CDM Smith

Memorandum

To: *Brian Davis, Metropolitan Council*

From: *Bill Davis, Jodi Polzin, CDM Smith*

Date: *April 2019 – Final Version*

Subject: *Water Efficiency Project – Maximizing Benefits from Community Water Efficiency Programs*

The focus of this study is to assess the economic benefits of residential-focused water efficiency programs for growing communities in the Twin Cities region which rely on groundwater as their primary water supply source. This memorandum presents the results of an initial economic analysis of efficiency programs for selected communities in the region.

The results presented in the memorandum assume the same set of model assumptions for all communities. These assumptions can be revised and customized for each individual community before interpreting any results as being appropriate for an individual community. The initial results presented in this memorandum illustrate the diversity of outcomes that can occur when applying a generic set of assumptions to all communities.

An initial analysis of all groundwater supply communities was conducted and reported in a November 10, 2017 technical memorandum from CDM Smith to the Metropolitan Council. That memorandum summarized the analysis used to identify those communities with the greatest potential of peak residential demand reduction. A screening of the following characteristics was used:

- Percentage of residential water use
- Residential gallon per capita per day (gpcd) rate of use
- Summer peak month to winter average water use ratio
- Projected population growth from 2017 to 2040
- Number of estimated new wells needed by 2040

Communities were sorted from high to low for each of these characteristics. The ranking in each of the five categories were added to create a composite score for each community. Twenty (20) communities were identified as having the greatest potential of economic benefit. All 20 communities were contacted by the Metropolitan Council for permission to be included in this analysis. A total of 15 communities agreed to participate.

Included in this memorandum are: (1) community-level inputs for the economic analysis model; (2) general model assumptions used in this initial analysis; (3) a summary of which combination of efficiency measures provide the maximum benefit for each community; and, (4) the comparison of costs both with and without efficiency for these communities.

The results presented in this memo are for comparative purposes only to demonstrate the utility of the methodology used in this analysis. For comparative purposes, the same set of assumptions are applied to all communities. These assumptions should be reviewed and refined for each individual community before assuming the results are valid for a given community.

Collection of Community System Data

Some of the data used in this analysis are derived from questionnaire responses submitted by the selected community utilities. Information was obtained regarding:

- Current number of wells
- Estimated number of new wells needed by 2040
- Capacity of most recent well installed
- Installation cost of most recent well installed
- Operations and maintenance (O&M) cost of most recent well installed
- Percent of firm yield used as a decision criterion or "trigger point" to determine that a new well is needed
- Detailed information about any outdoor water efficiency programs, including description of measures, incentives, who qualifies to participate, program costs, and any program evaluation metrics

The questionnaire sent to the participating utilities is attached to this technical memorandum as Appendix A. Twelve (12) of the 15 participating communities provided information as summarized in **Table 1**.

Table 1 – Community Responses

Community	No. of Wells	No. of New Wells	Newest Well			% Capacity Trigger	Outdoor Efficiency Program
			Capacity (gpm)	Cost ($)	O&M ($)		
City A	6	3	2,500	386,270	400,000	83%	No
City B	14	0	2,000	1,450,000	44,900	90%	No
City C	-	-	-	-	-	-	-
City D	4	2.5	350	1,296,694	-	-	No
City E	12	4	1,000	1,300,000	33,000	80%	Yes
City F	11	3	1,500	3,200,000	15,000	-	Yes
City G	15	4	1,500	1,500,000	28,171	-	Yes
City H	5	3	1,600	500,000	30,000	100%	Yes
City I	3	1	1,250	1,400,000	19,000	75%	No
City J	16	10	1,200	830,910	35,000	95%	No
City K	6	2	1,200	1,055,000	100,000	100%	No
City L	7	-	-	-	-	-	-
City M	7	2	1,600	355,911	22,600	85%	Yes
City N	3	3	1,500	1,500,000	35,000	90%	Yes
City O	19	2	2,000	1,800,000	75,000	90%	Yes
Average	-	-	**1,477**	**1,179,997**	**63,509**	**90%**	-

Economic Analysis Model Inputs

An economic analysis model was developed in Microsoft Excel to compare: (1) the number of new wells needed from 2017 to 2040 under the current "as is" or without efficiency scenario and under an alternative "with efficiency" scenario; and, (2) the costs of new wells under the "as is" scenario with the costs of efficiency implementation plus new wells under the efficiency scenario. This model requires a set of inputs and assumptions about the communities, wells, and efficiency measures. In this analysis, the same set of assumptions are applied to all communities.

The following parameters are either input values or values calculated within the model. These parameters are derived as described below and have significant influence on the outcome of the model for each community. Thus, it is recommended that these critical parameters be reviewed by any community wishing to use the model output for a more in-depth analysis.

- **Population Served** is derived from the file *MPARS_Inventory_20170607.xls*. This file contains the annual reported population served for 2013, 2014, 2015, and 2016 by community (i.e., permit number). The 2013 to 2016 reported population served was averaged by permit number to calculate the average population served for each community.
- **Future Population** is derived from the file *Thrive-MSP-2040-Forecasts-(January-2017).xlsx.* The 2010, 2020, 2030, and 2040 population for each community is provided in the Thrive

data. Annual population values for each year from 2017 to 2040 are interpolated from the Thrive MSP projected population for each community.

- **Persons per Household** is derived from the file *Thrive-MSP-2040-Forecasts-(January-2017).xlsx.* The Thrive population is divided by the Thrive number of households to derive the persons per household for each community.

- **GPCD (Residential)** is calculated from the file *MPARS_Inventory_20170607.xls*. This file contains annual reported residential gallons delivered by year (2013 through 2016) by permit number along with the population served. The reported residential gallons delivered for each year was divided by 365 and the corresponding population served to derive an annual residential gallon per capita per day (GPCD) value. The four annual values for 2013 through 2016 were then averaged by permit number to calculate the average residential GPCD for each community.

- **Peak Month to Winter Month Ratio** is calculated as the maximum monthly volume divided by the winter monthly average volume. Both values come from the file *MPARS_Monthly_20170607.xls*. This file contains historical monthly total water volumes by year, by "installation" (well), and by permit number. Data from 2000 to 2015 was used. Monthly volumes from 2000 to 2015 were summed across all installations (wells) by permit number and by year. Then, the average volume by month was calculated across all years by permit number for each month. The maximum month was identified from the monthly averages by permit number. The winter monthly average was calculated as the average monthly volume from January through April and October through December. The peak month to winter ratio was calculated from these two values for each community (permit number). The annual average volume was also calculated for each community. The "% Winter" was calculated as the winter monthly average divided by the annual average volume for each community.

- **Number of Wells** is derived from the *MDH Facility* data table (2016), which has records by public water system number (PWS_SEQ_No). For each PWS_SEQ_No, records are listed by facility. The data field *Facility_Code* indicates if the facility is a well (WL), treatment plant (TP), elevated storage tower (SE), distribution system component (DS), etc. The data field *Availability_Code* indicates if the facility is primary, emergency, observation, etc. A subset of data was created in which all facilities are primary wells (i.e., *Facility_Code* = WL and *Availability_Code* = Prim). From this subset, the number of well was counted per community (PWS_SEQ_No).

- **Population per Well** is calculated as the average population served divided by the number of wells. The average population served is derived from the *MPARS_Inventory* file by permit number as defined above for each community. The number of wells is derived from MDH data by PWS_SEQ_No. A mapping of PWS_SEQ_No and permit numbers was used to match the MDH number of wells by PWS_SEQ_No with the population served by permit number to calculate the average population per well by permit number.

- **Residential GPCD per Well** is derived from other parameters. The population served, residential GPCD and peak ratio are all multiplied together to derive an estimate of the peak residential demand for each community for each year. The estimated 2017 peak residential demand is divided by the number of current wells minus one to derive the average residential GPCD per well for each community.

  Important Note on Analysis Method

  The residential GPCD per well is multiplied in the model by the percent capacity trigger in calculating the number of wells needed. Note that subtracting one well from the current number of wells in this calculation simulates the estimated "firm capacity" from groundwater sources where firm capacity is defined as the available flow if the largest pump were out of service. This calculation assumes each well has the same capacity, which is likely not accurate. Also, we assume that in 2017 each community met its peak demand day with its firm capacity. Therefore, in 2018 each community needs one new well since its population is greater, i.e., for these growing communities, their 2018 peak demand day exceeds their firm capacity. This is true for both the as-is and efficiency scenarios. Therefore, the comparison of as-is vs. efficiency scenario costs is valid since the new well is needed in year one under both scenarios. We currently do not know if each community has plenty of excess capacity or is operating at its firm capacity. Furthermore, we do not know if each community's storage volume is used to limit the effect of firm capacity on the required number of wells. We plan to include this information in future versions of this model.

Table 2 shows the community inputs for the fifteen communities selected for this analysis as input into the economic analysis model. Data shown in blue (i.e., population served, current number of wells, and persons per household) are derived from MPARS, MDH and Thrive data described above, or from questionnaire responses. Data shown in green (most recent well installation cost, annual well O&M cost, and trigger capacity for needing a new well) are derived from questionnaire responses submitted by the respective communities. Data in Table 2 shown in yellow are rounded average values derived from questionnaire responses used to fill in missing data.

Table 2 – Community Inputs for the Economic Analysis Model

Community	2013 2016 Average Population Served	Current No. of Wells	Well Installation Cost ($)	Annual O & M Cost ($)	Persons per Household	Trigger % of Capacity for New Well
City A	19,572	6	386,270	400,000	3.12	83%
City B	50,450	14	1,450,000	44,900	2.60	90%
City C	78,312	10	1,000,000	35,000	2.89	90%
City D	4,219	4	1,296,694	35,000	3.15	90%
City E	24,639	12	1,300,000	33,000	2.75	80%
City F	34,056	11	3,200,000	15,000	2.95	90%
City G	62,628	15	1,500,000	28,171	2.54	90%
City H	11,380	5	500,000	30,000	2.67	100%
City I	3,465	3	1,400,000	19,000	2.90	75%
City J	59,027	16	830,910	35,000	2.99	95%
City K	15,517	6	1,055,000	100,000	3.27	100%
City L	24,438	7	1,000,000	35,000	2.70	90%
City M	12,682	7	355,900	22,600	2.95	85%
City N	8,009	3	1,500,000	35,000	3.02	90%
City O	66,451	19	1,800,000	75,000	2.74	90%

Yellow highlight indicates an average value is used.

Other model inputs assumed for this analysis include:

- A discount rate of 3 percent used to discount future dollars into present worth dollars. This is the current minimum rate that municipalities pay for money, i.e., the interest paid out on municipal bonds. Municipal bonds for water and sewer in Minnesota range from 3 percent to 4 percent (http://minnesota.municipalbonds.com).

- A 1 percent reduction per year in indoor residential water use is assumed for each community, unless the indoor water use per capita reaches the minimum of 40 gallons per capita per day. Comparative studies of single-family indoor use between 1999 and 2015 conducted by the Water Research Foundation (WRF Residential End Use Study 2016) show about a 15 percent decrease in average single-family indoor water use over 15 years (1 percent per year) as a result of more efficient toilets, clothes washers, and showerheads. EPA WaterSense guidelines for a water-efficient new home suggest that single-family indoor use could be reduced to 40 gallons per capita per day or less (EPA WaterSense New Home Guidelines 2014).

- A 15 percent participation rate of households per year for each selected measure, with a program implementation schedule of 5 years starting in 2018, is assumed in this analysis. A pre-program participation rate of 3 percent of households is assumed to represent those households that have already adopted the measures on their own. A maximum participation rate of 85 percent is assumed per community. After 5 years of implementation adding 15 percent of households per year, the cumulative participation approaches the maximum participation rate and thus limits the number of implementation years.

- A marketing cost of $2.00 per person per community is assumed if any efficiency measures are selected (Regional Water Providers Consortium 2003). Marketing and educational materials are assumed to be required in conjunction with any other efficiency measure. Thus, a community of 10,000 will spend $20,000 on marketing while a community of 50,000 will spend $100,000 on marketing of its efficiency program.

- A $2.00 administrative cost per participant (i.e., household) is assumed for all selected measures (Regional Water Providers Consortium 2003). This includes the cost of processing rebates and communications with program participants. This average administrative cost has been used successfully in other efficiency analyses.

A set of water efficiency measures were defined for potential implementation to address residential outdoor irrigation assumed to be a major contributor to peak water demand. These measures area summarized in **Table 3** and further defined below.

Table 3 – Summary of Efficiency Measure Inputs

Measure		Utility Cost	Percent Reduction in Peak Water Use
Marketing & Educational Materials	Required in conjunction with any other measures	$2 per capita	2%
Irrigation System Audit	On-site irrigation audit with recommendations provided to the participant	$100 per participant	3%
Sprinklerhead Replacement	Reimbursement of costs with field verification	$70 per participant	5%
Native Landscape Rebate	Rebate of $1.00 per square foot of turf replaced, up to $1,500	$1,500 per participant	13%
Smart (weather-based) Controller	Rebate for a "smart" weather-based irrigation controller	$200 per participant	20%

An incentive program would be sponsored by the community. This analysis computes the benefits for two levels of incentive: 100 percent of the cost of the device and 50 percent of the cost of the device. The information on costs for efficiency measures were obtained from local irrigation contractors in the Metropolitan region, and a literature review of professional sources. Estimates of water savings were derived from published research and not obtained from manufacturers' estimates. The following costs represent the 100 percent option:

- A sprinklerhead replacement measure with field verification and reimbursement of costs is assumed to cost the utility $70 per participant (About $7 per device and 10 per household) and provide a 5 percent reduction in peak water use (based on professional judgement after review of Alliance for Water Efficiency resource library, CUWCC 2005, EPA 2010, EPA WaterSense, and Vickers 2001).

- A $200 rebate (local cost) for a "smart" weather-based irrigation controller is assumed to provide a 20 percent reduction in peak water use (based on professional judgement after review of Alliance for Water Efficiency resource library, CUWCC 2005, EPA 2010, EPA WaterSense, and Vickers 2001).

- An on-site irrigation audit with recommendations provided to the participant (with the participant responsible for the cost of implementation) is assumed to cost the utility $100 per participant (local cost) and provide a 3 percent reduction in peak water use (based on professional judgement after review of Alliance for Water Efficiency resource library, CUWCC 2005, EPA 2010, EPA WaterSense, and Vickers 2001).

- A native landscape rebate of $1.00 per square foot of turf replaced (LADWP 2015), up to $1,500 (with the participant responsible for the cost of implementation) is assumed to cost the utility $1,500 per participant and provide a 13 percent reduction in peak water use (based on professional judgement after review of Alliance for Water Efficiency resource library, CUWCC 2005, EPA 2010, EPA WaterSense, and Vickers 2001).

The 50 percent option reduces the cost per participant by half without any changes to the estimated percent peak water use reduction. The economic analysis model developed for this analysis allows for these factors to be adjusted if community-specific information becomes available in the future.

Maximization of Benefits

The economic analysis model compares the cost and benefit of efficiency measures targeting outdoor irrigation with the cost of new wells required by a given community from 2018 to 2040. This analysis is conducted in four steps:

Step 1 – Estimate the number of new wells needed by the community to the year 2040 and estimate the present value (discounted) cost of new well installation, operations, and maintenance assuming a gradual decline in future residential per capita water demand due to indoor water use efficiency.

Step 2 – The user selects from a list of outdoor irrigation water-saving measures to be implemented in the community and selects a participation rate for the community. The cost of program implementation is estimated as a function of which measures are selected and the selected participation rate. Higher levels of program participation require higher program incentives and implementation costs.

Step 3 – The reduction in peak residential water use from the selected measures and participation rate is used to recalculate the number of wells needed by the community to the year 2040. Depending upon the reduction in residential peak demand from the implemented program, the need for new well(s) may not be completely eliminated by 2040 but may be delayed to a later year(s).

Step 4 – The delayed cost of new wells is recalculated and added with the cost of program implementation, which is discounted to its present value for comparison with the initial cost of new wells estimated in Step 1. The number of new wells eliminated by 2040 is reported and the difference in cost between the without efficiency and with efficiency scenarios is reported.

When conducting an economic analysis over a future time period, such as from 2018 to 2040, it is necessary to consider the 'time value of money' through a process called 'discounting.' Discounting converts the dollar values in future time periods into today's value, called the 'present value.' By doing so, economic values from diverse time periods can be compared on an equal basis. The concept of discounting assumes that a dollar today is more valuable than a dollar in the future. For example, $1 million 20 years from now does not have the same economic value as $1 million dollars today. In fact, the farther out in time the future value occurs, the less it is worth today. One million dollars invested today earning 3 percent per year would be worth about $1,343,900 in 10 years, and about $1,806,600 in 20 years. Conversely, at a discount rate of 3 percent, $1 million dollars in 10 years is equivalent to about $744,100 today, and $1 million dollars in 20 years is equivalent to about $553,700 today. Thus, avoiding the cost of a new well in 10 years has greater economic value (present worth) than avoiding the cost of a new well in 20 years if we use today's well costs (i.e., constant dollars) for all future costs.

The costs of implementing a water efficiency program initiated in the first five years of this analysis period are discounted back to a present worth value (the discounted cost) and the avoided costs of new wells in the future years are discounted back to a present worth value (the discounted benefit) so that program costs and benefits can be compared on an equal basis.

In Step 2, the user of the model may select a program participation rate for each community. For each program implementation year, the selected percent of households is added to the cumulative number of participating households. The number of program implementation years is determined as a function of the selected participation rate such that the cumulative participating households does not exceed 85 percent of households. For this initial analysis, a modest participation rate of 15 percent was selected for each community. Therefore, the corresponding program implementation continues for five years from the starting year of 2018.

Also, in Step 2, the user of the model selects the efficiency measures to be implemented for each community. The percent reduction in peak residential water use for each measure is listed in Table 3. The measure Marketing & Educational Material should always be selected in conjunction with any other measure or could be selected as a stand-alone measure. As additional measures are selected, the reduction percentages are added to provide a cumulative percent reduction in demand. Selecting all five measures results in a 43 percent reduction in peak residential water use.

An efficiency measure, or set of efficiency measures, may provide sufficient reduction in peak residential demand to eliminate a new well. In instances where a community is expected to need more than one new well in the future, the selection of a few measures may eliminate the need for one well by 2040, while selecting additional measures may eliminate or delay the need for additional new wells. In this analysis, the objective is to maximize benefits from the efficiency programs. Thus, it is assumed that a community will implement the program (i.e., combination of measures) that reduces or delays the maximum number of wells.

In some instances, efficiency measures can be added that may delay the need for a new well by a few years but not reduce the number of new wells needed by 2040. In this instance new wells may not be eliminated by 2040, but financial benefit is incurred from the delay of developing a new well. In this analysis it is assumed that communities will continue to add efficiency measures to their program as long as the monetary benefit increases.

For some communities, there is no positive economic benefit to an efficiency program under some scenarios. The methodology used in this economic analysis model is more detailed than the simplified approach used to estimate the need for new wells in the screening of potential communities. Because there is no need for a new well, the economic analysis model was not used for these communities.

For some communities, the reduction of peak residential demand required to delay or eliminate a new well cannot be achieved from efficiency measures without an economic loss (i.e., a net *cost* to the community). For this analysis, rather than not select any efficiency measures (with no cost and no benefit to the community), efficiency measures are selected to eliminate at least one well by 2040 with the minimum cost to the community.

Results of Water Efficiency Program Maximization

Table 4 shows the combination of measures selected to maximize benefits of water efficiency for each community. Note that marketing and educational materials are required in conjunction with any other measure.

As noted above, one assumption in this analysis is that the customer incentive paid by the utility would be 100 percent of the cost of the device, as shown in Table 3. A second scenario was evaluated in which this assumption was reduced to a payment of 50 percent of the cost of the device. This assumption reduced by half the payment per participant values shown in Table 3. No reduction was made to the education and marketing cost per capita or the administrative cost per participant. The following tables show results for both the 100 percent incentive scenario and the 50 percent incentive scenario.

Table 4 – Efficiency Measures Selected to Maximize Savings with 15% Participation per Year

Community	Marketing & Education	Sprinklerhead Replacement	Smart Controller	Irrigation System Audit	Native Landscaping Rebate	Marketing & Education	Sprinklerhead Replacement	Smart Controller	Irrigation System Audit	Native Landscaping Rebate
	100% Incentive					50% Incentive				
City A	✓	✓				✓	✓			
City B	✓		✓			✓		✓		
City C	✓	✓				✓	✓			
City D	✓	✓	✓	✓		✓	✓	✓	✓	
City E	✓	✓	✓	✓		✓	✓	✓	✓	
City F	✓	✓				✓	✓		✓	
City G	✓					✓	✓	✓		
City H	✓	✓	✓	✓		✓	✓	✓	✓	
City I	✓	✓	✓			✓	✓	✓	✓	
City J	✓	✓	✓			✓	✓	✓		
City K	✓	✓	✓			✓	✓	✓	✓	
City L	✓		✓			✓		✓		
City M	✓		✓			✓		✓		
City N	✓	✓		✓		✓	✓		✓	
City O	✓	✓				✓	✓			

Table 5 is an example of the efficiency program costs and benefits for measures and combinations of measures under both the 100 percent and 50 percent incentive scenarios. Each measure or combination has a cost per participant and an associated percent reduction in peak residential

water demand. The timing of the need for a new well varies for each community and therefore the economic benefits of delaying or eliminating a new well vary by community. Table 5 and Figure 1 show the analysis for City D in which the "as is" condition shows the need for four new wells by 2040. Figure 1 shows the 100 percent incentive scenario.

Implementing a program consisting of the sprinklerhead replacement measure, smart controller measure, irrigation audit along with the marketing would eliminate the need for an additional two wells by 2040. The economic benefit of the program would be approximately $2 million under the 100 percent incentive scenario and a net benefit of $2.1 million under the 50 percent incentive scenario. Thus, in Table 4 the marketing, sprinklerhead, controller, and audit measures are shown as being selected for City D for the maximization of benefits. Tables similar to Table 5 are included in Appendix B for all 15 communities for both the 100 percent and 50 percent incentive scenarios.

Table 5 – Incremental Benefits by Measure for City D

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year		At 15% Participation per Year	
		Years of Implementation: 5 Years		Years of Implementation: 5 Years	
		100% Incentive		50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	$12,517	$1.56	$12,517
M&E + Irrigation Audit	5%	$102.00	$99,381	$52.00	$0.127
M&E + Sprinklerhead	7%	$72.00	$0.167	$37.00	$0.186
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$0.866	$87.00	$0.913
M&E + Native Landscaping	15%	$1,502.00	$0.265	$752.00	$0.679
M&E + Smart Controller	22%	$202.00	$1.169	$102.00	$1.224
M&E + Smart Controller + Sprinklerhead	27%	$272.00	$1.311	$137.00	$1.385
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	**$2.005**	$187.00	**$2.107**
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	$1.408	$852.00	$1.877
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	$1.503	$887.00	$1.991
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	$1.540	$937.00	$2.056

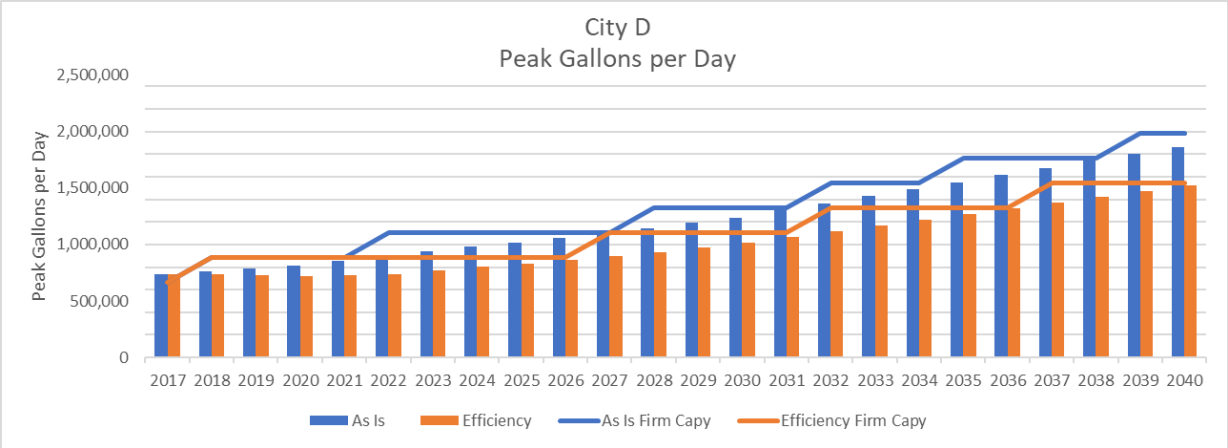

Figure 1 – City D Peak Demand and Well Firm Capacity Under As Is and Optimized Efficiency Scenarios.

Table 6 shows the results of maximizing benefits for each of the selected communities under the 100 percent incentive scenario. The number of wells needed and the associated cost for the "as is" or without efficiency scenario is compared to the number of wells needed and associated costs for the "with efficiency" scenario. The difference in the number of wells needed through 2040 is shown along with the difference in costs (i.e., the net benefit of program implementation). **Table 7** shows the results of maximizing benefits for each of the selected communities under the 50 percent incentive scenario. On both Table 6 and Table 7, the communities are sorted from highest to lowest net benefit.

Under the 100 percent incentive scenario, the total number of wells eliminated is 21, with a net economic benefit of $20,761,578. Under the 50 percent incentive scenario, the total number of wells eliminated is 22, with a net economic benefit of $26,043,687.

There are fourteen communities with positive benefits from efficiency measures that result in a reduction in the number of new wells needed by 2040 under the 100 percent incentive scenario. Under the 50 percent incentive scenario all fifteen communities have positive benefits while simultaneously reducing their costs for water efficiency measures. The 50 percent scenario assumes that residents assume half of the costs of the efficiency measures. Therefore, the effect is that the benefits are increased for all community utilities with efficiency programs.

The fourteen communities with positive benefits from irrigation efficiency measures under the 100 percent incentive scenario have benefits ranging from $98,572 for City C up to $6,041,632 for City A. Each of these communities has even higher net benefits under the 50 percent incentive scenario, ranging from $41,430 for City G up to $6,132,164 for City A.

- **City A** shows the need for two new wells under the "as-is" condition. Implementing the sprinklerhead replacement program with the marketing would eliminate the need for one new well through 2040 with an economic benefit of $6.0 million under the 100 percent incentive scenario and a net benefit of $6.1 million under the 50 percent incentive scenario. Other options would achieve similar results but at lower net savings.

- **City B** shows the need for two new wells under the "as is" condition. Implementing the smart controller replacement program with the marketing and education would eliminate the need for one new well through 2040 with an economic benefit of $122,000 under the 100 percent incentive scenario. Under the 50 percent incentive scenario, the smart controller replacement program with marketing and education would eliminate the need for one well through 2040 at an economic benefit of $921,000.

- **City C** shows the need for two new wells by 2040. Implementing sprinklerhead replacement with marketing and education would eliminate one of those two new wells, at an economic benefit of $99,000 under the 100% incentive scenario and $490,000 under the 50% incentive scenario.

- **City D** shows the need for six new wells by 2040. Implementing a program consisting of the irrigation audit, sprinklerhead replacement measure, and the smart controller measure along with the marketing and education would eliminate the need for an additional two wells. The economic benefit of the program would be approximately $2 million under the 100 percent incentive scenario and a net benefit of $2.1 million under the 50 percent incentive scenario.

- **City E** shows the need for five additional wells under the "as is" condition. Implementing the irrigation audit, smart irrigation controller and sprinklerhead replacement measures with the marketing and education would eliminate the need for three new wells through 2040 with an economic benefit of $2.8 million under the 100 percent incentive scenario and a net benefit of $3.5 million under the 50 percent incentive scenario.

- **City F** shows the need for two new wells by 2040 under the "as is" condition. Implementation of the smart controller program with the marketing and education would eliminate the need for one new well through 2040 with an economic benefit of $2.7 million under the 100 percent incentive scenario and an economic benefit of $2.9 million under the 50 percent incentive scenario.

- **City G** shows the need for two new wells by 2040 under the "as is" condition. Under the 100 percent incentive scenario, there is no combination of efficiency measures under which elimination of a new well is economically beneficial to the city. However, under the 50 percent incentive scenario, the sprinklerhead replacement and smart controller replacement with marketing and education eliminates the need for one new well with a net benefit of $41,430.

- **City H** shows the need for four new wells by 2040 under the "as is" condition. The number of new wells needed through 2040 can be reduced from four to two under a combination of smart controller replacement, sprinklerhead replacement, irrigation audit, and marketing and education. The net benefit is $0.55 million under the 100 percent incentive scenario and $0.88 million under the 50 percent incentive scenario.

- **City I** shows the need for three new wells by 2040 under the "as-is" condition. The number of wells can be reduced to two by 2040 with a net benefit of $1 million under the 100 percent incentive scenario with a program of marketing and education, sprinklerhead replacement

and smart irrigation controllers. Under the 50 percent incentive scenario, the number of wells can be reduced to two by 2040 with a net benefit of $1.1 million with a program of marketing and education, sprinklerhead replacement, smart irrigation controllers, and irrigation audits.

- **City J** shows the need for seven new wells by 2040 under the "as is" condition. Implementation of the smart controller program and sprinklerhead replacement program with the marketing and education would eliminate the need for four of the seven new wells by 2040 with a net benefit of $1.2 million under the 100 percent incentive scenario and with a net benefit of $2.3 million under the 50 percent incentive scenario.

- **City K** shows the need for two new wells by 2040 under the "as is" condition. Implementation of the sprinklerhead replacement measure and smart controllers with the marketing and education would eliminate one new well with a net benefit of $1.9 million under the 100 percent incentive scenario. Implementation of the irrigation audit measure, sprinklerhead replacement measure and smart controllers with the marketing and education would eliminate one new well with a net benefit of $2.3 million under the 50 percent incentive scenario.

- **City L** shows the need for two new wells by 2040 under the "as-is" condition. Implementation of the smart controller and sprinklerhead replacement measures along with the marketing and education would eliminate the need for one new well with a net benefit of $35,394 under the 100 percent incentive scenario. Implementation of the smart controller measure along with the marketing and education would eliminate the need for one new well with a net benefit of $0.67 million under the 50 percent incentive scenario.

- **City M** shows the need for three new wells by 2040 under the "as is" condition. The need for one well can be eliminated with the implementation of a program consisting of the smart irrigation controller program with the marketing and education. This program would generate a net benefit of $0.24 million under the 100 percent incentive scenario and a net benefit of $0.42 million under the 50 percent incentive scenario.

- **City N** shows the need for two additional wells by 2040 under the "as-is" condition. A combination of smart controller replacement and sprinklerhead replacement with the marketing and education can eliminate the need for one new well at an economic benefit of $0.6 million under the 100% incentive scenario and $0.69 million under the 50% incentive scenario.

- **City O** shows the need for three new wells by 2040 under the "as is" condition. Implementing a program of sprinklerhead replacement with the marketing and education would eliminate the need for one new well and generate a net benefit of $1.6 million under the 100 percent incentive scenario and a net benefit of $1.9 million under the 50 percent incentive scenario.

The results presented in this memorandum assume the same set of model assumptions for all 15 communities and illustrate the diversity of outcomes that can occur when applying a generic set of

assumptions to all communities. Changing the one assumption on the incentives paid by the community resulted in significant shifts in the outcome.

All model assumptions should be revised and customized for each individual community before interpreting any results as being appropriate for an individual community. Individual community inputs recommended to be revised and customized include:

- Storage available and its contribution to firm capacity operational characteristics
- Current level of firm capacity operation
- Operational characteristics of each well
- Population served and number of current wells.
- Cost of new wells (note that only the installation and O&M costs are assumed in this analysis). New well costs could also expansion related costs such as land, conveyance, additional treatment, etc.
- Percent of firm yield used as decision criteria for installation of new well.
- Cost of efficiency incentives, devices and implementation, including the percent of device cost used as incentive.

Table 6 – Economic Analysis of Efficiency Measures to Reduce Peak Water Use in 100% Incentive Scenario

Community	Without Efficiency		With Irrigation Efficiency				Difference (# of Wells from Implementation)	Difference (Savings from Implementation) ($)	Rank by Savings from Efficiency
	# New Wells	Discount Well Cost ($)	# New Wells	Discount Efficiency Program Costs ($)	Discount Well Cost ($)	Total Discount Cost ($)			
City A	2	$13,112,285	1	$320,689	$6,749,964	$7,070,653	1	$6,041,632	1
City E	5	$7,834,749	2	$1,543,970	$3,504,417	$5,048,387	3	$2,786,362	2
City F	2	$6,511,554	1	$576,365	$3,255,777	$3,832,142	1	$2,679,412	3
City D	6	$7,003,621	4	$234,293	$4,764,010	$4,998,304	2	$2,005,317	4
City K	2	$3,666,642	1	$637,891	$1,075,736	$1,713,628	1	$1,953,014	5
City O	3	$8,561,956	2	$1,175,584	$5,788,046	$6,963,630	1	$1,598,326	6
City J	7	$6,456,446	3	$2,615,109	$2,624,152	$5,239,261	4	$1,217,185	7
City I	3	$3,756,305	2	$157,580	$2,590,351	$2,747,932	1	$1,008,373	8
City N	2	$2,808,714	1	$243,243	$1,972,657	$2,215,900	1	$592,814	9
City H	4	$2,398,995	2	$731,278	$1,114,425	$1,845,703	2	$553,292	10
City L	2	$2,717,593	1	$920,151	$1,501,359	$2,421,511	1	$296,082	11
City M	3	$1,675,657	2	$445,475	$990,514	$1,435,990	1	$239,667	12
City B	2	$4,167,155	1	$1,961,819	$2,083,578	$4,045,397	1	$121,758	13
City C	2	$2,942,273	1	$1,342,343	$1,501,359	$2,843,702	1	$98,572	14
City G	2	$3,727,269	2	$430,229	$3,727,269	$4,157,498	0	($430,229)	15

Total wells eliminated: 21

Total dollars saved: $20,761,578

Table 7 – Economic Analysis of Efficiency Measures to Reduce Peak Water Use in 50% Incentive Scenario

Community	Without Efficiency		With Irrigation Efficiency				Difference (# of Wells from Implementation)	Difference (Savings from Implementation) ($)	Rank by Savings from Efficiency
	# New Wells	Discount Well Cost ($)	# New Wells	Discount Efficiency Program Costs ($)	Discount Well Cost ($)	Total Discount Cost ($)			
City A	2	$13,112,285	1	$230,157	$6,749,964	$6,980,121	1	$6,132,164	1
City E	5	$7,834,749	2	$860,309	$3,504,417	$4,364,726	3	$3,470,023	2
City F	2	$6,511,554	1	$647,702	$3,255,777	$3,903,479	1	$2,608,075	3
City J	7	$6,456,446	3	$1,518,424	$2,624,152	$4,142,576	4	$2,313,870	4
City K	2	$3,666,642	1	$471,862	$919,855	$1,391,716	1	$2,274,926	5
City D	6	$7,003,621	4	$132,189	$4,764,010	$4,896,199	2	$2,107,421	6
City O	3	$8,561,956	2	$826,023	$5,788,046	$6,614,069	1	$1,947,887	7
City I	3	$3,756,305	2	$115,775	$2,553,100	$2,668,875	1	$1,087,430	8
City B	2	$4,167,155	1	$1,162,191	$2,083,578	$3,245,768	1	$921,387	9
City H	4	$2,398,995	2	$406,483	$1,114,425	$1,520,909	2	$878,087	10
City N	2	$2,808,714	1	$150,224	$1,972,657	$2,122,881	1	$685,833	11
City L	2	$2,717,593	1	$547,740	$1,501,359	$2,049,099	1	$668,494	12
City C	2	$2,942,273	1	$951,326	$1,501,359	$2,452,685	1	$489,588	13
City M	3	$1,675,657	2	$268,070	$990,514	$1,258,584	1	$417,073	14
City G	2	$3,727,269	1	$1,822,204	$1,863,635	$3,685,839	1	$41,430	15

Total wells eliminated: 22

Total dollars saved: $26,043,687

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Appendix A – Community Questionnaire

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Municipal Efficiency Programs Interview Questions

January 2018

Thank you for agreeing to participate in the Metropolitan Council's analysis of the water supply benefits associated with water efficiency programs. Please take time to answer as many of these questions as possible. The information provided will be used to tailor the analysis to your community. We will use industry-based information where local information is not available.

1. Community Name

2. Community contact name and email

3. Water Supply Questions

    a. How many wells operated during 2017?

    b. What is the estimated number of additional wells needed to provide water supply in 2040?

    c. What was the year of the most recent well installation?

        i. Capacity of new well?

        ii. Well installation cost?

        iii. Average well operation and maintenance cost?

d. What % of firm capacity is used to decide that a new well should be installed (typical range is between 80% and 110%)?

4. Outdoor Water Efficiency Program Questions

    a. Does your community have an irrigation efficiency program? If yes, then answer the questions below.

        i. Describe your program:

        ii. Does your community have program metrics, such as number of items delivered, dollars expended, or number of participating customers for each of these program components? If yes, can you please provide us those data for this financial analysis?

        iii. What date was program initiated?

        iv. Describe any changes in the program since inception and the reasons for those changes:

    b. How do customers learn about the irrigation efficiency program?

    c. What are the qualifications to participate in the program?

d. What rebates and/or services does the program provide?

Device	Y/N	Rebate Amount
Soil moisture sensors		
Rain sensors		
EPA WaterSense labeled controllers		
Sprinkler heads		
Irrigation System Audits		
Follow-up inspections		
Workshops		
Educational Materials		
Other		

e. How many staff (in full-time employee – FTE) does this program require?

Position	FTE
Manager	
Administration	
Field Staff	
Other	
Total	

f. Does the program engage landscape contractors?

   i. Can contractors apply for program rebates?

g. Are commercial and/or industrial properties eligible for the program? If not, is there a separate program for these types of properties?

h. Are publicly-owned properties eligible for the program?

i. Does your community have a 'Direct Install' program where the utility pays for the installation or retrofit of equipment?

j. Does your community conduct workshops for landscape contractors?

k. What are the annual program costs? Please use an annual cost corresponding with the previous participation metrics, if possible:

Item	**Annual Cost**
Marketing and Education	
Device Rebates	
Vehicles	
Staff time	
Contractors/Consultants time	
Other	
Total	

l. Does the program require a matching amount from participants for each rebated activity? If so, how much? Are there any required private costs that the program does not fund?

m. What is the approximate % of customers that participate compared with the total number of potential participant households?

n. Does the program offer annual (or periodic) follow-ups?

o. Has your community made any estimates of water savings from irrigation efficiency?

    i. Estimate of peak demand reduction per participating customer (gallons per day)?

ii. Estimate of annual demand reduction per participating customer (gallons per year)?

iii. Estimate of system-wide peak (gallons per day) or annual demand reduction (gallons per year)?

p. Any 'Lessons Learned' or recommendations for others who are developing an irrigation efficiency program?

THANK YOU for your input!

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Appendix B – Economic Benefits by Community by Measure

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Incremental Benefits by Measure for City A

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	$1.641	$1.56	$1.641
M&E + Irrigation Audit	5%	$102.00	$5.964	$52.00	$6.093
M&E + Sprinklerhead	7%	$72.00	**$6.042**	$37.00	**$6.132**
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$5.783	$87.00	$6.003
M&E + Native Landscaping	15%	$1,502.00	$2.343	$752.00	$4.283
M&E + Smart Controller	22%	$202.00	$5.705	$102.00	$5.964
M&E + Smart Controller + Sprinklerhead	27%	$272.00	$5.524	$137.00	$5.874
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	$5.265	$187.00	$5.744
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	$1.825	$852.00	$4.024
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	$1.644	$887.00	$3.934
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	$1.386	$937.00	$3.804

Incremental Benefits by Measure for City B

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($0.347)	$1.56	($0.347)
M&E + Irrigation Audit	5%	$102.00	($1.162)	$52.00	($0.762)
M&E + Sprinklerhead	7%	$72.00	($0.922)	$37.00	($0.642)
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	($1.722)	$87.00	($1.042)
M&E + Native Landscaping	15%	$1,502.00	($12.357)	$752.00	($6.360)
M&E + Smart Controller	22%	$202.00	**$0.122**	$102.00	**$0.921**
M&E + Smart Controller + Sprinklerhead	27%	$272.00	($0.438)	$137.00	$0.642
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	($1.238)	$187.00	$0.242
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($11.873)	$852.00	($5.076)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($12.432)	$887.00	($5.356)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($13.232)	$937.00	($5.756)

Incremental Benefits by Measure for City C

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	$0.00	-	$0.00
Marketing & Education (M&E)	2%	$1.56	($0.538)	$1.56	($0.538)
M&E + Irrigation Audit	5%	$102.00	($0.237)	$52.00	$0.322
M&E + Sprinklerhead	7%	$72.00	**$98,572**	$37.00	**$0.490**
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	($1.019)	$87.00	($69,007)
M&E + Native Landscaping	15%	$1,502.00	($15.877)	$752.00	($7.498)
M&E + Smart Controller	22%	$202.00	($1.354)	$102.00	($0.237)
M&E + Smart Controller + Sprinklerhead	27%	$272.00	($2.136)	$137.00	($0.628)
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	($3.253)	$187.00	($1.186)
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($18.112)	$852.00	($8.616)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($18.894)	$887.00	($9.007)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($20.011)	$937.00	($9.565)

Incremental Benefits by Measure for City D

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	$12,517	$1.56	$12,517
M&E + Irrigation Audit	5%	$102.00	$99,381	$52.00	$0.127
M&E + Sprinklerhead	7%	$72.00	$0.167	$37.00	$0.186
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$0.866	$87.00	$0.913
M&E + Native Landscaping	15%	$1,502.00	$0.265	$752.00	$0.679
M&E + Smart Controller	22%	$202.00	$1.169	$102.00	$1.224
M&E + Smart Controller + Sprinklerhead	27%	$272.00	$1.311	$137.00	$1.385
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	**$2.005**	$187.00	**$2.107**
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	$1.408	$852.00	$1.877
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	$1.503	$887.00	$1.991
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	$1.540	$937.00	$2.056

Incremental Benefits by Measure for City E

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	$40,863	$1.56	$40,863
M&E + Irrigation Audit	5%	$102.00	($97,602)	$52.00	$87,171
M&E + Sprinklerhead	7%	$72.00	$0.198	$37.00	$0.327
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$0.706	$87.00	$1.020
M&E + Native Landscaping	15%	$1,502.00	($3.988)	$752.00	($1.217)
M&E + Smart Controller	22%	$202.00	$1.729	$102.00	$2.099
M&E + Smart Controller + Sprinklerhead	27%	$272.00	$2.389	$137.00	$2.888
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	**$2.786**	$187.00	**$3.470**
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($2.129)	$852.00	$1.013
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($2.387)	$887.00	$0.883
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($2.757)	$937.00	$0.698

Incremental Benefits by Measure for City F

Measure(s)	Percent Reduction	At 15% Participation per Year		At 15% Participation per Year	
		Years of Implementation: 5 Years		Years of Implementation: 5 Years	
		100% Incentive		50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($0.132)	$1.56	($0.132)
M&E + Irrigation Audit	5%	$102.00	$0.955	$52.00	$1.193
M&E + Sprinklerhead	7%	$72.00	**$2.679**	$37.00	**$2.846**
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$2.204	$87.00	$2.608
M&E + Native Landscaping	15%	$1,502.00	($4.121)	$752.00	($0.555)
M&E + Smart Controller	22%	$202.00	$2.061	$102.00	$2.537
M&E + Smart Controller + Sprinklerhead	27%	$272.00	$1.728	$137.00	$2.370
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	$1.253	$187.00	$2.132
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($5.073)	$852.00	($1.030)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($5.405)	$887.00	($1.197)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($5.881)	$937.00	($1.434)

Incremental Benefits by Measure for City G

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($0.430)	$1.56	($0.430)
M&E + Irrigation Audit	5%	$102.00	($1.467)	$52.00	($0.959)
M&E + Sprinklerhead	7%	$72.00	($1.162)	$37.00	($0.806)
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	($2.178)	$87.00	($1.314)
M&E + Native Landscaping	15%	$1,502.00	($15.691)	$752.00	($8.071)
M&E + Smart Controller	22%	$202.00	($2.483)	$102.00	($1.467)
M&E + Smart Controller + Sprinklerhead	27%	$272.00	($1.330)	$137.00	**$41,430**
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	($2.346)	$187.00	($0.467)
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($15.860)	$852.00	($7.223)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($16.571)	$887.00	($7.579)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($17.587)	$937.00	($8.087)

Incremental Benefits by Measure for City H

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($20,766)	$1.56	($20,766)
M&E + Irrigation Audit	5%	$102.00	($0.149)	$52.00	($61,710)
M&E + Sprinklerhead	7%	$72.00	($36,702)	$37.00	$24,745
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$80,651	$87.00	$0.230
M&E + Native Landscaping	15%	$1,502.00	($2.172)	$752.00	($0.855)
M&E + Smart Controller	22%	$202.00	$0.417	$102.00	$0.593
M&E + Smart Controller + Sprinklerhead	27%	$272.00	$0.405	$137.00	$0.642
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	**$0.553**	$187.00	**$0.878**
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($1.721)	$852.00	($0.228)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($1.759)	$887.00	($0.205)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($1.877)	$937.00	($0.236)

Incremental Benefits by Measure for City I

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year		At 15% Participation per Year	
		Years of Implementation: 5 Years		Years of Implementation: 5 Years	
		100% Incentive		50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	$9,294	$1.56	$9,294
M&E + Irrigation Audit	5%	$102.00	$38,449	$52.00	$63,040
M&E + Sprinklerhead	7%	$72.00	$99,017	$37.00	$0.116
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$0.126	$87.00	$0.167
M&E + Native Landscaping	15%	$1,502.00	($0.413)	$752.00	($44,351)
M&E + Smart Controller	22%	$202.00	$1.004	$102.00	$1.054
M&E + Smart Controller + Sprinklerhead	27%	$272.00	**$1.008**	$137.00	$1.075
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	$0.996	$187.00	**$1.087**
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	$0.414	$852.00	$0.832
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	$0.413	$887.00	$0.849
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	$0.397	$937.00	$0.857

Incremental Benefits by Measure for City J

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year		At 15% Participation per Year	
		Years of Implementation: 5 Years		Years of Implementation: 5 Years	
		100% Incentive		50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($0.259)	$1.56	($0.259)
M&E + Irrigation Audit	5%	$102.00	($0.374)	$52.00	$31,831
M&E + Sprinklerhead	7%	$72.00	$0.108	$37.00	$0.392
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	($0.370)	$87.00	$0.321
M&E + Native Landscaping	15%	$1,502.00	($10.363)	$752.00	($4.270)
M&E + Smart Controller	22%	$202.00	$1.074	$102.00	$1.886
M&E + Smart Controller + Sprinklerhead	27%	$272.00	**$1.217**	$137.00	**$2.314**
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	$0.544	$187.00	$2.047
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($9.669)	$852.00	($2.764)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($10.112)	$887.00	($2.923)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($10.498)	$937.00	($2.903)

Incremental Benefits by Measure for City K

Measure(s)	Percent Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	$0.332	$1.56	$0.332
M&E + Irrigation Audit	5%	$102.00	$0.538	$52.00	$0.635
M&E + Sprinklerhead	7%	$72.00	$0.671	$37.00	$0.739
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$0.821	$87.00	$0.987
M&E + Native Landscaping	15%	$1,502.00	($1.450)	$752.00	$14,741
M&E + Smart Controller	22%	$202.00	$1.924	$102.00	$2.120
M&E + Smart Controller + Sprinklerhead	27%	$272.00	**$1.953**	$137.00	$2.217
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	$1.914	$187.00	**$2.275**
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($0.537)	$852.00	$1.123
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($0.469)	$887.00	$1.259
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($96,511)	$937.00	$1.730

Incremental Benefits by Measure for City L

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year		At 15% Participation per Year	
		Years of Implementation: 5 Years		Years of Implementation: 5 Years	
		100% Incentive		50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($65,118)	$1.56	($65,118)
M&E + Irrigation Audit	5%	$102.00	($0.302)	$52.00	($0.116)
M&E + Sprinklerhead	7%	$72.00	($0.101)	$37.00	$28,923
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	($0.350)	$87.00	($33,766)
M&E + Native Landscaping	15%	$1,502.00	($4.545)	$752.00	($1.752)
M&E + Smart Controller	22%	$202.00	$0.296	$102.00	**$0.668**
M&E + Smart Controller + Sprinklerhead	27%	$272.00	**$35,394**	$137.00	$0.538
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	($0.337)	$187.00	$0.352
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($5.290)	$852.00	($2.125)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($5.551)	$887.00	($2.255)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($5.923)	$937.00	($2.441)

Incremental Benefits by Measure for City M

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($67,171)	$1.56	($67,171)
M&E + Irrigation Audit	5%	$102.00	($67,653)	$52.00	$21,050
M&E + Sprinklerhead	7%	$72.00	$79,641	$37.00	$0.142
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	($56,229)	$87.00	$94,566
M&E + Native Landscaping	15%	$1,502.00	($2.150)	$752.00	($0.820)
M&E + Smart Controller	22%	$202.00	**$0.240**	$102.00	**$0.417**
M&E + Smart Controller + Sprinklerhead	27%	$272.00	$0.172	$137.00	$0.411
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	$29,420	$187.00	$0.358
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($2.127)	$852.00	($0.619)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($2.251)	$887.00	($0.681)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($2.429)	$937.00	($0.770)

Incremental Benefits by Measure for City N

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year		At 15% Participation per Year	
		Years of Implementation: 5 Years		Years of Implementation: 5 Years	
		100% Incentive		50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($13,949)	$1.56	($13,949)
M&E + Irrigation Audit	5%	$102.00	($85,701)	$52.00	($30,984)
M&E + Sprinklerhead	7%	$72.00	($52,870)	$37.00	($14,569)
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	**$0.593**	$87.00	**$0.686**
M&E + Native Landscaping	15%	$1,502.00	($0.863)	$752.00	($41,903)
M&E + Smart Controller	22%	$202.00	$0.560	$102.00	$0.669
M&E + Smart Controller + Sprinklerhead	27%	$272.00	$0.483	$137.00	$0.631
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	$0.374	$187.00	$0.576
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($1.082)	$852.00	($0.151)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($1.158)	$887.00	($0.190)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($1.268)	$937.00	($0.244)

Incremental Benefits by Measure for City O

Efficiency Measure(s)	Percent Peak Reduction	At 15% Participation per Year Years of Implementation: 5 Years 100% Incentive		At 15% Participation per Year Years of Implementation: 5 Years 50% Incentive	
		Cost per Participant	Net Savings ($million)	Cost per Participant	Net Savings ($million)
No program	-	$0.00	-	$0.00	-
Marketing & Education (M&E)	2%	$1.56	($0.456)	$1.56	($0.456)
M&E + Irrigation Audit	5%	$102.00	$1.299	$52.00	$1.798
M&E + Sprinklerhead	7%	$72.00	**$1.598**	$37.00	**$1.948**
M&E + Irrigation Audit + Sprinklerhead	10%	$172.00	$0.600	$87.00	$1.449
M&E + Native Landscaping	15%	$1,502.00	($12.684)	$752.00	($5.193)
M&E + Smart Controller	22%	$202.00	$0.300	$102.00	$1.299
M&E + Smart Controller + Sprinklerhead	27%	$272.00	($0.399)	$137.00	$0.949
M&E + Irrigation Audit + Smart Controller + Sprinklerhead	30%	$372.00	($1.398)	$187.00	$0.450
M&E + Native Landscaping + Smart Controller	35%	$1,702.00	($14.681)	$852.00	($6.192)
M&E + Native Landscaping + Smart Controller + Sprinklerhead	40%	$1,772.00	($15.380)	$887.00	($6.541)
M&E + Native Landscaping + Smart Controller + Sprinklerhead + Irrigation Audit	43%	$1,872.00	($13.485)	$937.00	($4.147)