Water Conservation Program Evaluation

Prepared for

City of Longmont

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CH2MHILL®

9191 South Jamaica Street
Englewood, CO 80112

and

Great Western Institute

Contents

Abbreviations

ac-ft	acre-foot
ac-ft/yr	acre-feet per year
DF	Dual flush
gpcd	gallons per capita per day
GWI	Great Western Institute
HE	High efficiency
MG	million gallons
mgd	million gallon(s) per day
ULV	Ultra low volume
SIMS	Sustainability Information Management System

Definitions

Control groups:	Represents a selection of customers that used City water but did not participate in rebate or promotional programs. The SIMS methodology selects a group of up to 1000 participants based off of a semi-random selection of non-program participants composed of similar sub-sectors as found in the program participants.
Gross per capita:	Volume of water produced at the water treatment plant divided by the population receiving the treated water.
Seasonal water use:	Water use from April through October
Winter water use:	Water use from December through March

Unit Conversions

1 million gallons (MG) = 3.0689 acre-feet (ac-ft)

1 acre-foot (ac-ft) = 0.32585 million gallons (MG)

1 acre-foot (ac-ft) = 325,850 gallons

1 million gallons per day (mgd) = 1,120.147 acre-feet/year (ac-ft/yr)

Water Conservation Program Evaluation

Purpose

The purpose of this Water Conservation Program Evaluation (Program Evaluation) is to assess the effectiveness of water conservation programs supported by the City of Longmont (City) and recommend adjustments to programs that may make the program more cost effective. With the completion of this evaluation, the City continues to follow the outline of the Colorado Water Conservation Board (CWCB) Water Conservation Planning Guidance Document (updated June 2005). The Program Evaluation is part of Step 9 to Monitor, Evaluate, and Revise Conservation Activities.

Background

The City has been committed to supporting water conservation programs and community involvement for many years. In 2008, the City developed a detailed Water Conservation Master Plan (2008 Master Plan), which was an update to the original plan completed in 1996 and was required by the State of Colorado. Based on recommendations from the 2008 Master Plan, the City has continued many of its existing water conservation programs and added several new programs; a summary of ongoing water conservation programs is provided in Table 1.

TABLE 1
City of Longmont Water Conservation Programs

Program	Year Started	Residential	Commercial	City	Status
Indoor Programs					
Toilet Rebates (Dual Flush and Ultra low Volume)	2003	X	X		Ongoing
Dishwasher Rebates	2006	X			Ongoing
Clothes Washer Rebates	2003	X			Ongoing
Low Flow Bathroom Fixtures	2007			X	Ongoing for City facilities
Pre-Rinse Nozzle Conversion	2005		X		Coordinate with Partners for A Clean Environment (PACE); 35 restaurants in 2009-2010
Irrigation and Turf Programs					
Irrigation Audit	2005	X	X	X	Ongoing
Garden in a Box	2005	X			Ongoing
Rain Sensor Rebates	2009	X	X		Ongoing
Evapotranspiration Controller Rebates	2009	X	X		Ongoing
Water Audits					
Indoor Audits	2011	X	X		Residential: Coordinate with Center for Resource Conservation (CRC) pilot program 2010 Commercial: Coordinate with PACE

TABLE 1
City of Longmont Water Conservation Programs

Program	Year Started	Residential	Commercial	City	Status
Metering					
Automated Meter Reading (AMR)	1999		X		AMR installed as needed for commercial, irrigation, City taps
Education & Outreach					
Children's Water Fair with Education Kits	1998	X			Annually
Public Outreach	1993	X	X		Ongoing
Local Paper Advertising	1993	X	X		Ongoing
Annual Newsletter	1993	X	X		Annually
Training Workshops	2000	X			Annually
Enforcement					
Water Wasting	2005	X	X	X	City operations staff respond to water wasting complaints
Municipal Code	2007	X	X	X	Landscape Code (15.05.040) requires xeriscape on all open space areas, low water-consuming ground cover, etc.
Conversion to Raw Water Irrigation	1988			X	Project MUW-173, $674,000 budgeted for 2012-2016

The most widely used programs are the residential rebate programs, residential irrigation audits, and Garden in a Box program. All of these popular programs provide financial incentives or free services, subsidized by the City, for customers to install water-efficient indoor appliances or reduce the amount of water used for outdoor irrigation.

Table 2 presents treated water production from the City's water treatments plants and gross per capita water use from 1996 (the year the City's first conservation plan was implemented) to 2011. For purposes of this evaluation, the gross per capita water use is defined as the volume of water produced at the water treatment plant divided by the population receiving the treated water.

TABLE 2
City of Longmont Historical Water Use, 1996-2011

Year	Total Treated Water Production (million gallons, MG)	Gross Per Capita Water Use (gallons per capita per day, gpcpd)[1]	Residential Per Capita Water Use (gallons per capita per day, gpcpd)
1996	4,587	213	-
1997	4,562	206	-
1998	4,986	215	-
1999	4,706	195	-
2000	5,763	212	121
2001	5,650	201	115
2002	5,613	197	118
2003	5,300	181	108
2004	5,134	171	103
2005	5,492	180	109

TABLE 2
City of Longmont Historical Water Use, 1996-2011

Year	Total Treated Water Production (million gallons, MG)	Gross Per Capita Water Use (gallons per capita per day, gpcpd)[1]	Residential Per Capita Water Use (gallons per capita per day, gpcpd)
2006	6,007	193	122
2007	5,909	187	116
2008	5,608	176	110
2009	4,987	158	100
2010	5,298	166	107
2011	5,301	162	-

[1] Gross per capita water use is defined as the volume of water produced at the water treatment plant divided by the total service population.
[2] Residential per capita water use is defined as the volume of water consumed by residential customers divided by the total service population.

Data from Table 2 is presented graphically in Figure 1.

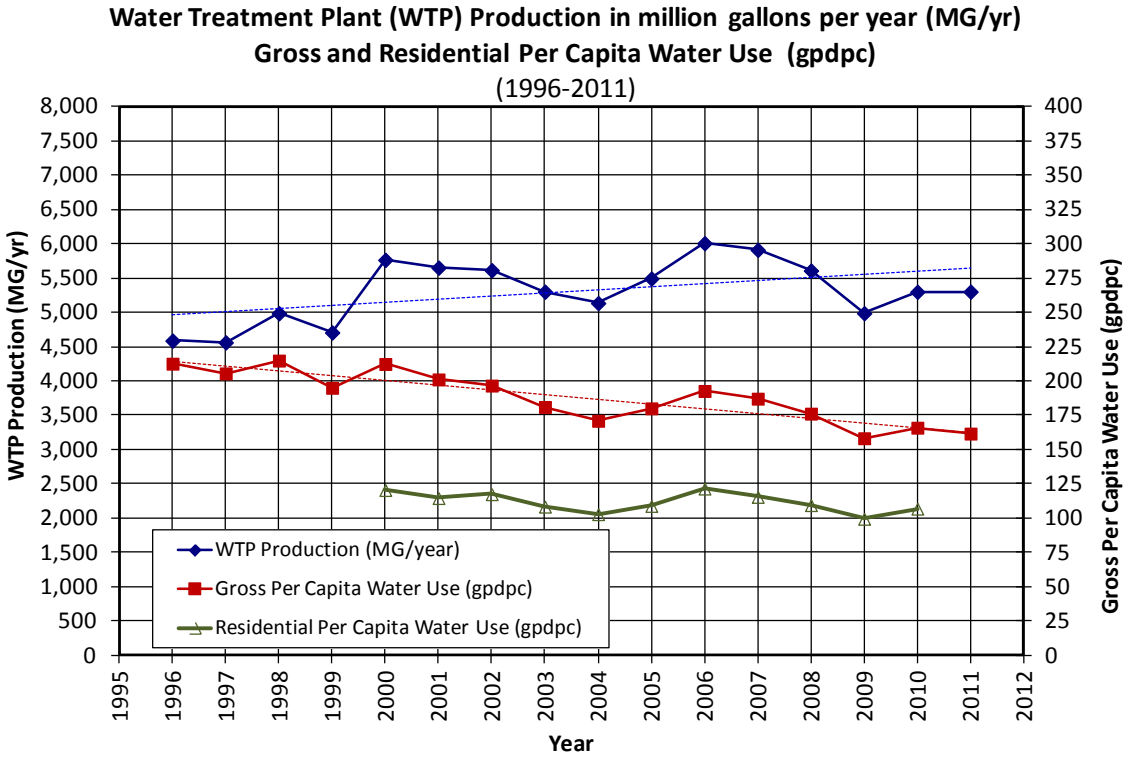

FIGURE 1
Water Treatment Plant Production and Gross per Capita Water Use, 1996-2011

Since the City's first water conservation plan was developed in 1996, gross per capita water use has decreased from approximately 213 gallons per capita per day (gpcpd) to 162 gpcpd. It is worth noting that residential customers were not fully metered until the end of 2006, but the gross per capita water use has generally continued to decrease past 2006. Based on the trend line from 2006 to 2011, the gross per capita water use decreased from 180 to 162 gpcpd, a decrease of approximately 9 percent. If the population in 2011 had consumed the same per capita volume of water as in 2006, the total volume of

water consumed in 2011 would have increased by 600 million gallons (MG) for the year, to 5,901 MG, or an average of 1.6 million gallons per day (mgd).

The decreasing trend in gross per-capita water use indicates water conservation is occurring. The previous calculation is a high-level estimation of the amount of water the City and its customers have been conserving throughout the years. However, this information does not help identify the most effective water conservation programs. The effectiveness of current water conservation programs is the focus of this Program Evaluation.

Evaluation of Water Conservation Programs

The evaluation of the effectiveness of water conservation programs requires extensive data collection, organization and management; which have been performed by the City over the past several years. The information collected and managed by the City during this time has included the following:

- Rebate program participant information, including account number, type of rebate, and the date the rebate was given;
- Monthly water use records for individual customers that have received rebates; and
- Monthly water use records for individual customers that have not received rebates.

In an effort to make data more accessible and reliable, the City contracted with Symbiotic Engineering (Symbiotic) to load water use and other attribute data (rebate type, customer category, age of house, square footage, etc.) into a GIS-based system.

To this end, the analyses presented in this report utilized the water demand data developed by Symbiotic from monthly billings from the City. Symbiotic utilized its proprietary Sustainability Information Management System (SIMS) software to cull and sort the City's billing data, removing duplicates, erroneous billings, and other inaccuracies to develop a robust data set for each customer account, segregated by address, customer class, account number, and program type (see Appendix 1 for a more detailed description of Symbiotic's methodology). The database includes the number of days in a month that the water use was billed and the total water use for the month. From these data, average daily water use per connection for each month of record was calculated. From this proprietary system, water use data was easily queried to support the analysis required to support the City's decision making needs.

Symbiotic also utilized the City's billing data to create lists of control customers that used City water but did not participate in rebate or promotional programs. These control groups were also segregated by address, customer class, and account number. The water demands for those customers that participated in the rebate and promotional programs were compared to the control group water use to estimate actual water savings related to each program. A description of how the control groups were selected is also presented in Appendix 1.

Overview of the Rebate and Promotional Programs

The evaluation of current water conservation measures and programs that the City has chosen to implement focuses on rebates and promotional efforts conducted since 2006. These programs involve the City providing cash incentives to its customers, primarily single family residential customers, for the programs listed below. Single family residential customers represent approximately 85 percent of the City's current customers and about 54 percent of the City's current total water demand.

- Ultra Low Volume (ULV) Toilets (1.28 or 1.6 gallons per flush [gpf])
- Dual Flush (DF) Toilets
- High Efficiency (HE) Clothes Washers

- High Efficiency (HE) Dish Washers
- Xeriscape Planting Packages (Garden in a Box)
- Outdoor Irrigation Audits (Slow the Flow)

The total costs incurred by the City for each program are summarized in Table 3 for the period of 2006-2011. This is a period of time that the City maintained detailed records of its rebate programs, such that the analyses conducted in this report are based on water demand patterns observed over this period of time. The water demand evaluations for this analysis included monthly customer water use data for the period January 2005 to January 2012.

TABLE 3
Summary of Rebate/Promotional[1] Costs Incurred 2006-2011

Program	Cost per Rebate	Total Cost
Indoor		
ULV Toilet	$50	$58,850
DF Toilet	$100	$41,400
HE Clothes Washer	$25	$56,475
HE Dishwasher	$25	$36,250
Outdoor		
Garden in a Box	$70	$22,750
Slow the Flow	$75[2]	$41,850

[1]These programs are considered rebates and/or promotional programs. Rebates are cash incentives provided to update indoor appliances with more water efficient models, where water savings are expected without changes in customer water use. Promotional activities include outdoor services or plant materials, which are effective only if customers follow up with additional installation efforts or changed behaviors (e.g., change irrigation clocks, install more efficient spray nozzles, install and maintain new plantings, etc.).
[2]Residential audits were $75 per audit; HOA audits were $150 per audit.

A review of the customers that used the City's rebate and promotional programs indicated the vast majority were single family residential customers, as shown in Table 4.

TABLE 4
Number of Rebate and Promotional Program Participants (2006 through 2011)

Rebate/ Promotional Program	Number Paid for By City	Number Valid in SIMS	Percent of rebates to Single Family Customers[1]
Indoor			
ULV Toilet	1177	871	94
DF Toilet	414	342	95
HE Clothes Washer	2250	1967	98
HE Dishwasher	1450	1320	98
Outdoor			
Garden in a Box	325	260	98
Slow the Flow Irrigation Audits	546	517	99

[1] Based on data contained in Symbiotic Engineering's SIMS database.

Other types of customers that participated in the programs and their levels of participation are provided in Table 5. Noteworthy is that the number of participants in the programs tracked by the City and the number of participants tracked in the SIMS database are different for a number of reasons. First, the SIMS database, which started with the entire City billing database, was culled to remove participant listings with partial records (e.g., missing account numbers, etc.) or locations without street addresses

(e.g., customers tracked with P.O. box numbers). Second, the SIMS database contained only customers with some water use records for the period of interest (January 2005 to January 2012). Customers that had partial customer information, P.O. box addresses, or no water use data for the period of interest were removed from the program lists.

TABLE 5
Number of Program Participants by Customer Category

Customer Category	Number of Participants Valid in the SIMS Database					
	Clothes Washers	Dish Washers	ULV Toilets	DF Toilets	Garden in a Box	Slow the Flow Audits
Auto Dealership			1			
Church				1		
Condo	1					4
Cross listed	1		9	3	1	1
Duplex/Triplex	10	8	8	7	2	1
Manufactured Home					1	
Hotel/Motel	1		1			
Multifamily (4-8)	2	3	7	1		1
Multifamily (9+)			1	1		1
Office		1	1	1	1	
Other	2	1	5			
Recreational	1					
Retail	1		2			
Single Family	1,918	1,298	819	325	254	506
Warehouse				1		
Undefined	30	9	17	2	1	3
Total	**1,967**	**1,320**	**871**	**342**	**260**	**517**

Summary of Water Demand Evaluations

The water use data used to characterize the impact of the City's programs was focused on single family residential customers with monthly water use data that extended back to January 2005 for the following reasons:

- Single family residential customers constitute the vast majority of the participants; and
- Monthly water use data from 2005 was needed to pre-date the customer involvement in the rebate and promotional programs.

Based on the SIMS database, customers that met these criteria accounted for between 38 and 69 percent of the program participants (noting that single family residential customers compromised over 95% of the rebate and promotional program participants as shown in Table 4). These data were considered to be randomly distributed within the participant groups, such that the evaluations conducted are considered to be representative of the overall water use trends. The specific percent of program participants that were included in the final evaluation of water demand reductions associated with each program is listed in Table 6.

TABLE 6
Percentage of Single Family Program Participants Included in the Water Demand Evaluation

Rebate/ Promotional Program	Percent of Participants with Records Dating Back to 2005[1]
Indoor	
ULV Toilet	46
DF Toilet	41
HE Clothes Washer	49
HE Dishwasher	58
Outdoor	
Garden in a Box	38
Slow the Flow Irrigation Audits	69

[1]Includes only those participants with records of water use dating back to January 2005.

The analyses were performed by calculating the average daily per-connection water use for each month for the list of participating customers. Therefore, for each month, an average daily water use was calculated by summing the daily water use of all participants (for a specific program) and dividing by the number of records available for that month since not all participants had complete records of water use for the entire period of interest. Using these data, the evaluation estimated the impact of each program on a year-by-year basis, as well as the accumulated impact over the period of interest (January 2005 to January 2011).

Calculations were performed for indoor water use and outdoor water use, as noted in Table 6.

To characterize the impact of indoor water use rebates, wintertime average daily water use for each month of record was calculated by averaging the daily water use for December through March for each year for the customers of note. The average wintertime daily water use for each month was calculated for each program for each group of participants that participated during a single calendar year. Therefore, for DF toilets, water use for each winter was calculated for all those that received a rebate in 2006, all those that received a rebate in 2007, etc. A cumulative wintertime water use for all DF Toilet rebate recipients was also calculated. These same calculations were performed for all indoor programs. All wintertime daily water use calculations used the average of December through March, except for 2005, which used January through March, and 2012, which used December and January.

To characterize the impact of the outdoor water use promotional programs, total summertime outdoor use was calculated by summing all daily water use for each participating customer over a 7-month period (April through October) for each year and subtracting estimated wintertime daily water use for the preceding winter multiplied by 214 days. Similar to the indoor program, the total summertime water use was calculated for each program for each group of participants that participated during a single calendar year, as well as for all the participants combined.

Using these calculations, indoor rebate impacts were determined based on changes in daily wintertime water use per connection (in gallons per day), and outdoor promotional program impacts were determined based on changes in seasonal water use per connection (in gallons).

Control Groups

As indicated above, Symbiotic utilized its SIMS database of the City's billing data and the customer attributes described in Appendix 1 to create control groups of water users to compare to the participant groups. One control group was created for each of the six rebate and promotional programs evaluated. The SIMS methodology selects a control group of up to 1000 participants based off of a semi-random selection of non-program participants composed of similar sub-sectors as found in the program

participants. A different selection was made for each of the six programs. As with the program-related databases, the control databases were culled to include only those customers with valid water use records dating back to January 2005.

The results of the control group calculations, which were performed to mirror the program wintertime and summertime water use calculations, are presented in Table 7.

To eliminate some of the variability in observed gallons per day (gpd) per connection, caused by variations in dates of meter reading from month to month and year to year, as well as other factors, a 3-year rolling average was calculated combining the results of each of the rebate control groups. This served to smooth the trend in calculated changes in daily wintertime use.

TABLE 7
Summary of Control Group Water Use By Year – Wintertime[1] and Summertime[1]

Rebate/ Promotion	Average Year Constructed[2]	Average Size (sq ft)	2005	2006	2007	2008	2009	2010	2011	2012
Indoor			**Average Wintertime Daily Use per Connection (gpd)**							
ULV Toilet	1965	1,659	165	174	155	153	156	154	149	151
DF Toilet	1965	1,657	165	174	155	152	156	153	149	151
HE Clothes Washer	1965	1,659	165	174	154	152	155	153	148	150
HE Dishwasher	1965	1,656	165	175	155	153	157	154	149	152
3-year rolling average					164.6	160.4	154.4	153.8	152.6	151.0
Outdoor			**Average Summertime Seasonal Use per Connection (total gallons)**							
Garden in a Box	1965	1,655	43,384	53,253	55,506	48,950	38,518	44,905	50,092	n/a
Slow the Flow	1965	1,656	43,250	52,086	55,724	49,089	38,738	45,004	50,129	n/a

[1] Wintertime water use is based on the average daily use from December through March. Summertime water use is total seasonal use for April through October.
[2] Refer to Symbiotic Engineering report in Appendix 1 for additional information on control groups.

Based on the available control group data, the wintertime daily water use in Longmont has been decreasing at a rate of about 8.3 percent over the period of interest (January 2005 to January 2012), from approximately 165 to 151 gpd per connection for single family residences based on the 3-year rolling average of wintertime(December through March) water use from the combination of all control groups (see Figure 2) This decrease is consistent with the rate predicted by the State of Colorado (GWI, 2010).

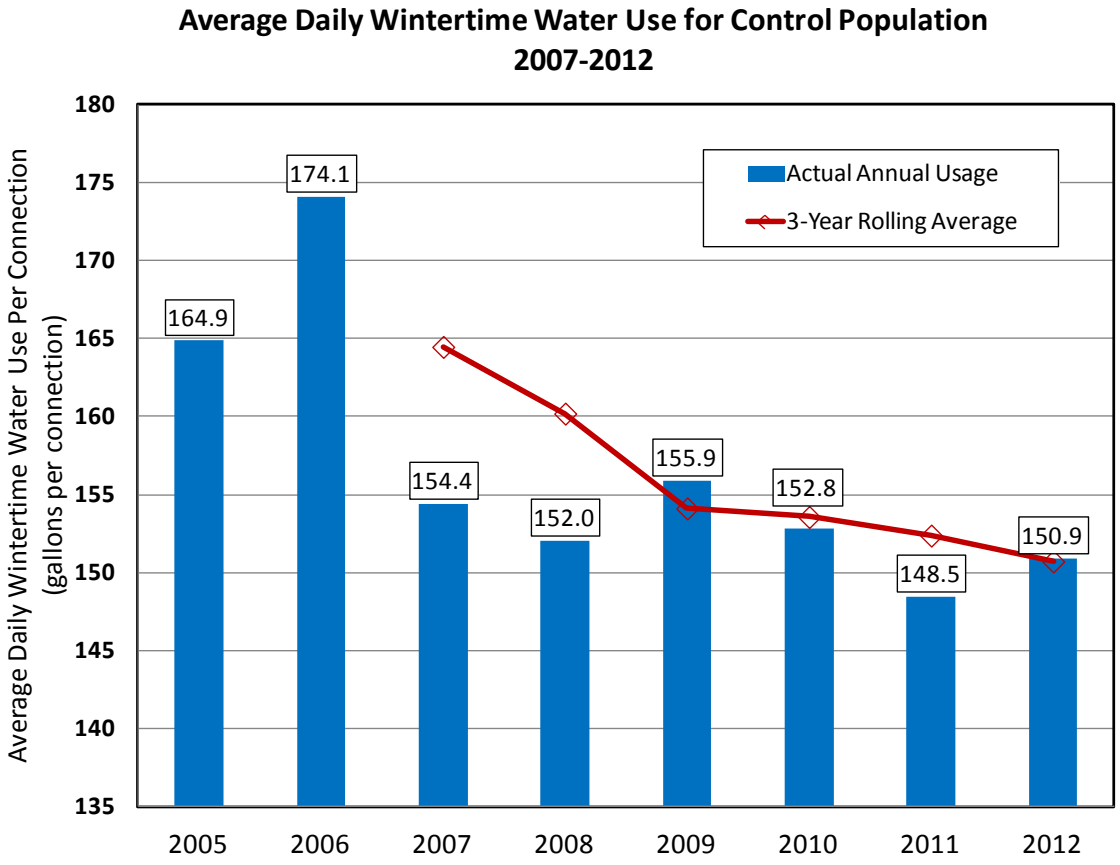

FIGURE 2
Average Daily Wintertime Water use for Control Population, 2007-2012

Summertime water use demands are more variable than wintertime water use due to the seasonal impact of precipitation, wind, and temperature. Therefore, seasonal total water use for each year was compared to the seasonal water usage for the year before the program began, which was 2005 for Slow the Flow and 2006 for Garden in a Box. For example, in 2009, summertime seasonal water use was about 90 percent of the 2005 summertime seasonal water use for the Slow the Flow control group (see Figure 3). This type of ratio analysis, using comparisons to the 2005 or 2006 season before any rebate or promotional program began, is the basis for evaluating the promotional program effectiveness. Figure 3 shows the seasonal water use from 2005-2011, normalized to the year 2005 for Slow the Flow and 2006 for Garden in a Box. Note that this comparative analysis takes into account changes in evapotranspiration (and weather related variability) as well as other factors effecting applied irrigation rates from year to year. Future assessment of outdoor irrigation programs conducted by the City should use this type of comparative analysis, since applied irrigation rates vary by more factors than just evapotranspiration.

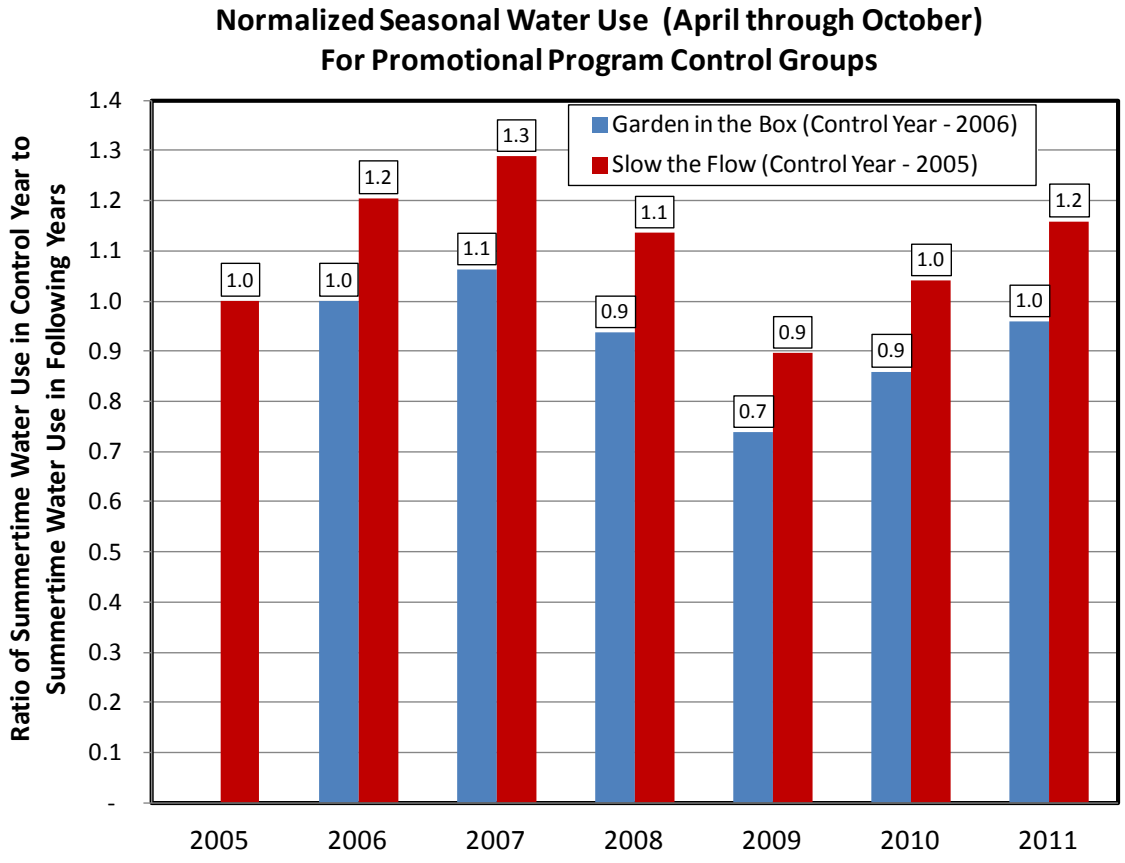

FIGURE 3
Normalized Seasonal (April through October) Water Use for Promotional Program Control Groups

Rebate Programs

The indoor rebate programs have been popular and well utilized by the Longmont citizenry. In all, nearly 5,300 customers have participated in the four different indoor rebate programs. This represents a penetration rate of over 20 percent for single family residential customers assuming that each rebate when to a different customer and that no customer received more than on rebate from the four programs offered by the City. The most popular rebate has been the HE clothes washer rebate. However, aside from the DF toilet rebate, each type of rebate has been utilized by more than 1,000 customers.

The impact of the rebate programs is typically measurable within one year of installation of the new, more efficient fixture or appliance. Table 8 presents the measured impact of the four different programs one year after the rebate was awarded.

TABLE 8
Change in Water Use for Single Family Residential Customers Receiving Indoor Rebates

Rebate Program	Change in Daily Per Connection Water Use (gpd)[1]					
	2007	2008	2009	2010	2011	Total[2]
ULV Toilet	(28.1)	0.6	(46.4)	(27.0)	(30.7)	(34.9)
DF Toilet	(32.1)	3.4	(22.2)	6.3	(53.6)	(24.3)
HE Clothes Washer	(30.3)	(13.9)	(34.2)	(9.1)	(20.4)	(29.4)
HE Dishwasher	(0.8)	4.0	(18.2)	10.2	(11.4)	(17.4)
Control Group	(4.3)	(6.1)	(0.6)	(1.2)	(1.7)	(13.7)

[1]Compares average water use based on a 3-year rolling average for the entire group of rebate customers. A negative value () indicates water use decreased and a positive value indicates water use increased for the average water use over the previous 3 years.

[2]Based on the 3-year rolling average of observed wintertime daily use per connection comparing 2007 to 2012 (where the 2007 average represents 2005 to 2007 and 2012 represents 2010 to 2012). Note that the total does not necessarily equal the sum of the 2007 to 2012 increases/decreases due to rounding error.

The impact of the rebate program on "next year" water use is somewhat variable based on the information presented in Table 8. The variability may be due to the timing of meter reading and billing from period to period. It may also be a function of large-scale water use trends that are not fully characterized at this time. However, the overall reduction of average wintertime water use (presented in the last column of the table), as measured for each rebate program, is consistent with expected water use reductions based on a comparison of old and new technology (GWI, 2010). Therefore, this metric (average water use reduction) is expected to provide an accurate representation of the long-term average water savings associated with each rebate program. The expected water savings and the cost of the water savings are summarized in Table 9.

TABLE 9
Summary of Average Water Savings per Rebate Program

Rebate	Number of Rebates[1]	Savings (gpd per connection)[2]	Savings (average AF per year)	Cost ($/AF)	Rebate Efficiency (AF/rebate)
Indoor					
ULV Toilet	1,177	21.3	28.1	$ 2,095	0.024
DF Toilet	414	10.7	5.0	8,343	0.012
HE Clothes Washer	2,250	15.8	39.8	1,418	0.018
HE Dishwasher	1,450	3.8	6.2	5,873	0.004
Total	**5,291**		**79.1**		

[1]For the period from 2007 to 2011.

[2]Adjusted based on average observed water demand reduction in the control group over the same period of time.

As shown in Table 9, the average annual savings from the combination of the rebate programs is approximately 79 acre-feet (AF), which has a replacement cost of about $1.6 million. The City spent a combined $192,975 to achieve savings valued at $1.6 million in replacement water cost, assuming $20,000 per AF for replaced water including water acquisition, transmission, treatment and distribution. Figure 4 presents a graphic view of some of the most dramatic water demand reductions observed – based on the HE clothes washer rebate program; the scale of the graphs is adjusted to focus on data for the wintertime months.

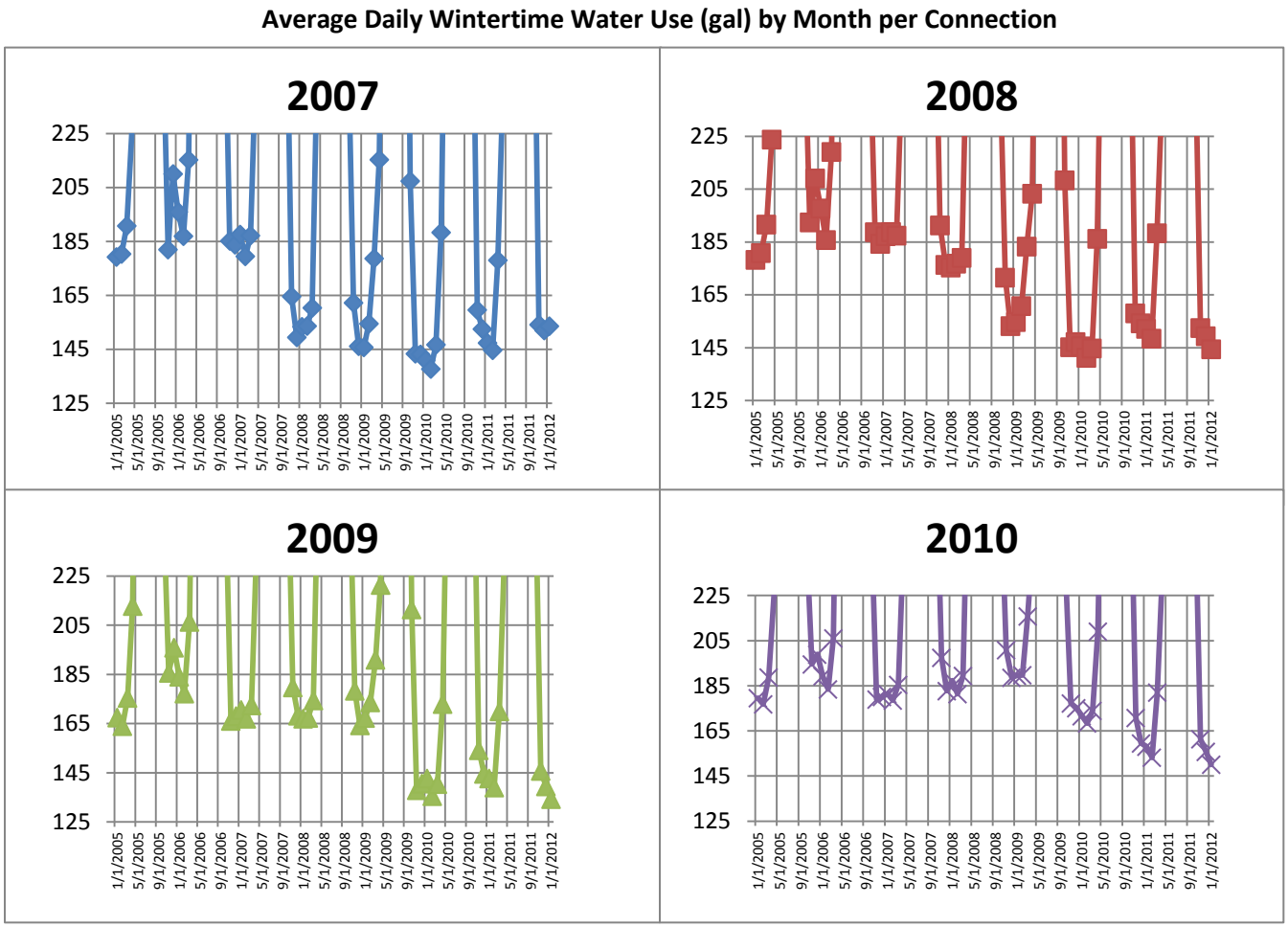

FIGURE 4
Daily Wintertime (December-March) Water Use by Month for Single Family Residential Customers Participating in the HE Clothes Washer Rebate Program by Year of Participation

Overall, the ULV toilet rebate is the most effective for the City (in terms of water saved per rebate), returning about 0.024 AF per rebate. Next most effective is the clothes washer rebate, followed by the DF toilet rebate. The dishwasher rebate returns the least water per rebate.

The cost of the rebates (in terms of dollars spent per AF of demand reduction) is a slightly different order. HE clothes washers have the best rate of return, followed by ULV toilets. The toilet rebates could be more cost effective with some adjustments. For example, the ULV toilet rebate would have the same rate of return (in dollars per AF of saved water) as the HE clothes washer if the rebate was reduced from $50 to about $35. The DF toilet rebate would have to be reduced to about $16 to obtain a comparable rate of return. For the HE dishwasher rebate to be as cost effective as the HE clothes washer program for the City, it would have to reduce the cash incentive from $25 to about $6.

Note that the DF toilet program may have a better rate of return for the City in the future compared to what has been observed in the past. The past performance of DF toilets has varied from small increases in water demand to over 50 gpd reductions per connection. The technology for DF toilets has been improving over the last 3 to 5 years, and it is expected that future DF toilets will be more robust and therefore create more reliable water savings. Because past DF toilets may not have functioned as well as

anticipated, water savings per rebate may underestimate future savings.[1] Therefore, it is reasonable to expect future DF toilet rebates to be cost effective at a rate of about $45 to $50 when compared to the HE clothes washer.

It should also be noted that the City should consider being more explicit in its requirements for acceptable toilet rebates, given that 1.6 gallon per flush (gpf) toilets are still available in big box stores (although more toilets are now available in 1.28 gpf models). The City should therefore consider specifying that rebates will only be made available for installations of 1.28 gpf toilets. In addition, the City may need to specify that only toilet replacements for those toilets with greater than 2.5 gpf will be eligible for rebates. In this way, the City will not pay for toilet replacements for 1.6 gpf to 1.28 gpf.

Finally, the City should consider methods to phase out certain rebate programs that may become obsolete. For example, HE dishwasher and clothes washers may become so prevalent by 2016 that providing rebates does not allow for a measurable reduction in customer water demand. Therefore, it is incumbent on the City to continue to collect data and evaluate the water savings for each rebate program on annual regular basis into the future to support decision making and appropriate management of utility funds.

Promotional Programs

The evaluation of the promotional programs is not as straightforward as the indoor rebates given the natural variability of irrigation demands over time. In addition, programs such as Garden in a Box involve water demand reductions that evolve as new, more efficient plantings are established. In the first 2 to 3 years, xeric plant materials require adequate irrigation to allow root zones to establish so that the mature plants are drought tolerant. Irrigation audits can also create delayed water savings, as home owners may take more than one season to implement recommended irrigation system improvements.

For these reasons, the evaluation of the two promotional programs implemented by the City, Garden in a Box and Slow the Flow, were performed by combining all of the single family residential customers participating in each program into a single group rather than differentiating the impact of the program on customers based on the year of their participation.

The key metric used to evaluate water use reduction associated with the two promotional programs was the ratio of current-year summertime seasonal water use to that of 2005 or 2006, before the Slow the Flow and Garden in a Box promotional programs were implemented, respectively (see Figure 3). Using this metric, changes in seasonal water use from year to year were normalized to the year before the program of interest was initiated, with the assumption that water use by the participants would lessen over time relative to the control year as the effect of the two promotional programs were established.

Table 10 presents a comparison of the seasonal water use for the control groups to that of the program participants for each of the two outdoor programs. Before analyzing these data, it is of interest to note the indoor water use behaviors of the customers that participated in the two promotional programs. For those that chose to participate in the two outdoor programs, the average wintertime daily water use (based on a 3-year rolling average) of the participants was approximately 150 gallons in 2007 and approximately 136 gallons in 2012. These rates of wintertime water use are about 9 to 10 percent below the control group of customers from across the City. This observation indicates that the customers that participated in the outdoor promotional programs have more efficient indoor water use than the average home in Longmont.

However, the customers that participated in the Garden in a Box and Slow the Flow programs have larger outdoor water use than the average Longmont home. For example, the participants used 27 and

[1] ULV toilets function using 1.28 gpf, whereas DF toilets function using 1.28 gpf and 0.7 gpf, depending on the waste, averaging less than 1 gpf in a residential setting (GWI, 2010).

60 percent more seasonal water in 2005, respectively, than the average Longmont home, as illustrated in Table 10. The difference between the control group water use in gallons and that of the program participants may result from a number of different root causes. For example, the control group includes older homes, on average, with most homes built around 1965 versus 1975 and 1985 for Garden in a Box and Slow the Flow, respectively. Older homes may be less likely to have automated irrigation systems. The difference may also be a function of lot size and/or different irrigation behaviors between the control group and the program participants, none of which have been characterized in this study. However, changes in weather conditions influence irrigation practices for both groups, supporting the normalizing method used herein.

TABLE 10
Summary of Summertime Seasonal Water Use for the Outdoor Promotional Programs

	Seasonal Water Use (gallons)[1]		Ratio to Control Year[2] Seasonal Water Use	
		Garden in a Box		
	Control (gallons)	Participants (gallons)	Control (ratio)	Participants (ratio)
2005	43,384	55,271		
2006	52,252	61,196	1.000	1.000
2007	55,505	60,731	1.062	0.992
2008	48,950	56,778	0.937	0.928
2009	38,598	42,938	0.739	0.702
2010	44,904	57,504	0.859	0.940
2011	50,092	54,457	0.959	0.890
		Average over the last 4 years >	0.873	0.865
		Slow the Flow Outdoor Irrigation Audits		
	Control (gallons)	**Participants (gallons)**	**Control**	**Participants**
2005	43,249	69,245	1.000	1.000
2006	52,085	79,550	1.204	1.149
2007	55,723	80,641	1.288	1.165
2008	49,088	76,830	1.135	1.110
2009	38,737	58,281	0.896	0.842
2010	45,004	72,634	1.041	1.049
2011	50,129	74,314	1.159	1.073
		Average over the last 4 years >	1.058	1.018

[1] Seasonal water use from April through October.
[2] The control year for Garden in a Box is 2006 and control year for Slow the Flow is 2005.

Based on the data presented in Table 10, the Garden in a Box participants appear to utilize about the same amount of water (proportionally) for summertime use as the control group. Averaging the seasonal water use ratio over the past 4 years to account for year-to-year variations, the Garden in a Box participants used about 0.8 percent less water compared to their 2006 usage, versus the control group. This reduction in outdoor water demand equates to about 326 gallons per connection; which constitutes a combined water savings of about 0.33 AF for the 325 Garden in a Box participants.

The Slow the Flow program appears to create slightly greater reductions in water demand with participants using slightly less water (proportionally) for summertime use as the control group. Participants used about 2,720 fewer gallons of water on average over the last 4 years compared to the control group. This constitutes a combined water savings of about 4.6 AF for the 542 Slow the Flow participants.

The cost for these two programs (i.e., based on the total cost for the program divided by the estimated acre-feet of customer demand reductions), is about $70,000 per AF for Garden in a Box and $9,000 per AF for Slow the Flow. In that these two programs are promotional in nature and do not directly impact water demands without a behavioral change by the customer, it is important for the City to evaluate future support of both Garden in a Box and Slow the Flow in this context.

Current Water Conservation Programs

The City funds these and other water conservation programs as part of its overall water conservation plan implementation efforts. These programs, and the 2012 budget for each, are summarized in Table 11. Table 11 also includes the 2012 budget for rebates and promotional programs. AMR replacement is funded from budgets outside of water conservation, including the sewer fund and the water fund.

TABLE 11
2012 Budget for Water Conservation Programs

Program	Description	Customer Classes	Budget $
Indoor Rebates	ULV, HE and DF toilets, HE clothes washers and dishwashers, ULV urinals	Residential and Commercial	$40,000
Irrigation Rebates	Garden in a Box, Slow the Flow audits, evapotranspiration controller rebate, rain sensor rebate, Xeriscape Seminars	Residential and Commercial	$41,700
Audits	Residential whole house audits, commercial facility audits,	Residential and Commercial	$26,000
Pre-Rinse Spray Nozzle Retrofit	Provide pre-rinse spray nozzles at local restaurants.	Commercial	$1,875
Soil Amendment Program Support	Plan review and site inspections to support City ordinance	Residential and Commercial	$42,500
Water Waste Program Support	Field inspections and administration to support City ordinance	Residential and Commercial	$1,000
Education	Workshops, advertisements, website, Water Fair, Educational Kits, Xeriscape Demo Garden	-	$ 46,700
		Total Water Conservation Budget	**$199,775**
Meter/AMR Installations	Replace large (>1 ½") meters with AMR when replaced.	Commercial and Irrigation	$30,000[1]

[1] AMR replacements are funded from budgets outside of water conservation, 25% from the sewer fund and 75% from the water fund.

A review of each of these programs as planned by the City currently is provided below, as is a listing of recommendations to improve and adjust the 2012 budget for future years.

Indoor Rebates

This is a continuation of the programs discussed in the previous portions of the report including ULV and DF toilets, and HE dishwashers and clothes washers; as well as the continuation of a ULV urinal rebate program, which had limited customer use prior to 2012.

Irrigation Rebates

The City has maintained two sets of related irrigation demand reduction programs – one for ET controller rebates and one that includes the promotional programs – Slow the Flow and Garden in a Box through the Center for Resource Conservation. Customers have had only limited involvement in the ET controller rebate program; whereas Slow the Flow and Garden in a Box have been popular.

Audits

The City has set aside funds for residential whole house audits and commercial and homeowner association (HOA) audits. These audits are planned to include installing showerhead and faucet aerator replacements depending on the type and need of the residential use/facility that is audited.

Pre-Rinse Spray Nozzle Retrofit

The City has budgeted for installing pre-rinse spray aerators at 15 local restaurants.

Soil Amendment Program Support

The City has an ordinance that requires soil amendment of three cubic yards per 1,000 feet, tilled to a depth of 6 inches (reimbursable), in order to obtain a Certificate of Occupancy (CO) for commercial and residential construction. In addition, incentives are in place for using xeriscape as well as landscaping ordinances that encourage more drought-tolerant vegetation. Section 15.05.090.H of the Land Development Code and Section 600 of the Design Standards and Construction Specifications require developers to utilize xeric practices in the design, installation, and maintenance of landscaping and irrigation systems in private common open space areas in residential developments. The administration and oversight of these programs requires the proper allocation of City staff, as well as expenses for onsite inspections.

The City currently has funds allocated for both staff and expenses; however, the effectiveness of the program is not well tracked.

Water Waste Program Support

The City also has a water waste ordinance. To facilitate compliance with this ordinance, the City maintains a water waste hotline for the public to call if they observe water being wasted. In 2011, the City responded to about one dozen complaints.

Meter/AMR Installations

Improved metering of customer water demand has long been a goal of the City's. To achieve this goal, the City has initiated an automated meter reading (AMR) program for its large commercial and irrigation water customers. Through this program, AMR equipment is installed when a large (1 ½" or larger) commercial or irrigation meter is replaced. As of the last water conservation planning effort in 2008, the City reported having the following systems in place: the Tel Data system has about 250 address that report meter readings hourly, the Metron system has 20 addresses which send readouts to laptops (for City monitoring), and the Neptune system has about 1,900 addresses with radio read devices. About 25 of the Neptune units are equipped with a program that can detect leaks or backflow at the meter.

The City also has a program that regularly inspects its larger meters; meters greater than 3-inches are tested every four years. Faulty meters are either replaced or repaired.

The City has a CIP project (MUW150) valued at about $5.5 million over a four year period to install all new AMR devices on all 25,000 residential customers; currently the project is not funded. This project is not included in this plan evaluation since it would be funded under separate means within the City's budget.

Education

Educational programs have long been the hallmark of local water conservation programs in Colorado; however, this trend is changing as more programs are being identified for municipalities to effectively reduce customer water demand at a reasonable cost and/or for municipalities to more efficiently distribute and bill for water. It is important to maintain a public outreach program promoting the work that the water utility performs for the City's citizens. However, a public relations program does not necessarily promote wise water use and water use efficiency. To this point, it is important to identify

those educational programs that link to and complement the water conservation programs that the City chooses to implement.

Currently, the City has educational programs related to:

- Public messaging development
- Customer workshops
- Water Fair (with educational kits)
- Website maintenance
- Annual newsletter
- Television and newspaper advertizing
- Xeriscape garden maintenance

Recommended Adjustments/Program Improvements

Indoor Rebates

Recommendations for each indoor rebate program that the City currently conducts are provided in the previous section.

Data on rebate and program participants is critical to tracking water savings and evaluating programs. The City should continue to collect and organize information from each participant including:

- Type of rebate;
- Account number and premise number from each participant;
- Name, address, and apartment number if applicable;
- If a P.O. box is given require the address where the program or rebate will be installed (must be within City of Longmont);
- Rebate application date.

Irrigation Rebates and Promotional Programs

The City has not provided more than a few rebates to customers for evapotranspiration (ET) controllers or rain sensors. Both of these types of rebate programs have been implemented in other locations in Colorado;[2] however, the effectiveness of these programs is still undocumented. Each type of rebate comes with challenges related to installation and operational requirements, which can hinder the overall success of the practice. For example, rain sensors must be installed in a location that will detect ambient rainfall. In practice, it has been shown that a significant number of rainfall sensors have been installed under roof eaves or in otherwise sheltered areas, making the detector ineffective in controlling irrigation clocks. ET controllers are more complex than rain sensors; however advances in technology allows for weather stations to be installed at each home which has an ET controller compatible irrigation clock, although some ET controllers do not include self-contained weather stations, but are linked via satellite to National Oceanic and Atmospheric Administration (NOAA) or other weather stations to control the irrigation clock. Finally, field audits have shown that the best technique to manage irrigation controllers is through personal observation and manual control of the irrigation clock.

Overall, ET controllers, which have become more affordable in recent years, and rainfall sensors are becoming a more reliable improvement in home irrigation control. However it is a rebate program that the City should monitor closely to support mid-term adjustments to rebates. Given that the current cost of an 8-station controller and weather station is in the range of $200, a rebate for ET controllers

[2] As reported by CWCB in 2011 (GWI, 2011), of 55 entities with water conservation plans on file with the State, 24 have implemented rain sensor rebates and 29 have implemented ET controller rebates.

consisting of a clock and a home-based weather station may be effective in the range of $50 to $75 per installation. The cost to the City for this type of ET controller rebate program may be in the range of $920 to $1,380 per acre foot of customer demand reduction (depending on the weather conditions in any given year). Given that rainfall sensors are substantially less expensive for homeowners and can be readily included in a home-based weather station, it is not recommended that the City support a rebate program for this irrigation clock add-on at this time.

In addition, the City should consider creating a rebate program for improved sprinkler heads (i.e., replacing existing spray rotors with MP™ rotators) that can save water and improve irrigation efficiency. Some MP rotators are equipped with pressure regulators, which help to reduce overspray and improve the distribution of the irrigation water over the plant materials. Care should be taken in the installation of MP rotators since the spray radius is reduced compared to traditional spray irrigation nozzles. Because irrigation system efficiency is dependent upon the overlap of irrigation water discharge from nozzle to nozzle, MP rotators may not provide adequate coverage between heads. However, many irrigation systems, especially in narrow strips of turf, may have significant nozzle-to-nozzle overshoot, which can be remedied by the MP rotator nozzle. Projected water savings from the use of MP rotators ranges from 10 to 25 percent of irrigation water delivered by traditional spray nozzles.[3]

MP rotators cost about $8 to $10 per nozzle. Rebates could be offered in the $25 range for a set of 10 nozzles, which may save between 6,500 and 16,000 gallons of summer irrigation water per rebate. The resulting cost to the City would be between $500 and $1,250 per AF of water demand reduction.

Audits

Audits may or may not allow for direct water savings since real water demand reductions typically occur after customers change their water use behaviors as a result of audit findings or recommendations. Therefore, it is not clear what kind of return the City can expect on this type of investment. However, based on recent documented experience (GWI 2009, 2011a, and 2011b), it is possible to craft audit programs that create reliable water demand reductions by focusing the effort on those customers that meet the following attributes:

- Are large water users;
- Fit into specific classes of customer types (e.g., lodging, restaurants, retail or recreational facilities, etc.) that have large numbers of visitors that use bathroom facilities; and/or
- Are interested in partnering with the City on major capital improvements (e.g., car washes, laundry facilities, etc.).

It may not be valuable to include customers that are part of a large chain of stores (e.g., Target, McDonalds, Taco Bell, etc.) since access to the facility is sometimes difficult to gain and it is difficult to obtain approval to install retrofits.

Another key to conducting successful audits is to include retrofits for sinks and showerheads in the budget. This can include installing pre-rinse spray nozzles in restaurant kitchens, 0.5 gallon per minute (gpm) faucet aerators in bathrooms and kitchen hand wash sinks (but not other kitchen sinks used to wash pots and pans, fill stations, etc.), and 1.5 gpm showerheads. The audits can also evaluate indoor and outdoor water use efficiency and identify any leaks occurring on the customer side of the meter. Past work conducted by GWI (2011a) has utilized audits in conjunction with retrofits to realize the rates of return on investments as shown in Table 12.

[3] Water Conservation Discussion, http://www.energy.ca.gov/appliances/irrigation/documents/2009-04-01_workshop/presentations/Gene_Smith.pdf

TABLE 12
Estimated Cost of Water Savings Associated with Retrofits During Commercial and Institutional Audits[1]

Type of Retrofit	Cost in Dollars per Acre Feet of Water Saved
Faucet Aerators	$250
Showerheads	$1,550
Toilets	$6,600
Washing Machines	$11,000
Leak Repair	$1,800

[1] Source: Great Western Institute (GWI 2011a)

In addition, retrofitting restaurants with pre-rinse spray nozzles are expected to provide a return on investment at a rate similar to faucet aerators (i.e., at a cost of about $250 per AF of replacement water).

Residential whole house audits, on the other hand, have not been found to consistently reduce customer water demand. This is typically due to the fact that residential audits are conducted on a voluntary basis without retrofits installed. If retrofits (specifically faucet aerators and showerheads) are included in residential audits, then it is anticipated that water savings in the range of 0.05 AF per year per audit would be realized. If the audit and retrofits cost the City about $150 to perform, then the cost of saved water would be on the order of $3,000 per AF.

Note that an additional benefit of conducting residential and/or commercial audits is that the audits provide the City with a means to directly market its indoor fixture rebate programs.

Overall, it is recommended that the City consider developing a commercial audit program that focuses on older restaurants within the City limits, in combination with other City programs that serve these establishments (e.g., industrial pretreatment program, power). A combined messaging campaign that brings City utility presence into the customer's place of business could provide the opportunity to create both water and energy use efficiencies, which will benefit both the customer and the City, as well as give the City the opportunity to educate the customer on water, wastewater, and energy best management practices. The City could include showerhead, pre-rinse spray nozzle, and faucet retrofits as one clear benefit that the customer will receive for participating in the program. The City's rebate programs can also be used to create interest and support the utility/customer relationship.

Soil Amendment (and Related) Ordinance Support

The City should consider creating a database that tracks applications and approvals by address and water account, as well as by program(s) (i.e., soil amendment, xeriscape, etc.) and/or ordinance relevant to that address. The data should also include irrigated acreage related to the project and a link to plans and as-builts. The City should continue this expenditure given that these programs are codified and may be worth considering expansion of the reach of each program depending on the outcome of future data tracking and assessments.

The City could also develop a listing of contractors that can support the permitting and implementation efforts of complying developers.

Water Waste Enforcement

The City will need to continue to fund and support this program, and it may consider expanding its enforcement using seasonal employees that could ride bicycles through the City looking for inefficient water use. These "water efficiency coaches" could provide real-time support to water wasters, identifying problems and providing guidance to those that would benefit from the assistance, while acting as emissaries for the Public Works and Natural Resources Department. If the City chooses to

implement seasonal employees, it should also consider developing a database to track the impact of the program on customer water use.

The City may also consider expanding its water waste ordinance language to limit the time of day for watering (to between 6 pm and 10 am during the irrigation season) in the future. Time-of-day watering could be policed by the seasonal employees as part of their job duties.

Meter/AMR Installations

AMR has many advantages for the City. AMR all but eliminates work staff injuries associated with meter reading by greatly reducing the number of times a meter vault needs to be accessed. AMR also improves the accuracy of customer water use data by eliminating transcription errors. Finally, AMR can be collected remotely, so that daily readings can be used to identify customer-side leaks and unusual use patterns. This helps the City to assist its largest customers in improving their water use efficiency.

The City should continue its expansion of the AMR program to include all large water users) and all large City facilities (there are about 50 City taps). This expansion could be implemented at a cost of about $340,000.

Noteworthy is that AMR device installation is only one part of the City's metering needs. The City also needs to continue a meter testing and replacement program, especially for its largest customers with tap sizes of 2 inches or greater, since older meters tend to under measure the amount of water delivered to customers. New or rebuilt meters for large taps can range from $500 to $3,000. The City should continue to maintain a funding program to support commercial meter replacement at a rate of about 10 percent of these meters per year, which would equate to a cost ranging from $150,000 to $300,000 annually.

The City has a group of parks/schools that are candidates to be converted from treated water to raw water irrigation. These irrigation-only taps would allow the City to reduce treated water use; which would also reduce the amount of non-revenue water associated with the combined water use of these facilities – currently estimated to constitute approximately 7.2 percent of treated water deliveries.

Table 13 summaries the water use for the three candidate facilities. Based on this summary, is it estimated that on average about 9 AF of water demand could be reduced during peak demand periods.

TABLE 13
Summary of Facilities to be Converted from Treated to Raw Water Irrigation

Location	Average Seasonal Usage (AF)	Total Seasonal Irrigation (inches)
School	12.2	29.3
Stephen Day Park	21.7	23.6
Sunset Golf Course	90.0	26.9
Total	**123.9**	-

Messaging Program

Developing a consistent messaging program integrated into the various educational programs is important to claiming water savings related to educational practices. The City has invested in the initial stages of developing a messaging campaign that provides the basic themes and talking points for conservation measures programs, focusing on water use efficiency and overall resource management, in a manner consistent with the needs of the City. With assistance from a public relations company the City

has developed a water conservation logo (Figure 5), a purpose statement, and a "WaterMatters" newsletter format.

FIGURE 5
City of Longmont Water Conservation Logo

For an effective messaging campaign to be established, it needs to be integrated into all parts of the City organization, both horizontally and vertically. An effective campaign creates a consistent look in advertizing; including the City's website, water utility vehicles, City posters and informational material and water bills. The campaign should continue to be developed working with a professional public relations firm that would allow for an honest third-party assessment. The campaign should also be linked into City Council and Water Board such that the tone and reach of the messaging effort, as well as the overall message, is consistent across all City organizations.

The City should continue to appropriate resources to the public messaging effort, reducing funds for the annual newsletter, advertising, and customer workshops until the overall themes and talking points have been established. This effort could increase the development budget from about $2,000 to nearly $20,000, while maintaining the Water Fair and xeriscape garden. Once the messaging has been established, funds can be shifted more appropriately to customer outreach and education efforts.

Once the messaging campaign is further developed, it can be rolled out and connected with other water conservation measures and programs, including rebates, water waste, soil amendment program, commercial audits, and metering. The City may also find that messaging improves with additional customer feedback, which could be obtained through regular surveys and/or focus groups.

Budgeting for the messaging campaign preparation and implementation may require funding from sources beyond the water utility's water conservation program. However, educational funds could be leveraged to support implementation and outreach, to the extent that these efforts align with the needs of the water conservation programs.

Summary and Recommendations

The City has an ongoing program of water conservation programs that have been shown to reduce customer water demand on a consistent basis. The most successful programs include the City's rebate programs; however, other water demand reductions are occurring in the City perhaps due to a combination of other City programs and organic changes in customer water use brought on by changing technology and behaviors. A summary of the water demand reductions measured in 2012 as a result of the analyses presented in this report are presented in Table 14.

TABLE 14
Summary of Program Water Demand Reductions

Program	Number of Participants	Estimated Water Demand Reductions (Avg. acre-feet per year)
Rebate Programs		
HE Clothes Washers	2,250	39.8
HE Dishwashers	1,450	6.2
ULV Toilets	1,177	28.1
DF Toilets	414	5.0

TABLE 14
Summary of Program Water Demand Reductions

Program	Number of Participants	Estimated Water Demand Reductions (Avg. acre-feet per year)
Promotional Programs		
Garden in a Box	325	0.3
Slow the Flow Irrigation Audits	546	4.6
Total Water Savings from Programs	**-**	**84**
Estimated Overall Savings (Programs, Organic Fixture Replacement, and Customer Behavior)[2]:		
Single Family Residential (Indoor)	24,800 connections	390
All Customers (Indoor and Outdoor)	87,850 population[1]	2,400[2]

[1] 2011 Population Estimate for the City of Longmont from the Department of Economic Development Planning Division
[2] Based on the reduction in water use from the average gross per capita use from 2005-2007 compared to 2009-2011.

Based on the information presented in the previous section, the programs listed in Table 15 are recommended for continued implementation by the City to best manage customer water demand, collect data that will help to characterize the benefit of future water conservation expenditures, and support the overall goals of the City as defined in its 2008 Water Conservation Master Plan. Note that the recommendations are based on an annual budget of approximately $120,000. If the city chooses to increase the budget to $175,000 or $250,000, it should consider expanding its rebate programs, and its audit and retrofit programs; Appendix 2 presents the details associated with these additional program budgets.

The City should also consider developing a more robust water waste ordinance, and committing additional resources to the enforcement of an expanded program of identifying and controlling wasteful water use practices.

Note that costs related to improved and enhanced metering – both in terms of meter replacement and installation of AMR – have not been included in the recommendations provided below since the costs for these programs are included in other Public Works budgets. Their absence here does not reduce the importance of these programs to the City; it only indicates that they are funded from separate sources.

Finally, it is understood that the measures and programs included in Table 15 may vary from year to year as implementation occurs based on the City's marketing and messaging campaigns, the response of the market to the programs being offered, and the availability of funding. The City reserves the right to adjust the number of rebates, audits and promotional programs that it funds; based on customer demands, institutional constraints, and future program effectiveness.

TABLE 15
Recommended Water Conservation Programs (for annual budget of $120,000)

Program	Estimated Annual Amount	Unit Cost	Rebate Cost	Demand Reduction (AF)	Cost per AF of Demand Reduction
Indoor Rebates		Per Rebate			
HE Clothes Washers	200 units	$25	$5,000	3.6	$1,400
ULV Toilets	150 units	$50	$7,500	3.6	$2,100
DF Toilets	150 units	$50	$7,500	5.0	$1,500
Outdoor Rebates					
ET Controllers	50 units	$50	$2,500	1.7	$1,500
MP Rotators (10 MP heads per unit)	40 units	$25	$1,000	0.8	$1,200
Outdoor Promotional Programs					
Garden in a Box	50 units	$70	$3,500	0.1	$70,000
Slow the Flow Irrigation Audits	50 units	$75	$3,750	0.4	$9,000
Audits		Per Unit			
Commercial (with retrofits)	10 units	$1,200	$12,000	8.0	$1,500
HOA	10 units	$650	$6,500	1.6	$4,000
Ordinances					
Soil Amendment Enforcement	35 applications	$35	$1,225	n/a	n/a
Water Waste Complaints	10 complaints	$25	$250	n/a	n/a
Education					
Message Development	Lump sum	$24,800	$24,800	n/a	n/a
Xeriscape Garden Maintenance	Lump sum	$1,200	$1,200	n/a	n/a
Water Fair (w/ educational kits)	Lump sum	$9,700	$9,700	n/a	n/a
Monitoring					
Water Data Collection and Assessment	Lump sum	$12,000	$12,000		
Subtotal	-	-	**$98,425**	**24.7**	
Personnel Needs	Hours	Cost/Hour[1]	Cost		
Indoor Rebates	98	$38	$3,769		
Outdoor Rebates	33	$38	$1,269		
Outdoor Promotional Programs	20	$38	$769		
Audits	80	$38	$3,077		
Ordinances	-	-	-		
Soil Amendment Enforcement	140	$38	$5,385		
Water Waste Complaints	20	$29	$577		
Water Waste Coaches	-	-	-		
Education	80	$29	$2,308		
Monitoring	115	$38	$4,423		
Personnel Total	586 (~0.30 FTEs)	-	**$21,580**		
Program Total			**$120,005**		

[1] Professional full-time engineer (FTE) at $80,000 annually ($38/hour), average FTE at $60,000 annually ($29/hour), seasonal employee at $20,000 annually ($12/hour) including some time for support from an FTE.

References

Great Western institute, “Douglas County Water Efficiency Analysis and Audits,” Douglas County Government, 2009.

Great Western Institute, “SWSI Conservation Levels Analysis – Phase I,” Colorado Water Conservation Board, 2010.

Great Western Institute, “SWSI Conservation Levels Analysis – Phase II,” Colorado Water Conservation Board, 2011c.

Great Western Institute, “Water Efficiency Grant Report,” for City of Brighton (as part of Water Efficiency Grant provided by Colorado Water Conservation Board), 2011a.

Great Western Institute, “Water Efficiency Grant Report,” for Pagosa Area Water and Sanitation District (as part of Water Efficiency Grant provided by Colorado Water Conservation Board), 2011b.

Appendix 1
Symbiotic Engineering Report

To: Holly Werth Link, CH2M Hill
From: Mark Reiner, Symbiotic Engineering
Re: Water Program Evaluations
Date: July 10, 2012

Symbiotic Engineering's Sustainability Information Management System (SIMS) software tool provides advanced analytics by integrating utility data, city GIS parcel data, numerous associated attributes of structures (e.g. footprint, date of construction, cost, etc.), property type categories (commercial, residential, etc.) and even subcategories (NAICS, duplex, schools) to generate reports and maps displaying utility usage and energy intensity patterns of individual properties or neighborhoods.

Longmont Water has contracted with Symbiotic to utilize the SIMS tool to help evaluate effectiveness for five conservation and water efficiency programs. Flat files of monthly consumption data were uploaded to Symbiotic Engineering's secure FTP site and processed for data anomalies prior to integrating with other third party data in the SIMS software. The following are the data check rule numbers that the SIMS uses during import to flag data that should NOT loaded into the SIMS (the data flag rule numbers and descriptions are identified in the enclosed itemized billing records spreadsheet).

SIMS Data Quality Rules:

1) Invalid DataType (check that integers are integers, alpha is alpha, dates are dates, etc.)
2) Invalid Estimate Code
3) Invalid ServiceType+RateCode
4) Invalid Daily Consumption Range
5) Duplicate Data
6) Days Of Service <= 0

As data can violate more than one of these rules, we identify all of the violated data quality rules and work with Longmont Water staff to identify which data records are legitimate and which are actual billing errors before loading into the SIMS. While the overall magnitude of these flagged data are very small (<0.1%) this review process can lead to corrections in historic flow rates and potentially could lead to recovering lost revenue from these historic billing errors. Once in the SIMS, additional checks are run using the Days of Service (DOS), the number of billing consumption days in the calendar month of interest for a particular meter. When a given meter has continuous billing, the days of service should equal the days in the month. New accounts, closing accounts, temporarily suspended accounts, etc. will not have the DOS equal to the number of days in the calendar month. The DOS are data received by the utility with each bill, and during the SIMS import process these are 'binned' into calendar months. When data is flagged, sometimes because the DOS is a negative number (i.e., bill end date is before the bill start date), as an example, this doesn't get loaded in the SIMS.
Please see below a breakdown for each program.

Table 1: Longmont Water Program Participants Matched to Utility Billing Accounts

Program	# of Rows in Original File	# of Rows Linked to SIMS Billing Acts	% of Total That Were Successfully Matched
ClothesWasherRebates	2251	2086	92.7%
DishwasherRebate	1431	1370	95.7%
GardenInBox	321	115	35.8%
OutdoorIrrigationAudits	546	480	87.9%
ToiletRebates	1278	1043	81.6%
Overall Total	**5827**	**5094**	**87.4%**

The poor match for the Garden in the Box program cannot be alleviated by better address formatting. All of the addresses are good and the existing process utilizing all street name variations, such St, St., Street, etc., so any changes in the formatting will not yield better results. The primary reason why there was poor matching for the Garden in the Box program is because, in many instances, one address is associated with many accounts and it is not known which account was the one that installed the water measure. For example, Table 2 shows the number of program input data rows that were matched to a utility billing account address (Match column), and the number of accounts found at those addresses. Overall, 47 program input rows were not matched to any utility billing accounts; 115 rows were matched to a utility billing address which only had one account at this address (considered successfully matched). The remaining cases had a matching address, but with more than one account per address.

Table 2: Garden in Box Participants Matched to Accounts

Match (Y/N)	Number of Accounts	Number of Program Input Data Rows
N	0	47
Y	1	115
Y	2	90
Y	3	40
Y	4	19
Y	5	4
Y	6	4
Y	7	1
Y	8	1

Overall, this means only 47 program input rows have the potential of being improved upon. These 47 were manually scanned and in most cases the street given for the Garden in the Box participant does not exist in the Longmont Water's billing data addresses. Or, the street exists but does not have an address in the numerical range matching the address number given.

Participant addresses not matching billing data is likely due to typos or that some of the street names appear to not be in Longmont which could mean, the owner's actual address rather than premise address.

The following tasks were completed:

- Task 1: Symbiotic provided monthly water use and number of connections, aggregated by rate code or tax assessor defined sector/sub-sector from 2007-2011. The rate codes used were: CWNC, CYWT, IRRG, LWCR, SIWT, WBLK, WCOO, WMU, WMUL, WRO, WTCO, and WTRS.

- Task 2: Symbiotic provided monthly water use from 2007 to 2011 by individual account for each account that has installed a rebate or received an audit, herein referred to as program participants. This file was accompanied by a look-up table for the raw program participant characteristics.

- Task 3: Symbiotic provided monthly water use from 2007 to 2011 aggregated for all customers that received rebates/audits, by rebate/program and year the rebate/program occurred.

- Task 4: Using City-provided information on rebates, Symbiotic provided a map of customers within City of Longmont that have received rebates or participated in the programs five programs from 2007-2011. Symbiotic provided a separate map for each rebate/program (see the attached figures). Each map identifies program participants, color-coded by measure install/audit date.

- Task 5: The SIMS methodology selects a control group of up to 1000 participants based off of a semi-random selection of non-program participants composed of similar sub-sectors as found in the program participants. A different selection was made for each program. Using SIMS control group methodology selection, aggregate data dumps will be provided by program, rate code, or sector/sub-sector by month from 2007 to 2011.

Appendix 2
Summary of Programs for Additional Annual Budget Amounts

TABLE FOR $170,000 BUDGET

Recommended Water Conservation Programs (for annual budget of $170,000)

Program	Estimated Annual Amount	Unit Cost	Rebate Cost	Demand Reduction (AF)	Cost per AF of Demand Reduction
Indoor Rebates		Per Rebate			
HE Clothes Washers	250 units	$25	$6,250	4.5	$1,400
ULV Toilets	200 units	$50	$10,000	4.8	$2,100
DF Toilets	200 units	$50	$10,000	6.7	$1,500
Outdoor Rebates					
ET Controllers	100 units	$50	$5,000	3.3	$1,500
MP Rotators (10 MP heads per unit)	50 units	$25	$1,250	1.0	$1,200
Outdoor Promotional Programs					
Garden in a Box	50 units	$70	$3,500	0.1	$70,000
Slow the Flow Irrigation Audits	50 units	$75	$3,750	0.4	$9,000
Audits		Per Unit			
Commercial (with retrofits)	12 units	$1,200	$14,400	9.6	$1,500
HOA	10 units	$650	$6,500	1.6	$4,000
Ordinances					
Soil Amendment Enforcement	35 applications	$65	$2,275	n/a	n/a
Water Waste Complaints	17 complaints	$25	$425	n/a	n/a
Education					
Message Development	Lump sum	$40,380	$40,380	n/a	n/a
Xeriscape Garden Maintenance	Lump sum	$3,500	$3,500	n/a	n/a
Water Fair (w/ educational kits)	Lump sum	$14,000	$14,000	n/a	n/a
Monitoring					
Water Data Collection and Assessment	Lump sum	$16,000	$16,000		
Subtotal	-	-	**$137,230**	**32.0**	
Personnel Needs	Hours	Cost/Hour[1]	Cost		
Indoor Rebates	113	$38	$4,346		
Outdoor Rebates	39	$38	$1,500		
Outdoor Promotional Programs	20	$38	$769		
Audits	88	$38	$3,385		
Ordinances	-	-	-		
Soil Amendment Enforcement	140	$38	$5,385		
Water Waste Complaints	34	$29	$981		
Water Waste Coaches	522	$12	$6,023		
Education	120	$29	$3,462		
Monitoring	180	$38	$6,923		
Personnel Total	1,256 (~0.60 FTEs)	-	**$32,770**		
Program Total			**$170,000**		

[1] Professional full-time engineer (FTE) at $80,000 annually ($38/hour), average FTE at $60,000 annually ($29/hour), seasonal employee at $20,000 annually ($12/hour) including some time for support from an FTE.

TABLE FOR $250,000 BUDGET

Recommended Water Conservation Programs (for annual budget of $250,000)

Program	Estimated Annual Amount	Unit Cost	Rebate Cost	Demand Reduction (AF)	Cost per AF of Demand Reduction
Indoor Rebates		Per Rebate			
HE Clothes Washers	400 units	$25	$6,250	7.1	$1,400
ULV Toilets	300 units	$50	$10,000	7.1	$2,100
DF Toilets	300 units	$50	$10,000	10.0	$1,500
Outdoor Rebates					
ET Controllers	150 units	$50	$5,000	5.0	$1,500
MP Rotators (10 MP heads per unit)	80 units	$25	$1,250	1.7	$1,200
Outdoor Promotional Programs					
Garden in a Box	75 units	$70	$3,500	0.1	$70,000
Slow the Flow Irrigation Audits	100 units	$75	$3,750	0.8	$9,000
Audits		Per Unit			
Commercial (with retrofits)	15 units	$1,200	$14,400	12.0	$1,500
HOA	10 units	$650	$6,500	1.6	$4,000
Ordinances					
Soil Amendment Enforcement	35 applications	$120	$2,275	n/a	n/a
Water Waste Complaints	25 complaints	$25	$425	n/a	n/a
Education					
Message Development	Lump sum	$50,000	$50,000	n/a	n/a
Xeriscape Garden Maintenance	Lump sum	$4,990	$4,990	n/a	n/a
Water Fair (w/ educational kits)	Lump sum	$20,000	$20,000	n/a	n/a
Monitoring					
Water Data Collection and Assessment	Lump sum	$25,000	$25,000		
Subtotal	-	-	**$191,565**	**45.0**	
Personnel Needs	Hours	Cost/Hour[1]	Cost		
Indoor Rebates	148	$38	$5,692		
Outdoor Rebates	47	$38	$1,808		
Outdoor Promotional Programs	20	$38	$769		
Audits	100	$38	$3,846		
Ordinances	-	-	-		
Soil Amendment Enforcement	140	$38	$5,385		
Water Waste Complaints	50	$29	$1,442		
Water Waste Coaches	2,076	$12	$23,954		
Education	200	$29	$5,769		
Monitoring	254	$38	$9,769		
Personnel Total	3,035 (~1.50 FTEs)	-	**$58,435**		
Program Total			**$250,000**		

[1] Professional full-time engineer (FTE) at $80,000 annually ($38/hour), average FTE at $60,000 annually ($29/hour), seasonal employee at $20,000 annually ($12/hour) including some time for support from an FTE.