Determining Cost Benefit and Demand Savings of Municipal Water Conservation Efforts

Texas Water Development Board

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Determining Cost Benefit and Demand Savings of Municipal Water Conservation Efforts

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1 EXECUTIVE SUMMARY

The Texas Water Development Board (TWDB) Water Conservation Best Management Practices (BMP) Model is a groundbreaking tool and represents a significant step forward for utilities and water conservation professionals within the State. It is especially geared towards small to mid-sized agencies or others who may not have the resources for more complex, commercially-available software programs.

With new annual reporting requirements for water conservation activities in effect in 2014, this model facilitates reporting of water savings associated with water conservation activities and BMPs. Additionally, the cost-benefit component assists agencies in maximizing the effectiveness of targeted BMP programs.

The TWDB Water Conservation BMP Model will:

1. Quantify the amount of water saved by individual conservation measures or BMPs;

2. Identify the most cost-effective conservation measures or BMPs for individual utilities;

3. Estimate cost-benefit impacts on revenue and effect of varying rebate values on cost-benefit;

4. Plan for future water supply and wastewater capacity with conservation measures and BMPs in-place;

5. Provide a consistent methodology for utilities to use in annual reporting to facilitate tracking the long-term effectiveness of conservation programs and water savings.

2 INTRODUCTION

The purpose of this project is to develop a desktop tool (i.e., spreadsheet) to assess the costs and benefits of various water conservation Best Management Practices (BMP)s. The target users for the TWDB Water Conservation BMP Model are water conservation planners at various water utilities throughout the State. While this model is targeted at small to mid-size utilities, it is also applicable for large utilities. However, many of the larger water utilities have either developed spreadsheets or models tailored for their specific programs or have in-house resources or available funding for consultants to use more advanced commercially-available water conservation modeling tools, such as the Alliance for Water Efficiency's (AWE)'s Tracking Tool.

The February 21, 2012 TWDB study *Water Conservation Savings Quantification Study* prepared by BBC Research & Consulting recommended development of a desktop modeling tool that water utilities within the State can use to provide a consistent and confident measure of actual water savings. Additionally, TWDB rules require that Water Provider's Annual Reports include an estimate of water savings from conservation measures.

The primary issues addressed by the TWDB Water Conservation BMP Model are:

1. Quantifying the amount of water saved by individual conservation measures or BMPs;

2. Identifying the most cost-effective conservation measures or BMPs for individual utilities;

3. Estimate cost-benefit impacts, potential revenue loss, and effect of varying rebate values on cost-benefit for each BMP;

4. Plan for future water supply with conservation measures and BMPs in-place;

5. Providing a consistent methodology for utilities to use in annual reporting to facilitate tracking the long-term effectiveness of conservation programs and water savings.

According to the *2012 State Water Plan*, municipal water demands are projected to rise from 4,851,201 acre-feet (ac-ft) in 2010 to 8,414,492 ac-ft in 2060 and to comprise 38.3% of the total demand in the year 2060. Irrigation demands, which comprised nearly 56% of the demand within Texas in 2010, are projected to fall to 38.1% of the total demand in the year 2060. Because municipal water conservation plays an important role in minimizing the growth rate of overall water demand with rising populations, the ability to determine large-scale conservation savings is increasingly critical.

As stated in the *2012 State Water Plan*, "the population in Texas is expected to increase 82 percent between the years 2010 and 2060, growing from 25.4 million to 46.3 million people," while the water demand for the State is anticipated to grow by only 22-percent. The moderate increase in demand is due to the anticipated decline in irrigation water use as well as a slight decrease in the per capita water use in the municipal category due to planned and anticipated conservation measures. Water conservation represents a key strategy to meet future water demands.

In addition to increased water demand from a growing population, periods of drought may continue to stress water supply systems and higher median temperatures may increase evapotranspiration from reservoirs and landscapes. Increases in median temperature of approximately 5°F to 6°F are anticipated by the period from 2070 – 2099 as compared to the baseline period from 1950 – 1979. The mean annual precipitation is also anticipated by the U.S. Bureau of Reclamation to decline by as much as five–percent or more in much of the State in the same time-frame (U.S. Bureau of Reclamation, April, 2011).

As stated in the November 12, 2012 memorandum prepared for this project entitled *List of Entities Affected by Results of this Research Project* (Appendix A), we anticipate that all utilities in Texas will benefit from this project. However, small to medium-sized cities throughout the State can be affected positively by having the model to use for measuring the implementation of their water conservation plans for annual reporting.

2.1 Data Evaluation

Data evaluated for inclusion in this project and the TWDB Water Conservation BMP Model includes the following:

- TWDB rules and regulations, studies, reports, and other relevant information;
- personal interviews with representative water utilities;
- literature review of scientific studies, existing programs, and available data.

The sections below describe the various data sources in further detail. An extensive literature review and interview follow-ups with the water utilities were performed.

2.2 TWDB Data

Table 1 summarizes TWDB rules and regulations, studies, reports, and other relevant information reviewed and evaluated for inclusion in this project:

TABLE 1: TWDB Data Used In Study

Title	Date	Purpose
A How to Guide for Submitting a Water Conservation Annual Report for Water Suppliers	Not Dated	Informational
Draft Population and Municipal Water Demand Projections for the 2016 Regional Water Plans and 2017 State Water Plan Memorandum	February 28, 2013	Used as a source for water conservation benefits and latest State fixture requirements. Reference for population projections in TWDB Water Conservation BMP Model
List of Existing and Potential Future Municipal BMPs[1]	Not Dated	Used to determine BMPs for inclusion in TWDB Water Conservation BMP Model
Precipitation & Lake Evaporation webpage	Website	www.twdb.state.tx.us/surfacewater/conditions/evaporation/index.asp
Preliminary Draft Texas GPCD Calculator	May 31, 2013	Format reference
Preliminary Draft Texas GPCD Calculator Instructions	May 31, 2013	User's Guide reference
Save Texas Water Water Conservation Advisory Website[2]	Not Dated	Informational regarding future BMPs
Texas Administrative Code. Title 30 Environmental Quality. Part 1 Texas Commission on Environmental Quality. Chapter 344: Landscape Irrigation	Not Dated	Informational
The Grass Is Always Greener… Outdoor Residential Water Use in Texas	November, 2012	Data for residential landscape use
Water Audit Reporting Form 2010. Texas Water Development Board Water Audit Worksheet	Not Dated	Informational
Water Conservation Annual Report Form for Water Suppliers	February 25, 2012	Informational
Water Conservation Best Management Practices Implementation Guide	November, 2004	Used to determine BMPs for inclusion in TWDB Water Conservation BMP Model and as a source for utility costs, and water conservation benefits
Water Conservation Savings Quantification Study	February 21, 2012	Background information regarding need for current study
Water for Texas 2012 State Water Plan	January, 2012	Informational and reference for population projections in TWDB Water Conservation BMP Model

[1]This reference is untitled and the Microsoft Word file name is *Future of MUNICIPAL BMPs 060111 rv.doc*.
[2] The website for this reference is http://www.savetexaswater.org/bmp/MunBMPindex.htm.

2.3 Water Utility Interviews

Representatives of several water utilities were interviewed to obtain information on current and planned water conservation BMPs, programs, and incentives used throughout various regions in Texas as well as the types of features of interest for inclusion in the model. The cities were identified in conjunction with the TWDB's Project Manager and a few agencies were substituted as representative contacts were not located for agencies identified in the initial assessment.

A summary of programs by various interviewed agencies is included in Appendix B. As shown in this table and the interview summaries included in Appendix C, there is a significant variation in the extent and type of water conservation program efforts among the interviewed agencies, which are listed below:

- Austin Water
- College Station
- Dallas
- El Paso
- Fort Worth
- Houston (initial)
- Round Rock
- San Antonio Water System (SAWS)
- San Marcos
- San Angelo
- Round Rock

Most utilities do not track costs by individual BMP; however, several did provide typical rebates and utility costs for specific BMPs. In general, costs, cost-benefit, avoided costs, and cost savings are not tracked separately and this information is not available for most utilities. College Station, Round Rock, and San Marcos indicated an interest in participating in beta-testing of the model. Several items were repeated by multiple agencies, including:

1. Many agencies are shifting to a focus on outdoor water conservation BMPs due to perceived saturation of efforts with indoor BMPs and fixtures. However, some agencies are uncertain of the benefits associated with these BMPs.

2. Many agencies are phasing out toilet rebates and other indoor fixtures programs due to fixture requirements contained in current local ordinances. Additionally, the 2009 Texas law requiring that all new toilets use no more than 1.28 gallons per flush by January, 2014 is anticipated to further accelerate conservation savings related to toilets (TWDB, 2013).

3. We received consistent requests that the TWDB Water Conservation BMP Model should be simple to use, intuitive, and not require specialized training. This is primarily due to limited resources (time and budget) for smaller to mid-sized agencies. Some agencies requested that data entry be limited to one-page.

3 LITERATURE REVIEW

Although a significant literature review was not anticipated for this project, due to limited data it was necessary to perform a comprehensive search of scientific papers as well as studies by various agencies in addition to the TWDB sponsored studies described above. In general, cost and performance data is better defined for indoor fixtures than for outdoor programs. Since the historical focus for municipal conservation efforts originated with indoor fixtures, the results of agricultural studies may be relevant for the current efforts in outdoor programs for municipal users. Even though the field of water conservation continues to evolve, benefits associated with educational water conservation BMPs are also typically challenging to quantify.

While numerous sources were reviewed, many did not include current quantified cost or performance data for the water conservation BMPs. The bibliography includes only those sources that included quantified cost or performance data. Information from those studies was used as a basis for default values in the TWDB Water Conservation BMP Model is included in Appendix D and listed in the ASSUMPTIONS worksheet of the model. A brief overview of other relevant regulations and studies not used in the TWDB Water Conservation BMP Model is provided below.

A basin wide study of the Yakima River Basin found that the most effective water conservation programs involve three key components: 1) program design, 2) consistent investment, and 3) long-term public outreach. Additionally, several societal factors were found to affect water use and conservation, including awareness of water scarcity, receptiveness to government-sponsored programs, and the cost of water in relation to household income (U.S. Bureau of Reclamation, 2011).

A recent study by University of California (UC), Berkeley of large universities' water usage concluded that total water usage varies substantially by size, location and climate, efficiency of water usage, and other factors. One drawback noted was that universities do not all report water consumption and do not follow the same protocol for reporting usage and a comparison was not possible. The most common water conservation BMPs were those with lower initial costs, including: education and outreach, enhanced leak detection and repair, improved irrigation practices, and installation of low-flow domestic fixtures (toilets, faucets, and showers). Several institutions also reduced water usage in laundries and cooling towers or reduced potable water use for irrigation through water reuse or rainwater harvesting. Most of the institutions reported that relatively low water pricing made many water conservation BMP project financially infeasible (UC Berkeley, 2010).

3.1 Federal Regulations

From the literature review, it seems that the States of Texas and California are generally ahead of much of the country in the field of water conservation. Additionally, the Arizona Department of

Water Resources, the Puget Sound region, and others in the western United States also appear to have leading water conservation programs. From a federal perspective, federal facilities are required to implement several water conservation programs due to Executive Order (E.O.) 13423 and E.O. 13514 as well as the Energy Independence and Security Act (EISA) of 2007.

Executive Order (E.O.) 13423, which was signed in 2007, requires Federal agencies to reduce water consumption intensity (gallons per square foot) by two-percent annually starting in 2008 with a 16-percent overall reduction by 2015. *E.O. 13423 Mandated Facility Water Intensity Reductions by Fiscal Year*. Federal facilities are also required to conduct annual water audits of at least 10% of facility square footage and to conduct audits at least every 10 years. The EISA of 2007 requires that agencies identify those facilities, which are referred to as covered facilities, which constitute at least 75% of the agency's facility energy and water use. Comprehensive energy and water evaluations must be completed on at least 25% of covered facilities each year.

E.O. 13514 expands the water efficiency requirements of the E.O. 13423 and EISA 2007 with the following requirements and specifically targets outdoor consumption and programs:

- Reducing potable water consumption intensity 2% annually through FY 2020, or a total reduction of 26% by the end of 2020 relative to the 2007 baseline;
- Reducing industrial, landscaping, and agricultural water consumption 2% annually, or a total reduction of 20% by the end of 2020 relative to a 2010 baseline;
- Identifying, promoting, and implementing water reuse strategies;
- Implementing U.S. Environmental Protection Agency (EPA) stormwater guidance and requirements;

The U.S. Department of Energy Federal Energy Management Program provides several case studies implementing these practices (August, 2009). One case study highlights a 30% reduction in outdoor water use through improved plant selection, landscape, irrigation, and maintenance practices as well as improved health of the landscape throughout the Pacific Northwest National Laboratory campus in Richland, Washington.

Further, the U.S. Bureau of Reclamation has engaged consultants to perform watershed-wide water efficiency/conservation studies. The study entitled *Yakima River Basin Study Municipal and Domestic Water Conservation Technical Memorandum* includes indoor and outdoor BMPs and places a significant emphasis on outdoor programs for reducing peak demands (U.S. Bureau of Reclamation, 2011). This study included similar BMPs to those used in the TWDB Water Conservation Model and discussed in Section 4.

3.2 Agricultural and Outdoor BMPs

A study by the Arizona Department of Water Resources (ADWR) on agricultural BMPs may apply to outdoor programs in general (ADWR, 2010). The authors found that if a water conservation program is not applied systematically, the benefits may be minimal. This study also recommended that BMPs be customized to the particular situation and that programs allow for revisions as scientific knowledge and experience better defines performance. Monitoring was recommended as well as checks and tests to evaluate the effectiveness of BMPs. Finally, water conservation BMPs must be cost-effective to be accepted by the end-user.

In an economic study from UC Davis investigating the use of efficient irrigation to reduce groundwater use, the authors noted that increases in groundwater use do not necessarily produce a negative economic outcome; some groundwater sources are easily and quickly replenished. However, increases in irrigation efficiency are likely to produce a positive economic outcome. Water conservation policies designed to increase irrigation efficiency and the associated behavioral responses to those policies must be examined critically. The authors concluded that increases in irrigation efficiency must be accompanied by corresponding decreases in the quantity of water that a user is allowed to extract (referring to groundwater specifically). Quantities may be limited through a decrease in the legal water right, a tax on water extraction, regulation of crop and fallow cycles, or through other measures. To enforce these regulations, clear property rights and effective reporting and enforcement systems are critical (Lin and Pfeiffer, 2013).

Different studies for weather-based irrigation controllers programmed to adjust to historical evapotranspiration rates (ETo) appear to produce inconsistent findings. The varying results may reflect the magnitude of irrigation use of the participants, differences in climate, and components included in the irrigation controller programs. Although results of several studies are described below, it seems that additional research as well as research within the State is needed in this area to optimize and further define performance of these controllers, which are also referred to as ET Controllers.

A *Water Efficient Irrigation Study* by the Seattle Public Utilities Commission investigated whether state-of-the-art irrigation devices and related practices could save water compared to conventional automatic irrigation approaches. Of the devices studied, the ET controller with rain sensor performed significantly better than the ET controller without a rain sensor with an average savings of 20,735 gallons per year (gpy) per customer. While the ET controller without a rain sensor saved an average of 10,071 gpy per customer, it was not clear whether the savings were due to the installation of the controller or other factors (Seattle Public Utilities, 2003).

During a November 28, 2012 phone interview, representatives of SAWS indicated that the data on weather-based irrigation controllers is inconsistent in terms of water conservation. Even though these controllers now have EPA WaterSense® labels, some research indicates these controllers reduce water consumption, while other research indicates there is no benefit or increased consumption. To achieve the stated benefit, these controllers may work best for high irrigation users and must be programmed appropriately. For those whose irrigation needs are lower, these systems may increase water use as compared to manual irrigation operation. Thus, SAWS is targeting only high irrigation users for this BMP.

Based on a September 19, 2013 interview with a City of Oakland Parks supervisor, an additional concern related to automated ET controllers is that low-bid contractors often skip the crucial step of installing the component that notifies the user by phone or email of issues with the irrigation system/controller. Without this component, leaks, system breaks, or other issues may go unnoticed until vegetation dies.

The *Water Efficiency Programs for Integrated Water Management* report co-sponsored by the U.S. EPA evaluated prior studies of two categories of residential ET Controllers: 1) Stand-Alone and 2) Broadcast Service. Stand-Alone Controllers are based on historical ETo data, while Broadcast Service provides real time measures of ETo by sending a signal by satellite pager technology or telephone line (AWWA, 2007).

For the Stand-Alone ET Controllers, most studies found savings in water consumption. While ET Controllers better match water needs than manually adjusted controllers, some manual adjustment is likely to be needed to account for appearance, runoff, or special weather conditions. Additionally, while the ET controllers adjusted their irrigation schedules through the year in approximation of rainfall and ETo, the magnitudes of their adjustments were not always proportional to the actual changes in ETo.

For the Broadcast Service ET Controllers, most studies found savings in water consumption. However, the following uncertainties and areas of future research were noted: 1) the irrigation system must be operated and maintained properly to achieve the full effectiveness; 2) the irrigation system must meet design standards or the benefits are limited; and 3) water savings potential is greater in climates with a long irrigation season, high temperature, low rainfall, and high weather and climate variability. Finally, most studies used large-volume customers and results should not be generalized because large-volume customers tend to generate larger absolute savings, although not necessarily larger percent savings.

A technical report summarizing various studies on the effectiveness of smart controllers was sponsored by the U.S. Bureau of Reclamation and most reviewed studies found water savings associated with these controllers (U.S. Bureau of Reclamation, 2008). The authors note that many of the studies consisted only of high water users and the associated water savings were not as representative of an area as those where participants were randomly selected. Additionally, volunteer participants may tend to be more conscientious about water use and studies with high proportions of volunteers may not be representative of an area.

The condition of the existing irrigation system is a significant issue affecting the potential for smart controller water savings at a site. In most cases, some improvements to an existing system are required to achieve maximum savings from installing a smart controller. Many studies included site inspections or audits prior to installation. For some studies, system improvements were required as a pre-requisite to installation. Post-installation inspections were also included in some studies. While pre-installation and post-installation inspections and check-ups may increase the efficiency and benefit of the BMP, including or excluding these items may significantly affect the cost of the BMP program to the utility.

3.3 Educational BMPs

While the benefits of educational water conservation BMPs have historically proven difficult to quantify, modernized tracking efforts seem to be producing results for some agencies. The City of Dallas has reported success in tracking reduction in consumption by zip code based on education programs within the school system (City of Dallas, 2013). In California, WaterSmart Software was used within the City of Cotati to provide consumers access to a web portal that tracks demand. As a result of these efforts, a 5% reduction in demand was noted among the users over a six-month time-frame. Long-term results are not reported in the case study (WaterSmart Software, Undated).

The December, 2011 East Bay Municipal Utility District (EBMUD) *Water Conservation Master Plan* includes technical assumptions used in BMP modeling for public education as follows:

- 0.5% reduction in water use per account
- Two-year life-cycle
- Annual cost of $2.00 per account

The source of this data is not documented; however, it may represent a starting point for future research. Others in public policy may contend that the effects of public education and outreach are long-lasting and challenging to quantify. For example, a middle-school student whose families receive flyers on a levee improvements project to protect them from flooding may be more likely to vote for California water/flood control bonds as an adult (Mierzwa, 2013).

4 TWDB WATER CONSERVATION BMP MODEL

The TWDB Water Conservation BMP Model is developed in Microsoft Excel 2010 and includes the components listed in Table 2. This table includes a brief synopsis of data related to each worksheet. For complete descriptions and instructions, refer to the *User's Guide for the TWDB's Water Conservation Model* (Appendix E). A brief overview of instructions is also provided in the INSTRUCTIONS worksheet of the model and comments are included in the model in cells or columns where data entry is required.

TABLE 2: TWDB WATER CONSERVATION BMP MODEL COMPONENTS

Worksheet Title	Data Entry Required/Allowed?	Synopsis
INTERACTIVE WORKSHEETS		
INSTRUCTIONS	No	Brief summary of instructions
INPUT DATA	Yes	Includes local service area characteristics and demands
BMP DATA	Yes	Includes BMP data for analysis of single or multiple BMPs
WATER SAVINGS	No	Annual water savings estimated for individual and multiple BMPs and by user class
WASTEWATER SAVINGS	No	Annual wastewater savings estimated for individual and multiple BMPs and by user class; used only in the economics calculations
RESULTS	No	Adjusted annual demand projections for selected BMPs and by user class
ECONOMICS INPUT	Yes – Economics analysis is optional	Allows for input of base per unit cost values, inflation and discount rate, current effective rate for water and wastewater service and data concerning the Utility's water supply capital improvement plan
COST-BENEFIT	No – Economics analysis is optional	Calculates the cost and benefits of each BMP and calculates the benefit cost ratio (BCR) as well as the projected water and wastewater revenue loss from BMP implementation
ECONOMICS SUMMARY	No – Economics analysis is optional	Summary of delayed capital cost investment, costs and benefits of each BMP and the program as a whole, and the revenue loss from BMP implementation
ASSUMPTIONS	No	Detailed list of BMP and economics default data values
HIDDEN WORKSHEETS[1]		

Worksheet Title	Data Entry Required/Allowed?	Synopsis
Input Data for Charts	No – Hidden Sheets	Used for graphing INPUT DATA
Input Data Long-Form		Used for water savings calculations
Water Savings Long-Form		Used for water savings calculations
Wastewater Savings Long-Form		Used for wastewater savings calculations
Results for Charts		Used for graphing on RESULTS worksheet
Education BMPs		Education BMPs default data
Rebate Retrofit Incentive BMPs		Rebate Retrofit Incentive BMPs default data
Conservation Analysis BMPs		Conservation Analysis BMPs default data
Landscaping BMPs		Landscaping BMPs default data
Economic		Economic default data
Avoided Costs		Utility avoided costs by BMP
Costs Before BMPs		Used for economics calculations
Costs After BMPs		Used for economics calculations

[1]Worksheets are hidden and password protected (TWDB-BMP). They are provided to perform calculations which are not necessary for the user to access and to facilitate future updates and/or incorporation of new data.

Because the goal of the model is to quantify water conservation and cost-benefit of various BMPs, impacts on water use due to changes in the plumbing code or natural rate of replacement are not included. Additionally, the cost-benefit analysis is conducted with respect to utilities; a participant (customer) cost-benefit is not included. If desired, these items may be incorporated into future revisions to the model.

The intent of this model is to provide an easy-to-use format for small to mid-sized utilities throughout the State to estimate and report water savings from implementation of BMPs. For agencies interested in incorporating savings due to plumbing code or estimating the cost-benefit to customers, avoided costs due to deferred water and wastewater treatment expansions, or greenhouse gas (GHG) reductions, the Alliance for Water Efficiency (AWE) *Tracking Tool* is a commercially-available program with these capabilities. The California Urban Water Conservation Council (CUWCC) also has water conservation BMP modeling software available for members entitled *Cost Effectiveness Analysis (CEA) Tool*.

4.1 Water Conservation BMPs and Customer Classes

4.1a How BMPs Were Determined

Based on input received from agencies during the interview process as well as input from the TWDB, the following customer classes are included in the model:

- Single-family residential
- Multi-family residential
- Industrial
- Commercial
- Institutional
- Landscape Irrigation Meters

While some agencies expressed interest in including a governmental class, this customer class may be evaluated under the Industrial, Commercial, and Institutional customer classes.

The water conservation BMPs included in the TWDB Water Conservation BMP Model are based on the TWDB's existing and potential future municipal BMPs as described in the version of the *List of Existing and Potential Future Municipal BMPs* and on the Save Texas Water Water Conservation Advisory website information at the time of model development between October, 2012 and October, 2013. Details on the existing BMPs are consistent with the BMPs outlined in the *Water Conservation Best Management Practices Implementation Guide* (http://www.twdb.state.tx.us/conservation/BMPs/index.asp). For those agencies electing to use BMPs not included in the TWDB Water Conservation BMP Model, the *Water Conservation Best Management Practices Implementation Guide* includes instructions and guidance on analyzing the various BMPs.

Since several agencies reported a shift in focus to outdoor water conservation BMPs due to perceived saturation of efforts with indoor BMPs and fixtures, multiple outdoor BMPs are included in the TWDB Water Conservation BMP Model. In addition to the requests for inclusion of outdoor BMPs, the focus of the model development was on widely-used BMPs with available data on performance, costs, life-cycle, and other required parameters.

4.1b BMPs in Model

The water conservation BMPs included in the TWDB Water Conservation BMP Model are divided into four categories and are consistent with the *List of Existing and Potential Future Municipal BMPs*: 1) Conservation Analysis and Planning, 2) Rebate, Retrofit, and Incentive Programs, 3) Landscaping, and 4) Education & Public Awareness. Tables 3 to 6 list BMPs included in the TWDB Water Conservation BMP Model.

TABLE 3: EDUCATION & PUBLIC AWARENESS BMPS

BMP/Customer Class	Education & Public Awareness
BMP	Education
Customer Classes[1]	SF and MF

[1]SF and MF included as separate BMPs in TWDB Water Conservation BMP Model tool.

TABLE 4: REBATES, RETROFITS, AND INCENTIVES BMPS

BMP/Customer Class	Surveys	Indoor Fixtures			Outdoor Programs
BMP	Non-Residential Surveys	Residential Toilet Replacement (ULFT)	Residential HE Washer	Showerhead, Aerator, and Toilet Flapper Retrofit[2]	Water Efficient Landscape Design
Customer Classes[1]	Industrial, Commercial, and Institutional	SF and MF	SF and MF	SF and MF	SF

[1]SF and MF included as separate BMPs in TWDB Water Conservation BMP Model.
[2]Toilet Flapper Retrofit included as separate BMP in TWDB Water Conservation BMP Model due to different decay rate than Showerhead and Aerator. However, both BMPs should be used to analyze Showerhead, Aerator, and Toilet Flapper Retrofit.

TABLE 5: CONSERVATION ANALYSIS AND PLANNING BMPS

BMP/Customer Class	Residential Surveys			
BMP	Showerhead and Aerator Replacement	Irrigation Audits	Showerhead and Aerator Replacement	Irrigation Audits
Customer Classes[1]	SF	SF	MF	MF

[1]SF and MF included as separate BMPs in TWDB Water Conservation BMP Model tool.

TABLE 6: LANDSCAPING BMPS

BMP/Customer Class	Landscaping				
BMP	Irrigation Controllers	Irrigation Controllers	Irrigation Nozzles	Irrigation Efficiency Evaluations	Landscape Water Budget
Customer Classes[1]	SF	MF, Industrial, Commercial,	MF	Industrial, Commercial,	Industrial, Commercial,

		Institutional and Irrigation		Institutional, and Irrigation	Institutional, and Irrigation

[1]SF, MF, Industrial, Commercial, Institutional, and Irrigation included as separate BMPs in TWDB Water Conservation BMP Model.

4.2 BMP Default Data

BMP default data is primarily based on the results of the literature review and listed in Appendix D, which also includes details on the data source(s). These tables are included in the model as in multiple BMP default data values worksheets named as follows: 1) Education BMPs, 2) Rebate Retrofit Incentives BMPs, 3) Conservation Analysis BMPs, and 4) Landscaping BMPs. These worksheets are hidden and password protected. They are provided to facilitate future updates and/or incorporation of new data. This documentation is also included in the model on the ASSUMPTIONS worksheet. The performance of the BMPs is divided into the following categories:

- Water savings per unit
- Annual rate of savings decay - (used for BMPs, such as toilet flappers, that lose effectiveness throughout their life-cycle rather than continuing the same effectiveness until failure or replacement)
- Peak period savings (percent of annual savings) – (indoor fixtures are typically constant throughout the year, whereas the majority of outdoor/landscaping BMPs derive the majority of benefit during peak demand months)
- Life-cycle – duration or life of BMP (yrs)
- Free-riders – (customers/participants who would have implemented the BMP even without the program)
- Wastewater savings per unit (used only in avoided cost calculations)

To provide default cost values reflective of experience within the State, default BMP cost values are based on the interviews with utilities described in Appendix C and supplemented with data from the literature review. The tables in Appendix D list the default cost values for the following components and includes details on the data source(s) for each cost component of each BMP:

- Year costs denominated
- Rebate cost – includes utility cost of rebate
- Program cost – includes utility cost of products, administrative, overhead, labor, marketing, outreach, and other miscellaneous costs

All costs are in 2013 dollars and costs from earlier years are escalated to 2013 dollars utilizing the following formula:

Future Value = Value in Year Costs Denominated * (1+ Inflation Rate ^ (Year of Future Value – Year Costs Denominated)

These values may be changed by user's as additional data is available or to reflect the utility's historical experience or projected budgets. If available, local cost data is preferred over the default values in the TWDB Water Conservation BMP Model. For those utilities without local cost data, the default values may be used until local data is collected.

These values may be changed by users in the BMP DATA worksheet as additional data is available or to reflect the utility's historical experience.

While a 2009 law that takes effect in January, 2014 requires increased showerhead efficiency requirements from 2.75 gallons per minute to 2.5 gallons per minute, this slight increase in efficiency is disregarded in the model, based on input from the TWDB's Project Manager. However, the increased savings due to the 1.28 gallons per flush due to adopting high-efficiency toilets is included in the model for a total savings of 12.13 gallons per capita per day (gpcd) (TWDB, February, 2013). Other details on BMP default values and savings are described in the ASSUMPTIONS worksheet in the model.

For the Landscaping BMPs and Water Efficient Landscape Design, percent-savings of the irrigation use is used rather than a water budget approach. For those agencies preferring a water budget approach, the *AWE Tracking Tool* may be considered.

4.3 Water Savings, Wastewater Savings, and Results

These worksheets are required for all projects; however, no data entry is needed. Results contained in these worksheets may be used for Annual Reporting documentation. The **WATER SAVINGS** worksheet reports water savings as a result of BMPs identified on the **BMP DATA** worksheet are estimated and reported as follows:

- Savings for each individual BMP (gpd)
- Savings by BMP type (i.e., Landscaping, etc.) (gpd)
- Savings by user class (gpd)
- Savings for all BMPs (gpd)
- Savings for all BMPs (gpcd)
- Savings for all BMPs (MG/yr)

The **WASTEWATER SAVINGS** worksheet is similar to the **WATER SAVINGS** worksheet and is calculated for all projects, but may not be of interest to all agencies. It is used only in the economics calculations. The **RESULTS** worksheet includes tabular results of projected demands with identified water conservation BMPs in-place and compares graphically to projected demands without BMPs.

4.4 Default Economics Values

The economics table in Appendix D lists the default economic values for items not specifically related to the water conservation BMPs, including: discount rate, inflation rates for general cost items, electricity, chemicals, and capital cost. Given the uniqueness of economic data to a local community, and the need to recognize the specific elements of each utility's cost of providing service, the remaining economic values are simply populated with placeholders at this time and must be adjusted by the user to produce accurate results for the utility.

As with the water conservation BMP cost values, all costs are in 2013 dollars and costs from earlier years are escalated to 2013 dollars using the formula identified in Section 4.2. All economic values may, and should be, changed by users as additional data is available or to reflect the utilities historical experience or projected budgets. Additionally, inflation rates and cost escalation rates may be changed to reflect future economic conditions if needed.

4.5 Economic Equations

Two specific calculations are performed within the Model with calculate and quantify the economic aspects associated with each BMP as well as for a utility's program in whole. These calculations are as follows:

1. Cost – Benefit

To determine the economic efficiency of each BMP, the cost of implementing the BMP is compared with the relative benefits associated with the BMP's implementation. These numbers are then taken in context with one another to develop a benefit cost rate ("BCR") for each respective BMP in each year in real dollars and on a present-value basis as well as in total over the entire analysis period contained within the model. In general, a BCR value of greater than one indicates that the benefit of the respective BMP, or the conservation program in total, outweighs the cost. If the BCR is less than 1, then the costs of the BMP's implementation are greater than the benefits realized, indicating that the quantified BMP is not the most economically viable for the utility. The BCR is an important tool for a utility as it can help them prioritize and make key management decisions regarding which BMP is most cost effective. This ensures that funding committed to a water conservation program is used in the most economically efficient manner.

2. BMP Cost

For each BMP, the cost of the BMP in each respective year is determined by taking the unit cost of implementing each BMP, as adjusted for inflationary pressure, and multiplying it by the number of instances the BMP occurs in a given year. The default BMP cost values within the model include the direct labor and materials costs associated with BMP implementation, as well as the indirect administrative and overhead costs of the program. Also included are the costs associated with program marketing and outreach and other miscellaneous costs essential for program implementation. In addition to the direct and indirect costs of the BMP, for those BMP's involving the granting of a customer rebate, the cost of the rebate to the City is included as part of the BMP's implementation cost. To adjust the annual cost of each BMP, the unit program and rebate costs are escalated annually based on the General Inflation rate entered by the user. The cost of each BMP is calculated in real dollars annually as well as on a present-value basis. The present value calculation included within the model calculates the present value for the year of costs denominated as indicated in the "Input Data" worksheet contained within the model.

3. BMP Benefits

The model recognizes two distinct benefits that are inherent as a result of a water conservation program. These included avoided variable costs which the utility will not incur due to conservation as well as the delay in capital costs and associated funding expense resulting from a delay in investment due to conservation.

To calculate the avoided variable cost of the utility, the user is requested to enter a number of variable cost assumptions as discussed below:

- Wholesale Water Supply

  For a utility that purchases either raw or treated water from a wholesale supplier, conservation will allow the utility to reduce its wholesale purchase cost. However, under many wholesale contracts, the contract is structured such that a portion of the cost is fixed annually, either through the establishment of a monthly or annual demand charge or a monthly minimum amount, sometimes structured as a take-or-pay contractual clause wherein the customer must pay for a certain volume of water whether that water is consumed or not. To reflect the unique nature of these wholesale contracts, the model permits the user to enter the cost of purchased water on a per 1,000 gallon basis and to segregate this cost into fixed and variable components. Within the model's calculations, only the variable component is considered within the avoided cost calculations. The model allows for the escalation of the variable rate on an annual basis to reflect rate adjustments by wholesale providers.

- Groundwater Production Fees

  Many utilities that obtain their water supply from groundwater wells are subject to the jurisdiction of a Groundwater Conservation District. To fund the cost of operations, many of these Groundwater Conservation District's charge a per 1,000 gallon production fee associated with the volume of water pumped. With the implementation of a water conservation program, the volume of water needed to be pumped will be reduced, thereby allowing the utility to avoid the payment of groundwater production fees. The model allows the user to enter, on a per 1,000 gallon basis, the current groundwater production fee the utility may be subject to, as well as the escalation of this rate annually to reflect adjustments by the respective Groundwater Conservation District.

- Water Supply Composition

  For Cities that utilize both a purchased wholesale water source and a groundwater source, the Model accommodates this by calculating an effective variable rate per 1,000 gallons which is then applied as an avoided variable cost benefit. The user inputs the percentage of composition by water supply component and the model calculates a weighted average variable cost to be applied based on the variable rates input for each water supply component.

- Variable O&M Cost

  As conservation occurs, the City's variable cost associated with water will decrease. Typically, these variable cost components include electricity and chemicals. The model allows the user to input, per 1,000 gallons, the unit costs of these variable cost categories, as well as an "other variable cost" line-item to facilitate capturing other variable costs unique to a City. These variable unit costs are also applied to calculate reductions in cost experienced due to a decrease in wastewater flow as a result of water conservation.

- Wholesale Wastewater Treatment Cost

  As noted above, with water conservation, wastewater flow will also reduce resulting in a reduction in variable wastewater cost. As with the reduction in purchased wholesale water, this will also include a reduction in purchased wholesale wastewater treatment cost for those that contract for the treatment of wastewater. To account for this, the model allows the user to input the fixed and variable rate components associated with wholesale wastewater treatment on an effective rate basis. This allows the utility to account for contractual terms and conditions which may require a fixed annual payment obligation regardless of wastewater flow. The variable amount is then escalated annually based on the user defined inflation rate and applied annually to the reduction in wastewater flow volumes.

To calculate the impact of delayed capital investment, the model requires the user to input the current system capacity, in million gallons per day, as well as the planned capital improvements needed for incremental system capacity to meet demand. For each incremental supply project, the user must enter the year the project is needed, the incremental capacity supplied by the project, the estimated cost of the project and the year the cost estimate was developed, as well as the method of funding that is anticipated to be used for the project (i.e., cash, debt, or grants). For projects that will be funded with debt, the user must also enter the anticipated interest rate and term of the debt to be issued. Finally, the user must also estimate the operations and maintenance cost impact of each project. This is projected as a percentage of the original capital cost, as defined by the user.

The project team would note that future water supply capital improvement information, if not readily available for the City's own capital improvement plan, can be obtained from the detailed regional water plan for the City's regional planning area. In each regional water plan, a specific City's projected water needs are outlined as well as the projects needed to meet those demands. In addition, the regional water planning guidance documents provide recommendations on percentages to be used to project operations and maintenance cost as a percentage of capital cost as well as projected interest rates to be used when planning future debt issuance.

Using these inputs, as well as the baseline water demand figures without the implementation of the BMPs, the model calculates the projected annual cost to the City, for both capital investment and operations and maintenance cost, to meet future water demand. Then, based on the water savings resulting from BMP implementation, the model calculates the projected annual cost to the City recognizing water conservation. These figures are then compared, both in real dollars and on a present value basis, to determine the benefit from delayed investment.

We would note that the same calculations could be made relevant to wastewater treatment as reduced water consumption will result in reduced wastewater flow. However, while the regional water plan provides for an easily accessible source to obtain needed data on water capital planning, the Project Team is not aware of a similarly available resource for wastewater planning. To the extent future resources become available, the functionality to assess the impact of delayed capital investment for wastewater treatment should be considered for inclusion into the model.

When calculating the total benefit-cost ratio for the program, the model takes into account both the impact of avoided variable cost as well as the impact of delayed capital investment. This result, on a present-value basis, is then compared to the cost of program implementation to develop the benefit-cost ratio for the program as a whole on an annual basis as well as in total. As previously mentioned, a BCR value of greater than 1 indicates that the benefits of the respective BMP, or the conservation program in total, outweighs the cost. If the BCR is less than 1, then the costs of the BMP's implementation are greater than the benefits realized, indicating that the quantified BMP is not the most economically viable for the utility.

2. Revenue Impact

As citizens use less water, it follows that the utility will see less revenue from this reduced usage. This includes a reduction in water revenue as well as a reduction in wastewater revenue due to reduced wastewater flow. To quantify this impact, the model allows the user to enter the effective rate per 1,000 gallons for water and wastewater service charged by the City. The City can calculate its effective rate by taking all water revenue divided by all water consumed over a defined monthly or annual period. The same calculation came be performed on billed wastewater flow and wastewater revenue to derive the effective wastewater rate. These per 1,000 gallon rates are then applied to the reduction in water volumes and wastewater flow to determine the total amount of revenue impact annually from water conservation. These figures are presented in the model in real dollars and on a present-value basis.

It should be noted that the model, at this time, assumes the effective rate will be held constant for water and wastewater service over the analysis period. However, it is assumed that as a utility sees a reduction in revenue, it will be necessary to adjust the rates charged to customers to ensure sufficient revenue recovery to maintain the financial stability of the utility. The model can assist in determining the revenue adjustment required annually as rates will need to be adjusted to, at minimum, recover the lost revenue as adjusted for the anticipated decrease in variable cost.

5 CONCLUSIONS

While results provided by this tool are anticipated to approximate water savings and cost-benefit of implementation of included water conservation BMPs, the accuracy of the estimated savings is limited to the accuracy of the data found during the literature review and the accuracy of the economic assumptions defined by the user. Improved results are anticipated over time as additional research is performed and better data becomes available. For example, an education BMP is included in the model; however, the performance data is based on a single value reported by an agency in the San Francisco Bay area. Local research and/or additional data may reveal that a significantly different value is more appropriate for educational BMPs or other BMPs included in the tool.

Because the goal of the model is to quantify water conservation and cost-benefit of various BMPs, impacts on water use due to changes in the plumbing code or natural rate of replacement are not included. Additionally, the cost-benefit analysis is focused on the utilities and a participant (customer) cost-benefit is not included. If desired, these items may be incorporated into future revisions to the model.

We recommend the TWDB incorporate updates to BMP default data values as additional research is performed within the State and costs and benefits are better defined. Additionally, we suggest the TWDB consider incorporating additional Municipal BMPs in future updates as well as alternative supply sources, such as greywater systems and rainwater harvesting.

Version 1.0 of the TWDB Water Conservation Model incorporates valuable input from our Beta Testers (City of Round Rock and City of College Station), which enhances the model for other users within the State. It is our hope that statewide use of the model leads to future expansions and improvements to the model by users and the TWDB.

6 ACKNOWLEDGEMENTS

We appreciate the opportunity to assist the TWDB with this ground-breaking project for the State. A special note of gratitude goes to John Sutton, the TWDB's Project Manager for his dedication and commitment to the success of this project. We would like to thank the following for their participation in agency interviews and data assistance for this project:

- Austin Water – Mark Jordan
- College Station – Jennifer Nations
- Dallas Water – Carol Davis and Dr. Nguyen
- El Paso - Anai Padilla
- Fort Worth - Mary Gugliuzza and Micah Reed
- Houston* – Carol Haddock, P.E.
- Round Rock – Jessica Woods
- San Antonio Water System (SAWS) – Karen Guz and staff
- San Marcos – Jan Klein
- San Angelo – Toni Fox

*based on January, 2013 *Water Conservation Plan – AWE Tracking Tool Memorandum of Assumptions* prepared by Watearth, Inc.

We especially appreciate Mark Jordan, Karen Guz, Jessica Woods, and Micah Reed for providing additional data and information on the costs associated with their agencies programs and/or specific BMPs. The enthusiasm and efforts of our beta-testers has also been instrumental in providing an easy-to-use model that meets the needs of the State's public agencies. Thank-you to Jennifer Nations with the City of College Station and Jessica Woods with the City of Round Rock.

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APPENDIX A: LIST OF ENTITIES AFFECTED BY RESULTS OF THIS RESEARCH PROJECT

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MEMORANDUM

Project: **Water Conservation Plan (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 11/12/2012
Purpose: List of Entities Affected by Results of This Research Project

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The purpose of this memorandum is to document a list of entities that potentially may be affected by the results of this Research Project. This list was compiled based on the scope of work and product deliverables for this project as well as with input from the Texas Water Development Board's (TWDB)'s Project Manager, John Sutton.

We anticipate that all utilities in Texas will benefit from this project. Small to medium-sized cities throughout the State can be affected positively by having the tool to use for annual reporting.

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APPENDIX B: SUMMARY OF PROGRAMS BY VARIOUS INTERVIEWED AGENCIES

APPENDIX B: WATER CONSERVATION EDUCATION COMPONENTS CURRENTLY USED BY AGENCIES SURVEYED

City/Agency	Billboards	Brochures	Direct Mail	Newsletter	Press Releases	Public Events	Public Television	Radio	School Presentations	Social Media	Tours	Videos/ website	Water Bill Inserts	Water Museum
Austin[2]	●	●				●	●	●	●	●		●	●	
College Station			●			●		●					●	
Dallas						●			●	●	●	●		
El Paso														
Fort Worth						●			●				●	
Houston					●	●			●				●	●
Round Rock		●				●			●					
San Angelo	●						●					●		
San Antonio Water Systems (SAWS)[3]														
San Marcos				●	●	●			●					

Notes:
1. Data as reported by agency staff during interview.
2. Austin Water Utility data provided in list format and included after interview summary in Appendix C.
3. Data on Education Components not provided by SAWS as interview focused on programs and outdoor items.

APPENDIX B: WATER CONSERVATION BMPS CURRENTLY USED AND PROPOSED BY AGENCIES SURVEYED

	Code, Ordinance, and Administrative Items						Supply		Free Items											Rebates						Landscape					
															Toilets											Irrigation					
City/Agency	City Dept. Requirments	Code Revisions	Drought Rates/ Restrictions	Meter Replacement	Tiered Rates	Watering Restrictions	Reclaimed Water	A/C Condensate	Aerators	Dye Tablets	Hose Timers	Low-Flow Shower	Rain Gauges	Tree Gators	Bag	Comm. Install	No Install	Low Income Install	Water Audits	Cisterns	CII Audit Items Rebate	Clothes Washers	Pressure Reg. Valves	Rain Barrels	Toilets	Audits	Controllers	Inspection	Nozzles	Rain Sensors	Water Effic. Landscape
Austin[6]	●	●	●	x[5]	●	●	●		●		●	●		●				●[4]	●	●		●	●	●		●	rebates	●	rebates	rebates	rebates
College Station					residential		●												x					●	●		x		x		x
Dallas	●	●				●											●	●[4]	●		●					●	rebates		rebates		
El Paso		x			●	●	●	x											●						x		x		x		
Fort Worth					●				●			●			●		●	●	●								x	●	x		
Houston		●	●		●																				x		x		x		
Round Rock	●			●						●	●											●		●	●		free	●	free		x
San Angelo			●		●			x	●			●	●												x		x		x		x
San Antonio Water Systems (SAWS)[7]																●	●	●								●	●	●	●	free	
San Marcos			●		●				●			●							●	x		●		●	●	x					

Notes:
1. Data as reported by agency staff during interview and simplified for inclusion in table format. For agencies with comprehensive programs, may not include each specific BMP.
2. Bullets denote current BMP and x denotes proposed BMP or BMP of interest.
3. Landscape BMPs are primarily proposed or of future interest and may include both rebates and free items.
4. Also includes leak and fixture repair for low income residents.
5. Austin Water is investigating the use of smart meters.
6. Austin Water Utility data provided in list format and included after interview summary in Appendix C.
7. Data on Code, Ordinance, and Administrative items not provided by SAWS as interview focused on programs and outdoor items.

APPENDIX C: INTERVIEW SUMMARIES WITH UTILITIES

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INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project: **Water Conservation Tool (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 12/03/2012
Purpose: Interview Questions for Municipalities
Contact: Austin Water – Mark Jordan (In-Person)

This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include?
    a. Program elements?
    b. What BMPs do you use and what customer classes do they apply to?
    c. What incentives or rebates do you offer?
    d. Do you provide items for "free"?

Program goals are: 1) 140 gpcd by 2020, 2) reduce peak day demand by one-percent per year over ten years or 25 MGD reduction (started in 2007 and achieved in 2010), 3) peaking factor of 1.5, and 4) delayed payment to LCRA for overage use. Program includes a tiered rate structure. A revenue-leveling fee has been incorporated so that the revenue is not lost due to conservation. Current programs listed in hand-outs provided.

Currently in Stage 2 Drought and watering only allowed one time per week. Normal restrictions are two times per week. Have a washwise commercial and residential program, but are phasing out residential program. Many City ordinance requires items that were previously rebated or incentiviced, which are now being phased out. The rainwater harvesting program is not completely cost-effective, but rebates are offered due to the educational component.

Free items include: timers, showerheads, and aerators.

There is a City Efficiency requirement/category to meet or exceed certain requirements. For example, the Parks Department uses reclaimed water for irrigation and was provided with tree gators for irrigating new plantings.

2. Do you have additional items planned for your water conservation program?
    a. Additional program elements?
    b. Any new BMPs?
    c. Any new incentives or rebates?

    Currently partnering with Austin Energy and Gas for one site visit with multiple rebates to save staff time. Includes low income plumbing repair partnership. Conducting a feasibility study for the use of smart meters. Pilot project using a water budget instead of number of times per week for watering for commercial entities. New programs listed in hand-outs provided.

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us?

    Yes – have analysis and data for a number of BMPs some based on City analysis, some on State numbers, and some on National numbers. Will provide data for requested BMPs.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

    Use AWE Tracking Tool, but modify some of the default values based on internal analysis of benefits. Major drawback is that tool only allows 50 BMPs and some default values should be regionally based instead.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool? No. It would be beneficial for the TWDB to conduct a study to assess the values used in the benchmarking or cost-benefit analysis (i.e., what programs achieved or are expected to achieve) as it would lend credibility to City's numbers and provide values for regional conditions.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB?
    a. Customer Classes – Suggest use SF, MF, and ICI. Possibly also City category.
    b. Specific BMPs or groups of BMPs – Suggest starting with the State's reporting requirements.
    c. Other items – The AWWA Guide *Water Conservation Programs – A Planning Manual* is a good place for small agencies to start.

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available?

    N/A

Austin Water Utility Conservation Programs

Indoor Conservation

WashWise Washer Rebate
The WashWise Rebate Program offers rebates of up to $100 to residential customers purchasing water and energy-efficient clothes washers selected from a list of models meeting Consortium for Energy Efficiency (CEE) criteria. This rebate consists of two parts: a $50 water rebate and an energy rebate of either $50 from Austin Energy or $25 from Texas Gas Service depending on the type of water heating used. Multi-family and commercial customers installing approved water and energy-efficient coin-operated washers may receive rebates of up to $250 per machine. For these customers, the program offers a $150 water rebate and a $100 energy rebate. Multi-family and commercial applicants must receive pre-approval prior to purchasing equipment.
Date Implemented: Ongoing since 1998

Free Showerheads/Faucet Aerators
To reduce water use, residential customers can pick up free water-efficient showerheads and faucet aerators from Austin Water. The showerheads, available in either regular or soap-up valve models, use 1.5 gallons per minute. The bathroom faucet aerators use 1.0 gallons per minute and the kitchen faucet aerators use 2.2 gallons per minute.
Date Implemented: Ongoing since December 2010

Pressure Regulating Valve (PRV) Rebate
Pressure Regulating Valves (PRVs) reduce incoming water pressure from water mains to a lower, more functional pressure for distribution throughout the property. Lowering high pressure can reduce water use and prevent damage to pipes, fixtures and appliances. Austin Water offers a $100 rebate to residential customers for the purchase and installation of a PRV. Multi-family customers can receive a rebate of $100 per unit, up to a maximum of $500 per property. To be eligible for the rebate, customers must have water pressure over 80 pounds per square inch and not have an existing PRV already installed.
Date Implemented: Ongoing since October 2007

Outdoor Conservation

Residential Irrigation System Evaluations
Because seasonal landscape watering is the driving factor in the City's peak day water usage, residential customers who use more than 25,000 gallons of water per month or 15,000 gallons in more than one month and have an in-ground sprinkler system are eligible to receive a free irrigation system evaluation to help them use their systems more efficiently. Often, customers have a limited understanding of how their controllers work, have multiple programs or start times that they are unaware of, lack a backup battery in their controller, or have heads that mist

through September for fall installations. Only the first 100 eligible applicants are accepted into the program per application period.

Date Implemented: Ongoing since July 2010. Current program began August 2012

Landscape Conversion Incentive: Lawn Remodel Option

In response to 2011's exceptional drought, Austin Water offered residential customers a one-time opportunity to replace water-thirsty turf with Bermuda or Buffalo grasses, which are more likely to survive future droughts. Rebate amounts for this program ranged from $10 to $30 for every 100 square feet of turf converted. Approximately 800 participants committed to stop watering stressed turf until the drought ended and a sustained recovery was projected. Once Stage 2 Restrictions were lifted, Austin Water asked these participants to submit a design plan that may include selected turf varieties, native plants, and non-irrigated areas.

Date Implemented: September 14 to October 31, 2011

Pressure Regulating Valve (PRV) Rebate

Pressure Regulating Valves (PRVs) reduce incoming water pressure from water mains to a lower, more functional pressure for distribution throughout the property. Lowering high pressure can reduce water use and make irrigation systems more efficient by eliminating over-spray and misting. Austin Water offers a $100 rebate to residential customers for the purchase and installation of a PRV. Multi-family customers can receive a rebate of up to a maximum of $500 per property. To be eligible for the rebate, customers must have water pressure over 80 pounds per square inch and not have an existing PRV already installed.

Date Implemented: Ongoing since October 2007

Alternative Compliance Pilot Program

Austin Water is conducting a pilot program for commercial customers that will allow them to water according to a calculated water budget rather than the assigned watering schedule. A total of 90 properties will participate over the course of the four-year pilot study. Participating properties must have a dedicated irrigation meter, have been a direct customer of Austin Water for at least 3 years, and be in compliance with Austin City Code, Chapter 6-4-63(D), Permanent Water Use Restrictions.

Date Implemented: May 2012

Institutional, Commercial, and Industrial (ICI) Conservation Programs

3C Business Challenge

Participation in the 3C Business Challenge provides businesses with information about ways to reduce water use and shows their commitment to saving water. After conducting a self-audit of water-using equipment at their business, commercial customers submit the completed audit form to Austin Water. Based on the information provided, conservation staff makes recommendations about steps the business could take to reduce water use and provides information about available rebates to assist with water-efficient upgrades. The 3C Business Challenge is also a component of the citywide Green Business Leader program initiated by the Office of Sustainability.

Date Implemented: Ongoing since FY 2011

WaterWise Partner Program
Through the WaterWise Partner program, Austin Water recognizes commercial customers that have made comprehensive water-efficiency upgrades in their facilities or incorporated efficiency measures into the design of new properties. This program has initially targeted the hotel sector but is anticipated to expand to include restaurants/bars, schools, hospitals, and car washes.
Date Implemented: Ongoing since September 2011

ICI Special Process Rebates
Austin Water offers rebates of up to $100,000 to industrial, commercial, and institutional customers for installing equipment and process upgrades that produce peak day water savings of at least 100 gallons per day. The incentive available for each project is the lesser of: half the cost of the purchase price of the equipment up to $100,000, or $1.00 for each gallon per day saved up to 100,000 gallons for a maximum rebate of up to $100,000. The rebate payment is based on documented savings following project completion. Applicants must obtain pre-approval for rebated projects and agree to post-installation inspection to verify installation and operation. Because water savings must be documentable, potential projects should be located in areas that can be sub-metered or otherwise measured or where savings can be calculated based on some measured parameter. Examples of eligible upgrades include: replacing single pass cooling with cooling tower water or air cooling; reuse of high quality rinse water, combined process or storm water reuse for landscape irrigation; and installing water-saving equipment in commercial laundry or car wash.
Date Implemented: Ongoing since 1996, rebate cap increased effective 2008

Whole System Water Conservation Audits and Surveys
Austin Water offers free water use evaluations to help commercial and industrial facilities determine if they are using water efficiently. The auditors suggest opportunities for reducing water consumption and discuss eligibility for the ICI Special Process Rebate program.
Date Implemented: Ongoing since 2004

Water Reclamation Program
Austin Water has provided reclaimed water for irrigation since 1974. Using reclaimed water benefits the water system by reducing demand for potable water for non-potable uses, including irrigation, cooling tower makeup, ornamental ponds, manufacturing, and toilet flushing. The City's Water Reclamation Initiative, enacted in 1990, is a plan to expand development of a reclaimed water system to meet current and future non-potable water demands. In 2009, a drought year with exceptionally high demand, about 5 percent of wastewater received at the City's wastewater treatment plants was treated and reused for non-potable uses, mostly irrigation of golf courses. In September 2010, the 51st Street Tower, which serves the University of Texas area, was brought online. In November 2011, the reclaimed system was expanded to Austin Bergstrom International Airport, which is anticipated to save 25 million gallons of drinking water annually. The reclaimed water system is anticipated to be complete within 25 years.
Date Implemented: Ongoing since 1974

to help mitigate revenue instability resulting from reduced sales, whether caused by an exceptionally wet year, drought restrictions, or increased conservation savings.

Date Implemented: Ongoing since FY 1994.

Water Use Management Ordinance

In 1983, the City of Austin enacted its first water use management ordinance, which allowed watering restrictions to be implemented in response to supply constraints. In 2001, the City enacted a permanent water waste prohibition making it a Class C misdemeanor (max. $500 fine) to waste water through poorly designed irrigation systems or fail to repair leaks. In 2007, a revised ordinance limited outdoor watering to twice a week year-round for commercial and multifamily customers and from May through September for residential customers. That ordinance also prohibited daytime watering and set forth progressive restrictions to respond to increased demand or decreased supply. In 2011, the City began a public process to discuss revising the Water Conservation Code (Chapter 6-4 of City Code) to better address the impacts of long-term drought. In August 2012, a revised ordinance established a Conservation Stage that limits outdoor irrigation for residential and commercial customers to no more than twice a week year-round, prohibits daytime irrigation, and places restrictions on the use of commercial patio misters. The revised ordinance also implements four drought stages which contain increasing levels of water use restrictions to maximize water savings during times of drought and provides for the assessment of administrative fines in addition to the criminal penalties. To educate the public about the mandatory watering schedule, the City produces magnets and stickers depicting the schedule; promotes the schedule heavily on television and radio, through bus wraps and in print ads; and increases education efforts during the summer when water use is highest. In August 2008, Austin Water partnered with Austin 3-1-1 to take water waste reports 24/7 and provide tracking assistance to callers. This has led to an increased number of water waste reports from the public and encourages compliance with the watering schedule.

Date Implemented: Ongoing since 1983. Current measures approved August 16, 2012.

Plumbing Code Revisions

In 2010, Austin revised its plumbing code to require high-efficiency toilets using an average of no more than 1.28 gallons per flush (gpf) and urinals that are either waterless or use no more than 0.5 gpf in all new construction and retrofit projects. Earlier additions to the plumbing code prohibited once-through cooling, commercial garbage grinders, and liquid ring vacuum pumps.

Date Implemented: Ongoing since January 2008

Innovative Commercial Landscape Ordinance

The Innovative Commercial Landscape Ordinance serves as both a water quality and conservation tool. This change to the land development code requires new commercial developments to direct stormwater to an area at least 50 percent of the size of the required landscape. Means for conveying stormwater to landscapes vary and range from passive to active methods, several of which can count towards receiving water quality credit. In an effort to limit non-essential irrigation, commercial customers may now choose whether to install permanent irrigation in the peripheral regions of the property, and undisturbed vegetation will count towards the "50 percent requirement."

Date Implemented: Ongoing since December 2010

Advertisements/Program Marketing
Austin Water uses advertising to provide citizens with information about water conservation practices and programs. It regularly places advertisements in local and neighborhood newspapers, on radio and television stations, on-line, and on area billboards, bus wraps, and pump-toppers.
Date Implemented: Ongoing since FY 1983. Beginning FY 2008, marketing efforts increased significantly with additional funds to promote new outdoor watering restrictions.

Dowser Dan Show
Targeting kindergarten through 4th grade students, the Dowser Dan Show is an original and highly popular assembly program that teaches kids (and teachers) about water conservation. The City of Austin first designed the program in 1992 and has modified and updated it each year. The Dowser Dan Show reaches approximately 30,000 students each school year. In addition to the show, students receive supplemental education materials such as calendars, magnets, stickers, and bookmarks with water conservation tips and lessons.
Date Implemented: The show, which originated in FY 1992, returned in FY 2010 after a brief suspension and has been ongoing since.

Speakers Bureau
Austin Water offers presentations on water conservation techniques and available programs to a variety of interest groups including homeowners associations, garden clubs, professional organizations and other community groups. Austin Water also participates in festivals, school events and informational fairs by providing staff and materials to promote water conservation. In 2009, it developed a Water Conservation Speakers Bureau, allowing area groups to schedule speakers on topics of interest. Staff members are available to speak on topics that include conservation measures, irrigation, leak detection, and water waste. Each year, Austin Water typically participates in more than 100 events and programs.
Date Implemented: Ongoing since FY 2000

Utility Bill Data
Austin Water customers can access data about their actual water use online at https://www.coautilities.com, which has a "history" tab that allows for month-to-month usage comparisons. In July 2010, Austin Water began providing 13-month usage graphs on customer bills and online to give customers easy access to usage pattern information and alert them to unusual usage spikes. Knowing about an unusual spike could alert a customer to the presence of a leak or some other problem that needs to be addressed. Since 2005, Austin Water has also contacted customers with unusually high meter readings to alert them to potentially high bills and the possibility of a leak.
Date Implemented: Ongoing since 2005

Water Theft Education
In an effort to curb water loss, the Water Conservation Division partnered with the Consumer Services Division and Austin 3-1-1 to implement a Water Theft Education program. Citizens are encouraged to report observed instances of water theft to Austin 3-1-1. To bring awareness to the campaign, Austin Water offered training to City staff and the construction development

Austin Water Utility: New/Revised Conservation Programs for FY2012

- **Revisions to the Water Conservation Code**

To better respond to the effects of long-term drought, Austin Water began a process to revise the Water Conservation Code (Chapter 6-4 of City Code). The goal was to balance the need to conserve the water supply and the desire to sustain the local economy and the natural surroundings unique to Austin. Austin Water encouraged the public, organizations, and businesses to attend workshops to discuss how the City should regulate water use in times of drought and review specific watering restrictions. The revised code was approved by City Council on August 16, 2012.

- **Landscape Conversion Incentive: Lawn Remodel Program**

In response to 2011's exceptional drought, Austin Water offered residential customers an opportunity to replace water-thirsty turf with Bermuda or Buffalo grasses, which are more likely to survive future droughts. Participants commit to stop watering stressed turf until the drought ends and a sustained recovery is projected. This program, which was only open from September 14 to October 31, 2011, received approximately 900 applications for replacing nearly 3.5 million square feet of turf.

- **Pool Cover Rebate Pilot Program**

This program assists homeowners with costs related to the purchase of a swimming pool cover to reduce the amount of water lost to evaporation and the cost of pool maintenance. Applications are being accepted through August 31, 2012. Austin Water residential customers can receive 50 percent of the purchase price up to $50 for a new manual pool cover or solar rings and $200 for a new permanent, mechanical pool cover

- **Tree Gator Distribution**

To assist with replacing trees lost to the drought and ensuring that these new trees receive adequate water during continued drought conditions, Austin Water developed a process to partner with local organizations such as the non-profit organization Tree Folks, Inc., that promote the planting of new trees to provide them with Tree Gators, drip irrigation bags that significantly reduce water loss from evaporation.

- **Drought Tool Checkout Program**

To monitor and control water use while irrigating lawns, gardens, and trees, washing cars, and more, Austin Water has partnered with the Austin Public Library to offer soil moisture meters and garden hose meters through the library checkout system. The hose meters not only educate customers on how much water is used in watering their gardens, but can also be used to apply no more water than is needed.

- **AE Partnership on Multi-family Efficiency Program**

- **Revenue Stability Fee**

Beginning November 1, 2011, Austin Water included a new Revenue Stability Fee in customers' utility bills. Because many water service provision costs are fixed and cannot be adjusted in response to changes in water sales, this fee allows the utility to have a predictable revenue source to help mitigate revenue instability resulting from reduced sales, whether caused by an exceptionally wet year, drought restrictions, or increased conservation savings.

- **Joint Committee on Austin Water Utility's Financial Plan**

The task of the Joint Committee was to perform a full cost of service study and develop recommendations for short and long-term Austin Water financial plans which strengthen the utility's financial stability. The Joint Committee included representatives from the Resource Management Commission, the Water and Wastewater Commission and the Impact Fee Advisory Committee, along with input from the public. Committee recommendations included a tiered fixed fee that will increase revenue stability while still allowing customers to save money by reducing water use, a new distribution of rate tiers with the bottom 10% in the first tier, the second tier covering average indoor use, the third tier covering average outdoor use, and the fifth tier addressing the top 10 percent of water users.

- **Modified leak adjustment policy**

Austin Water provides bill adjustments to customers experiencing broken water pipes or other uncontrollable leaks. To make this policy more consistent with existing water conservation ordinances and to encourage customers to be more diligent about monitoring their outdoor water use and maintaining their irrigation systems, Austin Water no longer offers adjustments for excessive usage that is the result of setting a system to run too often or too long, or for broken or misdirected sprinkler heads or leaky outdoor faucets. Austin City Council approved a resolution adopting this policy change on May 12, 2011.

- **WaterWise Partner Programs**

Through its WaterWise Partner program, Austin Water is recognizing commercial customers that have made comprehensive water-efficiency upgrades in their facilities or incorporated efficiency measures into the design of new properties. Austin Water launched the WaterWise Hotel Partner program at the end of FY 2011 and anticipates eventually expanding the program to include restaurants/bars, schools, hospitals, and car washes.

- **New Studies in Partnership with Water Research Foundation**

AWU joined two new studies sponsored by Water Research Foundation being conducted in collaboration with other utilities around the nation. These included: "Methodology for Determining Baseline Commercial, Institutional, and Industrial End Uses of Water," and "Water Demand Forecasting in Uncertain Times: Isolating the Effects of the Great Recession Water Demands for

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INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project: **Water Conservation Tool (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 11/27/2012
Purpose: Interview Questions for Municipalities
Contact: College Station - Jennifer Nations (979-764-6223)

This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include?
    a. Program elements? Education based (water bill inserts, public events, radio, and direct mail to residential single family on irrigation) and tiered rates for residential customers. Just started effluent reuse.
    b. What BMPs do you use and what customer classes do they apply to? Primarily single family residential
    c. What incentives or rebates do you offer? Rebates on rain barrels ($25/rain barrel) and water sense toilets (up to $100/toilet if replace; new construction up to $50 if put in water sense at 1.28 gpf). Garden supplier sells refurbished barrels for $27.99. Producers Garden Center – Bryan.
    d. Do you provide items for "free"? No

2. Do you have additional items planned for your water conservation program?
    a. Additional program elements? Would like to ramp-up irrigation education program and include irrigation check-up like Austin. If implement can get rebate on new controller, sprinkler heads, etc.
    b. Any new BMPs?
    c. Any new incentives or rebates?

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us? Double use in summers and starting to see some reductions in peak to average ratio. Sending out surveys this week regarding what they did with water budgets and irrigation reduction and comparison of use to neighborhood average use.

For toilets, have an estimate of what saved in terms of volumes (approximately 10,000 to 11,000 gallons/toilet/year or 849,000 gallons/year all toilet rebates – 70 toilet rebates since April, 2010). Have done 77 rain barrel rebates.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

   Have AWE Tracking Tool, but don't have all of the inputs: number of customers is not accurate, energy costs difficult to narrow down. Plans to get inputs for tool developed in 2013. Has used TWDB cost savings by goal spreadsheet.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool?

   Yes – primarily Jennifer with environmental science background. Will work with Engineering staff, utilities, and asset management.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB?
   a. Customer Classes – Single Family, Multi-Family, Commercial, Commercial Irrigation Only, and maybe City Government
   b. Specific BMPs or groups of BMPs – Irrigation Retrofits and any irrigation BMPs, Education (if can quantify), toilet rebates, rain barrel rebates, conservation rate structures, system water audit and water loss, and reuse of treated effluent, waterwise landscape design. Also interested in targeting commercial for irrigation water conservation.
   c. Other items – Include cost avoided water treatment, on groundwater – need to purchase land/drill well, but don't buy water – just treatment and new facilities; may want to incorporate cost for source water.

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available?

   Yes, would be interested in participating and getting assistance. Can get demand data by customer class.

INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project: **Water Conservation Tool (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 12/03/2012
Purpose: Interview Questions for Municipalities
Contact: Dallas Water – Carol Davis (214-243-1175) and (Dr. Nguyen) Water Analyst

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This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include?
    a. Program elements? 5-yr Strategic Plan adopted by City Council (originally 2005 and updated in 2010): 1) city commitment, 2) education and outreach, 3) incentives and rebates. City's primarily ordinance, etc. and internal requirements and grants for City departments to compete for (i.e., irrigation retro-fits, indoor plumbing retro-fits, waterwise landscaping retro-fits). Amended water conservation ordinance to outdoor irrigation maximum 2 x weekly (last year) – based on street address.

       Education and outreach extensive: water wise education, tour of homes, seminars, environmental education initiative (K-12) for recycling and water conservation – administered by University of North Texas, water conservation mascot (Stu) for special appearances, website with lots information (savedallaswater.com), full-scale public awareness campaign (multi-media) – now lawn whisperer theme (web + facebook), collaborative with Dallas Water Utilities and Tarrant Regional Water, and grass-roots outreach for community speaking, booths, etc.

    b. What BMPs do you use and what customer classes do they apply to? Residential and CII.
    c. What incentives or rebates do you offer? Toilet give-away (voucher and rebate) – "New throne for your home". Low income elderly program (minor plumbing repair) – go into home and repair minor leaks for free and replace high-water using fixtures with ultra-low flow fixtures, aerators, toilets. CII initiative that is 6 months old. Free audit and rebate. Assess larger commercial customers on water efficiency and then offer rebates up to $100,000 to make upgrades. Have

completed 14 audits to date for very large facilities.
    d. Do you provide items for "free"? Free irrigation system audits in residential users.

2. Do you have additional items planned for your water conservation program?
    a. Additional program elements? Planning to launch residential irrigation system rebate program in late spring/early summer of 2013. Will offer rebates for residential customers to upgrade irrigation system. Have found outdoor irrigation maintenance and issues huge issue for Dallas residents. Typically poorly designed or not well-maintained. Complements irrigation audit program. Will also start offering facility manager training for audited CII customers.
    b. Any new BMPs?
    c. Any new incentives or rebates?

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us?

    Dr. Nguyen auditor to measure effectiveness of programs. They have been in place since 2001 – 2002.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

    Two components – water conservation program effectiveness of program (overall average from savings for program). Quantify savings in terms of million gallons. Use mathematical model to quantify in terms of yearly and monthly. Also, provides details on savings of individual programs.

    Will share results of savings.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool?

    Probably not since have spent significant time and effort on model developed for Dallas and to maintain consistency plus model is more sophisticated than what is under development.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB?
    a. Customer Classes – Suggest sector analysis to track gpcd (i.e., SF, MF, CII) to help track use. The simpler the better. Many smaller utilities may not have capability to break-out sectors to measure gpcd.
    b. Specific BMPs or groups of BMPs –
    c. Other items – Keep it simple. Keep the spreadsheet simple. Keep reporting requirements simple, not too lengthy, and not too complex. Annual reporting is going to take more time to complete. More requirements will be challenging and

overwhelming for small agencies. Can be challenging since different levels sophistication and different amounts data.

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available?

   N/A

INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project: **Water Conservation Tool (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 11/28/2012
Purpose: Interview Questions for Municipalities
Contact: El Paso - Anai Padilla (915-621-2007)

This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include?
    a. Program elements? No BMPs implemented right now because met conservation goals in 2000. Preparing for continued drought. Constructing infrastructure changes to move groundwater around City to other areas that use surface water. Constructing new wells. Have reclaimed accounts. Yard (irrigation) meters have different rate structures. Have a tiered rate structure.
    b. What BMPs do you use and what customer classes do they apply to? Not at this point. Offer water audits for customers. Work with parks for parks audits turned over to City. Use TAMU Irrigation Audit software.
    c. What incentives or rebates do you offer? Not right now and not planned.
    d. Do you provide items for "free"? No

2. Do you have additional items planned for your water conservation program?
    a. Additional program elements? May reconvene advisory committee with LEED certified members to look into new technologies (super low-flow toilets, building codes, a/c, plumbing, etc.)
    b. Any new BMPs?
    c. Any new incentives or rebates?

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us? N/A.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

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Do not use AWE Tracking tool. No rebates or incentives because reached goal in 2000.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool?

   If available and easy-to-use, but already done inside with budget analysis.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB?
   a. Customer Classes – Residential, Commercial (MF Residential and Commercial), Government, Yard (Irrigation), and Industrial
   b. Specific BMPs or groups of BMPs – toilets, a/c, and irrigation changes
   c. Other items –

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available?

   N/A – larger size city.

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INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project:	**Water Conservation Tool (TWDB Contract No. 1248321507)**
Client:	Texas Water Development Board
From:	Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date:	11/27/2012
Purpose:	Interview Questions for Municipalities
Contact:	Fort Worth Water - Mary Gugliuzza, Public Information (817-392-8253) and Micah Reed, Water Conservation Coordinator (817-392-8211)

This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include?
   a. Program elements? Education and Outreach (Mary) – water bill inserts, not much social media, some electronic distribution via email, speaking at schools and youth organizations, talks to civic organizations, annual water quality report includes educational elements on water conservation, participate in resource action program's water wise program/partnering with Tarrant Regional, annual event with Fort Worth ISD 4th graders (approx. 3,000/year) by partnering with many federal/state agencies.
   b. What BMPs do you use and what customer classes do they apply to? Care program targets seniors over 70 or low-income (meet poverty guidelines) maximum of 2 free and must have old toilets; pay for installation in this program. Small piece of overall program. Conservation ordinance prohibits watering between 10 am and 6 pm year-round. Have tiered rate structure (in ccf not gallons) – revised in 2003 to three-tiered for residential rates. In 2006 modified break-points and in 2008 to four tiers in rate structure. In 2008, irrigation rates went to two-tiered structure and in 2011 three-tiered structures. In 2005, changed commercial/industrial to go from declining block rate to uniform rates and created super-user category.
   c. What incentives or rebates do you offer? No rebates.
   d. Do you provide items for "free"? Toilet retro-fit program (includes commercial and residential voucher program – have approx. 7,000/year free – user must install and max. of 2 provided), ICI audits to commercial and industrial users free of charge (includes pay-back periods) – program is in third year. Random follow-ups on residential and follow-ups on all commercial. Program is in fourth year. Also, offer free irrigation systems check-ups.

2. Do you have additional items planned for your water conservation program?
    a. Additional program elements? In planning and maintaining phase and then focusing on outdoor use.
    b. Any new BMPs?
    c. Any new incentives or rebates?

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us? Water Wise program – each student gets kit with low-flow shower heads and aerators, toilet water bag – includes pre and post-surveys. Have extrapolated savings based on schools funded in Fort Worth.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

   Yes – do it all in excel. Use formulas from Vicker's AWWA book Water Use and Conservation based on flushes/day/person, etc. Primarily estimating gallons saved. Only one of three programs has a direct cost.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool?

   Yes – would use tool. It would be Micah and a staff analyst as well as a couple of conservation specialists – backgrounds vary from Environmental Science as well as other fields, but all have been in industry for seven years plus.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB?
    a. Customer Classes – SF, MF, and CII. For reports to TWDB, include MF in residential, but internally separate things out. Institutional may be classified in commercial class. City is separated out. Irrigation meters are separate for commercial classification. Some large residences do separate out.
    b. Specific BMPs or groups of BMPs – Focus is currently on outdoor water use items. Not sure about ET controllers.
    c. Other items – Try to tie new programs to a study from the TWDB on cost of building future reservoirs and look at cost of program vs. savings vs. new water (recurring vs. one-time cost). Helps to show demand decrease and decrease in infrastructure for operations group. How does their institutional compare to national average?

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available?

   N/A.

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Subject: RE: TWDB Water Conservation Modeling Tool - Fort Worth Data
From: "Reed, Micah" <Micah.Reed@fortworthtexas.gov>
Date: Thu, Mar 21, 2013 8:57 am
To: "'jwalker@watearth.com'" <jwalker@watearth.com>

For the smartflush toilet program, our target is 7,000 toilets. For the ICI audits we don't have a target, but the cost has averaged $1,500 to $2,000 per each audit completed. Because of the size and the detail of the audits, $250,000 is too much to try to spend in one year so that total will be adjusted in the 2014 budget. A good target number for this program, based on our experience, would be about 50 audits per year for a total cost of $100,000.

From: jwalker@watearth.com [mailto:jwalker@watearth.com]
Sent: Tuesday, March 19, 2013 5:15 PM
To: Reed, Micah
Cc: jwalker@watearth.com
Subject: RE: TWDB Water Conservation Modeling Tool - Fort Worth Data

Thanks Micah. Do you have a targeted number of participants for the toilet rebates and ICI audits, so we can approximate the cost per participant?

Jennifer

Jennifer J. Walker, P.E., D.WRE, CFM, QSD
President
Watearth, Inc.
jwalker@watearth.com
832.444.0663
1.877.302.2084
1.800.519.3774 (F)

Visit our website at: www.watearth.com

> -------- Original Message --------
> Subject: RE: TWDB Water Conservation Modeling Tool - Additional Data Assistance
> From: "Reed, Micah" <Micah.Reed@fortworthtexas.gov>
> Date: Tue, March 19, 2013 9:12 am
> To: "'jwalker@watearth.com'" <jwalker@watearth.com>
>
> For ICI audits we budgeted $250,000 in 2012. For the toilet replacement program, we budgeted $700,000. I don't break down overhead, labor etc. for each program, rather I have a budget for all conservation functions that includes staff costs and overhead. For 2012, the adopted budget was $1.8 million. That number includes all marketing, administrative and personnel costs as well as products for programs.
>
> ---
>
> **From:** jwalker@watearth.com [mailto:jwalker@watearth.com]
> **Sent:** Monday, March 18, 2013 3:08 PM
> **To:** Reed, Micah
> **Cc:** jwalker@watearth.com; Gugliuzza, Mary

Subject: TWDB Water Conservation Modeling Tool - Additional Data Assistance

Micah and Mary,

In developing the modeling tool for the TWDB, we're trying to use data for the state rather than nationally published values. I'd appreciate your help with the following, if available.

The agency's cost to implement the program (i.e., administrative, labor, product, overhead, marketing/outreach) as well as known participant costs (initial and follow-on) for the following:

1. non-residential water use surveys
2. showerheads, aerators, and toilet kits (SF and MF)

Please call if you'd like to discuss further. Thanks for your input.

Jennifer

Jennifer J. Walker, P.E., D.WRE, CFM, QSD
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Water Resources + Green Infrastructure

INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project: **Water Conservation Tool (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 12/18/2012
Purpose: Interview Questions for Municipalities
Contact: Round Rock – Jessica Woods (512.671.2872)

This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include?
    a. Program elements? Very new program started in 2009. Educational includes literature in City buildings. Provide presentations to schools, adult groups, etc. Work with Master Gardeners and give presentations to their classes. Also, have leak and loss detection program for internal users. Also, replacing every meter in the City (to be completed end of 2013) to AMR.
    b. What BMPs do you use and what customer classes do they apply to? Do not specifically target customer classes – anyone can benefit, although single-family residential is primary participant.
    c. What incentives or rebates do you offer? Toilet replacement program – rebate is 50% of cost up to maximum of $100 per toilet off water sense list. Just started washing machine rebate for machines off CEC list. Rebate is $75 per washer. Irrigation system upgrade rebate for upgrading existing system to be more efficient (i.e., reducing water pressure, adding rain sensors, soil moisture sensors, etc.). Rebate a portion of the cost with a maximum of $400 for residential and a minimum of $50. One-day sale of 50-gallon rain barrels at a discounted rate at $58 – sold 400 barrels. Planning to hold again. Year-round sale "homemade" version at $25. Programs are based on a specific budget until it runs out.
    d. Do you provide items for "free"? Only dye tablets to check toilets for leaks. Periodically may give out hose timers or other items. Free irrigation system inspection and evaluation.

2. Do you have additional items planned for your water conservation program?
    a. Additional program elements? Focus on outdoor water programs for future and anticipate new watering restrictions.

b. Any new BMPs? May consider working with toro company for free sprinkler program (freesprinklers.com) on a pilot program for precision nozzles (similar to State of California). Free to customers, but pay distributor $2.25 each.
c. Any new incentives or rebates? May include rebate for large rainwater harvesting systems. Or, may have rain barrel program year-round.

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us?

   Use values from EPA water sense program to estimate savings. For irrigation systems evaluations, track usage pre (from billing) and post from recommendations of change in water meter usage while at site with changes implemented.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

   N/A – just spreadsheet calculations as indicated above.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool?

   Yes – would use the tool. Develop spreadsheet that is not as cumbersome as AWE Tracking Tool due to time and labor constraints. Masters in Geography is background and Jessica will be primary person.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB? Less options than AWE Tracking Tool. Not so much detail on energy rates. Focus more on water.
   a. Customer Classes – Single Family, Multi-Family, Commercial, Industrial, and Institutional. They bill by meter size, but can access usage by classes. City buildings are tracked separately.
   b. Specific BMPs or groups of BMPs – Outdoor emphasis, would like to see plant replacement included.
   c. Other items –

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available? Yes, could separate data by customer classes and is interested in participating.

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Subject: RE: TWDB Water Conservation Modeling Tool - Round Rock Irrigation Items
From: Jessica Woods <jwoods@roundrocktexas.gov>
Date: Thu, May 02, 2013 8:01 am
To: "'jwalker@watearth.com'" <jwalker@watearth.com>

I do not.

Jessica

From: jwalker@watearth.com [mailto:jwalker@watearth.com]
Sent: Wednesday, May 01, 2013 4:03 PM
To: Jessica Woods
Cc: jwalker@watearth.com
Subject: RE: TWDB Water Conservation Modeling Tool - Round Rock Irrigation Items

Thanks Jessica. Do you have an approximate number of nozzles you are planning to distribute with this year?
Jennifer

> -------- Original Message --------
> Subject: Re: TWDB Water Conservation Modeling Tool - Round Rock Irrigation Items
> From: Jessica Woods <jwoods@roundrocktexas.gov>
> Date: Wed, May 01, 2013 1:41 pm
> To: "jwalker@watearth.com" <jwalker@watearth.com>
>
> Yes, that's program staff, use of a pre-existing website, nozzles
>
> Sent from my iPhone
>
> On May 1, 2013, at 11:07 AM, "jwalker@watearth.com" <jwalker@watearth.com> wrote:
>
>> Jessica,
>>
>> One last question - does the $7,000 cover the entire program (staff, etc.) or just the purchase of the nozzles?
>>
>> Thanks,
>>
>> Jennifer
>>
>>> -------- Original Message --------
>>> Subject: Re: TWDB Water Conservation Modeling Tool - Round Rock Irrigation Items
>>> From: Jessica Woods <jwoods@roundrocktexas.gov>
>>> Date: Wed, May 01, 2013 11:01 am
>>> To: "jwalker@watearth.com" <jwalker@watearth.com>
>>>
>>> Close to $2.75 each I think
>>>
>>> Sent from my iPhone
>>>
>>> On May 1, 2013, at 10:09 AM, "jwalker@watearth.com" <jwalker@watearth.com> wrote:
>>>
>>>> Thanks Jessica. Do you know a cost per nozzle?
>>>>
>>>> Jennifer
>>>>
>>>>> -------- Original Message --------
>>>>> Subject: RE: TWDB Water Conservation Modeling Tool - Round Rock Irrigation Items
>>>>> From: Jessica Woods <jwoods@roundrocktexas.gov>
>>>>> Date: Wed, May 01, 2013 8:02 am
>>>>> To: "'jwalker@watearth.com'" <jwalker@watearth.com>
>>>>>
>>>>> Hi Jennifer, answers are below.
>>>>>
>>>>> *Jessica Woods*
>>>>> Water Conservation Program Coordinator
>>>>> City of Round Rock
>>>>> 2008 Enterprise Dr.
>>>>> Round Rock, TX 78664
>>>>>
>>>>> 512.671.2872 office
>>>>> 512.844.8514 mobile
>>>>> jwoods@roundrocktexas.gov

From: jwalker@watearth.com [mailto:jwalker@watearth.com]
Sent: Tuesday, April 30, 2013 6:58 PM
To: Jessica Woods
Cc: jwalker@watearth.com
Subject: TWDB Water Conservation Modeling Tool - Round Rock Irrigation Items

Jessica,

The information you provided below has been very helpful.

Do you happen to have an approximate idea of what the irrigation nozzles will cost the City? $7000 annually

Also, do you have an average ICI or non-residential rebate for the irrigation items you mention below or an idea of the rebates to the school district per site? Any insights here (even if not exact) would be great. There have been so few, it's been about $75 per account (the rebates are per water account, many HOAs/sites, have multiple water accounts and they are simply adding a sensor on each controller, so that's a pretty minimal rebate).

Thanks again for your assistance.

Jennifer

Jennifer J. Walker, P.E., D.WRE, CFM, QSD
President
Watearth, Inc.
jwalker@watearth.com
832.444.0663
1.877.302.2084
1.800.519.3774 (F)

Visit our website at: www.watearth.com

-------- Original Message --------
Subject: RE: TWDB Water Conservation Modeling Tool Research Project - Additional Data Assistance
From: Jessica Woods <jwoods@roundrocktexas.gov>
Date: Mon, March 25, 2013 4:02 pm
To: "'jwalker@watearth.com'" <jwalker@watearth.com>

Hi Jennifer,
Things are still going busy here, sorry for the delay in getting back to you, again! So to answer your questions:

1. So far the toilet rebate program has only had participation with single-family, residential customers, though it has been open to all customer classes. The average rebate since it's been offered (4 seasons now) has been for $79.24/toilet; there has been zero paid advertising for the program—strictly website, announcements on the water bill, city newsletters, and me going to talk to local plumbing stores about the program. There are no product costs, as I'm not purchasing any product to give out to these customers. Labor/staff costs would be my time and the finance department's time to cut the checks. I honestly have no idea how much time this is and can research it for you if needed.

   The grand total of money spent on rebates each year has varied:
   - Pilot program in 2010=$22,908.26
   - FY 2010-11 = $12,440.57 (number is lower here than other years because I was purchasing other materials—drought signs, materials to assist with other activities)
   - FY 11-12 = $20,660.47
   - FY 12-13 = $15,544.32 (probably will increase to about $20k, as program is still going on for a little while longer)

2. The irrigation nozzle specific program has not yet been implemented, though we do have an on-going irrigation rebate program that rebates items in addition to nozzles (like sensors, pressure reduction valves, etc). Participation has always been a little lower in this program. Effort here has been less as well. Advertised in the same ways as the toilet program above. There are no product costs here, as I'm not purchasing any give-away product for these customers. The staff time is probably longer here, though again, I have not actually calculated the time spend with each application. These all require a site inspection, which the toilet doesn't, so that automatically increases the time by driving, contacting the customer.

   Average rebate over the 3 seasons has been $205.16 I'm not including this year's number's in this average because I have our school district that is participating and has skewed the number for the average rebate, as theirs is much larger than the typical residential rebate.

   Funds dedicated to the irrigation rebate each FY have been a little varied as well:
   - Pilot 2010 = $3181.19
   - FY 2010-11 = $5297.93

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Subject: RE: TWDB Water Conservation Modeling Tool Research Project - Additional Data Assistance
From: Jessica Woods <jwoods@roundrocktexas.gov>
Date: Mon, Mar 25, 2013 4:02 pm
To: "'jwalker@watearth.com'" <jwalker@watearth.com>

Hi Jennifer,
Things are still going busy here, sorry for the delay in getting back to you, again! So to answer your questions:

1. So far the toilet rebate program has only had participation with single-family, residential customers, though it has been open to all customer classes. The average rebate since it's been offered (4 seasons now) has been for $79.24/toilet; there has been zero paid advertising for the program—strictly website, announcements on the water bill, city newsletters, and me going to talk to local plumbing stores about the program. There are no product costs, as I'm not purchasing any product to give out to these customers. Labor/staff costs would be my time and the finance department's time to cut the checks. I honestly have no idea how much time this is and can research it for you if needed.

   The grand total of money spent on rebates each year has varied:
   - Pilot program in 2010=$22,908.26
   - FY 2010-11 = $12,440.57 (number is lower here than other years because I was purchasing other materials—drought signs, materials to assist with other activities)
   - FY 11-12 = $20,660.47
   - FY 12-13 = $15,544.32 (probably will increase to about $20k, as program is still going on for a little while longer)

2. The irrigation nozzle specific program has not yet been implemented, though we do have an on-going irrigation rebate program that rebates items in addition to nozzles (like sensors, pressure reduction valves, etc). Participation has always been a little lower in this program. Effort here has been less as well. Advertised in the same ways as the toilet program above. There are no product costs here, as I'm not purchasing any give-away product for these customers. The staff time is probably longer here, though again, I have not actually calculated the time spend with each application. These all require a site inspection, which the toilet doesn't, so that automatically increases the time by driving, contacting the customer.

   Average rebate over the 3 seasons has been $205.16 I'm not including this year's number's in this average because I have our school district that is participating and has skewed the number for the average rebate, as theirs is much larger than the typical residential rebate.

   Funds dedicated to the irrigation rebate each FY have been a little varied as well:
   - Pilot 2010 = $3181.19
   - FY 2010-11 = $5297.93
   - FY 11-12 = $6080.78
   - FY 12-13 (still open) = $2350.60

I'm sure I have overlooked something you have asked, so please let me know what else I may be able to assist with.

INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project: **Water Conservation Tool (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 11/28/2012
Purpose: Interview Questions for Municipalities
Contact: SAWS – Elliot Fry, Karen Guz, and Phillip Weynard (210-233-3118)

This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include? Do not like (ET) weather-based irrigation controllers, which now have water-sense label. The data shows it works and the data shows it doesn't work. May not really work unless aimed at high users that excessively irrigate and it is programmed well, then can save. Otherwise, if given out may increase water use for frugal people that ask for them. CAVEAT – only target at high users with irrigation systems.
    a. Program elements?
    b. What BMPs do you use and what customer classes do they apply to? Residential – toilet replacements, commercial toilet rebates, custom rebates commercial, industrial, institutional. Irrigation programs for both residential and commercial. Not as much data on conversion of spray to drip irrigation. They have some data on enforcement (i.e., pre and post citations for spraying street, etc. – residential more consistent).
    c. What incentives or rebates do you offer?
    d. Do you provide items for "free"? Residential toilets if meet criteria and install if very low income. Only one more year for toilets and may open to senior/disabled for installation. Cost is $65/toilet installation. Toilet is $105 and cost/ac-ft savings is excellent. Commercial buy toilets and pay installation if enough volume to make it logical. Sometimes cheaper for them to buy in bulk and other utilities can tie-in to process and piggy-back on bid.

2. Do you have additional items planned for your water conservation program?
    a. Additional program elements? Moving towards outdoor and irrigation programs, although some commercial/industrial/institutional programs are still a good program. Now shifting to six month metric to target peak use in summer months.

b. Any new BMPs? Rain sensors properly installed should interrupt 8 irrigation cycles/year and each stopped irrigation cycle saves 2,000 gallons (based on looking at 100s of irrigation systems). Results in 16,000 gallons/year x 3 years life span = total per household and then overall total.
c. Any new incentives or rebates? SAWS bought rain sensors in bulk at $40 each down from $100 and can afford $60 installation with irrigator on contract, so would not exceed that in a rebate if they want to get installed sooner. Irrigator must be on accepted list though. Smaller utilities might have to offer rebate, but harder to manage did buy right one, etc. Trying to get higher cost/ac-ft approved with no cost share by customer.

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us? Based on later conversations with Elliott Fry, costs are not tracked on a BMP basis and funds are often transferred between programs.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

   Have developed an excel spreadsheet that goes through every program effort to estimate how much saved in ac-ft per year. For planning, typically just look at SAWS cost per acre-foot to make sure in that parameter. If big project (i.e., commercial), will look at consumer's cost-benefit and payback period. Typically people want good payback period like 2 to 3 years, although some will make changes with 5 to 7 year payback period.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool?

   They have their own spreadsheet modeling tool. Elliott can send summary of what was saved from program.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB? How much water did they save would be useful – most people have no idea. They typically debate assumptions and numbers and life-span. Maybe best to use non-standard inflation rates (i.e., direction water rates are going in) rather than just the same one inflation index in AWE Tracking Tool. Finance department has suggested more sophisticated return on investment for large projects to promote custom rebate projects. In general though, people understand simpler methods. People like payback period and understand it well. Everything on one screen is good. Some buttons ok, but not too many.
   a. Customer Classes – Residential, Commercial/Industrial/Institutional, and MF Residential
   b. Specific BMPs or groups of BMPs – The hardest BMPs to put a value on are if depending on customer behavior to have success (i.e., turf conversion to native plants dependent on whether they change watering pattern). The degree of savings

varies based on watering patterns to start. Initial programs ended up with no savings due to old irrigation systems not switched out. Now focus on change of irrigation systems with change in plants for better success. Hold-back some rebate until succeed in saving for one-year.

c. Other items – 1) Outdoor programs are very important - different values throughout state (i.e., interrupted events in rain sensors) due to changes in rainfall. **Include especially if peak summer demand is the issue that outdoor programs need to be included**, 2) Key item = factor x # units installed per year. May need drop-down with factors for various areas of state. Or, could list as average cost/1,000 gallons. 3) consider offering conservation consult or audit as get pretty good numbers on those programs (averages probably work here regardless of where in state – see San Marcos, San Antonio, Austin), 4) target very high users (top 1%) and send a letter with information on how to change and get pretty consistent long-term performance as has Austin and Frisco, 5) conversion spray to drip.

Dean Michelow with Tarrant (they have good savings numbers) one City has very good data on requiring audits of very large commercial sites. SAWS thinks it works, but don't have the data to support it yet. Carol for Dallas and Dreema Gross Austin.

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available?

   N/A – larger size city. Elliott will review as he reviewed AWE tool and provide feedback/input.

INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project: **Water Conservation Tool (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 11/28/2012
Purpose: Interview Questions for Municipalities
Contact: San Angelo - Toni Fox (325-657-4510)

This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include? City Council now interested because of droughts.
    a. Program elements? Basic BMPs right now.
    b. What BMPs do you use and what customer classes do they apply to? Education, public tv, news, and billboards. Horticulturist is producing videos for website with regards to water filtration, watering trees, sprinklers, etc. Consultation with homeowners when violation notice sent. Tiered rate structures and drought-level surcharges.
    c. What incentives or rebates do you offer? No incentives or rebates.
    d. Do you provide items for "free"? Low-flow shower heads, rain gauges, aerators.

2. Do you have additional items planned for your water conservation program? Hopefully, with City Council involved.
    a. Additional program elements? Will probably look at toilets, landscape rebates, irrigation.
    b. Any new BMPs?
    c. Any new incentives or rebates? Probably will look at toilet rebates.

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us? N/A.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

    Do not use AWE Tracking tool or other tools at this point.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool?

   Yes – use excel all the time. Funding and manpower the biggest issue. Business and HR background; water conservation, public education, and customer service manager.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB? Information help convince manager and council of benefit.
   a. Customer Classes – Residential, Apartments, Commercial, Industrial, Government, Irrigation (not required as separate meter, have about 1,600 sprinkler meters)
   b. Specific BMPs or groups of BMPs – toilets, a/c, and irrigation changes
   c. Other items –

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available?

   Might be interested if approval from director, but would need written request to make decision.

INTERVIEW QUESTIONS FOR MUNICIPAL WATER PROVIDERS

Project: **Water Conservation Tool (TWDB Contract No. 1248321507)**
Client: Texas Water Development Board
From: Jennifer J. Walker, P.E., D.WRE, CFM, QSD
Date: 12/03/2012
Purpose: Interview Questions for Municipalities
Contact: San Marcos – Jan Klein (512-393-8310)

This research will assist municipal water providers in their conservation planning and implementation through the development of a "desktop tool". This "tool" will allow for evaluation and measurement of the impacts and savings resulting from the implementation of their water conservation program. The need for this "tool" was identified in the *TWDB Water Conservation Savings Quantification Study*.

The "tool" will assist in planning for future water supply and infrastructure needs, help in evaluating cost-efficiency and water savings effectiveness of programs and measures, track effectiveness and water savings over time, and establish a consistent method of reporting.

1. What does your water conservation program currently include?
    a. Program elements? Public (promote green, energy, water conservation at events and do presentations for groups) and school education (not as much as used to because Edwards Aquifer Authority provides a similar program). Annual groundwater festival. Quarterly newsletter in utility bills. Press releases on drought restrictions. Tiered rate structure. Drought restrictions stage 2 now – one time per week watering restriction. When not in drought restrictions, no daytime watering. No charity car washes.
    b. What BMPs do you use and what customer classes do they apply to?
    c. What incentives or rebates do you offer? High-efficiency toilets since 1995. Opened to commercial a few years ago, but not a lot right now. SF, MF, and commercial, but targeting old apartments and hotels for program. Up to $100 per toilet high volume to high efficiency or low-flow to high efficiency (new or replace) = $25. Clothes washer rebate (consortium for energy efficiency tiers to determine what qualifies). Most qualify for $100 rebate. Rain barrel rebate = $50 or 50-percent, whichever is lower.
    d. Do you provide items for "free"? Free energy and water audits for residential or commercial. Free shower heads and faucet aerators with toilet program (primarily MF and hotels). Might offer partial irrigation audits again (previously offered) – more of a check-up/inspection.

2. Do you have additional items planned for your water conservation program?
    a. Additional program elements?
    b. Any new BMPs?
    c. Any new incentives or rebates? Want to expand rain barrel to cisterns. Probably

same as Austin ($1/gallon for pressurized systems).

3. Do you collect information on costs, cost-benefit, avoided costs, and cost savings from your program? If so, can you provide them for us?

   Only quantify savings in terms of dollars per acre-foot for washer and toilet rebate.

4. What modeling tools do you currently use for to quantify water conservation savings and cost-benefits?

   Use excel to quantify currently. California Urban Council method for toilets and clothes washers.

5. Will your agency use the desktop tool developed by the TWDB? If so, what type of staff (i.e., engineer, administrative, consultant, scientist, etc.) will likely work with the tool?

   Yes would use the tool. Environmental Science background.

6. What, if any, features or characteristics would you like to have included in the desktop tool being developed by the TWDB?
   a. Customer Classes – SF, MF, ICI. City could be helpful.
   b. Specific BMPs or groups of BMPs – Nice if education programs could be included, but understand hard to get numbers on. Open to outdoor programs, but haven't done it yet because values seemed inconclusive.
   c. Other items – Needs to be user friendly and intuitive or won't be used. Standardized tool would be nice. More user friendly than AWE. Understand benefits are estimates and prefer user-friendly and easy over detailed, cumbersome, and "100% correct".

7. If you are a small metropolitan area, would you be willing to provide us with data to use in beta testing the desktop tool? If so, what data do you have available?

   Billing data can be separated into classes. Yes, would be interested in being a beta tester.

APPENDIX D: DEFAULT VALUES IN THE TWDB WATER CONSERVATION BMP MODEL

EDUCATION & PUBLIC AWARENESS DEFAULT SAVINGS AND COST VALUES [1]

Item	Education & Public Awareness
	Education
Customer Class	SF and MF
Items Included in BMP	Educational Outreach
Units	gpd/account
Water Savings per Unit[2]	0.50%
Annual Rate of Savings Decay[3] (%)	0
Peak Period Savings[4] (% of Annual Savings)	50
Life-Cycle[5,6] (yrs)	2
Free Riders[7] (%)	0
Year Costs Denominated[8]	2013
Rebate Cost[9] ($)	0
Program Cost[10] ($)	2.11
Sewer Savings per Unit[11]	0.25%

Notes:

1. Calculations do not account for conversions due to plumbing codes or cost-benefit to customers, including water, sewer, or electricity rate savings.
   Utilities assumed not to have follow-up costs.
   BMPs components are consistent with the TWDB Report 362 *Water Conservation BMPs Implementation Guide* , November, 2004 to the extent practical.
2. Water savings per unit for Educational BMPs based on December, 2011 East Bay Municipal Utility District *Water Conservation Master Plan.*
3. Annual rate of savings decay for Educational BMPs assumed at zero.
4. Peak period savings assumed to be same as average annual and a value of 50-percent is used, based on a six-month peak season and six-month non-peak season.
5. Life-cycle of Educational BMPs based on December, 2011 East Bay Municipal Utility District *Water Conservation Master Plan* .
6. Note not used this table.
7. Assume no free riders.
8. Assume all costs in 2013 dollars. Conversion for costs from other years based on escalating at 2.8% from the municipal cost index.
9. Assume no rebates for Education BMPs.
10. Program cost includes: utility cost of products, administrative, overhead, labor, marketing, outreach, and other miscellaneous costs.
    Utility costs for Educational BMPs based on $2.00 per account from December, 2011 East Bay Municipal Utility District *Water Conservation Master Plan* escalated to 2013 dollars.
11. Sewer savings assumed to equal 50% of water savings for Educational BMPs. This savings in wastewater flow is used only in determining avoided costs for utility.

CONSERVATION ANALYSIS AND PLANNING DEFAULT SAVINGS AND COST VALUES[1]

Item	Residential Water Use Surveys - Showerhead/Aerator Replacements	Residential Water Use Surveys - Irrigation Audit	Residential Water Use Surveys - Showerhead/Aerator Replacements	Residential Water Use Surveys - Irrigation Audit
Customer Class	SF	SF	MF	MF
Items Included in BMP	1 Showerhead and Aerator Replacement	Irrigation Audit	1 Showerhead and Aerator Replacement	Irrigation Audit
Units	gpd/device	gpd/household	gpd/device	gpd/household
Water Savings per Unit[2]	5.5	26	5.5	208
Annual Rate of Savings Decay[3] (%)	0	0	0	0
Peak Period Savings[4] (% of Annual Savings)	50	70	50	70
Life-Cycle[5,6] (yrs)	Permanent	5	Permanent	5
Free Riders[7] (%)	0	0	0	0
Year Costs Denominated[8]	2013	2013	2013	2013
Rebate Cost[9] ($)	0.00	0.00	0.00	0.00
Program Cost[10] ($)	133.02	133.02	5.00	184.63
Sewer Savings per Unit[11]	5.5	0	5.5	0

Notes:

1. Calculations do not account for conversions due to plumbing codes or cost-benefit to customers, including water, sewer, or electricity rate savings. Utilities assumed not to have follow-up costs.
   BMPs components are consistent with the TWDB Report 362 *Water Conservation BMPs Implementation Guide* , November, 2004 to the extent practical.
2. Water savings per unit for Residential Surveys based on data from TWDB Report 362 *Water Conservation BMPs Implementation Guide* , November, 2004.
3. Annual rate of savings decay for Residential Surveys assumed at zero.
4. Peak period savings assumed to equal average savings for indoor fixtures and a value of 50-percent is used, based on a six-month peak season and six-month non-peak season.
   Peak period savings for landscape-based BMPs assumed at 70-percent of annual savings.
5. Life-cycle of irrigation audits portion of Residential Surveys based on December, 2011 East Bay Municipal Utility District *Water Conservation Master Plan* .
6. Based on TWDB Report 362 *Water Conservation BMPs Implementation Guide* , November, 2004, the life-cycle of showerheads and aerators is five to 15 years, but set as permanent since new fixtures must be efficient.
7. Assume no free riders for surveys as changes typically made during survey.
8. Assume all costs in 2013 dollars. Conversion for costs from other years based on escalating at 2.8% from the municipal cost index.
9. Assume no rebates for Residential (SF and MF) Surveys and that provided directly by City staff or contractor based on phone interviews with City of San Marcos, City of Dallas, and City of Fort Worth.
10. Program cost includes: utility cost of products, administrative, overhead, labor, marketing, outreach, and other miscellaneous costs.
    Utility costs for SF and MF Irrigation Audit assumed at average of all costs and maximum of all costsfor Residential Surveys, respectively, listed in TWDB Report 362 Water Conservation BMPs Implementation Guide, November, 2004.
    Utility costs for SF and MF Showerhead and Aerators Replacement assumed at $5 per participant based on Water Wise kits distributed to students by the City of Fort Worth. For direct installation approach, default values should be revised accordingly.
11. Sewer savings assumed to equal water savings for indoor plumbing fixtures for Residential Surveys. This savings in wastewater flow is used only in determining avoided costs for utility.

REBATES, RETROFITS, AND INCENTIVES DEFAULT SAVINGS AND COST VALUES [1]

		Indoor Fixtures								Outdoor
Item	Non-Residential Water Use Surveys	Residential Toilet Replacement Programs (ULFT)	Residential Toilet Replacement Programs (ULFT)	Residential HE Washer	Residential HE Washer	Showerhead, Aerator, and Toilet Flapper Retrofit		Showerhead, Aerator, and Toilet Flapper Retrofit		Water Efficient Landscape Design
Customer Class	ICI	SF	MF	SF	MF	SF	SF	MF	MF	SF
Items Included in BMP	Varies	All Toilets in Household Replaced	All Toilets in Household Replaced	1 Washer Replacement	1 Washer Replacement in Unit	1 Showerhead and Aerators	1 Toilet Flapper Retrofit	1 Showerhead and Aerators	1 Toilet Flapper Retrofit	Turf Grass Replacement
Units	gpd/account	gpcd	gpcd	gpcd	gpcd	gpd	gpd	gpd	gpd	gpcd
Water Savings per Unit[2]	1,133.71	12.13	12.13	6.45	6.45	5.50	12.80	5.50	12.80	3.50
Annual Rate of Savings Decay[3] (%)	0	0	0	0	0	0	20	0	20	0
Peak Period Savings[4] (% of Annual Savings)	60	50	50	50	50	50	50	50	50	70
Life-Cycle[5,6] (yrs)	5	Permanent	Permanent	Permanent	Permanent	Permanent	5	Permanent	5	20
Free Riders[7] (%)	0	25	25	10	10	0	0	0	0	0
Year Costs Denominated[8]	2013	2013	2013	2013	2013	2013	2013	2013	2013	2013
Rebate Cost[9] ($)	0.00	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00	1,000.00
Program Cost[10] ($)	1,750.00	100.00	100.00	44.23	44.23	5.00	0.00	5.00	0.00	162.19
Sewer Savings per Unit[11]	866.2	12.13	12.13	6.45	6.45	5.50	12.80	5.50	12.80	0

Notes:

1. Calculations do not account for conversions due to plumbing codes or cost-benefit to customers, including water, sewer, or electricity rate savings. Utilities assumed not to have follow-up costs.
   BMPs components are consistent with the TWDB Report 362 *Water Conservation BMPs Implementation Guide*, November, 2004 to the extent practical.
2. Water savings per unit based on February 28, 2013 TWDB *Draft Population and Municipal Water Demand Projections for the 2016 Regional Water Plans and 2017 State Water Plan Memorandum.*
   For Showerhead, Aerator, and Toilet Flapper Retrofit, total of 18.3 gpd includes 5.5 gpd for showerhead and aerators and 12.8 gpd/toilet. This BMP is split into two components due to differing life-cycles and decay rates. All costs are assigned under Showerhead and Aerators; however, costs include the Toilet Flapper Retrofit. Both BMP components should be used to estimate savings.
   While a 2009 law that takes effect in January, 2014 requires increased showerhead efficiency requirements from 2.75 gallons per minute to 2.5 gallons per minute, this slight increase in efficiency is neglected in the model, based on input from the TWDB's Project Manager.
   For Residential Toilet Replacement Programs, the 12.13 gpcd includes 10.6 gpcd for replacing all toilets in household from the TWDB Report 362 *Water Conservation Implementation Guide*, November 2004 plus the additional 1.63 gpcd savings noted in the February 28, 2013 *TWDB Draft Population and Municipal Water Demand Projections for the 2016 Regional Water Plans and 2017 State Water Plan Memorandum* due to the 2009 law that takes effect in January, 2014.
   Water savings per unit of Non-Residential Surveys based on Table 2-11 and Table 3-3 from the 2003 Technical Update of the *Urban Water Conservation Potential*, which was prepared by A&N Technical Services on behalf of the California Urban Water Agencies.
   Water savings per unit for Water Efficient Landscape Design based on an assumed 20-percent savings applied to the average Texas landscape use of 17.50 gpcd from the February 28, 2013 *TWDB Draft Population and Municipal Water Demand Projections* memorandum yielding an estimated savings of 3.50 gpcd.
3. Efficiency of indoor fixtures assumed not to decay during life-cycle except toilet flapper, which is based on default values in 2003 Technical Memorandum Regarding Assumptions Used in BMP Reporting Database Water Savings Calculations for CUWCC by M.Cubed.
   Efficiency of Outdoor Programs assumed not to decay during life-cycle.
4. Peak period savings assumed to equal average savings for indoor fixtures and a value of 50-percent is used, based on a six-month peak season and six-month non-peak season.
   Peak period savings for Non-Residential Surveys averaged at 60-percent, based on 50-percent for indoor fixtures and 70-percent for outdoor BMPs.
5. Life-cycles for washing machines assumed to be permanent based on federal standards in effect in 2015.
   MF washing machines have average of eight-year life-cycle from Vicker's 2010 *Handbook of Water Use and Conservation*. Life-cycle for SF washing machines is approximately 12 years based on composite average from February 28, 2013 TWDB *Draft Population and Municipal Water Demand Projections for the 2016 Regional Water Plans and 2017 State Water Plan Memorandum.*
6. Based on TWDB Report 362 *Water Conservation BMPs Implementation Guide*, November, 2004, the life-cycle of showerheads and aerators is five to 15 years, but set as permanent since new fixtures must be efficient. The toilet flapper life-cycles are five years based on this document.
   Assume toilet replacement programs are permanent as replacements will automatically be low-flow fixtures due to plumbing codes.
   Life-cycles for Water Efficient Landscape Design assumed at 20 years.
   Life-cycle of Non-Residential Surveys based on December, 2011 East Bay Municipal Utility District *Water Conservation Master Plan*.
7. Free ridership values for ULFTs and washing machines based on default values in 2003 Technical Memorandum Regarding Assumptions Used in BMP Reporting Database Water Savings Calculations for CUWCC by M.Cubed. Assume no free riders for showerhead, aerator, and flapper program.
   Assume no free riders for outdoor programs.
8. Assume all costs in 2013 dollars. Conversion for costs from other years based on escalating at 2.8% from the municipal cost index.
9. HE Washer and ULFT rebate of $100 based on phone interview with City of San Marcos. City of Round Rock also offers maximum of $100 rebate on ULFTs (average is approximately $79.24). Assume no rebate cost for showerhead, aerator, and toilet flapper. Based on phone interview, City of Fort Worth provides at no cost in Water Wise kits for students.
   Average rebate for Water Efficient Landscape Design based on maximum value in the TWDB Report 362 *Water Conservation BMPs Implementation Guide*, November, 2004. The $1.00 per square foot value was assumed to be in 2013 dollars and not escalated based on other programs.
   The City of Austin rebates ranged from $0.10 to $0.30 per square foot, the Long Beach Water Department offers rebates of $3.00 per square foot, and the Metropolitan Water District of Orange County (MWDOC) offers rebates of $1.00 and $3.00 per square foot for residential and large landscape/commercial sites, respectively.
   A default value of $1,000 is assumed for conversion of 1,000 square feet of turf (50% of assumed landscape area on a 5,000 square-foot lot with 60% impervious cover) with an associated rebate of $1.00 per square foot. This default value of $1,000 should be adjusted as needed for local programs.
10. Program cost includes: utility cost of products, administrative, overhead, labor, marketing, outreach, and other miscellaneous costs.
    Utility costs for SF and MF Residential ULFT assumed at $100/unit based on information from City of Fort Worth.
    Utility costs for SF and MF Residential HE Washers assumed at average of all costs listed in TWDB Report 362 Water Conservation BMPs Implementation Guide, November, 2004.
    Utility costs for SF and MF Showerhead, Aerators, and Toilet Flappers assumed at $5 per participant based on Water Wise kits distributed to students by the City of Fort Worth. For direct installation approach, default values should be revised accordingly.
    Utility costs for Non-Residential Surveys assumed at $1,750 based on input from City of Fort Worth and average of typical costs. The CUWCC *Landscape BMP Implementation Guidebook* (2010 or later, but not dated) indicates costs range from $500 to $1,500 with an average of $1,000.
    Utility costs for Water Efficient Landscape Design assumed at average of all costs listed in TWDB Report 362 Water Conservation BMPs Implementation Guide, November, 2004.
11. Sewer savings assumed to equal water savings for indoor plumbing fixtures. This savings in wastewater flow is used only in determining avoided costs for utility.

LANDSCAPING DEFAULT SAVINGS AND COST VALUES[1]

Item	Outdoor Programs								
	Irrigation Controllers	Irrigation Controllers	Irrigation Controllers	Irrigation Controllers	Irrigation Nozzles	Irrigation Efficiency Evaluations	Irrigation Efficiency Evaluations	Landscape Water Budget	Landscape Water Budget
Customer Class	SF	MF	ICI	Irrigation	SF	Irrigation	ICI	Irrigation	ICI
Items included in BMP	Replace All Irrigation Controllers	Replace All Irrigation Controllers	Replace All Irrigation Controllers	Replace All Irrigation Controllers	Replace All Irrigation Nozzles	Irrigation Efficiency Evaluation	Irrigation Efficiency Evaluation	Development of Landscape Water Budget	Development of Landscape Water Budget
Units	gallons/household/yr	per account	per account	per account	gpd/household	per account	per account	per account	per account
Water Savings per Unit[2]	15,403.00	4%	4%	15%	3.62	15%	4%	15%	4%
Annual Rate of Savings Decay[3] (%)	0	0	0	0	0	0	0	0	0
Peak Period Savings[4] (% of Annual Savings)	70	70	70	70	70	70	70	70	70
Life-Cycle[5,6] (yrs)	10	10	10	10	5	5	5	5	5
Free Riders[7] (%)	0	0	0	0	0	0	0	0	0
Year Costs Denominated[8]	2013	2013	2013	2013	2013	2013	2013	2013	2013
Rebate Cost[9] ($)	205.00	75.00	75.00	75.00	0.00	0.00	0.00	0.00	0.00
Program Cost[10] ($)	131.80	131.80	131.80	131.80	10.00	162.96	162.96	162.96	162.96
Sewer Savings per Unit[11]	0	0	0	0	0	0	0	0	0

Notes:

1. Calculations do not account for conversions due to plumbing codes or cost-benefit to customers, including water, sewer, or electricity rate savings. Utilities assumed not to have follow-up costs.
   BMPs components are consistent with the TWDB Report 362 *Water Conservation BMPs Implementation Guide* , November, 2004 to the extent practical.
2. Water savings per unit for SF Irrigation Controllers based on the May 12, 2003 Seattle Public Utilities/The Saving Water Partnership report *Water Efficient Irrigation Study Final Report and include an average for systems with and without sensors.*
   For SF Irrigation Controllers with and without sensors, the study showed an annual savings of 20,735 and 10,071 gallons per residence, respectively.
   Water savings per unit for MF, ICI, and Irrigation Irrigation Controllers of 15% of outdoor use based on data from the U.S. EPA *WaterSense Specification for Weather-Based Irrigation Controllers Supporting Statement* , November 3, 2011.
   Water savings per unit for MF and ICI Irrigation Controllers and ICI Landscape Water Budget assumes irrigation is approximately 25% of overall use, resulting in an overall savings of 4% by applying the 15% savings to outdoor use only.
   Water savings per unit for Irrigation Nozzles based on data of 6,000 gallons over a five-year period from the City of Carrollton, Texas and City of Riverside GreenRiverside websites.
   Water savings per unit for Irrigation Efficiency Evaluations and Landscape Water Budgets based on TWDB Report 362 *Water Conservation BMPs Implementation Guide* , November, 2004.
   Irrigation Efficiency Evaluations assumed the same as Landscape Water Surveys for ICI customers. Texas AgriLife's September, 2012 Water Conservation in Landscape Irrigation indicates a savings range from 12-percent to 30-percent for Irrigation Efficiency Evaluations.
3. Efficiency of Outdoor Programs assumed not to decay during life-cycle.
4. Peak period savings for landscape-based BMPs assumed at 70-percent of annual savings.
5. Life-cycles for Irrigation Controllers based on May 12, 2003 Seattle Public Utilities/The Saving Water Partnership report *Water Efficient Irrigation Study Final Report* .
   Life-cycles for Irrigation Nozzles based on data from the City of Carrollton, Texas and City of Riverside GreenRiverside websites.
6. Life-cycles for Irrigation Efficiency Evaluations and Landscape Water Budgets based on December, 2011 East Bay Municipal Utility District *Water Conservation Master Plan* .
7. Assume no free riders for outdoor programs.
8. Assume all costs in 2013 dollars. Conversion for costs from other years based on escalating at 2.8% from the municipal cost index.
9. Average rebate for SF, MF Irrigation Controllers and ICI, Irrigation category Irrigation Controllers based on average of $205.16 and $75.00, respectively, reported by City of Round Rock over a three-year period.
   No rebate on Landscape Water Budget as budget as assumed to be developed at no cost to participants. For rebate programs, the applicable rebate value should be entered.
   No rebate on Irrigation Nozzles and Irrigation Efficiency Evaluations as assumed to be provided at no cost to participants.
10. Program cost includes: utility cost of products, administrative, overhead, labor, marketing, outreach, and other miscellaneous costs.
    Utility costs for SF, MF Irrigation Controllers based on May 12, 2003 Seattle Public Utilities/The Saving Water Partnership report *Water Efficient Irrigation Study Final Report* .
    Utility costs for ICI and Irrigation Irrigation Controllers assumed at same cost as ICI Surveys ($1,750) provided by the City of Fort Worth as an average of typical costs.
    Utility costs for Irrigation Nozzles assumed at $10 per participant based on cost of $2.75 each from City of Round Rock plus additional $7.25 for marketing/administration. For direct installation approach, default values should be revised accordingly.
    Utility costs for Landscape Water Budgets based on CUWCC *Landscape BMP Implementation Guidebook* (not dated) average of $150 per site converted from 2010 to 2013 dollars. Irrigation Efficiency Evaluations assumed to have similar cost.
11. Sewer savings assumed at zero for Landscaping BMPs.

ECONOMIC DEFAULT COST VALUES[1,2,3,4,5]

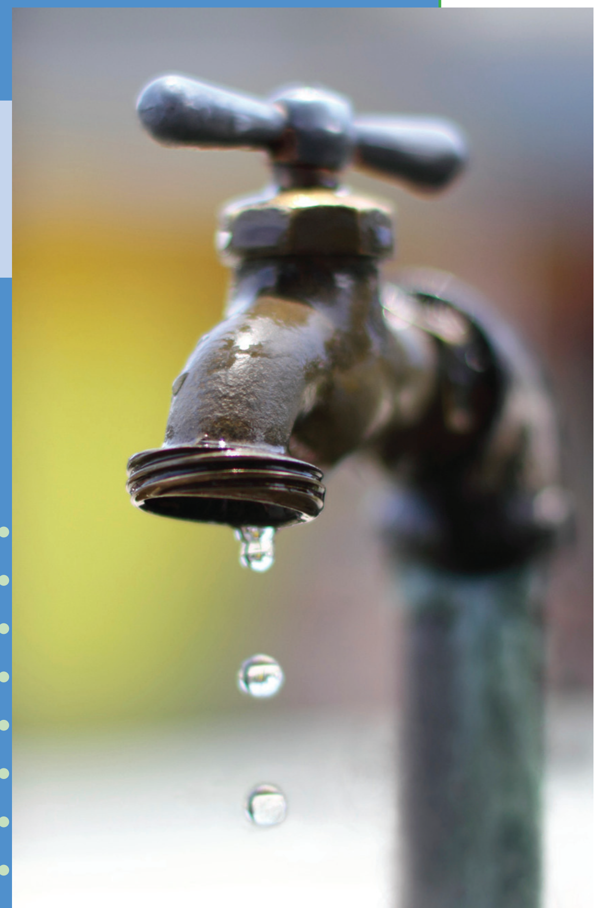
Notes:

1. Discount Rate assumed as simple average of 20-year nominal treasury interest rate, 1993-2011, Federal Reserve Board FRB_H15.
2. General Inflation Rate assumed as long-term US Inflation from the Bureau of Labor Statistics, U.S. City Annual Average, 1981 – 2011.
3. Chemicals Inflation Rate assumed as average annual increase in Water treatment compounds, Producer Price Index, 1986 - 2013.
4. Capital Cost Inflation Rate assumed as 30-year (1981-2011) compounded annual growth rate in Engineering News Record Average Annual Construction Cost Index.
5. O&M Cost as a % of Capital assumed from Exhibit C, Guidelines for Regional Water Plan Development, August 2012, Page 28 of 61.

APPENDIX E: ***USER'S GUIDE FOR THE TWDB'S WATER CONSERVATION MODEL***

User's Guide for the TWDB Water Conservation BMP Model

Texas Water Development Board



Prepared for the Texas Water Development Board
August, 2015

Watearth™ RPS Espey J STOWE & CO

User’s Guide for the TWDB Water Conservation Best Management Practices Model

This Texas Water Development Board (TWDB) Water Conservation BMP Model is focused on water savings and cost-benefit to the utility related to implementation of water conservation Best Management Practices (BMPs). The primary goal of this model is to provide an easy-to-use format for small to mid-sized utilities throughout the State to estimate and report water savings from implementation of BMPs.

The model was developed in Microsoft Excel 2010 and includes the components listed in Table 1. While this table includes a brief synopsis of data related to each worksheet, refer to the sections below for complete descriptions and instructions. Several worksheets that are used for calculations are hidden. These worksheets along with calculation cells in the interactive worksheets are password protected. While we suggest most users avoid revising formulas or calculations within the model, the password is provided in the INSTRUCTIONS page of the model.

Details on the existing BMPs are consistent with the BMPs outlined in the *Water Conservation Best Management Practices Implementation Guide* (http://www.twdb.state.tx.us/conservation/BMPs/index.asp). For those agencies electing to use BMPs not included in the TWDB Water Conservation BMP Model, the *Water Conservation Best Management Practices Implementation Guide* includes instructions and guidance on analyzing the various BMPs.

TABLE 1: TWDB WATER CONSERVATION BMP MODEL COMPONENTS

Worksheet Title	Data Entry Required/Allowed?	Synopsis
INTERACTIVE WORKSHEETS		
INSTRUCTIONS	No	Brief summary of instructions
INPUT DATA	Yes	Includes local service area characteristics and demands
BMP DATA	Yes	Includes BMP data for analysis of single or multiple BMPs
WATER SAVINGS	No	Annual water savings estimated for individual and multiple BMPs and by user class
WASTWATER SAVINGS	No	Annual wastewater savings estimated for individual and multiple BMPs and by user class; used only in the economics calculations
RESULTS	No	Adjusted annual demand projections for selected BMPs and by user class
ECONOMICS INPUT	Yes – Economics analysis is optional	Allows for input of base per unit cost values, inflation and discount rate, current effective rate for water and wastewater service and data concerning the Utility’s water supply capital improvement plan

Worksheet Title	Data Entry Required/Allowed?	Synopsis
COST-BENEFIT	No – Economics analysis is optional	Calculates the cost and benefits of each BMP and calculates the benefit cost ratio (BCR) as well as the projected water and wastewater revenue loss from BMP implementation
ECONOMICS SUMMARY	No – Economics analysis is optional	Summary of delayed capital cost investment, costs and benefits of each BMP and the program as a whole, and the revenue loss from BMP implementation
ASSUMPTIONS	No	Detailed list of BMP and economics default data values
HIDDEN WORKSHEETS[1]		
Input Data for Charts	No – Hidden Sheets	Used for graphing INPUT DATA
Input Data Long-Form		Used for water savings calculations
Water Savings Long-Form		Used for water savings calculations
Wastewater Savings Long-Form		Used for wastewater savings calculations
Results for Charts		Used for graphing on RESULTS worksheet
Education BMPs		Education BMPs default data
Rebate Retrofit Incentive BMPs		Rebate Retrofit Incentive BMPs default data
Conservation Analysis BMPs		Conservation Analysis BMPs default data
Landscaping BMPs		Landscaping BMPs default data
Economic		Economic default data
Avoided Costs		Utility avoided costs by BMP
Costs Before BMPs		Used for economics calculations
Costs After BMPs		Used for economics calculations

[1]Worksheets are hidden and password protected (TWDB-BMP). They are provided to perform calculations which are not necessary for the user to access and to facilitate future updates and/or incorporation of new data.

INSTRUCTIONS WORKSHEET

The TWDB Water Conservation BMP Model is developed within Microsoft Excel 2010. Unless labeled otherwise, all units are in gallons format (gal) or gallons per day (gpd). The following conversions may be useful:

- 1-acre = 43,560 square feet (ft^2)
- 1 acre-foot = 43,560 cubic feet (ft^3)
- 1 acre-foot = 325,829 gallons
- 1 cubic feet (ft^3) = 7.48 gallons (gal)
- 100 cubic feet = ccf
- 1 million gallons (MG) = 1,000,000 gal

To facilitate annual reporting, results are also reported in gallons per capita per day (gpcd).

Note these worksheets are interactive and will present results based on the data each user enters. A white background on a cell means that users must enter data into that cell. A yellow background means that the data in that cell is a default value. It is highly recommended that users not change the values in yellow-shaded cells unless they are very certain that their situation is different from the default. Green shaded cells contain formulas, references and links. Those cells should not be changed.

INPUT DATA WORKSHEET

This worksheet is required for all projects. Information on required and optional input data is given below:

1. **Year to Denominate Costs (cell C8) – Optional Data**

   a. Enter year to denominate costs; default is 2013 if not specified.

2. **Base Year to Start Calculations (cell C9) – Optional Data**

   a. Enter base year to start calculations (i.e., starting year); default is 2013 if not specified. Note that calculations are performed for a 48-year time period.

3. **Historical and Projected Population (cells C14 to J14) – Required Data**

   a. Enter census population for the service area for prior decades (cells C14 to E14). If better data is available locally, it may be substituted for census data.

   b. Enter population projections for future decades (cells F14 to J14). If local projections are not available, use one or both of the following sources from the Texas Water Development Board (TWDB):

      - *Draft Population and Municipal Water Demand Projections for the 2016 Regional Water Plans and 2017 State Water Plan Memorandum*. February 28, 2013. http://www.lrgvdc.org/downloads/water/20130305ProjectionsMemo.pdf
      - *Water for Texas 2012 State Water Plan*. January, 2012. The most current version of the Plan should be used. http://www.twdb.state.tx.us/waterplanning/swp/2012/

   c. Graphs are automatically generated and graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc. The following graphs are included in this section:

      - Historical and Projected Population
      - Population Growth Rate (percent/year)

      Use the click-down arrow to switch between graph types.

4. **Persons Per Household – SF (cell C15) – Required Data**

    a. Enter persons per household for single family. If data is not available, obtain from census data, which may only provide a single value that includes all households (i.e., single family as well as multi-family).

5. **Persons Per Household – MF (cell C16) – Required Data**

    a. Enter persons per household for multi-family. If data is not available, obtain from census data, which may only provide a single value that includes all households (i.e., single family as well as multi-family).

6. **Peak Season Start Date (cell C41) – Optional Data**

    a. Enter peak season start date (i.e., month); default is May if not specified. If default is changed, month should be based on local water use data and peak season end date changed accordingly.

7. **Peak Season End Date (cell C42) – Optional Data**

    a. Enter peak season end date (i.e., month); default is October if not specified. If default is changed, month should be based on local water use data and peak season start date changed accordingly.

8. **Water User Classes – No. of Accounts (cells C46 to C51) – Required Data**

    a. Enter number of accounts for each of the following type of water user classes:

        - Single Family
        - Multi-Family
        - Industrial
        - Commercial
        - Institutional
        - Landscape Irrigation Meters

        If accounts are not separated into user classes, all data may be entered under Single Family. Note that it is not required to use all user classes. Enter 0 if a specific class is not used.

9. **Water User Classes – Annual Demands (cells E46 to E51) – Required Data**

    a. Enter annual demands (gallons) in the base year (i.e., year analysis is started) for each of the following type of water user classes:

        - Single Family
        - Multi-Family

- Industrial
- Commercial
- Institutional
- Landscape Irrigation Meters

If accounts are not separated into user classes, all data may be entered under Single Family. Note that it is not required to use all user classes. Enter 0 if a specific class is not used.

b. Graphs are automatically generated and graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc. The following graphs are included in this section:

- Water User Demand Shares
- Number of Accounts by User Class

Use the click-down arrow to switch between graph types.

10. **Projected Demands (cells C82 to C84) – Required Data**

a. Enter annual demands (gallons per day) in the base year (i.e., year analysis is started) in cell C82. This value should match the total summed in cell F52.

b. Enter peak season annual demands (gallons per day) in the base year (i.e., year analysis is started) in cell C83. This value should be calculated for the months corresponding to the peak season as entered in cells C41 and C42.

c. Enter off-peak season annual demands (gallons per day) in the base year (i.e., year analysis is started) in cell C84. This value should be calculated for the months corresponding to the off-peak season as entered in cells C41 and C42.

11. **Projected Demands (cells D82 to J82, D89 to J89, D96 to J96, D103 to J103, D110 to J110, and D117 to J117) – Optional Data**

a. If desired, enter projected annual demands for the analysis time period in the cells indicated. It is not necessary to enter projected peak and off-peak demands as they are calculated automatically from the peak to off-peak demand ratio for the base year. If local projections are not available, one or both of the following sources from the TWDB may be used:

- *Draft Population and Municipal Water Demand Projections for the 2016 Regional Water Plans and 2017 State Water Plan Memorandum*. February 28, 2013.
- *Water for Texas 2012 State Water Plan*. January, 2012. The most current version of the Plan should be used.

b. As a default, annual demands are projected automatically using the same growth rate as the population growth rate from values specified in cells D15 to J15.

12. **Projected Demands – Automatically Calculated, No Data Entry Required**

    a. Graphs are automatically generated and graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc. The following graphs are included in this section:

    - Total Annual Demands (gallons per day)
    - Peak Demands (gallons per day)
    - Off-Peak Demands (gallons per day)
    - Peak to Average Ratio

    Use the click-down arrow to switch between graph types.

13. **Projected Demands by User Class – Automatically Calculated, No Data Entry Required**

    a. Projected demands by user class are listed in tabular format for the analysis time period.

    b. Graphs are automatically generated and graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc. Projected annual demands by user class are included in this section.

    Use the click-down arrow to switch between graph types.

BMP DATA WORKSHEET

This worksheet is required for all projects. One BMP or multiple BMPs can be evaluated within a single scenario. If multiple scenarios (i.e., various program durations, BMP combinations, or number of installations) are desired, save a new copy of the spreadsheet after the Input Data worksheet is completed.

The majority of the data for this worksheet is documented in the **ASSUMPTIONS** worksheet. If better local data is available, white cells should be modified within the **BMP DATA** worksheet. Do not modify the hidden worksheets (Education BMPs, Rebate Retrofit Incentive BMPs, Conservation Analysis BMPs, and Landscaping BMPs) that contain the default data.

The Showerhead, Aerator, and Toilet Flapper Retrofit BMP is split into two components due to differing life-cycles and decay rates. All costs are assigned under Showerhead and Aerators; however, costs include the Toilet Flapper Retrofit. Both BMP components should be used to estimate savings.

1. **Number of Installations/Year (column D) – Required Data**

    a. Enter number of installations for each BMP type/user class per year of program. BMPs are separated into user classes. Use the appropriate user class.

    b. Decimal points may be used for partial replacement on BMPs that assume all items replaced on that account. For example, if two of three toilets are replaced per household in the Residential Toilet Replacement BMP, use a value of 0.667 rather than 1 for number of installations.

    c. It is not necessary to include every BMP; the model will run with one BMP or with all BMPs included. For those BMPs with no implementation in the scenario analyzed, leave number of installations at default value of zero.

2. **Enter Program Start (year) (column F) – Optional Data**

    a. Enter program start (year) for each selected BMP type/customer class. If data is not entered, default of 2013 is used by model.

3. **Program Duration (years) (column F) – Optional Data**

    a. Enter program duration (years) for each selected BMP type/customer class. If data is not entered, default of five years is used by model.

4. **Cost and Performance Data (columns J, L, M, N, O, Q, R, and S) – Optional Data**

    a. It is strongly recommended that default values be used for the items below excluding rebate and program costs, unless researched and validated current data is available:

        - Water Savings per Unit (in specified units) – do not change units or formulas are not valid (column J);
        - Annual Rate of Savings Decay (%) (column L);
        - Peak Period Savings (% of Annual Savings) (column M);
        - Life-Cycle (yrs) (column N);
        - Free Riders (%) (column O);
        - Rebate Cost ($) (column Q);
        - Program Cost ($) – includes utility cost of products, administrative, overhead, labor, marketing, outreach, and other miscellaneous costs (column R);
        - Wastewater Savings per Unit (in specified units) – do not change units or formulas are not valid (column S).

    If data is not entered, default data, which is documented in the **ASSUMPTIONS** worksheet, is used.

WATER SAVINGS WORKSHEET

This worksheet is required for all projects. Data entry and/or modification is not required on this worksheet and cells/formulas should not be revised. Water savings as a result of BMPs identified on the **BMP DATA** worksheet are estimated and reported as follows:

- Savings for each individual BMP (gpd)
- Savings by BMP type (i.e., Landscaping, etc.) (gpd)
- Savings by user class (gpd)
- Savings for all BMPs (gpd)
- Savings for all BMPs (gpcd)
- Savings for all BMPs (gallons/yr)

WASTEWATER SAVINGS WORKSHEET

This worksheet is calculated for all projects, but may not be of interest to all agencies. It is used only in the economics calculations. Data entry and/or modification is not required on this worksheet and cells/formulas should not be revised. Wastewater savings as a result of BMPs identified on the **BMP DATA** worksheet are estimated and reported as follows:

- Savings for each individual BMP (gpd)
- Savings by user class (gpd)
- Savings for all BMPs (gpd)
- Savings for all BMPs (gallons/yr)

RESULTS WORKSHEET

This worksheet is required for all projects. Data entry and/or modification is not required on this worksheet and cells/formulas should not be revised. Graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc.

Projected demands input into the **INPUT DATA** worksheet are adjusted to reflect water conservation savings estimated in the **WATER SAVINGS** worksheet and reported in tabular and graphical format as follows:

Tabular

- Total, peak, and off-peak adjusted projected demands (GPD)
- Adjusted projected demands by user class (gal)

Graphical

- Projected total, peak, and off-peak annual demands with water conservation BMPs (gpd)
- Projected annual demands with water conservation BMPs (gal) for individual user classes
- Projected annual demands for all user classes with water conservation BMPs (gal)

ECONOMICS INPUT WORKSHEET

This worksheet is optional and should be used only if the cost benefit and revenue loss calculations are desired by the user. Data entry and/or modification is required for this worksheet if the user elects to perform economics calculations.

1. **Discount Rate (Cell C9) – Optional Data**

    a. This value is used to calculate the present value of all economic calculations. The year to which values are discounted is equal to the year costs denominated as entered in Cell C6 on the Input Data Worksheet.

    b. The default value entered into the model is 5.48% which is equivalent to the simple average of the 20-year nominal treasury interest rate as published by the Federal Reserve Board from 1993 to 2011.

2. General Inflation Rate (Cell C11) – Optional Data

    a. This value is used as a general inflation factor for program rebate costs and general operations and maintenance costs for which a more specific factor is not identified within the model.

    b. The default value entered into the model is 3.07%; this is equivalent to the average annual increase in long-term United States inflation per the consumer price index, U.S. City average from 1981 to 2011 as published by the Bureau of Labor Statistics.

3. Electricity Inflation Rate (Cell C12) – Optional Data

    a. This value is used to annually inflate a utility's variable electricity cost. The default value entered into the model is 2.00%. While this may be a typical value, it is not from any specific resource or reference.

    b. This value should be adjusted by the user to reflect local trends in electricity cost and potential participation in an electricity aggregation group.

4. Chemicals Inflation Rate (Cell C13) – Optional Data

    a. This value is used to annually inflate a utility's variable chemical cost.

    b. The default value entered into the model is 2.33%; this is equivalent to the average annual increase from 1986 to 2013 in the cost of water treatment compounds according to the Producer Price Index as published by the Bureau of Labor Statistics.

5. **Other Variable O&M Inflation Rate (Cell C14) – Optional Data**

    a. This value is used to annually inflate any other variable O&M defined by the utility within the model.

    b. The default value contained within the model is 1.5% and should be adjusted by the user to reflect actual historical cost trends experienced by the utility.

6. **Variable Wholesale Cost Inflation Rate (Cell C15) – Optional Data**

    a. This value is used to annually inflate the variable cost component to the utility associated with receiving wholesale water service.

    b. The default value contained within the model is 1.75% and should be adjusted by the user to reflect actual historical cost trends experienced. While this may be a typical value, it is not from any specific resource or reference.

7. **Groundwater Production Cost Inflation Rate (Cell C16) – Optional Data**

    a. This value is used to annually inflate the cost associated with groundwater production fees as applicable to the utility.

    b. The default value contained within the model is 2.5% and should be adjusted by the user to reflect actual historical cost trends experienced. While this may be a typical value, it is not from any specific resource or reference.

8. **Capital Cost Inflation Rate (Cell C17) – Optional Data**

    a. This value is used to project the impact of inflation on the utility's needed capital investment.

    b. The default value contained in the model is 3.19%; this is equivalent to the average annual increase over 30 years (1981 to 2011) in the Construction Cost Index as published by *Engineering News Record.*

9. **Fixed Component, per 1,000 gallons, of Wholesale Water Supply (Cell C23) – Required Data**

    a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

    b. For utilities that purchase raw or treated water from a wholesale supplier, this input allows the utility to define the portion of the rate, per 1,000 gallons, that the utility is charged which will not vary due to reduced consumption resulting from water conservation. Typically, this portion of the rate will be composed of a monthly or annual demand charge or a monthly or annual minimum charge, sometimes referred to as a "take or pay".

c. The default value entered in the model is $2.00 per 1,000 gallons, but should be adjusted by the user to reflect their particular contractual situation. If a utility does not receive wholesale water service, a value of $0.00 should be entered.

10. Variable Component, per 1,000 gallons, of Wholesale Water Supply (Cell C24) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. For utilities that purchase raw or treated water from a wholesale supplier, this input allows the utility to define the portion of the rate, per 1,000 gallons, that the utility is charged which will vary due to reduced consumption. Typically, this portion of the rate will be composed of a volumetric charge per 1,000 gallons or a variable O&M rate per 1,000 gallons. If the utility does not have a monthly minimum charge, a monthly or annual demand charge, or a take or pay contractual provision, then the entire wholesale rate can be entered here.

c. The default value entered in the model is $0.50 per 1,000 gallons, but should be adjusted by the user to reflect their particular contractual situation. If a utility does not receive wholesale water service, a value of $0.00 should be entered.

11. Groundwater Production Fees, per 1,000 gallons (Cell C27) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. For utilities that are within a groundwater conservation district and subject to a groundwater production fee, this input allows the utility to define, per 1,000 gallons, the current level of the fee.

c. The default value in the model is $1.00 per 1,000 gallons; however, this should be adjusted based on the particular situation of the utility. If the utility is not subject to a groundwater production fee, a value of $0.00 should be entered.

12. **Percentage of Water Purchased Wholesale (Cell C30) and Percentage of Water Supplied by Self-Owned Surface Water Sources (Cell C31) – Required Data**

a. In an effort to recognize the mix of water supply sources (i.e., purchased wholesale service, self-owned surface water sources, and groundwater), the model allows the user to enter the percentage of each source utilized, on average. These percentages are then used to develop a weighted average of variable water supply cost which the model then uses to project variable cost savings associated with purchased water.

b. The model defaults to 100% groundwater production if a utility does not enter a percentage associated with purchased wholesale service of self-owned surface water sources. The default model value assumes the utility purchases 50% of their water from wholesale sources and produced 50% of their water through groundwater sources; however, these values should be adjusted by the user based on the utility's actual operating conditions.

13. Electricity Variable O&M Cost, per 1,000 gallons (Cell C40) – Optional Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. This input allows the user to define, on a per 1,000 gallon basis, the City's variable electricity cost which is then used to calculate variable cost savings from reduced water consumption and wastewater flow.

c. The default value in the model is $0.05 per 1,000 gallons. While this may be a typical value, it is not from any specific resource or reference. This value should be adjusted by the user based on actual historical operating experience.

14. Chemical Variable O&M Cost, per 1,000 gallons (Cell C41) – Optional Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. This input allows the user to define, on a per 1,000 gallon basis, the City's variable chemical cost which is then used to calculate variable cost savings from reduced water consumption and wastewater flow.

c. The default value in the model is $0.02 per 1,000 gallons. While this may be a typical value, it is not from any specific resource or reference. This value should be adjusted by the user based on actual historical operating experience.

15. Other Variable O&M Cost, per 1,000 gallons (Cell C42) – Optional Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. This input allows the user to define, on a per 1,000 gallon basis, the City's variable cost, other than electricity and chemicals, which is then used to calculate variable cost savings from reduced water consumption and wastewater flow.

c. The default value in the model is $0.10 per 1,000 gallons. While this may be a typical value, it is not from any specific resource or reference. This value should be adjusted by the user based on actual historical operating experience.

16. Fixed Component, per 1,000 gallons, of Wholesale Wastewater Treatment Cost (Cell C46) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. Similar to purchased wholesale water, a utility may also purchase wholesale wastewater treatment services. With reduced water consumption, wastewater flow will be reduced which results in the need for less purchased wastewater treatment. For utilities that purchase wholesale wastewater treatment service, this input allows the utility to define the portion of the rate, per 1,000 gallons, that the utility is charged which will not vary due to reduced wastewater flow resulting from water conservation. Typically, this portion of the rate will be composed of a monthly or annual capacity charge or a monthly or annual minimum charge.

c. The default value entered in the model is $2.00 per 1,000 gallons, but should be adjusted by the user to reflect their particular contractual situation. If a utility does not receive wholesale wastewater treatment water service, a value of $0.00 should be entered.

17. Variable Component, per 1,000 gallons, of Wholesale Wastewater Treatment Cost (Cell C47) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. For utilities that purchase wholesale wastewater treatment service, this input allows the utility to define the portion of the rate, per 1,000 gallons, that the utility is charged which will vary due to reduced wastewater flow. Typically, this portion of the rate will be composed of a volumetric charge per 1,000 gallons or a variable O&M rate per 1,000 gallons. If the utility does not have a monthly minimum charge or a monthly or annual capacity charge, then the entire wholesale rate can be entered here.

c. The default value entered in the model is $0.50 per 1,000 gallons, but should be adjusted by the user to reflect their particular contractual situation. If a utility does not receive wholesale wastewater treatment service, a value of $0.00 should be entered.

18. Effective Water Rate, per 1,000 gallons (Cell C53) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. With reduced water consumption, a utility will experience a corresponding reduction in revenue assuming existing rates are held constant. To quantify this reduction, this model input allows the user to input the utility’s current effective water rate per 1,000 gallons. The effective rate takes into account the two-part rate structure (i.e., a fixed minimum monthly charge plus a volumetric charge per 1,000 gallons) adopted by most utilities.

c. To calculate the effective rate, the utility can take its water revenue over a given period divided by the metered volumes, in 1,000 gallons, consumed over that same period. This will provide an approximate effective per 1,000 gallons unit rate for the utility. This is entered into the model and then used to calculate the projected loss in water revenue from BMP implementation.

19. Effective Wastewater Rate, per 1,000 gallons (Cell C54) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. Similar to reduced water consumption, a utility will also see reduced wastewater flow from conservation and a corresponding reduction in wastewater revenue assuming existing rates are held constant. To quantify this reduction, this model input allows the user to input the utility's current effective wastewater rate per 1,000 gallons. The effective rate takes into account the two-part rate structure (i.e., a fixed minimum monthly charge plus a volumetric charge per 1,000 gallons) adopted by most utilities.

c. To calculate the effective rate, the utility can take its wastewater revenue over a given period divided by the wastewater flow volumes, in 1,000 gallons, billed over that same period. This will provide an approximate effective per 1,000 gallons unit rate for the utility. This is entered into the model and then used to calculate the projected loss in wastewater revenue from BMP implementation.

d. Note that a number of utilities base wastewater bills on winter average water consumption. Currently, the model assumes that any reduced water consumption will result in an equal reduction in billed wastewater flow. Assuming that the water conservation experienced corresponds to peak summer flows for irrigation, then the reduced wastewater revenue numbers calculated by the model may be greater than experienced.

20. Current Supply Capacity (Cell H9) – Required Data

a. In calculating the overall cost-benefit impact of each BMP, the model quantifies not only avoided variable cost but also the delay in capital improvements cost and the subsequent benefit this has to the utility.

b. To perform these calculations, it is necessary to establish the baseline water supply capacity of the utility. This input allows for this value input stated in Million Gallons per Day (MGD). This value should be changed by the user based on the actual system characteristics of the utility.

21. **Capital Improvement Planning Information (Cells F13 through R22) – Required Data**

To calculate the benefit from delayed capital investment associated with water conservation, the utility must also provide its capital improvement plan and the planned method of funding the proposed plan. The following provides more detail on these inputs. Please note that the majority of these inputs can be taken from the utility's specified water management strategies within the respective regional water plan.

a. Water Project Description (Cells G13 – G22) – Optional Data

These inputs are purely for informational purposes and allow the user to provide descriptions of up to ten (10) water supply capital projects.

b. Opinion of Probable Water Supply Cost (Cells H13 – H22) – Required Data

For each water supply project defined in Column G, the corresponding total project capital cost should be input in these fields.

c. Year of Cost Estimate (Cells I13 – I22) – Required Data

For each cost value defined in Column H, the corresponding year associated with the dollar value of the cost estimate should be input in these fields. For example, if a capital cost estimate has been prepared based on 2013 dollars, then 2013 should be entered in this field.

d. Incremental Supply Capacity (Million Gallons per Day) (Cells J13-22) – Required Data

For each water project defined, the incremental capacity of water supply added from each project should be input in these fields. Input values should be stated in Million Gallons per Day.

e. O&M Cost as a Percent of Capital Cost (Cells K13 – K22) – Optional Data

Each capital project constructed may result in additional operations and maintenance expense for the utility. To project these costs and the associated impact, the user should estimate annual operations and maintenance expense as a percentage of the total capital cost. The default values included within the model are sourced from Exhibit C to the Guidelines for Regional Water Plan Development as published by the Texas Water Development Board, August 2012.

f. Capital Funding Plan (Cells M12 – N22) – Required Data

In projecting the impact of the future capital improvements, it is necessary for the utility to define the funding sources for each project. The model assumes that a project will be funded with 100% debt, unless cash or grant funds are otherwise defined within the model. For each identified project, the user should input the planned mix of funding mechanisms to be used stated as a percentage of the total funding requirement.

g. **Debt Assumptions (Cells Q12 – R22) – Required Data**

Based on the capital funding plan input by the user, to the extent debt is being used, specific assumptions will need to be defined to project debt service interest. These include the term of the debt issue, in years, as well as the assumed interest rate at which debt will be issued. These inputs should be defined by the user based on the utility's typical funding patterns and the current bond rating for the utility.

COST BENEFIT WORKSHEET

The Cost-Benefit Worksheet requires no user entry and serves as one of two reporting formats for the cost-benefit analysis and quantification of revenue loss impact from BMP implementation. Specifically, for each BMP by year, this worksheet calculates the total cost of the BMP as well as the reductions in variable cost experienced due to water conservation and associated reductions in wastewater flow. These values are presented in real dollars (i.e., projected dollar value in the year of occurrence) and in present value (i.e., dollar value in the year specified for cost denomination in the model).

These numbers are then taken to develop the benefit-cost ratio ("BCR"). Under this ratio, a value greater than one indicates that the benefits outweigh the cost and the BMP is considered economically efficient. If the BCR is less than one, the costs of implementing the BMP outweigh the benefits.

Also presented on this worksheet is the annual total water and wastewater revenue impact resulting from BMP implementation. These values are also presented in real dollars and on a present value basis. Please note that the revenue impact assumes that the utility's current rates will remain in place over the life of the analysis.

ECONOMICS SUMMARY WORKSHEET

The Economic Summary Worksheet expands the analysis presented on the Cost-Benefit Worksheet to include the benefits resulting from the delay of capital investment, both in real dollars and on a present value basis. These costs are presented annually as well as in total. The present value of the benefit-cost ratio for each BMP as well as total revenue impact by BMP is also presented annually and in total. Finally, all of the benefits and costs of the conservation program in total are summarized on a present value basis and a benefit-cost ratio calculated for the program in total. The total revenue impact from the program is also summarized on a present value basis.

ASSUMPTIONS WORKSHEET

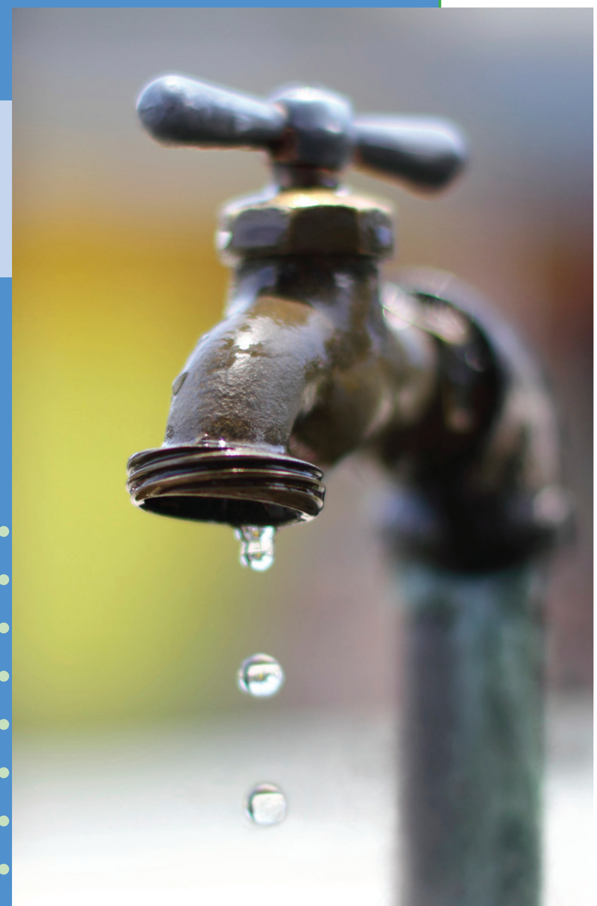
This worksheet provides a detailed list of BMP and economics default data values. Default values for the BMPs are included in the following hidden worksheets, which should not be modified:

- Education BMPs
- Rebate Retrofit Incentives BMPs
- Conservation Analysis BMPs
- Landscaping BMPs
- Economic

If different values are more appropriate, enter on **BMP DATA** or **ECONOMICS INPUT** worksheets.

User's Guide for the TWDB Water Conservation BMP Model

Texas Water Development Board



Prepared for the Texas Water Development Board
August, 2015

Watearth™ RPS Espey J STOWE & CO

User's Guide for the TWDB
Water Conservation Best Management Practices Model

This Texas Water Development Board (TWDB) Water Conservation BMP Model is focused on water savings and cost-benefit to the utility related to implementation of water conservation Best Management Practices (BMPs). The primary goal of this model is to provide an easy-to-use format for small to mid-sized utilities throughout the State to estimate and report water savings from implementation of BMPs.

The model was developed in Microsoft Excel 2010 and includes the components listed in Table 1. While this table includes a brief synopsis of data related to each worksheet, refer to the sections below for complete descriptions and instructions. Several worksheets that are used for calculations are hidden. These worksheets along with calculation cells in the interactive worksheets are password protected. While we suggest most users avoid revising formulas or calculations within the model, the password is provided in the INSTRUCTIONS page of the model.

Details on the existing BMPs are consistent with the BMPs outlined in the *Water Conservation Best Management Practices Implementation Guide* (http://www.twdb.state.tx.us/conservation/BMPs/index.asp). For those agencies electing to use BMPs not included in the TWDB Water Conservation BMP Model, the *Water Conservation Best Management Practices Implementation Guide* includes instructions and guidance on analyzing the various BMPs.

TABLE 1: TWDB WATER CONSERVATION BMP MODEL COMPONENTS

Worksheet Title	Data Entry Required/Allowed?	Synopsis
INTERACTIVE WORKSHEETS		
INSTRUCTIONS	No	Brief summary of instructions
INPUT DATA	Yes	Includes local service area characteristics and demands
BMP DATA	Yes	Includes BMP data for analysis of single or multiple BMPs
WATER SAVINGS	No	Annual water savings estimated for individual and multiple BMPs and by user class
WASTWATER SAVINGS	No	Annual wastewater savings estimated for individual and multiple BMPs and by user class; used only in the economics calculations
RESULTS	No	Adjusted annual demand projections for selected BMPs and by user class
ECONOMICS INPUT	Yes – Economics analysis is optional	Allows for input of base per unit cost values, inflation and discount rate, current effective rate for water and wastewater service and data concerning the Utility's water supply capital improvement plan

Worksheet Title	Data Entry Required/Allowed?	Synopsis
COST-BENEFIT	No – Economics analysis is optional	Calculates the cost and benefits of each BMP and calculates the benefit cost ratio (BCR) as well as the projected water and wastewater revenue loss from BMP implementation
ECONOMICS SUMMARY	No – Economics analysis is optional	Summary of delayed capital cost investment, costs and benefits of each BMP and the program as a whole, and the revenue loss from BMP implementation
ASSUMPTIONS	No	Detailed list of BMP and economics default data values
HIDDEN WORKSHEETS[1]		
Input Data for Charts	No – Hidden Sheets	Used for graphing INPUT DATA
Input Data Long-Form		Used for water savings calculations
Water Savings Long-Form		Used for water savings calculations
Wastewater Savings Long-Form		Used for wastewater savings calculations
Results for Charts		Used for graphing on RESULTS worksheet
Education BMPs		Education BMPs default data
Rebate Retrofit Incentive BMPs		Rebate Retrofit Incentive BMPs default data
Conservation Analysis BMPs		Conservation Analysis BMPs default data
Landscaping BMPs		Landscaping BMPs default data
Economic		Economic default data
Avoided Costs		Utility avoided costs by BMP
Costs Before BMPs		Used for economics calculations
Costs After BMPs		Used for economics calculations

[1]Worksheets are hidden and password protected (TWDB-BMP). They are provided to perform calculations which are not necessary for the user to access and to facilitate future updates and/or incorporation of new data.

INSTRUCTIONS WORKSHEET

The TWDB Water Conservation BMP Model is developed within Microsoft Excel 2010. Unless labeled otherwise, all units are in gallons format (gal) or gallons per day (gpd). The following conversions may be useful:

- 1-acre = 43,560 square feet (ft^2)
- 1 acre-foot = 43,560 cubic feet (ft^3)
- 1 acre-foot = 325,829 gallons
- 1 cubic feet (ft^3) = 7.48 gallons (gal)
- 100 cubic feet = ccf
- 1 million gallons (MG) = 1,000,000 gal

To facilitate annual reporting, results are also reported in gallons per capita per day (gpcd).

Note these worksheets are interactive and will present results based on the data each user enters. A white background on a cell means that users must enter data into that cell. A yellow background means that the data in that cell is a default value. It is highly recommended that users not change the values in yellow-shaded cells unless they are very certain that their situation is different from the default. Green shaded cells contain formulas, references and links. Those cells should not be changed.

INPUT DATA WORKSHEET

This worksheet is required for all projects. Information on required and optional input data is given below:

1. **Year to Denominate Costs (cell C8) – Optional Data**

   a. Enter year to denominate costs; default is 2013 if not specified.

2. **Base Year to Start Calculations (cell C9) – Optional Data**

   a. Enter base year to start calculations (i.e., starting year); default is 2013 if not specified. Note that calculations are performed for a 48-year time period.

3. **Historical and Projected Population (cells C14 to J14) – Required Data**

   a. Enter census population for the service area for prior decades (cells C14 to E14). If better data is available locally, it may be substituted for census data.

   b. Enter population projections for future decades (cells F14 to J14). If local projections are not available, use one or both of the following sources from the Texas Water Development Board (TWDB):

      - *Draft Population and Municipal Water Demand Projections for the 2016 Regional Water Plans and 2017 State Water Plan Memorandum*. February 28, 2013. http://www.lrgvdc.org/downloads/water/20130305ProjectionsMemo.pdf
      - *Water for Texas 2012 State Water Plan*. January, 2012. The most current version of the Plan should be used. http://www.twdb.state.tx.us/waterplanning/swp/2012/

   c. Graphs are automatically generated and graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc. The following graphs are included in this section:

      - Historical and Projected Population
      - Population Growth Rate (percent/year)

      Use the click-down arrow to switch between graph types.

4. **Persons Per Household – SF (cell C15) – Required Data**

    a. Enter persons per household for single family. If data is not available, obtain from census data, which may only provide a single value that includes all households (i.e., single family as well as multi-family).

5. **Persons Per Household – MF (cell C16) – Required Data**

    a. Enter persons per household for multi-family. If data is not available, obtain from census data, which may only provide a single value that includes all households (i.e., single family as well as multi-family).

6. **Peak Season Start Date (cell C41) – Optional Data**

    a. Enter peak season start date (i.e., month); default is May if not specified. If default is changed, month should be based on local water use data and peak season end date changed accordingly.

7. **Peak Season End Date (cell C42) – Optional Data**

    a. Enter peak season end date (i.e., month); default is October if not specified. If default is changed, month should be based on local water use data and peak season start date changed accordingly.

8. **Water User Classes – No. of Accounts (cells C46 to C51) – Required Data**

    a. Enter number of accounts for each of the following type of water user classes:

        - Single Family
        - Multi-Family
        - Industrial
        - Commercial
        - Institutional
        - Landscape Irrigation Meters

        If accounts are not separated into user classes, all data may be entered under Single Family. Note that it is not required to use all user classes. Enter 0 if a specific class is not used.

9. **Water User Classes – Annual Demands (cells E46 to E51) – Required Data**

    a. Enter annual demands (gallons) in the base year (i.e., year analysis is started) for each of the following type of water user classes:

        - Single Family
        - Multi-Family

- Industrial
- Commercial
- Institutional
- Landscape Irrigation Meters

If accounts are not separated into user classes, all data may be entered under Single Family. Note that it is not required to use all user classes. Enter 0 if a specific class is not used.

b. Graphs are automatically generated and graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc. The following graphs are included in this section:

- Water User Demand Shares
- Number of Accounts by User Class

Use the click-down arrow to switch between graph types.

10. **Projected Demands (cells C82 to C84) – Required Data**

a. Enter annual demands (gallons per day) in the base year (i.e., year analysis is started) in cell C82. This value should match the total summed in cell F52.

b. Enter peak season annual demands (gallons per day) in the base year (i.e., year analysis is started) in cell C83. This value should be calculated for the months corresponding to the peak season as entered in cells C41 and C42.

c. Enter off-peak season annual demands (gallons per day) in the base year (i.e., year analysis is started) in cell C84. This value should be calculated for the months corresponding to the off-peak season as entered in cells C41 and C42.

11. **Projected Demands (cells D82 to J82, D89 to J89, D96 to J96, D103 to J103, D110 to J110, and D117 to J117) – Optional Data**

a. If desired, enter projected annual demands for the analysis time period in the cells indicated. It is not necessary to enter projected peak and off-peak demands as they are calculated automatically from the peak to off-peak demand ratio for the base year. If local projections are not available, one or both of the following sources from the TWDB may be used:

- *Draft Population and Municipal Water Demand Projections for the 2016 Regional Water Plans and 2017 State Water Plan Memorandum*. February 28, 2013.
- *Water for Texas 2012 State Water Plan*. January, 2012. The most current version of the Plan should be used.

b. As a default, annual demands are projected automatically using the same growth rate as the population growth rate from values specified in cells D15 to J15.

12. **Projected Demands – Automatically Calculated, No Data Entry Required**

a. Graphs are automatically generated and graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc. The following graphs are included in this section:

- Total Annual Demands (gallons per day)
- Peak Demands (gallons per day)
- Off-Peak Demands (gallons per day)
- Peak to Average Ratio

Use the click-down arrow to switch between graph types.

13. **Projected Demands by User Class – Automatically Calculated, No Data Entry Required**

a. Projected demands by user class are listed in tabular format for the analysis time period.

b. Graphs are automatically generated and graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc. Projected annual demands by user class are included in this section.

Use the click-down arrow to switch between graph types.

BMP DATA WORKSHEET

This worksheet is required for all projects. One BMP or multiple BMPs can be evaluated within a single scenario. If multiple scenarios (i.e., various program durations, BMP combinations, or number of installations) are desired, save a new copy of the spreadsheet after the Input Data worksheet is completed.

The majority of the data for this worksheet is documented in the **ASSUMPTIONS** worksheet. If better local data is available, white cells should be modified within the **BMP DATA** worksheet. Do not modify the hidden worksheets (Education BMPs, Rebate Retrofit Incentive BMPs, Conservation Analysis BMPs, and Landscaping BMPs) that contain the default data.

The Showerhead, Aerator, and Toilet Flapper Retrofit BMP is split into two components due to differing life-cycles and decay rates. All costs are assigned under Showerhead and Aerators; however, costs include the Toilet Flapper Retrofit. Both BMP components should be used to estimate savings.

1. **Number of Installations/Year (column D) – Required Data**

    a. Enter number of installations for each BMP type/user class per year of program. BMPs are separated into user classes. Use the appropriate user class.

    b. Decimal points may be used for partial replacement on BMPs that assume all items replaced on that account. For example, if two of three toilets are replaced per household in the Residential Toilet Replacement BMP, use a value of 0.667 rather than 1 for number of installations.

    c. It is not necessary to include every BMP; the model will run with one BMP or with all BMPs included. For those BMPs with no implementation in the scenario analyzed, leave number of installations at default value of zero.

2. **Enter Program Start (year) (column F) – Optional Data**

    a. Enter program start (year) for each selected BMP type/customer class. If data is not entered, default of 2013 is used by model.

3. **Program Duration (years) (column F) – Optional Data**

    a. Enter program duration (years) for each selected BMP type/customer class. If data is not entered, default of five years is used by model.

4. **Cost and Performance Data (columns J, L, M, N, O, Q, R, and S) – Optional Data**

    a. It is strongly recommended that default values be used for the items below excluding rebate and program costs, unless researched and validated current data is available:

        - Water Savings per Unit (in specified units) – do not change units or formulas are not valid (column J);
        - Annual Rate of Savings Decay (%) (column L);
        - Peak Period Savings (% of Annual Savings) (column M);
        - Life-Cycle (yrs) (column N);
        - Free Riders (%) (column O);
        - Rebate Cost ($) (column Q);
        - Program Cost ($) – includes utility cost of products, administrative, overhead, labor, marketing, outreach, and other miscellaneous costs (column R);
        - Wastewater Savings per Unit (in specified units) – do not change units or formulas are not valid (column S).

    If data is not entered, default data, which is documented in the **ASSUMPTIONS** worksheet, is used.

WATER SAVINGS WORKSHEET

This worksheet is required for all projects. Data entry and/or modification is not required on this worksheet and cells/formulas should not be revised. Water savings as a result of BMPs identified on the **BMP DATA** worksheet are estimated and reported as follows:

- Savings for each individual BMP (gpd)
- Savings by BMP type (i.e., Landscaping, etc.) (gpd)
- Savings by user class (gpd)
- Savings for all BMPs (gpd)
- Savings for all BMPs (gpcd)
- Savings for all BMPs (gallons/yr)

WASTEWATER SAVINGS WORKSHEET

This worksheet is calculated for all projects, but may not be of interest to all agencies. It is used only in the economics calculations. Data entry and/or modification is not required on this worksheet and cells/formulas should not be revised. Wastewater savings as a result of BMPs identified on the **BMP DATA** worksheet are estimated and reported as follows:

- Savings for each individual BMP (gpd)
- Savings by user class (gpd)
- Savings for all BMPs (gpd)
- Savings for all BMPs (gallons/yr)

RESULTS WORKSHEET

This worksheet is required for all projects. Data entry and/or modification is not required on this worksheet and cells/formulas should not be revised. Graph formats may be revised if needed, including: colors, linetypes, fonts, axis scales, labels, etc.

Projected demands input into the **INPUT DATA** worksheet are adjusted to reflect water conservation savings estimated in the **WATER SAVINGS** worksheet and reported in tabular and graphical format as follows:

Tabular

- Total, peak, and off-peak adjusted projected demands (GPD)
- Adjusted projected demands by user class (gal)

Graphical

- Projected total, peak, and off-peak annual demands with water conservation BMPs (gpd)
- Projected annual demands with water conservation BMPs (gal) for individual user classes
- Projected annual demands for all user classes with water conservation BMPs (gal)

ECONOMICS INPUT WORKSHEET

This worksheet is optional and should be used only if the cost benefit and revenue loss calculations are desired by the user. Data entry and/or modification is required for this worksheet if the user elects to perform economics calculations.

1. **Discount Rate (Cell C9) – Optional Data**

    a. This value is used to calculate the present value of all economic calculations. The year to which values are discounted is equal to the year costs denominated as entered in Cell C6 on the Input Data Worksheet.

    b. The default value entered into the model is 5.48% which is equivalent to the simple average of the 20-year nominal treasury interest rate as published by the Federal Reserve Board from 1993 to 2011.

2. **General Inflation Rate (Cell C11) – Optional Data**

    a. This value is used as a general inflation factor for program rebate costs and general operations and maintenance costs for which a more specific factor is not identified within the model.

    b. The default value entered into the model is 3.07%; this is equivalent to the average annual increase in long-term United States inflation per the consumer price index, U.S. City average from 1981 to 2011 as published by the Bureau of Labor Statistics.

3. **Electricity Inflation Rate (Cell C12) – Optional Data**

    a. This value is used to annually inflate a utility's variable electricity cost. The default value entered into the model is 2.00%. While this may be a typical value, it is not from any specific resource or reference.

    b. This value should be adjusted by the user to reflect local trends in electricity cost and potential participation in an electricity aggregation group.

4. **Chemicals Inflation Rate (Cell C13) – Optional Data**

    a. This value is used to annually inflate a utility's variable chemical cost.

    b. The default value entered into the model is 2.33%; this is equivalent to the average annual increase from 1986 to 2013 in the cost of water treatment compounds according to the Producer Price Index as published by the Bureau of Labor Statistics.

5. **Other Variable O&M Inflation Rate (Cell C14) – Optional Data**

    a. This value is used to annually inflate any other variable O&M defined by the utility within the model.

    b. The default value contained within the model is 1.5% and should be adjusted by the user to reflect actual historical cost trends experienced by the utility.

6. **Variable Wholesale Cost Inflation Rate (Cell C15) – Optional Data**

    a. This value is used to annually inflate the variable cost component to the utility associated with receiving wholesale water service.

    b. The default value contained within the model is 1.75% and should be adjusted by the user to reflect actual historical cost trends experienced. While this may be a typical value, it is not from any specific resource or reference.

7. **Groundwater Production Cost Inflation Rate (Cell C16) – Optional Data**

    a. This value is used to annually inflate the cost associated with groundwater production fees as applicable to the utility.

    b. The default value contained within the model is 2.5% and should be adjusted by the user to reflect actual historical cost trends experienced. While this may be a typical value, it is not from any specific resource or reference.

8. **Capital Cost Inflation Rate (Cell C17) – Optional Data**

    a. This value is used to project the impact of inflation on the utility's needed capital investment.

    b. The default value contained in the model is 3.19%; this is equivalent to the average annual increase over 30 years (1981 to 2011) in the Construction Cost Index as published by *Engineering News Record.*

9. **Fixed Component, per 1,000 gallons, of Wholesale Water Supply (Cell C23) – Required Data**

    a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

    b. For utilities that purchase raw or treated water from a wholesale supplier, this input allows the utility to define the portion of the rate, per 1,000 gallons, that the utility is charged which will not vary due to reduced consumption resulting from water conservation. Typically, this portion of the rate will be composed of a monthly or annual demand charge or a monthly or annual minimum charge, sometimes referred to as a "take or pay".

c. The default value entered in the model is $2.00 per 1,000 gallons, but should be adjusted by the user to reflect their particular contractual situation. If a utility does not receive wholesale water service, a value of $0.00 should be entered.

10. Variable Component, per 1,000 gallons, of Wholesale Water Supply (Cell C24) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. For utilities that purchase raw or treated water from a wholesale supplier, this input allows the utility to define the portion of the rate, per 1,000 gallons, that the utility is charged which will vary due to reduced consumption. Typically, this portion of the rate will be composed of a volumetric charge per 1,000 gallons or a variable O&M rate per 1,000 gallons. If the utility does not have a monthly minimum charge, a monthly or annual demand charge, or a take or pay contractual provision, then the entire wholesale rate can be entered here.

c. The default value entered in the model is $0.50 per 1,000 gallons, but should be adjusted by the user to reflect their particular contractual situation. If a utility does not receive wholesale water service, a value of $0.00 should be entered.

11. Groundwater Production Fees, per 1,000 gallons (Cell C27) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. For utilities that are within a groundwater conservation district and subject to a groundwater production fee, this input allows the utility to define, per 1,000 gallons, the current level of the fee.

c. The default value in the model is $1.00 per 1,000 gallons; however, this should be adjusted based on the particular situation of the utility. If the utility is not subject to a groundwater production fee, a value of $0.00 should be entered.

12. **Percentage of Water Purchased Wholesale (Cell C30) and Percentage of Water Supplied by Self-Owned Surface Water Sources (Cell C31) – Required Data**

a. In an effort to recognize the mix of water supply sources (i.e., purchased wholesale service, self-owned surface water sources, and groundwater), the model allows the user to enter the percentage of each source utilized, on average. These percentages are then used to develop a weighted average of variable water supply cost which the model then uses to project variable cost savings associated with purchased water.

b. The model defaults to 100% groundwater production if a utility does not enter a percentage associated with purchased wholesale service of self-owned surface water sources. The default model value assumes the utility purchases 50% of their water from wholesale sources and produced 50% of their water through groundwater sources; however, these values should be adjusted by the user based on the utility's actual operating conditions.

13. Electricity Variable O&M Cost, per 1,000 gallons (Cell C40) – Optional Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. This input allows the user to define, on a per 1,000 gallon basis, the City's variable electricity cost which is then used to calculate variable cost savings from reduced water consumption and wastewater flow.

c. The default value in the model is $0.05 per 1,000 gallons. While this may be a typical value, it is not from any specific resource or reference. This value should be adjusted by the user based on actual historical operating experience.

14. Chemical Variable O&M Cost, per 1,000 gallons (Cell C41) – Optional Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. This input allows the user to define, on a per 1,000 gallon basis, the City's variable chemical cost which is then used to calculate variable cost savings from reduced water consumption and wastewater flow.

c. The default value in the model is $0.02 per 1,000 gallons. While this may be a typical value, it is not from any specific resource or reference. This value should be adjusted by the user based on actual historical operating experience.

15. Other Variable O&M Cost, per 1,000 gallons (Cell C42) – Optional Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. This input allows the user to define, on a per 1,000 gallon basis, the City's variable cost, other than electricity and chemicals, which is then used to calculate variable cost savings from reduced water consumption and wastewater flow.

c. The default value in the model is $0.10 per 1,000 gallons. While this may be a typical value, it is not from any specific resource or reference. This value should be adjusted by the user based on actual historical operating experience.

16. Fixed Component, per 1,000 gallons, of Wholesale Wastewater Treatment Cost (Cell C46) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. Similar to purchased wholesale water, a utility may also purchase wholesale wastewater treatment services. With reduced water consumption, wastewater flow will be reduced which results in the need for less purchased wastewater treatment. For utilities that purchase wholesale wastewater treatment service, this input allows the utility to define the portion of the rate, per 1,000 gallons, that the utility is charged which will not vary due to reduced wastewater flow resulting from water conservation. Typically, this portion of the rate will be composed of a monthly or annual capacity charge or a monthly or annual minimum charge.

c. The default value entered in the model is $2.00 per 1,000 gallons, but should be adjusted by the user to reflect their particular contractual situation. If a utility does not receive wholesale wastewater treatment water service, a value of $0.00 should be entered.

17. Variable Component, per 1,000 gallons, of Wholesale Wastewater Treatment Cost (Cell C47) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. For utilities that purchase wholesale wastewater treatment service, this input allows the utility to define the portion of the rate, per 1,000 gallons, that the utility is charged which will vary due to reduced wastewater flow. Typically, this portion of the rate will be composed of a volumetric charge per 1,000 gallons or a variable O&M rate per 1,000 gallons. If the utility does not have a monthly minimum charge or a monthly or annual capacity charge, then the entire wholesale rate can be entered here.

c. The default value entered in the model is $0.50 per 1,000 gallons, but should be adjusted by the user to reflect their particular contractual situation. If a utility does not receive wholesale wastewater treatment service, a value of $0.00 should be entered.

18. Effective Water Rate, per 1,000 gallons (Cell C53) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. With reduced water consumption, a utility will experience a corresponding reduction in revenue assuming existing rates are held constant. To quantify this reduction, this model input allows the user to input the utility's current effective water rate per 1,000 gallons. The effective rate takes into account the two-part rate structure (i.e., a fixed minimum monthly charge plus a volumetric charge per 1,000 gallons) adopted by most utilities.

c. To calculate the effective rate, the utility can take its water revenue over a given period divided by the metered volumes, in 1,000 gallons, consumed over that same period. This will provide an approximate effective per 1,000 gallons unit rate for the utility. This is entered into the model and then used to calculate the projected loss in water revenue from BMP implementation.

19. Effective Wastewater Rate, per 1,000 gallons (Cell C54) – Required Data

a. To convert acre-feet to 1,000 gallons, multiply acre-feet value by 325.829.

b. Similar to reduced water consumption, a utility will also see reduced wastewater flow from conservation and a corresponding reduction in wastewater revenue assuming existing rates are held constant. To quantify this reduction, this model input allows the user to input the utility's current effective wastewater rate per 1,000 gallons. The effective rate takes into account the two-part rate structure (i.e., a fixed minimum monthly charge plus a volumetric charge per 1,000 gallons) adopted by most utilities.

c. To calculate the effective rate, the utility can take its wastewater revenue over a given period divided by the wastewater flow volumes, in 1,000 gallons, billed over that same period. This will provide an approximate effective per 1,000 gallons unit rate for the utility. This is entered into the model and then used to calculate the projected loss in wastewater revenue from BMP implementation.

d. Note that a number of utilities base wastewater bills on winter average water consumption. Currently, the model assumes that any reduced water consumption will result in an equal reduction in billed wastewater flow. Assuming that the water conservation experienced corresponds to peak summer flows for irrigation, then the reduced wastewater revenue numbers calculated by the model may be greater than experienced.

20. Current Supply Capacity (Cell H9) – Required Data

a. In calculating the overall cost-benefit impact of each BMP, the model quantifies not only avoided variable cost but also the delay in capital improvements cost and the subsequent benefit this has to the utility.

b. To perform these calculations, it is necessary to establish the baseline water supply capacity of the utility. This input allows for this value input stated in Million Gallons per Day (MGD). This value should be changed by the user based on the actual system characteristics of the utility.

21. **Capital Improvement Planning Information (Cells F13 through R22) – Required Data**

To calculate the benefit from delayed capital investment associated with water conservation, the utility must also provide its capital improvement plan and the planned method of funding the proposed plan. The following provides more detail on these inputs. Please note that the majority of these inputs can be taken from the utility's specified water management strategies within the respective regional water plan.

a. Water Project Description (Cells G13 – G22) – Optional Data

These inputs are purely for informational purposes and allow the user to provide descriptions of up to ten (10) water supply capital projects.

b. Opinion of Probable Water Supply Cost (Cells H13 – H22) – Required Data

For each water supply project defined in Column G, the corresponding total project capital cost should be input in these fields.

c. Year of Cost Estimate (Cells I13 – I22) – Required Data

For each cost value defined in Column H, the corresponding year associated with the dollar value of the cost estimate should be input in these fields. For example, if a capital cost estimate has been prepared based on 2013 dollars, then 2013 should be entered in this field.

d. Incremental Supply Capacity (Million Gallons per Day) (Cells J13-22) – Required Data

For each water project defined, the incremental capacity of water supply added from each project should be input in these fields. Input values should be stated in Million Gallons per Day.

e. O&M Cost as a Percent of Capital Cost (Cells K13 – K22) – Optional Data

Each capital project constructed may result in additional operations and maintenance expense for the utility. To project these costs and the associated impact, the user should estimate annual operations and maintenance expense as a percentage of the total capital cost. The default values included within the model are sourced from Exhibit C to the Guidelines for Regional Water Plan Development as published by the Texas Water Development Board, August 2012.

f. Capital Funding Plan (Cells M12 – N22) – Required Data

In projecting the impact of the future capital improvements, it is necessary for the utility to define the funding sources for each project. The model assumes that a project will be funded with 100% debt, unless cash or grant funds are otherwise defined within the model. For each identified project, the user should input the planned mix of funding mechanisms to be used stated as a percentage of the total funding requirement.

g. **Debt Assumptions (Cells Q12 – R22) – Required Data**

Based on the capital funding plan input by the user, to the extent debt is being used, specific assumptions will need to be defined to project debt service interest. These include the term of the debt issue, in years, as well as the assumed interest rate at which debt will be issued. These inputs should be defined by the user based on the utility's typical funding patterns and the current bond rating for the utility.

COST BENEFIT WORKSHEET

The Cost-Benefit Worksheet requires no user entry and serves as one of two reporting formats for the cost-benefit analysis and quantification of revenue loss impact from BMP implementation. Specifically, for each BMP by year, this worksheet calculates the total cost of the BMP as well as the reductions in variable cost experienced due to water conservation and associated reductions in wastewater flow. These values are presented in real dollars (i.e., projected dollar value in the year of occurrence) and in present value (i.e., dollar value in the year specified for cost denomination in the model).

These numbers are then taken to develop the benefit-cost ratio ("BCR"). Under this ratio, a value greater than one indicates that the benefits outweigh the cost and the BMP is considered economically efficient. If the BCR is less than one, the costs of implementing the BMP outweigh the benefits.

Also presented on this worksheet is the annual total water and wastewater revenue impact resulting from BMP implementation. These values are also presented in real dollars and on a present value basis. Please note that the revenue impact assumes that the utility's current rates will remain in place over the life of the analysis.

ECONOMICS SUMMARY WORKSHEET

The Economic Summary Worksheet expands the analysis presented on the Cost-Benefit Worksheet to include the benefits resulting from the delay of capital investment, both in real dollars and on a present value basis. These costs are presented annually as well as in total. The present value of the benefit-cost ratio for each BMP as well as total revenue impact by BMP is also presented annually and in total. Finally, all of the benefits and costs of the conservation program in total are summarized on a present value basis and a benefit-cost ratio calculated for the program in total. The total revenue impact from the program is also summarized on a present value basis.

ASSUMPTIONS WORKSHEET

This worksheet provides a detailed list of BMP and economics default data values. Default values for the BMPs are included in the following hidden worksheets, which should not be modified:

- Education BMPs
- Rebate Retrofit Incentives BMPs
- Conservation Analysis BMPs
- Landscaping BMPs
- Economic

If different values are more appropriate, enter on **BMP DATA** or **ECONOMICS INPUT** worksheets.

MEMORANDUM

Project: Texas Water Development Board Water Conservation Project
Client: Texas Water Development Board
Prepared By: Jennifer J. Walker, P.E., D.WRE, CFM
Date: 8/20/2015
Purpose: Status of Addressing TWDB's Comments

The purpose of this memorandum is to document the status/approach for addressing comments from the Texas Water Development Board (TWDB) on the referenced project. Note that we have made a number of revisions to formulas as well as a few minor edits based on our internal review. TWDB's comments were addressed as follows:

COMMENTS ADDRESSED FULLY

Change Sewer Savings to Wastewater Savings - This comment received in-person after the live webinar presentation was addressed throughout the model, the report, and the User's Guide.

Input Data – Projected Annual Demands by User Class should be defaulted to a line graph without discrete points. This will make it easier to see the different classes.

COMMENTS NOT ADDRESSED WHERE USER'S CAN MAKE REVISIONS

While the following is a useful comment, fixing the range of the vertical axis values may result in graphs only including partial information for agencies with higher or lower values than those fixed. As indicated on the INSTRUCTIONS page, the graph values and formats may be revised as needed by the user. Therefore, this comment was not incorporated.

Results – Change the vertical (Demand(GPCD)) axis values to a narrower range so that the difference between those and Projected Annual Demands with WC BMPs can be better illustrated. The same would apply to the other graphs on this worksheet.

COMMENTS NOT ADDRESSED

While the following comments seem useful for future revisions and updates to the model, the project budget has been exhausted and no budget remains to add additional graphs or make major formatting changes to the model structure.

Water Savings and Sewer Savings – Graphs would be nice.

Cost Benefit –Graphs would be nice.

Overall, there is a lot of information produced by entries made on only a few pages, which is good. There were several comments in the facility personnel interviews requesting a simple, preferably 1-page, tool for ease of use and application. While this may not be possible, the sheer volume of information provided in the worksheets could be a little daunting. It would be nice if the user had the option of displaying 5-year or 10-year data instead of all 42 years on each of the pages on which this occurs.

Thank-you for the opportunity to assist the TWDB on this important project for long-term water conservation within the State.