table 3 (DWR Table 4-1) presents current water use for Cambria by customer class in AFY.

Table 3. (DWR Table 4-1) Demands for Potable and Non-Potable Water – Actual

Submittal Table 4-1 Retail: Demands for Potable and Non-Potable Water - Actual			
Use Type	2020 Actual		
	Additional Description	Level of Treatment When Delivered	Volume (AFY)
Single Family	Includes vacation rental water use	Drinking Water	340
Multi-Family		Drinking Water	18
Commercial		Drinking Water	114
Losses	Non-Revenue Water	Drinking Water	61
Other		Drinking Water	8
		TOTAL	539

Table 4 (DWR Table 4-2) presents projected water use by customer category in acre-feet per year and includes passive savings. The demands in Table 4 do not include climate change. Results with climate change are available.

Table 4. (DWR Table 4-2) Use for Potable and Non-Potable Water – Projected, AFY

Submittal Table 4-2 Retail: Use for Potable and Non-Potable Water - Projected						
Use Type	Additional Description	Projected Water Use (AFY)				
		2025	2030	2035	2040	2045 (opt)
Single Family	Includes vacation rental home water use	350	350	360	370	370
Multi-Family		20	20	20	20	20
Commercial		140	150	150	160	160
Losses	Non-Revenue Water	60	60	70	70	70
Other Potable		10	10	10	10	10
	TOTAL	580	590	610	630	630

Note: Demands have been rounded to the nearest 10 AFY.

Table 5 (DWR Table 4-5) represents what was included in the water use projections. More information about passive water savings can be found in Appendix B of this memo.

Table 5. (DWR Table 4-5) Factors Included in Water Use Projections

Submittal Table 4-5 Retail Only: Inclusion in Water Use Projections	
Are Future Water Savings Included in Projections? (Refer to Appendix K of UWMP Guidebook)	Yes
If "Yes" to above, state the section or page number, in the cell to the right, where citations of the codes, ordinances, etc.... utilized in demand projections are found.	Appendix G
Are Lower Income Residential Demands Included In Projections?	Yes

The 2010 census data indicated approximately 13.4% of all households in Cambria were within a low-income group (i.e. annual income earned less than $24,999). Cambria's 2010 median income was approximately $72,100. To project low income water demands, it was assumed that the 13.4% were evenly distributed between the single-family water use sectors. The projected low-income demands using this approach are shown in Table 4-5b below.

Table 4-5b. Low-Income Projected Water Demands, AFY

CCSD Low-Income Projected Water Demands (AF)					
Use Type	2025	2030	2035	2040	2045 (opt)
Single Family	47	48	48	50	50
Multi-Family	2	2	2	2	2
Total	**50**	**50**	**51**	**52**	**52**

6. CONCLUSIONS AND NEXT STEPS

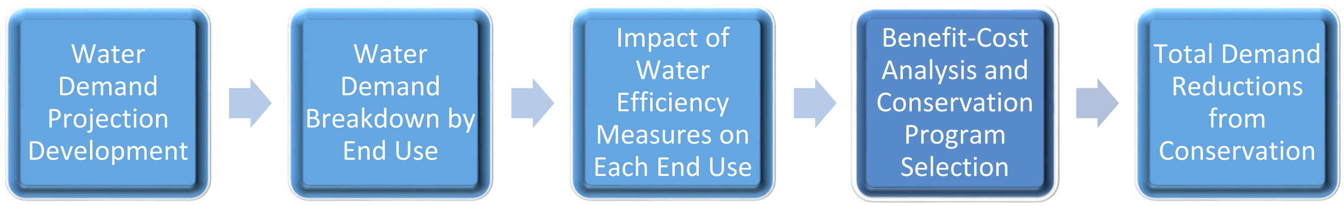
The population and water demand forecasts contained in this memorandum reflect an enhancement from those used in the 2015 UWMP. Though similar methodologies were employed in this analysis, the more current estimate used more refined information as presented earlier in this document. This effort also leveraged updated results from AirDNA for Vacation Rental basis and recent climate models to factor climate change into demands.

Further analysis is planned for the Water Conservation Program planning effort as more information becomes available on future regulations within the 2018 "Making Water Conservation a California Way of Life" legislation. Until regulations are finalized, Cambria is planning to continue with its current conservation program while completing retrofit saturation studies and a planned addendum to the 2013 Water Use Efficiency Plan.

Cambria plans to refine its active water conservation program in the future, which would include conducting a benefit-cost analysis for various conservation measures that Cambria could implement.

For comparison purposes, the projected demands and population that were reported in Cambria's 2015 UWMP can be found in Appendix C.

APPENDIX A – DSS MODEL DESCRIPTION



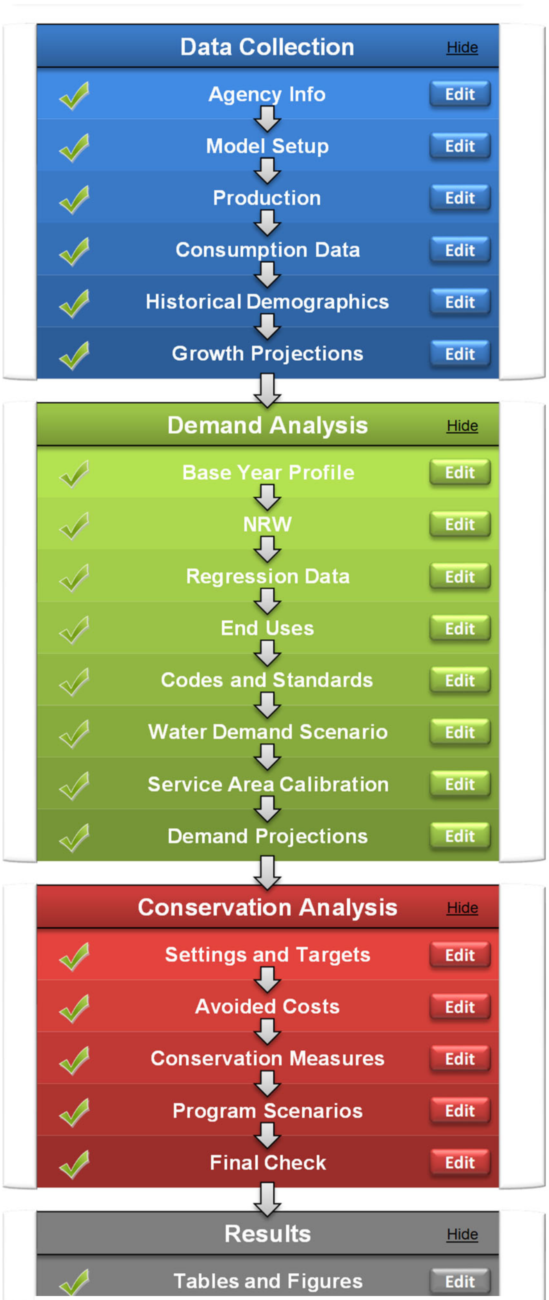


Figure A-1. DSS Model Main Page

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

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

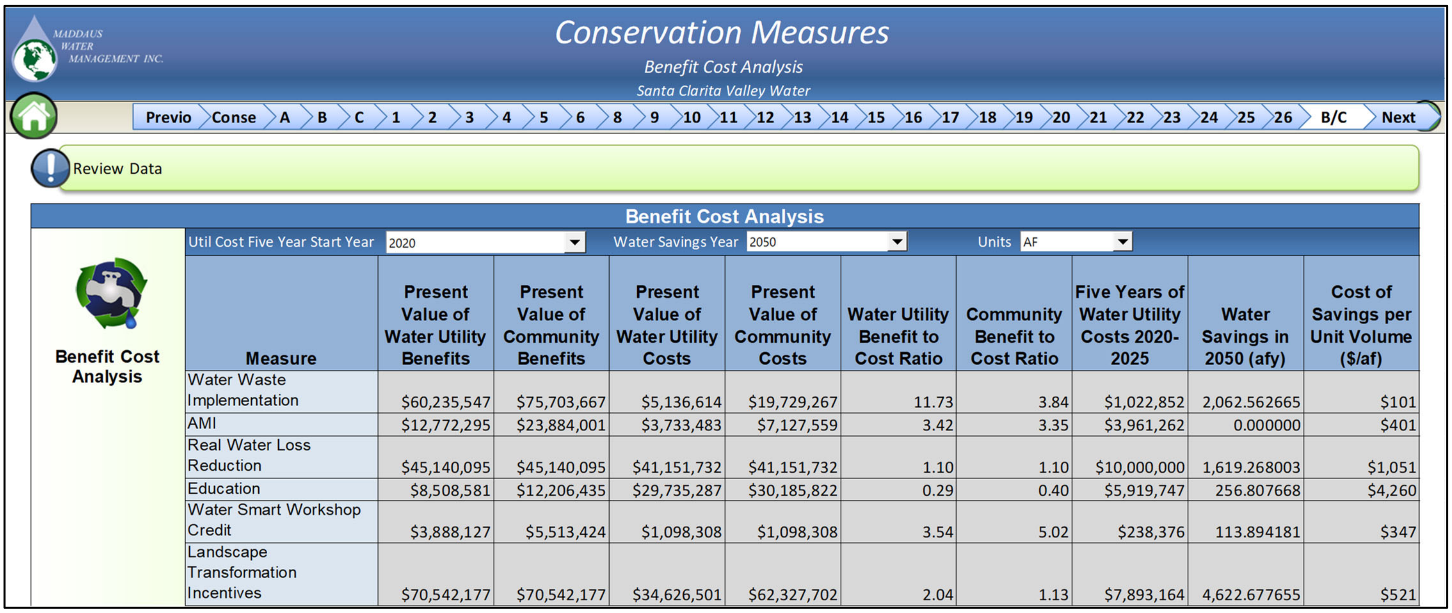
Demand Forecast Development and Model Calibration: To forecast urban water demands using the DSS Model, customer demand data is obtained from the water agency being modeled. Demand data is reconciled with available demographic data to characterize water usage for each customer category in terms of number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

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

Active Conservation Measure Analysis Using Benefit-Cost Analysis: The DSS Model evaluates active conservation measures using benefit-cost analysis with the present value of the cost of water saved ($/Million Gallons or $/Acre-Feet). Benefits are based on savings in water and wastewater facility operations and maintenance (O&M) and any deferred capital expenditures. The figures on the previous page illustrate the processes for forecasting conservation water savings, including the impacts of fixture replacement due to existing plumbing codes and standards.

The modeling for the 2020 UWMP did not include active conservation measure analysis. Cambria has planned an addendum to the 2013 Water Use Efficiency Plan which will include active conservation measure analysis.

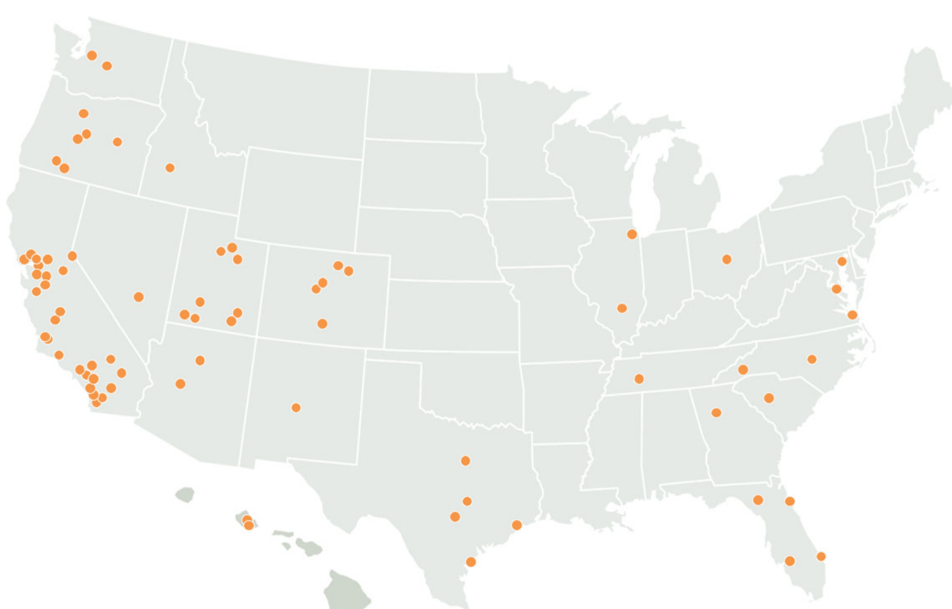
Figure A-2. Sample Benefit-Cost Analysis Summary



Measure	Present Value of Water Utility Benefits	Present Value of Community Benefits	Present Value of Water Utility Costs	Present Value of Community Costs	Water Utility Benefit to Cost Ratio	Community Benefit to Cost Ratio	Five Years of Water Utility Costs 2020-2025	Water Savings in 2050 (afy)	Cost of Savings per Unit Volume ($/af)
Water Waste Implementation	$60,235,547	$75,703,667	$5,136,614	$19,729,267	11.73	3.84	$1,022,852	2,062.562665	$101
AMI	$12,772,295	$23,884,001	$3,733,483	$7,127,559	3.42	3.35	$3,961,262	0.000000	$401
Real Water Loss Reduction	$45,140,095	$45,140,095	$41,151,732	$41,151,732	1.10	1.10	$10,000,000	1,619.268003	$1,051
Education	$8,508,581	$12,206,435	$29,735,287	$30,185,822	0.29	0.40	$5,919,747	256.807668	$4,260
Water Smart Workshop Credit	$3,888,127	$5,513,424	$1,098,308	$1,098,308	3.54	5.02	$238,376	113.894181	$347
Landscape Transformation Incentives	$70,542,177	$70,542,177	$34,626,501	$62,327,702	2.04	1.13	$7,893,164	4,622.677655	$521

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

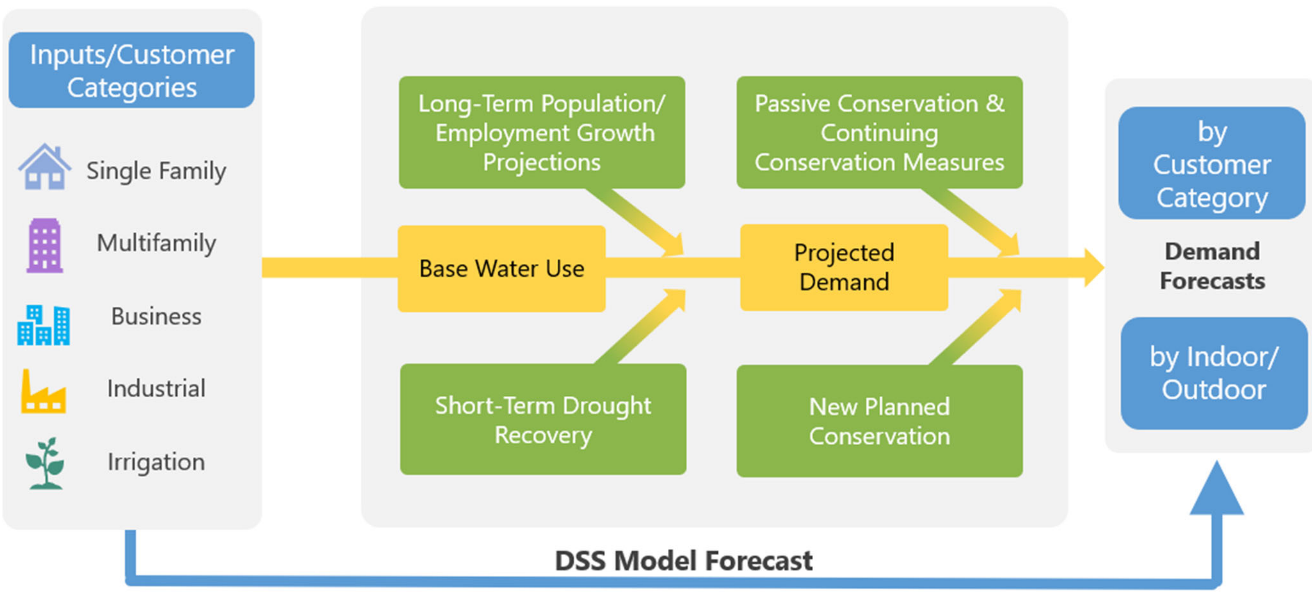
Figure A-3. DSS Model Analysis Locations in the U.S.



The California Water Efficiency Partnership, or CalWEP (formerly the CUWCC), has peer reviewed and endorsed the model since 2006. It is offered to all CalWEP members for use to estimate water demand, plumbing code, and conservation program savings.

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

Figure A-4 Potable DSS Model Flow Diagram



APPENDIX B – PASSIVE CONSERVATION SAVINGS BASIS

This appendix presents the methodology used to determine passive water savings in the Cambria Community Services District DSS Model, information regarding local, national, and state plumbing codes, and key inputs and assumptions used in the DSS Model including fixture replacement and estimates. Note: The DSS Model does not assess passive water savings for outdoor use. It focuses on plumbing code change impacts on indoor fixtures. However, the DSS Model does incorporate impacts of outdoor code changes, such as MWELO updates, into the active conservation savings analyses.

B.1 Plumbing Code Savings Summary

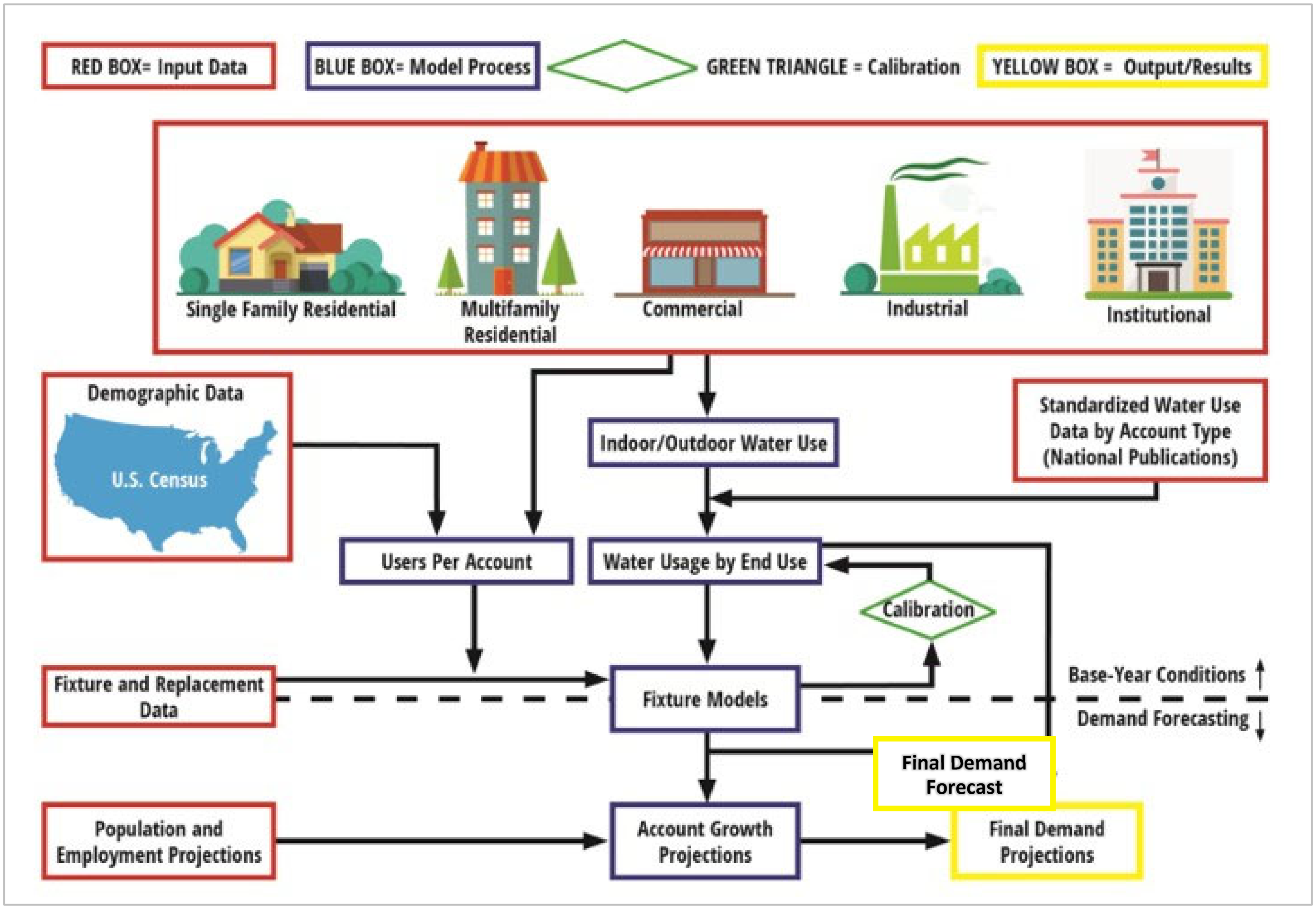
In the codes and standards portion of the DSS Model, specific fixture end-use type (point of use fixture or appliance), average water use, and lifetime are compiled to forecast service area water fixture use. Additionally, local, state, and national plumbing codes and appliance standards for toilets, urinals, showers, faucet aerators and clothes washers are modeled by customer category. This approach yields two distinct demand forecasts related to plumbing code savings: 1) with plumbing codes and 2) without plumbing codes. Plumbing code measures are independent of any water use efficiency program and are based on customers following applicable local, state, and federal laws, building codes, and ordinances.

Plumbing code-related water savings are considered “passive” and reliable long-term savings and can be depended upon over time to help reduce overall system water demand. In contrast, water savings are considered “active” if a specific action unrelated to the implementation of codes and standards is taken by Cambria to accomplish water use efficiency measure savings (e.g., offering turf removal rebates). The DSS Model incorporates the following items as a “code,” meaning that the savings are assumed to occur and therefore are “passive” savings:

- The Federal Energy Policy Act of 1992 (amended in 2005)
- California Code of Regulations Title 20 California State Law (Assembly Bill 715)
- California State Law Senate Bill 407
- 2015 California Code of Regulations Title 20 Appliance Efficiency Regulations
- 2019 CALGreen Code (effective January 1, 2020)
- Cambria Municipal Code (https://www.cambriacsd.org)

Figure B-1 conceptually describes how plumbing codes using “fixture models” are incorporated into the flow of information in the DSS Model. The demand forecast, including plumbing code savings, further assumes no active involvement by Cambria and that the costs of purchasing and installing replacement equipment (and new equipment in new construction) are borne solely by the customers, occurring at no Cambria expense.

Figure B-1. DSS Model Overview Used to Make Water Demand Forecast



The inverse of the fixture life is the natural replacement rate expressed as a percent (i.e., 10 years is a rate of 10% per year).

B.2 National Plumbing Code

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

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

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

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

In this analysis, the DSS Model forecasts a gradual transition to high efficiency clothes washers (using 12 gallons or less) so that by 2025 that will be the only type of machine available for purchase. In addition to the industry becoming more efficient, rebate programs for washers have been successful in encouraging customers to buy more water efficient models. Given that machines last about 10 years, eventually all machines on the market will be the more water efficient models. Energy Star washing machines have a water factor of 6.0 or less – the equivalent of using 3.1 cubic feet (or 23.2 gallons) of water per load. The maximum water factor for residential clothes washers under current federal standards is 6.5 (equates to approximately 19 gallons per load based on an average 2.9 cubic ft. tub). The water factor equals the number of gallons used per cycle per cubic foot of capacity.

Water Factor (WF) = gallons per load/tub volume

OR

washer capacity (cubic ft.)/average tub volume

Prior to the year 2000, the water factor for a typical new residential clothes washer was around 12 (equates to approximately 35 gallons per load based on an average 2.9 cubic ft. tub). In March 2015, the federal standard reduced the maximum water factor for top- and front-loading machines to 8.4 and 4.7, respectively. In 2018, the maximum water factor for top-loading machines was further reduced to 6.5. For commercial washers, the maximum water factors were reduced in 2010 to 8.5 and 5.5 for top- and front-loading machines, respectively. Beginning in 2015, the maximum water factor for Energy Star certified washers was 3.7 for front-loading and 4.3 for top-loading machines. In 2011, the U.S. Environmental Protection Agency estimated that Energy Star washers comprised more that 60% of the residential market and 30% of the commercial market (Energy Star, 2011). A new Energy Star compliant washer uses about two-thirds less water per cycle than washers manufactured in the 1990s.

B.3 State Plumbing Code

This section describes California state codes applicable to Cambria's water use.

B.3.1 California State Law – AB 715

Plumbing codes for toilets, urinals, showerheads, and faucets were initially adopted by California in 1991, mandating the sale and use of ultra-low flush toilets (ULFTs) using 1.6 gpf, urinals using 1 gpf, and low-flow showerheads and faucets. AB 715 led to an update to California Code of Regulations Title 20 (see Section B.2.3) mandating that all toilets and urinals sold and installed in California as of January 1, 2014 must be high efficiency versions having flush ratings that do not exceed 1.28 gpf (toilets) and 0.5 gpf (urinals).

B.3.2 California State Laws – SB 407 and SB 837

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

B.3.3 2019 CALGreen and 2015 CA Code of Regulations Title 20 Appliance Efficiency Regulations

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

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

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

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

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

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

B.4 Cambria Community Services District Municipal Code

The Cambria Municipal code also contains water efficiency criteria, which was recently modified to include mandatory Cal Green requirements as well as a few specific items which were considered non-mandatory within the Cal Green code. The most recent Cambria Municipal Code requirements related to indoor water use include:

- 1.28 gallon per flush maximum toilets
- 1/8 gallon per flush maximum urinals
- 1.5 gallon per minute showerheads
- 0.5 gallon per minute lavatory faucet aerators
- Hot water circulating pumps in new construction
- Clothes washers with water factors of no greater than 4.0

More information on these requirements can be found here: https://www.cambriacsd.org/

B.5 Key Baseline Potable Demand Inputs, Passive Savings Assumptions, and Resources

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

Table B-1. List of Key Assumptions

Parameter	Model Input Value, Assumptions, and/or Key References		
Model Start Year for Analysis	2021		
Water Demand Factor Year (Base Year)	2013, 2018 and 2019		
Population Projection Source	Cambria SF and MF billing data, 2010 Census, 2019 ACS & AirDNA		
Employment	Economic Census of the United States 2012 and 2017		
Potable Water System Base Year Water Use Profile			
Customer Categories	**Total Water Use Distribution**	**Demand Factors (gpd/acct)**	**Indoor Use %**
Single Family	63%	88	81%
Multifamily	3%	122	83%
Commercial	27%	556	79%
Other	2%	371	37%
Vacation Rentals	5%	102	83%
Total	100%	N/A	N/A

Table B-2. Key Assumptions Resources

Parameter	Resource
Residential End Uses	Key Reference: CA DWR Report "California Single Family Water Use Efficiency Study," (DeOreo, 2011 – Page 28, Figure 3: Comparison of household end uses) and AWWA Research Foundation (AWWARF) Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016). Table 2-A. Water Consumption by Water-Using Plumbing Products and Appliances - 1980-2012. PERC Phase 1 Report. Plumbing Efficiency Research Coalition. 2013. http://www.map-testing.com/content/info/menu/perc.html Model Input Values are found in the "End Uses" section of the DSS Model on the "Breakdown" worksheet.
Non-Residential End Uses, percent	Key Reference: AWWARF Report "Commercial and Institutional End Uses of Water" (Dziegielewski, 2000 – Appendix D: Details of Commercial and Industrial Assumptions, by End Use). Santa Clara Valley Water District Water Use Efficiency Unit. "SCVWD CII Water Use and Baseline Study." February 2008. Model Input Values are found in the "End Uses" section of the DSS Model on the "Breakdown" worksheet.
Efficiency Residential Fixture Current Installation Rates	U.S. Census, Housing age by type of dwelling plus natural replacement plus rebate program (if any). Key Reference: GMP Research, Inc. (2019). 2019 U.S. WaterSense Market Penetration Industry Report. Key Reference: Consortium for Efficient Energy (www.cee1.org). Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.
Water Savings for Fixtures, gal/capita/day	Key Reference: AWWARF Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016). Key Reference: CA DWR Report "California Single Family Water Use Efficiency Study" (DeOreo, 2011 – Page 28, Figure 3: Comparison of household end uses). Key Reference: California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model.

Parameter	Resource
Non-Residential Fixture Efficiency Current Installation Rates	Key Reference: 2010 U.S. Census, Housing age by type of dwelling plus natural replacement plus rebate program (if any). Assume commercial establishments built at same rate as housing, plus natural replacement. California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Santa Clara Valley Water District Water Use Efficiency Unit. "SCVWD CII Water Use and Baseline Study." February 2008. Model Input Values are found in the "Codes and Standards" green section of the DSS Model by customer category fixtures.
Residential Frequency of Use Data, Toilets, Showers, Faucets, Washers, Uses/user/day	Key Reference: AWWARF Report "Residential End Uses of Water, Version 2 - 4309" (DeOreo, 2016). Summary values can be found in the full report: http://www.waterrf.org/Pages/Projects.aspx?PID=4309 Key Reference: California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Key Reference: Alliance for Water Efficiency, The Status of Legislation, Regulation, Codes & Standards on Indoor Plumbing Water Efficiency, January 2016. Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model and confirmed in each "Service Area Calibration End Use" worksheet by customer category.
Non-Residential Frequency of Use Data, Toilets, Urinals, and Faucets, Uses/user/day	Key References: Estimated based on AWWARF Report "Commercial and Institutional End Uses of Water" (Dziegielewski, 2000 – Appendix D: Details of Commercial and Industrial Assumptions, by End Use). Key Reference: California Energy Commission, Staff Analysis of Toilets, Urinals and Faucets, Report # CEC-400-2014-007-SD, 2014. Fixture uses over a 5-day work week are prorated to 7 days. Non-residential 0.5gpm faucet standards per Table 2-A. Water Consumption by Water-Using Plumbing Products and Appliances - 1980-2012. PERC Phase 1 Report. Plumbing Efficiency Research Coalition, 2012. http://www.map-testing.com/content/info/menu/perc.html Model Input Values are found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model and confirmed in each "Service Area Calibration End Use" worksheet by customer category.
Natural Replacement Rate of Fixtures (percent per year)	Residential Toilets 2%-4%
	Non-Residential Toilets 2%-3%
	Residential Showers 4% (corresponds to 25-year life of a new fixture)
	Residential Clothes Washers 10% (based on 10-year washer life). Key References: "Residential End Uses of Water" (DeOreo, 2016) and "Bern Clothes Washer Study, Final Report" (Oak Ridge National Laboratory, 1998).

Parameter	Resource
	Residential Faucets 10% and Non-Residential Faucets 6.7% (every 15 years). CEC uses an average life of 10 years for faucet accessories (aerators). A similar assumption can be made for public lavatories, though no hard data exists and since CII fixtures are typically replaced less frequently than residential, 15 years is assumed. CEC, Analysis of Standards Proposal for Residential Faucets and Faucet Accessories, a report prepared under CEC's Codes and Standards Enhancement Initiative, Docket #12-AAER-2C, August 2013.
	Model Input Value is found in the "Codes and Standards" green section on the "Fixtures" worksheet of the DSS Model.
Residential Future Water Use	Increases Based on Population Growth and Demographic Forecast
Non-Residential Future Water Use	Increases Based on Employment Growth and Demographic Forecast

B.5.1 Fixture Estimates

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

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

In 2014, the Water Research Foundation updated its 1999 Residential End Uses of Water Study (REUWS). Water utilities, industry regulators, and government planning agencies consider it the industry benchmark for single family home indoor water use. This Plan incorporates recent study results that reflect the change to the water use profile in residential homes including adoption of more water efficient fixtures over the 15 years that transpired from 1999 to 2014. REUWS results were combined with Cambria's historical rebate and billing data to enhance and verify assumptions made for all customer accounts, including saturation levels on the above-mentioned plumbing fixtures.

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

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

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

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

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

APPENDIX C – 2015 UWMP COMPARISON

The 2015 Cambria Community Services District Urban Water Management Plan tables for population and water demands are included below.

Table 3-1. Population

Table 3-1 Retail: Population - Current and Projected						
Population Served	2015	2020	2025	2030	2035	2040
	6,032	6,353	6,755	7,157	7,558	7,719
NOTES: Between 2010 and 2016, the population in Cambria has not grown due to a building moratorium. There was minimal change in number of accounts between 2010 and 2015. Therefore, the 2010 census population for Cambria CDP per the "Profile of General Population and Housing Characteristics: 2010" is assumed to be applicable to year 2015 population. From 2016 through year 2037 a population growth rate of approximately 1% per year is projected based on the County of San Luis Obispo growth management ordinance and a maximum population of 7,719 representing 4,650 housing units x 1.66 average people per household based on the 2010 census.						

Table 4-1. 2015 Actual Demands, AFY

Table 4-1 Retail: Demands for Potable and Raw Water - Actual			
Use Type *(Add additional rows as needed)*	2015 Actual		
Drop down list *May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool*	Additional Description *(as needed)*	Level of Treatment When Delivered *Drop down list*	Volume (AF)
Single Family	Includes vacation rental water use	Drinking Water	239
Multi-Family		Drinking Water	14
Commercial		Drinking Water	109
Other	CCSD internal account use for 2006 Warren water rights settlement (agriculture water), & process water for water and wastewater treatment.	Drinking Water	51
Losses	Non-revenue water	Drinking Water	54
		TOTAL	467
NOTES: Other water use of 51 acre-feet includes: 46.5 acre-feet provided to Warren property per a 2006 water rights settlement agreement between Warren and the CCSD; 2.9 acre-feet of filter backwash water from the wells SR3 and SR4 wellhead treatment facilities; and 1.6 acre-feet of other internal CCSD meters. This water is metered downstream from the CCSD production well meters, and is authorized and metered. Depending upon the level of use, the metered Warren water may be billed or unbilled water (it is billed when demand exceeds 20 AF). Non-revenue water is the difference between the amount of water produced and the amount of water metered and billed to customers (except for the aforementioned Warren settlement agreement water).			

Table 4-2. Demands for Potable and Raw Water – Projected, AFY

Table 4-2 Retail: Demands for Potable and Raw Water - Projected						
Use Type	Additional Description	Projected Water Use (AFY)				
		2020	2025	2030	2035	2040
Single Family	Does NOT include vacation rental home water use	440	442	445	455	453
Multi-Family	Does NOT include vacation rental home water use	23	22	23	23	23
Commercial		167	174	182	190	192
Other	CCSD internal account use for 2006 Warren water rights settlement (agriculture water), & process water for water and wastewater treatment.	26	26	26	26	26
Single Family	Vacation rental homes ONLY.	35	35	35	35	35
Losses	Non-revenue water	56	58	59	62	61
	TOTAL	747	757	770	791	789

NOTES: Projected water use only includes savings resulting from plumbing code updates. The passive savings methodology is presented in Appendix X. Other demands include 20 AFY of agriculture water to the Warren property (2015 actual water use was higher than historical average use), which is used in areas where non-potable water is excluded (described further within a 2006 water rights settlement agreement between the CCSD and Warren). Non-revenue water is the difference between the amount of water produced and the amount of water billed to customers. The percentage of non-revenue water was estimated by comparing water production statistics to water sales statistics. Sources of non-revenue water may include:

• Fire Hydrant Operations by the Fire Department - This represents the use of water for emergencies.

• Customer Meter Inaccuracies - Customer meters represent one of the main sources of non-revenue water. As they age, they tend to under-represent the actual customer use.

• Leaky water lines - Leakage from water pipes is a common occurrence in water systems. A significant number of leaks remain undetected over long periods of time as they are very small. However, these small leaks contribute to the overall non-revenue water.