WATER CONSERVATION POTENTIAL ASSESSMENT

EXECUTIVE SUMMARY

Seattle Public Utilities

MAY 1998

WHAT IS THE CPA?

In the Fall of 1996 the Seattle City Council requested that Seattle Public Utilities (SPU) complete a Water Conservation Potential Assessment (CPA). Specifically, Council asked that the CPA provide a rigorous analysis of the cost, volume, and reliability of conservation opportunities available within Seattle's wholesale and direct service areas through 2020. The CPA has been completed, using the criterion that *no measure identified and analyzed will result in a loss of service or satisfaction for the customer*. Water shortage actions such as irrigation bans that would reduce customer service were not considered. This executive summary provides an overview of the CPA findings.

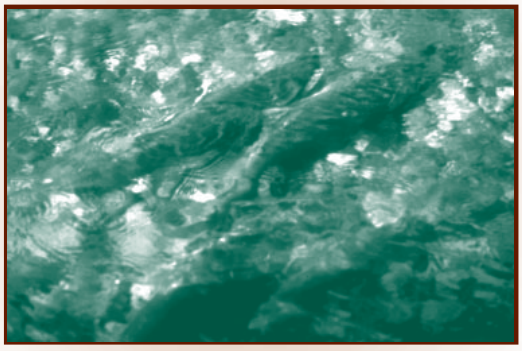
The CPA found that substantial water savings, up to 31 million gallons per day (mgd) or 16% of water use in the peak season, can be achieved over the next 20 years with no reduction in customers' ability to use water nor in their satisfaction with water services. The cost of these savings is comparable to the current marginal cost of new peak season water supply.

PEAK SEASON

The regional water crunch occurs during Seattle's peak season (May 15th - September 15th) when irrigation, cooling and other seasonal demands rise and precipitation and streamflows decline. To address this peaking issue directly, all costs and volume savings in the CPA are shown as peak season values. Costs should be compared to SPU's 1998 marginal cost for new peak season water supply at $2.41/ccf (hundred cubic feet = 748 gallons).

HOW DOES THE CPA FIT INTO THE REGIONAL WATER SUPPLY PICTURE?

Historically water supply planning and development has followed a predictable path of tapping a single, large water source every 30-50 years to meet growth in regional water demand. Today reliance on any single option to meet future demand is an increasingly high-risk gamble due to environmental, political, and demographic uncertainties. In response to this uncertain future, Seattle and its partners are creating a diverse portfolio of water supply and conservation options including new supply, water reuse, enhanced system efficiency, and conservation. The portfolio approach, or integrated resource planning and development, provides decision makers with many options to meet growing water demand efficiently and reliably.



During the last decade, Seattle's regional conservation programs have achieved demand reductions of approximately 1.5% per year. For the next five years, planned conservation savings roughly equal the growth in water demand in the existing service area (Figure 1). Conservation not only has proven to be a reliable way to stretch existing supplies; it also has been popular with customers. Numerous surveys conducted by SPU show strong preference for continued and expanded conservation programs. Current conservation efforts, in conjunction with added water supply from the Tolt Filtration Project, will meet projected demand through 2013. After that, based on current projections, demand will exceed supply and new sources of supply and/or conservation initiatives will be necessary.

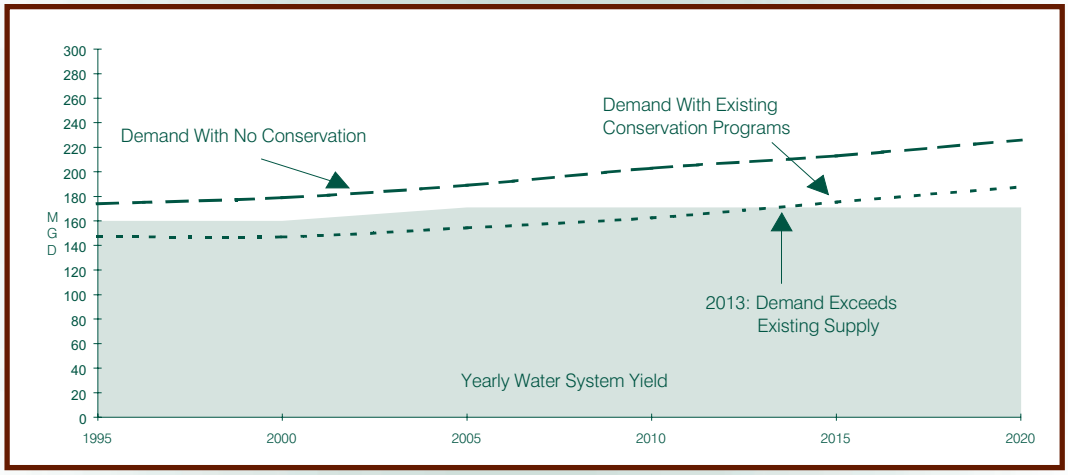


Figure 1
Regional Water Supply & Demand (MGD - Annual Average)

WHAT IS THE REGION'S CONSERVATION POTENTIAL?

The findings of the CPA are shown below in graphic and tabular formats. Note that all savings in the CPA are beyond those from presently implemented or planned conservation programs. In Figure 2, the Water Conservation Cost Curve shows all 74 identified conservation measures plotted in order of levelized cost by cumulative water savings. The 'marginal cost by measure' line represents the most expensive measure needed to achieve a particular volume of savings. The 'cumulative average cost' line indicates the average cost of all measures used to capture those savings. The graph provides a visual means to determine the cost of conservation savings at any volume. As an example, the point labeled 'Cost-effective Package' represents 31 mgd of savings at an average cost of $1.52/ccf, with the most expensive measure at $2.39/ccf, $0.02 below the marginal cost of new peak season water supply.

LEVELIZED COST

Levelized cost is the discounted present value cost per unit of water saved or produced over the lifetime of a measure. Conservation is cost-effective if its levelized cost is less than marginal cost of new supply, currently estimated to be $2.41/ccf in the peak season. The amount of conservation that is cost-effective would be greater if the marginal cost of supply were to increase.

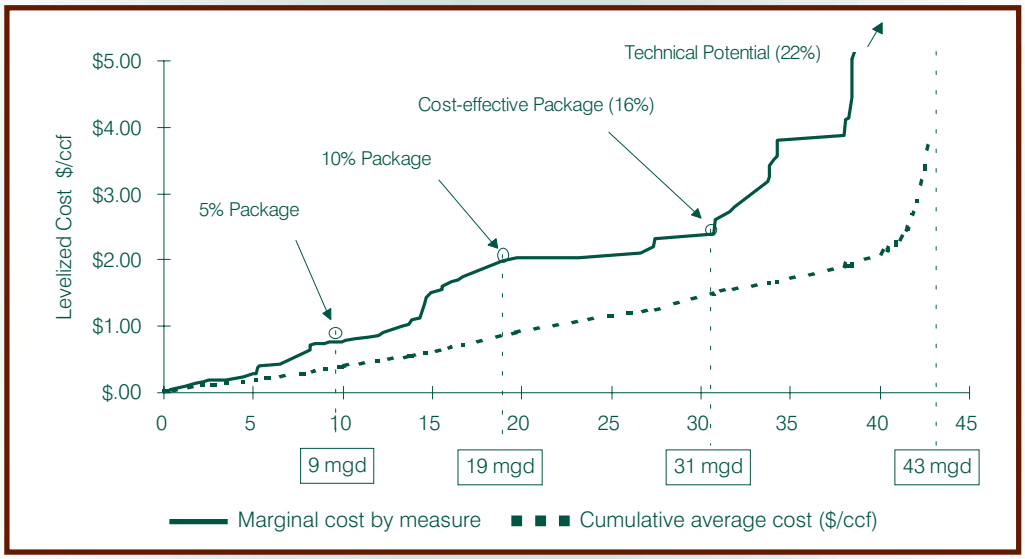


Figure 2
Peak Season Water Conservation Cost Curve

In Figure 3, the CPA findings are presented in a tabular format, showing four specific conservation packages (indicated as points in Figure 2). A package is a group of measures used to meet a specific cost or volume goal. For this report, four packages were selected, using the criteria described below. As shown, the savings achievable through these four packages range between 9 and 43 mgd.

- **Technical Potential Package** (22% savings compared with projected peak season demand in 2020) represents all measures, regardless of cost, that could be implemented over the next 20 years without a loss of service or satisfaction for the customer.
- **Cost-Effective Package** (16% savings) includes all conservation measures that could be implemented at a cost lower than the current peak-season marginal cost for new water supply, $2.41/ccf.
- **Five and Ten Percent Packages** include the most cost-effective measures that could be combined to result in 5% and 10% savings in volume, respectively.

Figure 3
Conservation Potential Assessment Package Results

Package	Year 2020 Savings[1]		Average Annual Cost[2]	Average Cost[3]	Marginal Cost[4]	Seattle/ Purveyor
	mgd[5]	% Projected Demand[6]	1997 Dollars[7] (millions)	$/ccf	$/ccf	% Savings Shares
Technical Potential	43	22%	$19	$3.86	$136	50 / 50
Cost-Effective Savings	31	16%	$5	$1.52	$2.39	50 / 50
10% Savings	19	10%	$2	$0.86	$1.99	46 / 54
5% Savings	9	5%	$0.30	$0.35	$0.75	45 / 55

[1] Water savings have an uncertainty range of +/- 15%.
[2] Program costs have an uncertainty range of +/- 25%.
[3] Average levelized cost of package.
[4] Marginal levelized cost of package.
[5] Peak season savings May 15th - September 15th.
[6] Based on SPU's demand forecast .
[7] Undiscounted 1997 dollars (does not equal present value of cost stream).

The annual average cost, representing the total cost of all measures associated with each package divided over the 20 year life of the program, varies between $300,000 and $19,000,000 per year. This cost represents the full economic cost of conservation measures, including all equipment, material, labor, and program administration costs. The Seattle/Purveyor column demonstrates that water savings from each of the packages is evenly split between Seattle's direct service area and wholesale regions. Purveyors would achieve a slightly higher share savings under the 5% and 10% savings packages. These savings only include conservation potential within SPU's existing service area and do not include conservation potential in adjacent unserved areas of King, Snohomish, or Pierce County.

Each of the four packages includes measures that capture water savings from all water use sectors (commercial process, residential domestic, commercial domestic, commercial landscape, and residential landscape). In all four packages, the residential domestic end-use sector (toilets, showers, clothes washers, and faucets) consistently offers the largest volume of savings. These savings are in addition to savings expected from implementation of the 1993 State Plumbing Code. Figure 4 shows the distribution of savings by program area from the Cost-Effective Package. The other three packages show a similar distribution of results.

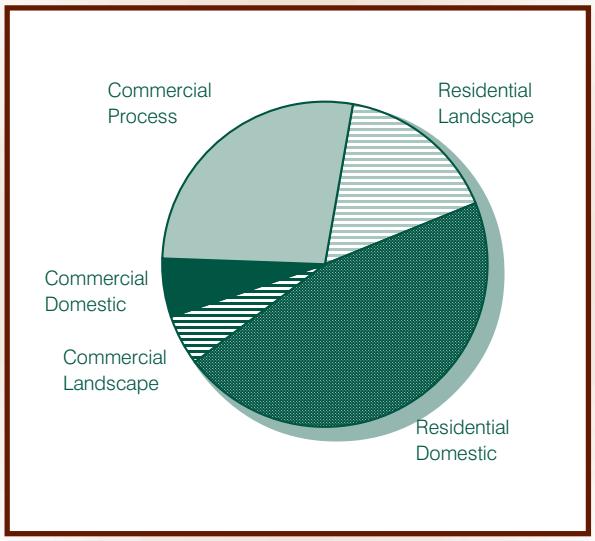


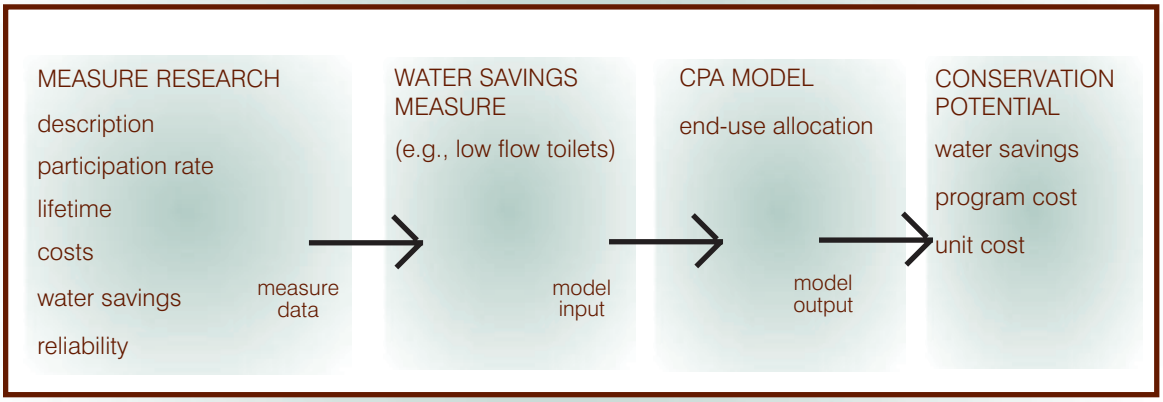
Figure 4
Distribution of Savings for Cost-Effective Package

While the CPA has identified substantial water savings available to the region over the next 20 years, these estimates are believed to be conservative. The CPA did not model the benefits of improved future technology, which will likely increase the potential savings while reducing the cost. In addition, the CPA did not calculate the non-water benefits, for example energy savings and process control improvements, that will likely make the conservation measures more cost-effective to implement.

HOW HAS CONSERVATION POTENTIAL BEEN DETERMINED?

The CPA is the result of a substantial literature review and applied research into water use habits and conservation measures available to make water use more efficient. Extensive data were collected in order to define potential measures and determine each measure's impact (Figure 5). A conservation measure is defined as a change in water-using hardware or behavior that results in reduced water consumption. For example, the replacement of a 5 gallon per flush (gpf) toilet with a new 1.6 gpf unit was evaluated as a hardware measure. Improved irrigation scheduling was evaluated as a behavioral measure. The CPA uses an econometric demand model that predicts future water demand given demographic and economic information from the Puget Sound Regional Council (PSRC) and historical SPU and wholesale water purveyor consumption data. Starting with the econometric demand forecast's customer categories, the CPA model allocates

Figure 5
Measure Data Collection and Modelling



water usage within sectors, for example manufacturing and single family, to specific end-uses such as toilets, showers, and ice machines. The number of people who eventually adopt a particular conservation measure, and the eventual water savings, depends on the number of customers who potentially could adopt the measure (for example, households with high-volume toilets or inefficient clothes washers), the direct costs and benefits to customers, any external costs and benefits, and the information available to customers regarding the more efficient alternative. Each of the measures modeled in the CPA was assigned a participation rate that indicates the number of customers who would be expected to adopt the measure given an aggressive information and/or incentive effort by SPU.

The participation of technical experts, local business leaders, elected officials, wholesale water purveyors, and the environmental community, along with input from the public (Figure 6), ensured that decisions made during development of the CPA reflected both public policy and technical reality. The final version of the CPA incorporates comments from more

than 30 conservation and industry experts outside of SPU. For example, Sandra Postel, director of the Global Water Policy Project, commented, "I applaud Seattle Public Utilities for undertaking this assessment. Far too few water utilities and agencies take a far-sighted view of conservation's potential to meet new water needs." Marsi Steirer, CIP Program Manager for the San Diego Water Department, responded, "As a water resource planner, I would have great confidence in adopting the CPA and using it as the blueprint for how water savings can be achieved at a desired level over the course of the next 20 years. ... This is first class, cutting edge resource planning. All in all, an impressive undertaking."

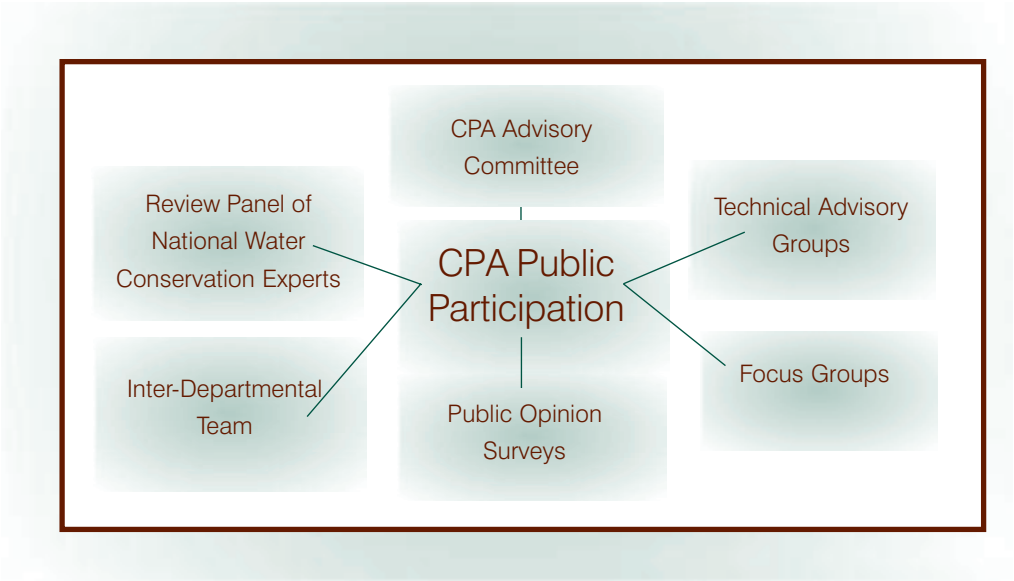


Figure 6
CPA Public Participation Process

WHAT'S NEXT?

The results of the CPA will be used by regional water supply planners in the evaluation of future water supply options, their costs, benefits, and uncertainties. Water conservation may also produce indirect benefits and costs. For instance, energy savings, wastewater reductions or environmental benefits may arise from water conservation. On the other hand, reduced water system flows associated with conservation may increase the cost and complexity of water quality operations required to meet high water quality standards. These and other important emerging issues will be addressed when planning future conservation strategies. Meanwhile, the CPA model, assumptions, and measure characteristics will continue to be refined as new information and comments are received. The CPA will provide a flexible planning tool as SPU and the region move into the next century.

The following CPA supporting documents are also available:

- Water Conservation Potential Assessment: Final Project Report
- Water Conservation Attitudes & Perceptions Study
- Model and Data Technical Documentation (Available June 1998).
- All CPA materials are available on the Seattle Public Utilities Website (www.ci.seattle.wa.us/util.)

Paul Schell, Mayor

Diana Gale, Director

Seattle Public Utilities

Cover image by Susan Point, "Preservation."

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HB16989

WATER CONSERVATION POTENTIAL ASSESSMENT

FINAL PROJECT REPORT

Seattle Public Utilities

MAY 1998

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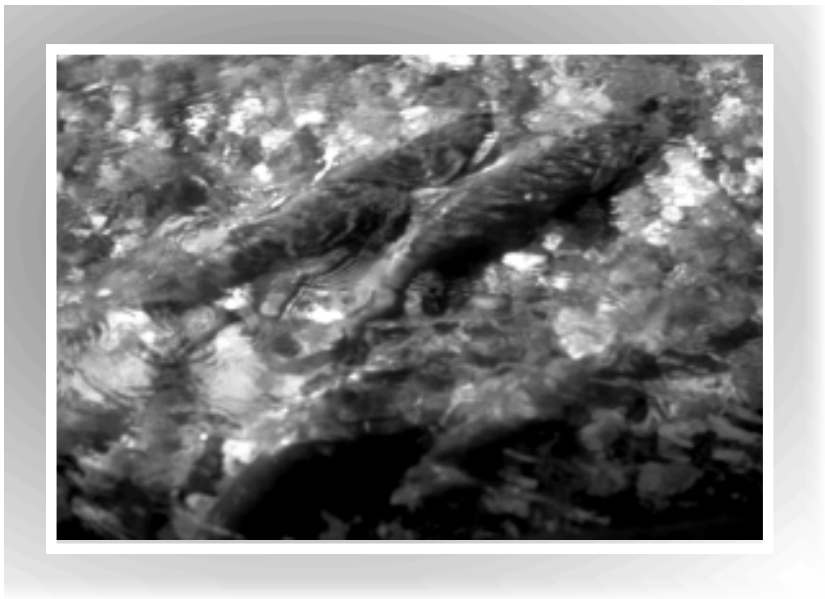

This Conservation Potential Assessment Report and many supporting documents are available on Seattle Public Utilities website at **www.ci.seattle.wa.us/util.**

APPENDICES

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ACKNOWLEDGEMENTS

The Conservation Potential Assessment was developed by SPU staff with assistance from many others groups and individuals including the CPA Advisory Committee, the Interdepartmental Team, the Technical Advisory Groups and the Expert Review Panel. Their efforts are much appreciated and the individuals are acknowledged in another section of this report. The following people were instrumental in producing the CPA.

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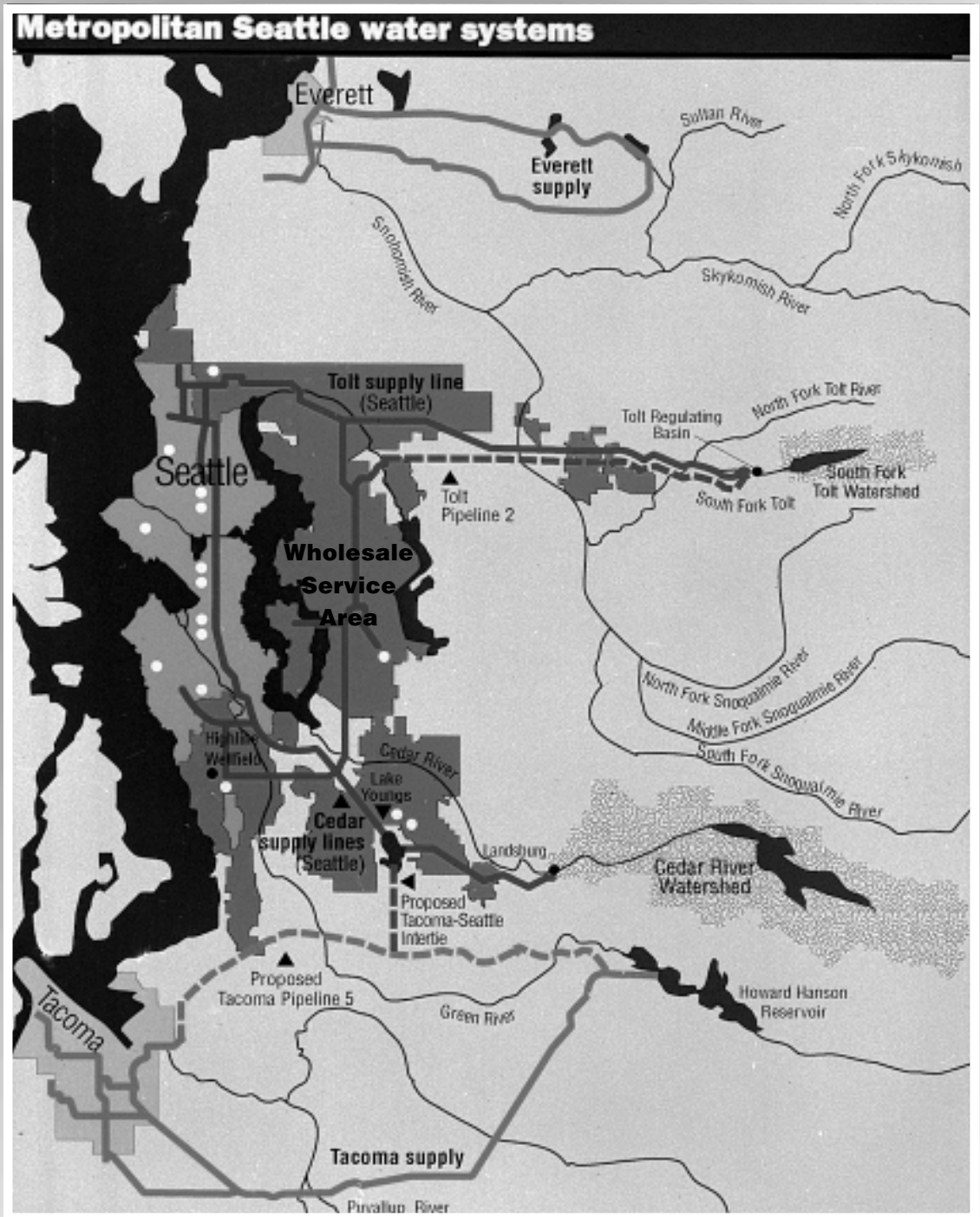
Thanks also go to the many reviewers of draft documents.
Special thanks to Seattle Councilmember Margaret Pageler,
Chair of the Utilities and Environmental Management Committee.



Seattle's water system serves Seattle and its wholesale service area.

WHAT IS THE CPA?

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HOW DOES THE CPA FIT INTO THE REGIONAL WATER SUPPLY PICTURE?

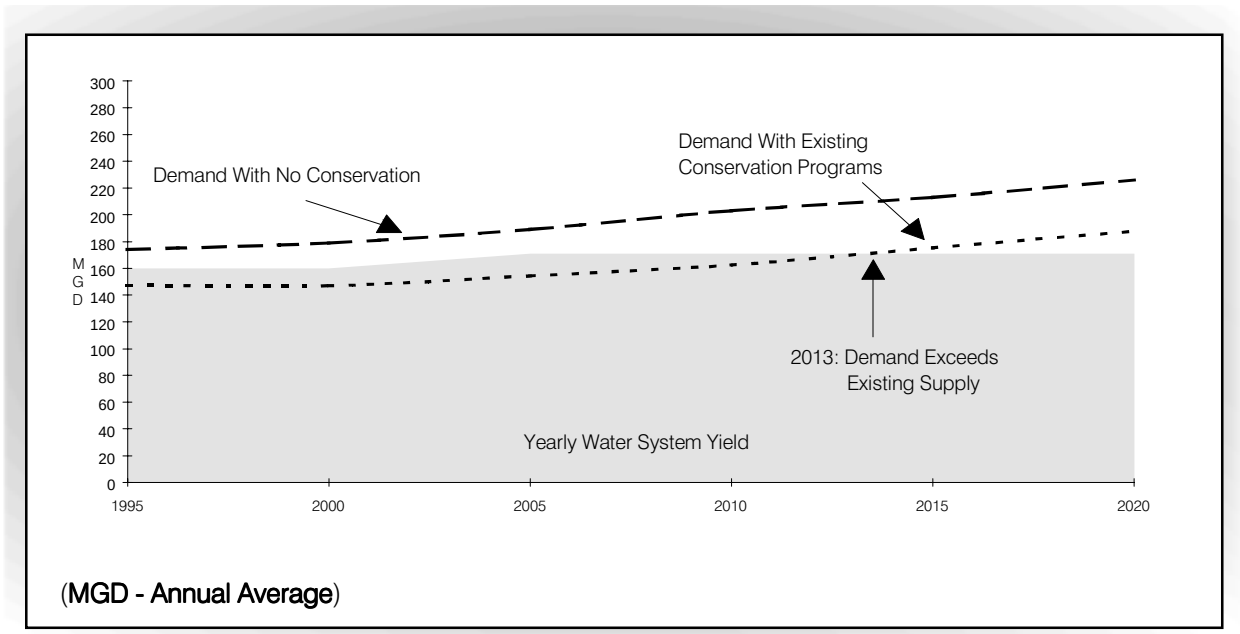
SPU supplies drinking water to nearly 1.3 million customers through direct service and 26 wholesale water purveyors in the greater Seattle region. The current firm yield for the SPU water system (Tolt River, Cedar River, and the Highline Well Fields) is 160 mgd with 98% reliability[2] on an annual average basis. Yield will increase by 11 mgd to 171 mgd in 2002 when the Tolt filtration facility comes on line and increases the volume of water that can be withdrawn from the Tolt River system.

Historically water supply planning and development has followed a predictable path of tapping a single large water source every 30-50 years to meet growth in regional water demand. Today reliance on any single option to meet future demand is an increasingly high-risk gamble due to environmental, political, and demographic uncertainties. In response to this uncertain future, Seattle and its partners are creating a diverse portfolio of water supply and conservation options including new supply, water reuse, enhanced system efficiency, and demand management (conservation). The portfolio approach, or integrated resource planning and development, provides decision makers with many options to meet growing water demand efficiently and reliably.

[1] The regional water crunch occurs during Seattle's peak season (May 15th - September 15th) when irrigation, cooling and other seasonal demands rise and precipitation and streamflows decline. To address this peaking issue directly, all costs and volume savings in the CPA are shown as peak season values. Costs should be compared to SPU's 1998 marginal cost for new peak season water supply, $2.41/ccf (hundred cubic feet = 748 gallons). If the marginal cost for water supply changes, for example, if the cost of new supply becomes greater, then the amount of conservation which is cost effective will also change, in this case, the amount of cost-effective conservation would increase.

[2] 98% reliability indicates that on average, in 98 years out of 100, Seattle's water supply will meet regional demand without the need for mandatory curtailment of water use.

Figure 1 - Regional Water Supply & Demand



During the last decade, Seattle's regional conservation programs have achieved demand reductions of approximately 1.5% per year. For the next five years, planned conservation savings will roughly equal growth in water demand in the existing service area (see Figure 1). Conservation not only has proven to be a reliable way to stretch existing supplies; it also has been popular with customers. Numerous surveys conducted by SPU show strong preference for continued and expanded conservation programs. Current conservation efforts, in conjunction with added water supply from the Tolt Filtration Project, will meet projected demand through 2013. After that, based on current projections, demand will exceed supply and new sources of supply and/or additional conservation initiatives will be necessary.

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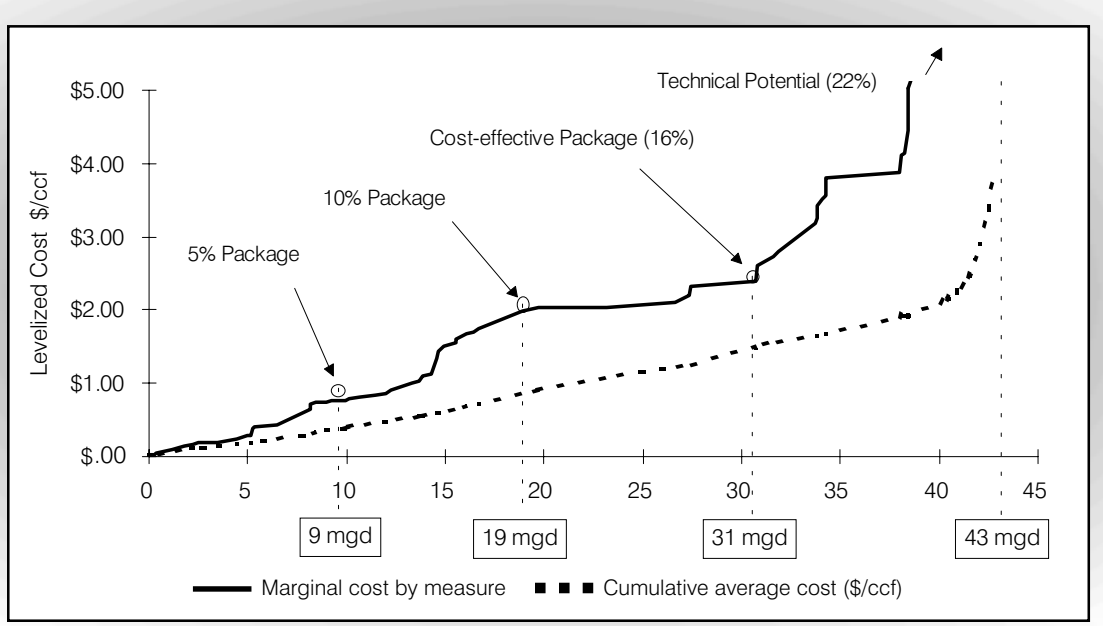
[3] Levelized cost is the discounted cost per unit of water saved or produced over the lifetime of a measure.

Figure 2 - Peak Season Water Conservation Cost Curve



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- Technical Potential Package (22% savings compared with projected peak season demand in 2020) represents all measures, regardless of cost, that could be implemented over the next 20 years without a loss of service or satisfaction for the customer.
- Cost-Effective Package (16% savings) includes all conservation measures that could be implemented at a cost lower than the current peak-season marginal cost for new water supply, $2.41/ccf.
- Five and Ten Percent Packages include the most cost-effective measures that could be combined to result in 5% and 10% savings in volume, respectively.

Figure 3 - Conservation Potential Assessment Package Results

Package	Year 2020 Savings[1]		Average Annual Cost[2]	Average Cost[3]	Marginal Cost[4]	Seattle/ Purveyor
	mgd[5]	% Projected Demand[6]	1997 Dollars[7] (millions)	$/ccf	$/ccf	% Savings Shares
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As shown, the savings achievable through these four packages range between 9 and 43 mgd.

The annual average cost, representing the total cost of all measures associated with each package divided over the 20 year life of the program, varies between $300,000 and $19,000,000 per year. This cost represents the full economic cost of conservation measures, including all equipment, material, labor, and program administration costs. The Seattle/Purveyor column demonstrates that water savings from each of the packages is evenly split between Seattle's direct service area and wholesale regions; purveyors would achieve a slightly higher share of savings under the 5% and 10% savings packages. Figures 4 through 7 provide more detail about each of the four packages. More detailed information on the packages is provided in Appendix 2. These savings only include conservation potential within SPU's existing service area and do not include conservation potential in adjacent unserved areas of King, Snohomish, or Pierce County.

Each of the four packages includes measures that capture water savings from all water use sectors (commercial process, residential domestic, commercial domestic, commercial landscape, residential landscape). In all four packages, the residential domestic end-use sector (toilets, showers, clothes washers, faucets) consistently offers the largest volume of savings. These savings are in addition to savings expected from implementation of the 1993 State Plumbing Code.

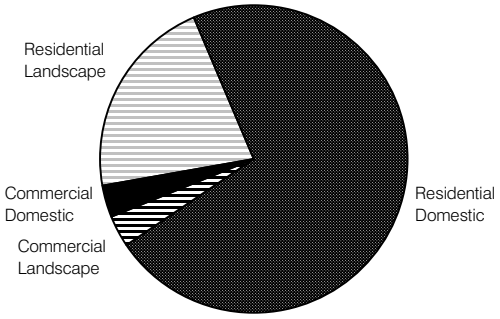
While the CPA has identified substantial water savings available to the region over the next 20 years, these estimates are believed to be conservative. The CPA did not model the benefits of improved future technology, which will likely increase the potential savings while reducing the cost. In addition, the CPA did not calculate the non-water benefits, for example energy savings and process control improvements, that will likely make the conservation measures more cost-effective to implement. The nature of the CPA assumptions as well as external benefits from conservation are discussed more fully in the sections which follow.

Figure 4 - Five Percent Peak Savings Package

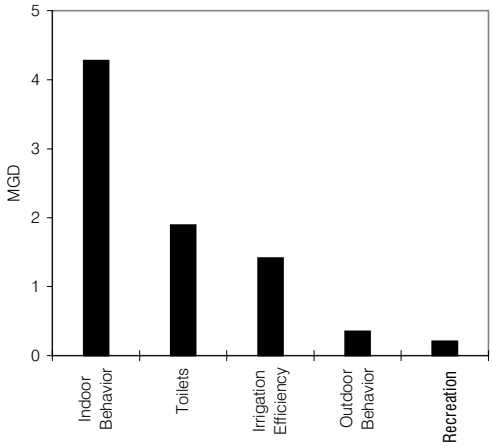
Program Area	Year 2020 Savings[1]		Average Annual Cost[2]	Average Cost[3]
	mgd[4]	% Projected Demand[5]	1997 Dollars[6] (thousands)	($/ccf)
Residential Landscape	1.9	11%	$60	$0.36
Residential Domestic	6.4	5%	$200	$0.32
Commercial Landscape	0.3	7%	$30	$0.74
Commercial Domestic	0.3	2%	$20	$0.57
Commercial Process	-	-	-	-
Total Package	8.9	5%	$310	$0.35

Package Definition: The Five Percent Peak Savings Package represents the most cost-effective conservation measures available to reduce 2020 peak season demand by 5%, approximately 9 mgd.

Savings Distribution by Sector



Savings by Measure Type



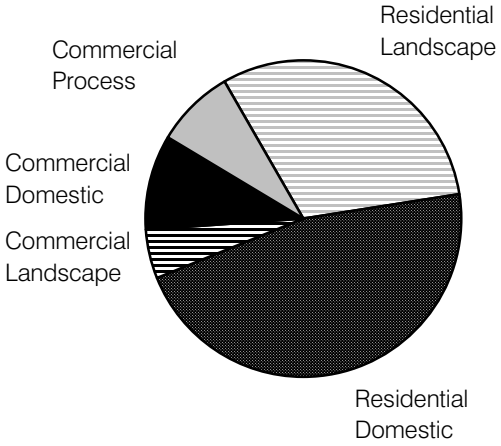
[1] Water savings have an uncertainty range of +/- 15%.
[2] Program costs have an uncertainty range of +/- 25%.
[3] Average levelized cost of package.
[4] Peak season savings May 15th - September 15th.
[5] Savings as a percent of SPU demand forecast for program area.
[6] Undiscounted 1997 dollars (does not equal present value of cost stream).

Figure 5 - Ten Percent Peak Savings Package

Program Area	Year 2020 Savings[1]		Average Annual Cost[2]	Average Cost[3]
	mgd[4]	% Projected Demand[5]	1997 Dollars[6] (thousands)	($/ccf)
Residential Landscape	5.7	33%	$800	$1.29
Residential Domestic	8.6	7%	$400	$0.47
Commercial Landscape	0.9	20%	$100	$1.04
Commercial Domestic	1.8	14%	$200	$1.07
Commercial Process	1.5	4%	$200	$1.14
Total Package	18.5	10%	$1,700	$0.86

Package Definition: The Five Percent Peak Savings Package represents the most cost-effective conservation measures available to reduce 2020 peak season demand by 10%, approximately 19 mgd.

Savings Distribution by Sector



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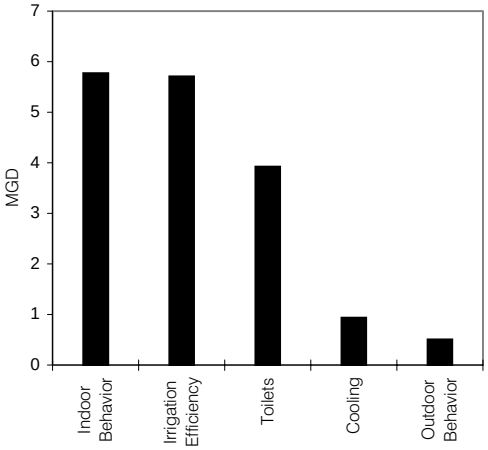

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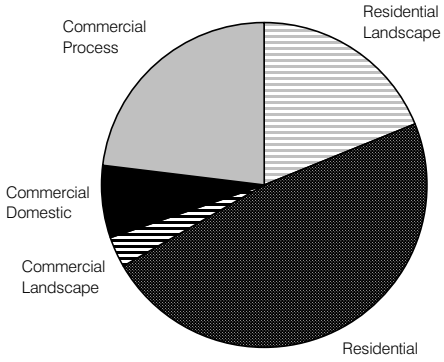
Figure 6 - Cost-Effective Peak Savings Package

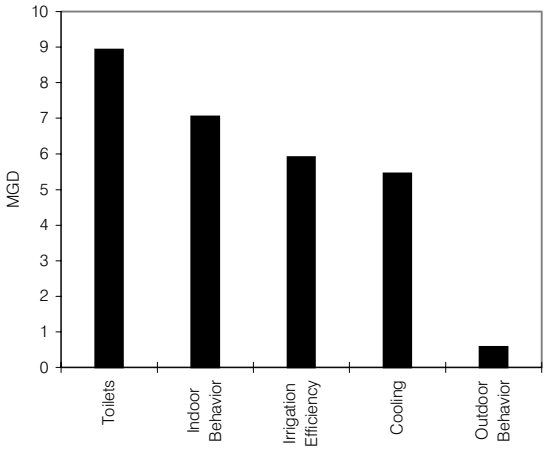
Program Area	Year 2020 Savings[1]		Average Annual Cost[2]	Average Cost[3]
		% Projected	1997 Dollars[6]	
	mgd[4]	Demand[5]	(thousands)	($/ccf)
Residential Landscape	5.8	33%	$1,100	$1.56
Residential Domestic	14.7	12%	$1,900	$1.27
Commercial Landscape	1.0	22%	$200	$1.47
Commercial Domestic	2.2	17%	$300	$1.49
Commercial Process	7.1	18%	$1,300	$2.00
Total Package	30.8	16%	$4,800	$1.52

Package Definition: The Cost-Effective Peak Savings Package represents all measures that can be implemented over the next 20 years at a cost, in 1997 dollars, of less than $2.41/ccf, SPU's current marginal cost for new peak water supply.

Savings Distribution by Sector



Savings by Measure Type



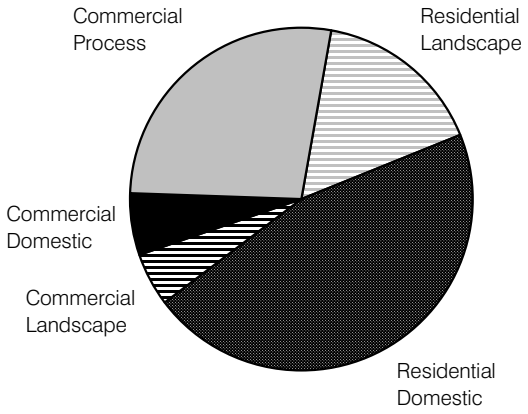
[1] Water savings have an uncertainty range of +/- 15%.
[2] Program costs have an uncertainty range of +/- 25%.
[3] Average levelized cost of package.
[4] Peak season savings May 15th - September 15th.
[5] Savings as a percent of SPU demand forecast for program area.
[6] Undiscounted 1997 dollars (does not equal present value of cost stream).

Figure 7 - Technical Potential Peak Savings Package

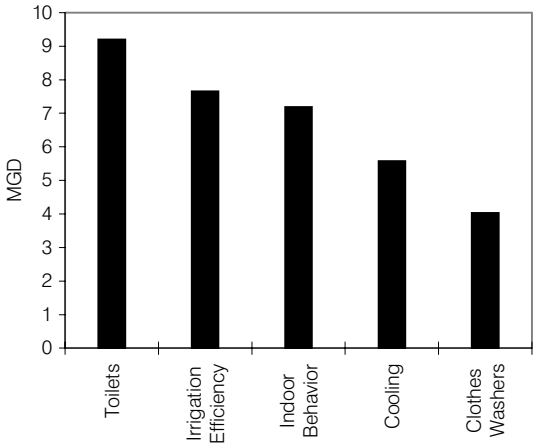
Program Area	Year 2020 Savings[1]		Average Annual Cost[2]	Average Cost[3]
	mgd[4]	% Projected Demand[5]	1997 Dollars[6] (thousands)	($/ccf)
Residential Landscape	6.9	39%	$3,800	$4.45
Residential Domestic	19.5	16%	$9,100	$4.04
Commercial Landscape	2.2	48%	$1,000	$3.03
Commercial Domestic	2.5	19%	$1,100	$3.93
Commercial Process	11.6	30%	$4,100	$3.35
Total Package	42.7	22%	$19,100	$3.86

Package Definition: The Technical Potential Savings Package represents all measures that can be implemented over the next 20 years with no loss of customer service or satisfaction regardless of the levelized cost of the measure.

Savings Distribution by Sector



Savings by Measure Type



[1] Water savings have an uncertainty range of +/- 15%.
[2] Program costs have an uncertainty range of +/- 25%.
[3] Average levelized cost of package.
[4] Peak season savings May 15th - September 15th.
[5] Savings as a percent of SPU demand forecast for program area.
[6] Undiscounted 1997 dollars (does not equal present value of cost stream).

HOW HAS CONSERVATION POTENTIAL BEEN DETERMINED?

The CPA is the result of a substantial literature review and applied research into the customer water use habits and conservation measures available to make customer water use more efficient. This section describes the methods used and assumptions made in creating the CPA.

Demographic and water use baseline

Projecting the conservation potential over time requires development of a detailed, accurate regional water use and demographics baseline that can be easily updated as conditions change. The CPA uses an econometric demand model that predicts future water demand using demographic and economic information from the Puget Sound Regional Council (PSRC) and historical SPU and wholesale water purveyor consumption data. Figure 8 represents a summary of these data. The CPA also uses an end-use water demand model that allocates the actual 1990-1995 regional water consumption and SPU's 2000-2020 econometric demand forecast to the various component end-uses.

Using the econometric demand forecast's customer categories as the starting point, the CPA model allocates water usage within sectors (e.g., manufacturing, single family residential) to specific end-uses (e.g. toilets, showers, ice machines). The allocations are believed to be highly accurate in areas where extensive data are available from existing literature, customer surveys, American Water Works Association Research Foundation (AWWARF) [4] and other primary research, customer audits, water use studies and manufacturers' data. Excellent data are available for the largest water uses, such as toilets.[5] The remaining unallocated volume has been divided within the smaller end uses using best professional judgment. For example, outdoor single-family residential water use is well known but allocation among smaller uses such as sidewalk washing must be estimated based on more limited data. While the volume estimates for these smaller uses may need to be refined in the future, changes will not have a significant effect on the results for the overall sectors.

[4] AWWARF Study collected peak and off-peak data from 12 cities throughout the United States during 1996 and 1997. The results represent the most detailed end-use analysis yet completed. Seattle was one of the participating cities.

[5] See Appendix 6 for Research Bibliography

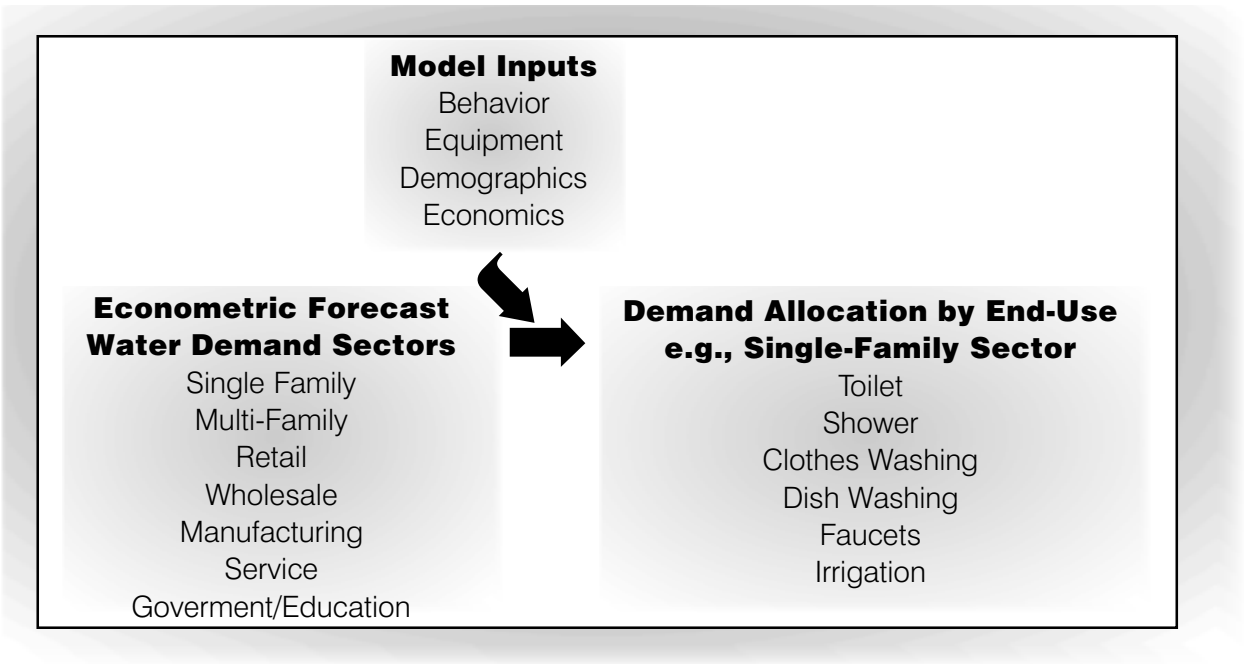
Figure 8 - Demographic and Water Use Statistics[1]

Overall Statistics	1995	2020
Population	1,242,619	1,566,565
Employment	909,757	1,221,887
Average System Water Consumption - Peak Season (mgd)	155	193
Per Capita Water Consumption - Peak Season (gal/day)	125	123
Single Family Statistics		
Average System Water Consumption - Peak Season (mgd)	78	87
Per Capita Water Consumption - Peak Season (gal/day)	93	98
Households	327,857	375,997
Persons/household	2.6	2.4
Lot size (square feet/person)	3,406	3,291
Multi-Family Statistics		
Average System Water Consumption - Peak Season (mgd)	27	49
Per Capita Water Consumption- Peak Season (gal/day)	67	73
Households	202,402	357,315
Persons/household	2.0	1.9
Lot size (square feet/person)	637	585
Nonresidential Statistics		
Average System Water Consumption - Peak Season (mgd)	50	56
Per Employee Water Consumption - Peak Season (gal/day)	55	46
Nonresidential accounts	23,665	34,712
Lot size (square feet/employee)	1,371	1,409
Building size (square feet/employee)	808	769

[1] System water use figures include only billed water sales. Non-revenue water from system leaks, maintenance, and other losses is not included.

Within the CPA model, end uses are linked to the demographic factors that directly affect the volume of water used. Figure 9 shows how the model allocates demand to its end-use components. For instance, the amount of water used for toilet flushing, as well as the costs and savings of a low-flow toilet retrofit program is directly related to the number of toilets and their gallons per flush, toilet flushing behavior, population, housing, and other demographic factors. These linkages are all coded into the model and will reflect future demographic data updates.

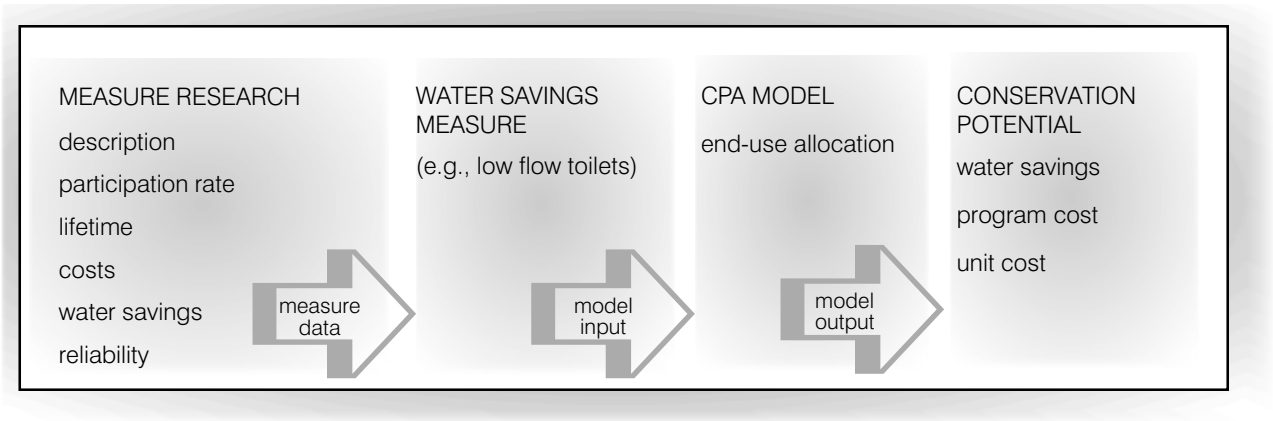
Figure 9 - CPA End-Use Allocation Model



Research and data collection

By far, the largest part of the CPA effort was collecting, reviewing, and analyzing water use and conservation measure data. The information used in the CPA was the latest and best available for residential and commercial water use. Figure 10 illustrates how measures were defined based on the research, then entered into the CPA Model where the water savings potential was calculated using the end-use allocations.

Figure 10 - Data Collection and Modeling Methodology



A conservation measure was defined as a change in water-using hardware or behavior that results in reduced water consumption. For example, the replacement of a 5 gallon per flush (gpf) toilet with a new 1.6 gpf unit was evaluated as a hardware measure. Improved irrigation scheduling was evaluated as a behavioral measure.

Measures were identified based upon two criteria. First, no measure could have a negative impact on customer satisfaction or service. Second, all measures would have to provide reliable water savings.

For each of the 74 measures modeled in the CPA, researchers gathered data on unit cost, reliability, lifetime, maintenance, and "acceptability." In addition to this measure-specific data, estimates were made regarding the number of units that could be retrofitted or number of customers whose behavior could be changed by a conservation measure. Measure-by-measure details from this research is available in Appendix 1 of this report.

Benefits and costs in addition to those directly associated with water conservation were also identified. No attempt was made at this stage to quantify these externalities, but SPU anticipates including them in the model as the CPA is refined. Consideration of externalities will be important in any application of the CPA results.

Implementation scenarios

The number of people who eventually adopt a particular conservation measure, and the eventual water savings, depends on the number of customers who potentially could adopt the measure (for example, households with high-volume toilets or inefficient clothes washers), the direct costs and benefits to customers, any external costs and benefits, and the information available to customers regarding the more efficient alternative. While the CPA did not develop any detailed program designs - this is a required next step before any conservation measures identified in the CPA could be implemented - the CPA made some assumptions about program implementation strategies and costs, and the likely resulting customer participation rates.

Each of the measures modeled in the CPA was assigned a maximum participation rate that indicates the maximum number of customers who would be expected to adopt the measure given an aggressive information and/or incentive effort by SPU. Best professional judgment and previous utility experience was used to set these maximum participation rates and the associated administrative costs. Appendix 1 gives the participation rates for all measures modeled in the CPA.

A measure implemented to attain maximum participation was deemed to have achieved its "technical potential." In other words, the measure would achieve all water savings available without a negative impact on customer service or satisfaction. For some of the four savings "packages" described above, the measures have been modeled to achieve participation lower than the technical potential when lower levels would achieve greater cost effectiveness. Measures were evaluated at levels achieving savings at 25%, 50%, 75%, and 100% of technical potential.

For the purposes of the CPA, administrative costs were assigned based on the average participation rate of all measures in a package. Administrative costs increase as the technical potential is approached. Figure 11 summarizes the administrative costs assigned to each package based on the intensity of implementation needed to meet a targeted participation rate.

Administrative costs include the cost for program staff, marketing, and consultant support. Budget dollars represent costs over the 20 year planning horizon. These expenditures depend on the specific needs of each measure and will not necessarily be applied evenly over time.

Figure 11 - Cumulative Administration Costs (2000-2020) [a]

	Participation Rates as % of Technical Potential (TP)		
	50% of TP	75% of TP	100% of TP
CPA Package	5% Package	10% Package	Cost-Effective & Technical Potential
Staff ($000)	$2,700	$7,200	$14,400
Marketing ($000)	$1,500	$3,000	$10,000
Consultant ($000)	$1,500	$3,000	$10,000
Total Cost ($000)	$5,700	$13,200	$34,400

[a] Undiscounted 1997 dollars (does not equal present value of cost stream)

External benefits and costs

Many of the measures identified in the CPA have additional costs and benefits beyond those directly addressed and quantified in this report. For example, measures adopted by commercial/industrial customers may have broad financial and environmental benefits beyond simple water savings. Recycling systems installed as part of SPU's Water Smart Technology Program have already helped customers to reduce energy costs, improve process control, eliminate need for wastewater and stormwater discharge permits, and reduce chemical costs. Residential customers who have installed more efficient clothes washers have reduced energy costs for washing and drying, and reduced wear on the clothes. Some landscape measures that save water will also reduce stormwater runoff of pesticides and fertilizers.

Conversely, other measures may cause adverse financial or environmental impacts. For example conservation programs can have a negative impact on water quality in the water distribution system. During the last five years, Seattle's aggressive water conservation has made water quality management more challenging. The system was sized to handle peak demands of 325 mgd but has been delivering peaks of only 250-275 mgd since 1992. Conservation, especially from programs that decrease peak season flows, may require additional management measures to address possible deteriorated bacteriological quality, possible increase in unpleasant taste and odor, or possible increase in disinfection by-products.

Due to the complexity of calculating the monetary value of these indirect costs and benefits, or externalities, they have been identified where possible and will be investigated in more detail during future CPA refinements and program planning efforts. Figure 12 identifies indirect benefits for the highest volume commercial and residential measures. Appendix 1 identifies externalities for all measures. Four types of external benefits were identified:

- **Service value** - improved product quality, reduced operating and maintenance expense, time and labor savings
- **Wastewater** - reduced wastewater flows that reduce wastewater costs
- **Energy** - reduced energy costs
- **Stormwater -** reduced flows and runoff of pollutants

Figure 12 - External Benefits From Conservation (Selected Measures)

Measure Name	Service Value	Wastewater	Energy	Stormwater
Residential				
Install 1.6 Gallons Per Flush Toilets		•		
Water Efficient Clothes Washers	•	•	•	
Improve Perform.of Irrigation System	•			•
Install Redesigned Toilet Flappers		•		
Decrease Shower Use		•	•	
Decrease Faucet Use		•	•	
Improve Irrigation Scheduling	•			•
Decrease Toilet Flushes		•		
Install Automatic Rain Shut-Off	•			•
Elimin. Partial Clothes Washer Loads		•	•	
Commercial/ Industrial/Institutional				
Switch to Air Cooling		•		
Recycle Process Water	•	•		
Recycle Wastewater for Processes		•		
Improve Perform.of Irrigation System	•			•
Install 1.6 Gallons Per Flush Toilets		•		
Improve Perf. of Cooling towers	•	•	•	
Improve Irrigation Scheduling	•			•
Improved Control of Process Water	•	•	•	
Install Automatic Rain Shut Off				•
Install Weather-Bsd. Irrig. Controllers	•			•
Install 1.0 Gallon Per Flush Urinals		•		

Comparison of conservation and new supply costs

The levelized cost described in dollars per hundred cubic feet for each of the conservation measures and packages represents a discounted cost over the entire 20-year planning period divided by the volume of water saved. The levelized cost of a conservation measure or a package of measures can most easily be compared to the marginal cost of the next new source of water supply to determine whether a measure or package is cost effective compared with other alternatives for meeting demand. The marginal cost is the sum of the new supply source and other system costs of delivering the water during the peak season. The most likely next supply option used in this calculation is the Tacoma-Seattle Intertie that could provide up to 22 mgd to the Seattle system on an annual average basis within the next 10 years.

The regional water crunch occurs during Seattle's peak season (May 15th - September 15th) when irrigation, cooling and other seasonal demands rise and precipitation and streamflows decline. To address this peaking issue directly, all costs and volume savings in the CPA are shown as peak season values. CPA costs should be compared to SPU's 1998 marginal cost for new peak season water supply, $2.41/ccf (hundred cubic feet = 748 gallons), as illustrated in Figure 13 for the Tacoma-Seattle Intertie.

Figure 13 - Seattle Public Utilities' Marginal Cost for New Peak Season Supply

Component	Peak Season $/ccf
Marginal Supply Cost (Tacoma Seattle Intertie)	$1.22/ccf
Marginal Transmission Cost	$0.84/ccf
Marginal Distribution Cost	$0.13/ccf
Variable Operating Cost	$0.22/ccf
Total Marginal Cost	$2.41/ccf

Crucial assumptions and range of uncertainty

The CPA is subject to the uncertainty of estimating quantities based on statistical research and sample data as well as the general uncertainty inherent in predicting the future. This uncertainty will be reduced with further program development, refined modeling, and improved technical understanding of conservation measures. This section describes the nature of these uncertainties and estimates the magnitude of uncertainty.

The CPA deliberately takes a conservative approach to estimating conservation costs, benefits, and water savings. Volume estimates provided in the CPA have a greater likelihood of being low than of being high, for the following reasons:

- Conservation measures for which there was not sufficient information to reliably estimate savings, or for which the technology is not yet tested, have not been included in the CPA - even though these measures will likely be available in the next 20 years.
- Conservation measures that are now available, but for which SPU implementation experience is limited, are assumed to have lower water savings than the mid-range estimates made by water conservation experts.
- While significant effort has been made to eliminate any double-counting of savings from overlapping measures, no effort was made to account for additional savings gained through synergies generated by implementing measures together. These synergies are in addition to the possible cost economies of providing a single customer with multiple measures.

In addition, overall uncertainty is reduced for the following reasons:

- Measures providing the highest percentage of savings in the CPA tend to be the best understood measures affecting the clearly defined end uses, for example toilet replacement measures to reduce residential toilet water consumption. The certainly of cost and savings data is very high, +/-5%.
- Measures and end uses that are less well understood account for a smaller percentage of overall savings.
- In general uncertainty tends to cancel out across many varied measures. As in investment portfolio risk pooling, uncertainty as a whole tends to be minimized.

Overall, volume savings projections are estimated to be accurate to +/- 15% of the values in this report. Cost savings are estimated to be accurate to within +/-25% of the values reported here.

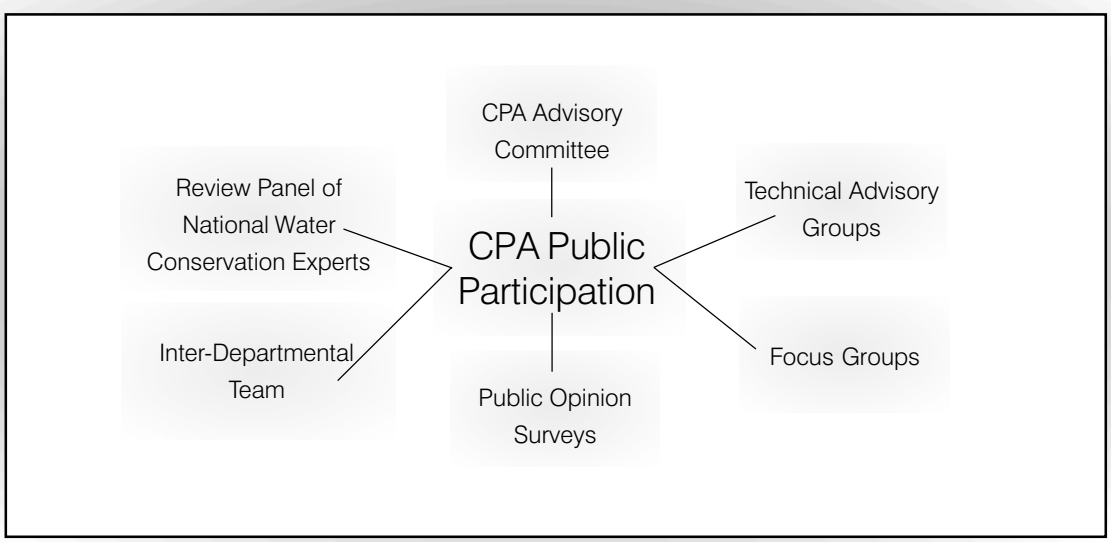
As a point of reference, per capita peak season use in SPU's baseline forecast for 2020 is expected to be 123 gallons per day. This compares with actual per capita use in 1995 of 125 gallons per day. The CPA Cost-Effective Package would reduce 2020 peak season per capita use to 103 gallons per day - an 18% reduction from the 1995 actual per capita consumption. This is a level of use reduction which has been exceeded in many areas, such as the Southwestern U.S., where inadequate water supply has made conservation a vital part of water management.

SPU has an excellent record of meeting or exceeding its pre-implementation savings estimates for programs implemented to date. SPU's considerable experience, as well as that of other utilities in North America, has been used in designing dependable measures and reducing the uncertainty of conservation savings estimates. Finally, implementation of conservation measures is rarely affected by legal, permitting, or environmental barriers and legal barriers common to traditional water supply development projects.

HOW HAS THE PUBLIC PARTICIPATED?

The participation of technical experts, local business leaders, elected officials, wholesale water purveyors, and environmental community, along with input from the public ensured that decisions made during development of the CPA reflected both public policy and technical reality. Figure 14 shows the public participation process. The CPA incorporates comments from more than 30 conservation and industry experts outside of SPU. For example, Sandra Postel, director of the Global Water Policy Project, commented: "I applaud Seattle Public Utilities for undertaking this assessment. Far too few water utilities and agencies take a far-sighted view of conservation's potential to meet new water needs." Marsi Steirer, CIP Program Manager for the San Diego Water Department, responded: "As a water resource planner, I would have great confidence in adopting the CPA and using it as the blueprint for how water savings can be achieved at a desired level over the course of the next 20 years. ... This is first class, cutting edge resource planning. All in all, an impressive undertaking." The sections below describe each component of the CPA public participation process.

Figure 14 - CPA Public Participation Process



Conservation Potential Assessment Advisory Committee

Since November 1996, the Conservation Potential Assessment Advisory Committee (CPAAC), listed in Figure 15, has represented diverse business, community, customer, and environmental perspectives on conservation and the impact of potential measures. During program design, CPAAC met monthly to review the CPA model and research findings. Throughout the CPA process the project team depended on the CPAAC to raise and help resolve significant issues pertaining to the conservation program equity, measurement of cost effectiveness, and external costs and benefits of program options. Overall, CPAAC participation assured that project results would reflect the reality of SPU's customers.

Figure 15 - Conservation Potential Assessment Advisory Committee

Rod Bailey, Evergreen Services

Erik Fairchild, Washington Department of Health

Dick Fiddler, Sierra Club

Joellyn Hawn, Horticultural Consulting

Hugh Morrison, student, University of Washington School of Public Affairs

Peter Orser, Quadrant Corporation

Lorie Parker, CH2M Hill, Inc.

Gene Peterson, RH2 Engineering

Eric Smith, Apartment Association of King County

Pat Sumption, Washington Environmental Council

Fay Weaver, The Boeing Company

Jim Young, Seattle Steam Corporation

Technical Advisory Groups

The CPA project team convened four Technical Advisory Group (TAG) Workshops and invited technical experts from local businesses and consulting practices to discuss their industries (commercial landscape, residential landscape, commercial/ industrial/ institutional water use, and domestic use). Each facilitated workshop generated a list of the most promising conservation opportunities in that water use category. Of great value was the anecdotal information gathered from these professionals regarding water use behaviors and opportunities for conservation and enhanced efficiency. The CPA project team incorporated the findings from each of these sessions into the development of water conservation measures. The TAG final reports are available in Appendix 5.

Customer focus groups and survey

Public opinion regarding water conservation and specific conservation measures under consideration in the CPA was evaluated in the *Water Conservation Attitudes and Perception Study*[7]. The study provided current focus group and survey data regarding customer water use, conservation perceptions, attitudes, and receptivity to implementing certain conservation measures in the future.

The dominant themes identified in the focus groups and confirmed in the survey provided valuable information for selecting and refining specific conservation measures and assigning reasonable savings and cost targets. From an extensive list of customer attitudes, the following themes emerged:

- The conservation ethic is important to people living in the study area and most are already taking actions to conserve water. The conservation ethic is just as strong within wholesale water purveyor communities as in the City of Seattle.
- People are already responding to conservation messages, but more information and education regarding conservation opportunities will increase participation in water conservation programs.
- People are motivated to practice water conservation because of
    - The conservation ethic — "It's the right thing to do!"
    - Direct monetary benefits.
    - Having learned to conserve in another time or place.

Interdepartmental Working Team

To ensure that the CPA project was appropriately coordinated within the City of Seattle, and with outside interested agencies, the project team convened the Inter-Departmental Working Team (IDT). The IDT includes staff from SPU and other City of Seattle departments, King County, and representatives from SPU's wholesale water purveyors. This internal team provided detailed review of intermediate CPA products and modeling assumptions to assure that the CPA was fully integrated with past and current Seattle conservation efforts and was responsive to the needs of wholesale water purveyors and compatible with King County's regional wastewater planning efforts.

[7] Seattle Public Utilities Water Conservation Attitudes and Perception Study, Carolyn Browne Associates, 1997. A copy of the study is available upon request.

Conservation Expert Review Panel

Five national water conservation experts, listed in Figure 16, were asked to review and comment on the CPA model and findings. The goal of this review was to provide an objective review of the results by industry professionals familiar with conservation efforts throughout the nation. The full summary of the expert panel members' review is attached in Appendix 4. In addition, the CPA draft was reviewed by Sandra L. Postel, Director of the Global Water Policy Institute and author of *Last Oasis: Facing Water Scarcity* and several other books on water policy.

Figure 16 - Expert Review Panel

Thomas W. Chesnutt, President, A&N Technical Services, Inc.

Edward Cebron, Vice President, FCS Group

Richard Pinkham, Senior Research Associate , Rocky Mountain Institute

Scott Chaplain, Senior Research Associate, Rocky Mountain Institute

Marsi A. Steirer, Water Conservation and CIP Program Manager,
City of San Diego Water Department

WHAT'S NEXT?

The results of the CPA will be used by regional water supply planners in the evaluation of future water supply options, their costs, benefits, and uncertainties. Water conservation may also produce indirect benefits and costs. For instance, energy savings, wastewater reductions or environmental benefits may arise from water conservation. On the other hand, reduced water system flows associated with conservation may increase the cost and complexity of water quality operations required to meet high water quality standards. These and other important emerging issues will be addressed when planning future conservation strategies. Meanwhile, the CPA model, assumptions, and measure characteristics will continue to be refined as new information and comments are received. The CPA will provide a flexible planning tool as SPU and the region move into the next century.

APPENDIX 1: MEASURE DEFINITIONS AND ASSUMPTIONS

MEASURE NAME	Peak Savings MGD	Levelized Cost Peak ($/CCF)	INDIRECT BENEFITS			
			Service Value	Waste Water	Energy	Storm Water
Commercial/Domestic						
1. Dry Sidewalk Cleaning	0.3	$1.48				•
2. Install Fill Cycle Diverters	0.3	$3.57		•		
3. Improve Hot Tub Use	0.1	$1.37	•	•	•	
4. Improve Swimming Pool Use	0.2	$0.23	•	•	•	
5. Install Redesigned Toilet Flappers	3.3	$1.06		•		
6. Reduce Faucet "Run Until Hot" Use	0.0	$135.80	•	•	•	
7. Install 1.0 Gallons Per Flush Urinals	0.5	$1.78		•		
8. Install 1.6 Gallons Per Flush Toilets	1.6	$1.31		•		
9. Install Waterless Urinals	0.4	$2.36		•		
10. Storm Water For Toilet And Urinal Flushes	0.2	$14.63				•
11. Switch To Low Flow Car Wash Equipment	0.0	$9.43	•		•	•
Commercial/Landscape						
1. Install Auto Rain Shut-Off	0.7	$2.79	•			•
2. Install Drip/Bubbler Irrigation	0.1	$7.27	•			•
3. Improve Irrigation Scheduling	1.1	$1.74	•			•
4. Improve Maintenance Of Turf	0.2	$19.40	•			•
5. Improve Performance Of Irrigation System	1.8	$2.73	•			•
6. Improve Soil Amendments	0.2	$4.13	•			•
7. Install Low Water Use Plantings	0.1	$3.25	•			•
8. Install Soil Moisture Sensors	0.5	$1.72	•			•
9. Storm Water For Irrigation	0.0	$3.80				•
10. Install Weather Based Irrigation Controllers	0.6	$1.02	•			•

MEASURE NAME	Peak Savings MGD	Levelized Cost Peak ($/CCF)	INDIRECT BENEFITS			
			Service Value	Waste Water	Energy	Storm Water
Commercial/Process						
1. Comprehensive Leak Reduction	0.3	$3.52		•		
2. Eliminate Single-Pass Decorative Features	0.0	$0.07		•		
3. Improve Disposal Usage	0.1	$13.31		•		
4. Improve Performance For Steam Boilers	0.2	$4.13	•	•	•	
5. Improved Control Of Process Water	1.1	$2.23	•	•	•	
6. Improve Food Preparation and Washing	0.3	$6.77		•	•	
7. Improve High Efficiency Dish Washers	0.3	$17.01		•	•	
8. Improved Cooling Tower Performance	1.4	$1.00	•	•	•	
9. Recycle Laundry Wash Water	0.5	$1.93		•	•	
10. Recycle Process Water	2.3	$3.19	•	•		
11. Improve Recycle Water For Vehicle Washes	0.0	$14.67			•	•
12. Recycle Water For Retail Car Washes	0.0	$22.82			•	•
13. Recycled Waste Water For Processes	1.9	$6.28		•		
14. Switch to Air Cooling	5.2	$2.26		•		
15. Install Recirculating Cooling System	0.2	$2.62	•	•		
16. Water Efficient Clothes Washers	0.4	$1.65	•	•	•	
Residential/Domestic						
1. Decrease Toilet Flushes	1.9	$0.89		•		
2. Decrease Faucet Use	2.3	$0.73		•	•	
3. Decrease Shower Use	3.3	$0.52		•	•	
4. Dry Sidewalk Cleaning	0.3	$1.48				•
5. Eliminate Partial Clothes Washer Loads	1.0	$1.03		•	•	
6. Eliminate Partial Dish Loads	0.2	$7.64		•	•	
7. Install Fill Cycle Diverters	0.0	$3.57		•		
8. Improve Hot Tub Use	0.1	$1.37	•	•	•	
9. Improve Swimming Pool Use	0.1	$0.23	•	•	•	
10. Switch To Recirculating Car Wash	0.4	$1.06				•
11. Install Redesigned Toilet Flappers	3.3	$1.06		•		
12. Reduce Faucet “Run Until Hot” Use	0.4	$52.16	•	•	•	
13. Install 1.6 Gallons Per Flush Toilets	5.0	$2.39		•		
14. Storm Water For Toilet Flushes	0.1	$41.30				•
15. Water Efficient Clothes Washers	4.5	$3.88	•	•	•	
16. Water Efficient Dish Washers	0.3	$86.13		•	•	

MEASURE NAME	Peak Savings MGD	Levelized Cost Peak ($/CCF)	INDIRECT BENEFITS			
			Service Value	Waste Water	Energy	Storm Water
Residential/Landscape						
1. Allow Lawn To Go Dormant	1.0	$0.25				•
2. Install Auto Rain Shut Off	1.1	$2.00	•			•
3. Grey Water For Irrigation	0.2	$38.70		•		•
4. Install Drip/Bubbler Irrigation	0.1	$7.99	•			•
5. Improve Irrigation Scheduling	2.3	$.70	•			•
6. Improve Maintenance Of Turf	0.5	$32.36	•			•
7. Improve Mulching	0.5	$9.55	•			•
8. Improve Performance Of Irrigation System	3.7	$2.26	•			•
9. Improve Soil Amendments	0.3	$4.46	•			•
10. Install Low Water Use Plantings	0.4	$1.32	•			•
11. Rain Barrel Catchment	02	$17.88				•
12. Install Soil Moisture Sensors	0.9	$1.92	•			•

Commercial/Domestic

1. Dry Sidewalk Cleaning

Description: Reduce sidewalk and drive cleaning with water by switching to sweeping one-half the time.

Technical Potential Inputs (Year 2020)

Participation Rate: .. 80% of nonresidential accounts using water to clean sidewalks

Water Use Reduction: ..... 50% reduction in water used for cleaning sidewalks

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 1,787

Annual Direct Measure Cost: $0.00

Annual Administration Cost: $10,375

Peak Season Savings: ..... 39,050 gallons per day

Peak Season Levelized Cost: ..... $3.42 /ccf

2. Install Fill Recycle Diverters

Description: Install fill cycle diverters in tank type 3.5 gallon per flush or higher toilets.

Technical Potential Inputs (Year 2020)

Participation Rate: .. 50% of nonresidential accounts with tank type 3.5 gallon per flush or higher toilets

Water Use Reduction: .....0.25 gallon per flush reduction

Direct Measure Cost: ..... $5.25 per fill cycle diverter installed

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 2,029

Annual Direct Measure Cost: $2,694

Annual Administration Cost: $11,780

Peak Season Savings: ..... 34,864 gallons per day

Peak Season Levelized Cost: ..... $5.02 /ccf

3. Improve Hot Tub Use

Description: Reduce the number of drains and fills of hot tubs through better water quality control.

Technical Potential Inputs (Year 2020)

Participation Rate: .. 50% of nonresidential accounts with hot tubs

Water Use Reduction: ..... 25% reduction in hot tub water use

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 195

Annual Direct Measure Cost: $0.00

Annual Administration Cost: $1,132

Peak Season Savings: ..... 19,807 gallons per day

Peak Season Levelized Cost: ..... $0.74 /ccf

4. Improve Swimming Pool Use

Description: Reduce the number of drains and fills of pools by better water quality control.

Technical Potential Inputs (Year 2020)

Participation Rate: . 50% of nonresidential accounts with swimming pools

Water Use Reduction: ...25% reduction in pool water use

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 years

Technical Potential Results (Year 2020)

Accounts Participating: 122

Annual Direct Measure Cost: $0.00

Annual Administration Cost: $708

Peak Season Savings: ..... 106,851 gallons per day

Peak Season Levelized Cost: ..... $0.09 /ccf

Commercial/Domestic

5. Install Redesigned Toilet Flappers

Description: Install redesigned, long life toilet flappers in leaking tank-type toilets.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 40% of nonresidential accounts with tank-type toilet flapper leaks

Water Use Reduction: 50% reduction in flapper leaks

Direct Measure Cost: .....$8 per installed flapper

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 3,471

Annual Direct Measure Cost: $6,960

Annual Administration Cost: $20,152

Peak Season Savings ..... 22,451 gallons per day

Peak Season Levelized Cost: ..... $14.23 /ccf

6. Reduce Faucet "Run Until Hot" Use

Description: Install plumbing system with re-circulating pump or on-demand close proximity water heater system to provide "instant hot" water to tap in new construction and plumbing remodel accounts.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of nonresidential new construction and plumbing remodel accounts

Water Use Reduction: . 10% reduction in faucet, bath and shower water usage

Direct Measure Cost: .... $1,500 per system installed

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 4,598

Annual Direct Measure Cost: $344,877

Annual Administration Cost: $26,695

Peak Season Savings: ..... 24,415 gallons per day

Peak Season Levelized Cost: ..... $135.80 /ccf

7. Install 1.0 Gallons Per Flush Urinals

Description: Install 1.0 gallon per flush urinals to replace high flush urinals

Technical Potential Inputs (Year 2020)

Participation Rate: .. 95% of nonresidential accounts with high flush urinals

Water Use Reduction: ..... 2.0 gallons per flush reduction

Direct Measure Cost: ..... $45 per urinal installed

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 7,348

Annual Direct Measure Cost: $20,769

Annual Administration Cost: $42,661

Peak Season Savings: ..... 408,177 gallons per day

Peak Season Levelized Cost: ..... $1.78 /ccf

8. Install 1.6 Gallons Per Flush Toilets

Description: Install 1.6 gallon per flush toilets to replace high flush toilets.

Technical Potential Inputs (Year 2020)

Participation Rate: . 95% of nonresidential accounts with 3.5 gallon per flush toilets or higher

Water Use Reduction: 2.4 gallon per flush reduction

Direct Measure Cost: .....$65 per toilet installed

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 8,164

Annual Direct Measure Cost: $134,197

Annual Administration Cost: $47,399

Peak Season Savings: .... 1,346,648 gallons per day

Peak Season Levelized Cost: ..... $1.31 /ccf

Commercial/Domestic

9. Install Waterless Urinals

Description: Install waterless urinals to replace high flush urinals.

Technical Potential Inputs (Year 2020)

Participation Rate: .. 15% of nonresidential accounts with high flush urinals

Water Use Reduction: 100% reduction in gallons per flush

Direct Measure Cost: ..... $200 per urinal installed

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 4,686

Annual Direct Measure Cost: $46,861

Annual Administration Cost: $27,206

Peak Season Savings: ..... 330,088 gallons per day

Peak Season Levelized Cost: ..... $2.36 /ccf

10. Storm Water For Toilet And Urinal Flushes

Description: Install a storm water collection and distribution system for toilet and urinal flushing for large scale new construction.

Technical Potential Inputs (Year 2020)

Participation Rate: 60 of the largest new construction nonresidential accounts

Water Use Reduction: 60% reduction in water usage for toilets and urinals

Direct Measure Cost: ..... $100,000 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 60

Annual Direct Measure Cost: ..... $ 300,000

Annual Administration Cost: $348

Peak Season Savings: ..... 177,069 gallons per day

Peak Season Levelized Cost: ..... $14.63 /ccf

11. Switch To Low Flow Car Wash Equipment

Description: Reduce hose car washing by changing to portable, high-pressure, low-flow equipment.

Technical Potential Inputs (Year 2020)

Participation Rate: 95% of the largest nonresidential accounts with hose car washing

Water Use Reduction: . 75% reduction in water used per car wash

Direct Measure Cost: ..... $300 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 128

Annual Direct Measure Cost: $4,858

Annual Administration Cost: $743

Peak Season Savings: ..... 7,014 gallons per day

Peak Season Levelized Cost: ..... $9.43 /ccf

Commercial/Landscape

1. Install Auto Rain Shut Off

Description: Install automatic rain shut-off devices for automatic irrigation systems.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of nonresidential accounts with automatic in-ground irrigation systems

Water Use Reduction: 10% decrease in irrigation use

Direct Measure Cost: ..... $50 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 14,579

Annual Direct Measure Cost: $36,448

Annual Administration Cost: $53,667

Peak Season Savings: ..... 301,396 gallons per day

Peak Season Levelized Cost: ..... $2.79 /ccf

2. Install Drip/Bubbler Irrigation

Description: Install drip/bubbler irrigation systems for new construction and remodeled landscapes that would have relied on in-ground sprinkler systems for 1,000 sq ft of landscaping.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 35% of nonresidential new construction and remodeled landscapes

Water Use Reduction: 50% decrease in irrigation use for 1,000 sq ft of landscape

Direct Measure Cost: ..... $1,000 per installation

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 1,126

Annual Direct Measure Cost: $56,315

Annual Administration Cost: $4,145

Peak Season Savings: ..... 39,210 gallons per day

Peak Season Levelized Cost: ..... $7.27 /ccf

3. Improve Irrigation Scheduling

Description: Improve the efficiency of existing irrigation system through better irrigation scheduling.

Technical Potential Inputs (Year 2020)

Participation Rate: .. 50% of nonresidential accounts with manual and automatic irrigation systems

Water Use Reduction: 25% decrease in irrigation use

Direct Measure Cost: ..... $30 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 9,112

Annual Direct Measure Cost: $68,337

Annual Administration Cost: $33,542

Peak Season Savings: ..... 470,939 gallons per day

Peak Season Levelized Cost: ..... $1.74 /ccf

4. Improve Maintenance of Turf

Description: Improve turf maintenance through actions such as: thatching, aerating, over-seeding, and top-dressing.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of nonresidential accounts with irrigated lawn

Water Use Reduction: ..... 10% reduction in lawn irrigation use

Direct Measure Cost: ..... $75 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 10,553

Annual Direct Measure Cost: $197,861

Annual Administration Cost: $38,847

Peak Season Savings: ..... 83,782 gallons per day

Peak Season Levelized Cost: ..... $19.40 /ccf

Commercial/Landscape

5. Improve Performance of Irrigation Systems

Description: Improve the efficiency of existing irrigation system through repair, removal, replacement, or adjustment of in-ground sprinkler system components.

Technical Potential Inputs (Year 2020)

Participation Rate: .. 50% of nonresidential accounts with manual and automatic irrigation systems

Water Use Reduction: 40% decrease in irrigation use

Direct Measure Cost: ..... $250 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 9,112

Annual Direct Measure Cost: $284,738

Annual Administration Cost: $33,542

Peak Season Savings: ..... 753,502 gallons per day

Peak Season Levelized Cost: ..... $2.73 /ccf

6. Improve Soil Amendments

Description: Improve soil amendments, adding material such as compost, to new construction and remodeled landscapes.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of nonresidential new construction and remodeled landscapes

Water Use Reduction: ..... 20% reduction in irrigation use

Direct Measure Cost: ..... $150 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 4,192

Annual Direct Measure Cost: $31,440

Annual Administration Cost: $15,431

Peak Season Savings: ..... 79,524 gallons per day

Peak Season Levelized Cost: ..... $4.13 /ccf

7. Install Low Water Use Plantings

Description: Replace 300 sq. ft. of lawn with plants having low water use requirements in new construction and remodeled landscapes.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of nonresidential new construction and remodeled landscapes

Water Use Reduction: 80% reduction in irrigation use for 300 sq ft of landscaping

Direct Measure Cost: ..... $25 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 2,795

Annual Direct Measure Cost: $3,494

Annual Administration Cost: $10,289

Peak Season Savings: ..... 45,071 gallons per day

Peak Season Levelized Cost: ..... $3.25 /ccf

8. Install Soil Moisture Sensors

Description: Install soil moisture sensors for automatic irrigation systems.

Technical Potential Inputs (Year 2020)

Participation Rate: .. 20% of nonresidential accounts with automatic in-ground irrigation systems

Water Use Reduction: 25% decrease in irrigation use

Direct Measure Cost: ..... $200 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 3,645

Annual Direct Measure Cost: $36,448

Annual Administration Cost: $13,418

Peak Season Savings: ..... 188,372 gallons per day

Peak Season Levelized Cost: ..... $1.72 /ccf

Commercial/Landscape

9. Storm Water For Irrigation

Description: Install a storm water collection and distribution system for 1,000 sq ft of landscape irrigation for large scale new construction where stormwater detention is required.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 10% of large nonresidential new construction accounts with landscaping

Water Use Reduction: ..... 100% reduction in potable water usage for 1,000 sq ft of landscaping

Direct Measure Cost: ..... $1,000 per system

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 240

Annual Direct Measure Cost: $12,000

Annual Administration Cost: $883

Peak Season Savings: ..... 5,975 gallons per day

Peak Season Levelized Cost: ..... $3.80 /ccf

10. Install Weather Based Irrigation Controllers

Description: Convert largest accounts with automatic irrigation systems to centrally controlled system that will adjust schedules based upon current weather conditions and plant requirements.

Technical Potential Inputs (Year 2020)

Participation Rate: 80% of the largest nonresidential accounts with automatic in-ground irrigation systems

Water Use Reduction: 40% decrease in irrigation use

Direct Measure Cost: ..... $1,500 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 716

Annual Direct Measure Cost: $53,700

Annual Administration Cost: $2,636

Peak Season Savings: ..... 249,702 gallons per day

Peak Season Levelized Cost: ..... $1.02 /ccf

Commercial/Process

1. Comprehensive Leak Reduction

Description: Reduce leaks for all types of equipment and end-uses in nonresidential accounts with largest leaks.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 90% of nonresidential accounts with the largest leaks

Water Use Reduction: . 50% reduction in water leaks

Direct Measure Cost: ..... $1,000 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 500

Annual Direct Measure Cost: $62,500

Annual Administration Cost: $2,917

Peak Season Savings: ..... 212,447 gallons per day

Peak Season Levelized Cost: ..... $3.52 /ccf

2. Eliminate Single-Pass Decorative Water Features

Description: Install re-circulating equipment on single-pass decorative water features.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 90% of nonresidential accounts with single-pass decorative water features

Water Use Reduction: ..... 90% reduction in water use for decorative water features

Direct Measure Cost: ..... $675 per unit

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 4

Annual Direct Measure Cost: $144

Annual Administration Cost: $23

Peak Season Savings ..... 21,384 gallons per day

Peak Season Levelized Cost: ..... $0.07 /ccf

3. Improve Disposal Usage

Description: Decrease time and flow rate of disposal water use.

Technical Potential Inputs (Year 2020)

Participation Rate: .. 50% of nonresidential accounts with disposal uses

Water Use Reduction: .... 25% reduction in water for disposal use

Direct Measure Cost: ..... $50 per unit

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 9,791

Annual Direct Measure Cost: $68,636

Annual Administration Cost: $57,113

Peak Season Savings: ..... 113,904 gallons per day

Peak Season Levelized Cost: ..... $13.31 /ccf

4. Improve Performance For Steam Boilers

Description: Increase efficiency of largest accounts' steam boilers through improved water quality control and increasing boiler cycles.

Technical Potential Inputs (Year 2020)

Participation Rate: 50% of the largest nonresidential accounts with steam boiler uses

Water Use Reduction: .... 25% reduction in water for steam boiler use

Direct Measure Cost: ..... $500 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 816

Annual Direct Measure Cost: $50,996

Annual Administration Cost: $4,760

Peak Season Savings: ..... 155,206 gallons per day

Peak Season Levelized Cost: ..... $4.13 /ccf

Commercial/Process

5. Improve Control of Process Water

Description: Decrease process water use by improving control of process water used in manufacturing, rinsing, washing, film processing, laboratories, pollution control, and other process uses.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of the largest nonresidential accounts with process uses

Water Use Reduction: .... 25% reduction in water for process use

Direct Measure Cost: ..... $2,500 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 580

Annual Direct Measure Cost: $181,250

Annual Administration Cost: $3,383

Peak Season Savings: ..... 941,749 gallons per day

Peak Season Levelized Cost: ..... $2.23 /ccf

6. Improve Food Preparation and Washing

Description: Decrease water used to rinse, wash, and prepare food items.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of nonresidential accounts with food preparation uses

Water Use Reduction: .... 25% reduction in water for food preparation use

Direct Measure Cost: ..... $50 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 9,791

Annual Direct Measure Cost: $61,191

Annual Administration Cost: $57,113

Peak Season Savings: ..... 211,449 gallons per day

Peak Season Levelized Cost: ..... $6.77 /ccf

7. Install High Efficiency Dishwashers

Description: Install high efficiency dishwashers in accounts providing restaurant or cafeteria food services.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of nonresidential accounts with dishwashing uses

Water Use Reduction: .... 20% reduction in water for dishwashing

Direct Measure Cost: ..... $1,000 per unit

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 2,448

Annual Direct Measure Cost: $348,180

Annual Administration Cost: $14,280

Peak Season Savings: ..... 240,240 gallons per day

Peak Season Levelized Cost: ..... $17.01 /ccf

8. Improve of Cooling Tower Performance

Description: Improve efficiency of largest accounts' HVAC and equipment cooling towers by improving water treatment and increasing cooling tower cycles.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 75% of the largest nonresidential accounts with cooling tower uses

Water Use Reduction: .... 50% reduction in water for cooling tower use

Direct Measure Cost: ..... $750 per unit

Measure Lifetime: ..... 10 years

Technical Potential Results (Year 2020)

Accounts Participating: 1,712

Annual Direct Measure Cost: $124,120

Annual Administration Cost: $9,986

Peak Season Savings: .... 1,150,453 gallons per day

Peak Season Levelized Cost: ..... $1.00 /ccf

Commercial/Process

9. Recycle Laundry Wash Water

Description: Recycle water for large commercial and industrial laundry washing

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of nonresidential accounts with large laundry facility uses

Water Use Reduction: .... 50% reduction in water for laundry use

Direct Measure Cost: ..... $10,225 per unit

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 176

Annual Direct Measure Cost: $89,980

Annual Administration Cost: $1,027

Peak Season Savings: ..... 390,051 gallons per day

Peak Season Levelized Cost: ..... $1.93 /ccf

10. Recycle Process Water

Description: Implement comprehensive recycling of process water used in manufacturing, rinsing, washing, film processing, laboratories, pollution control, and other process uses for largest accounts.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of the largest nonresidential accounts with process uses

Water Use Reduction: .... 50% reduction in water for process use

Direct Measure Cost: ..... $25,000 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 580

Annual Direct Measure Cost: $725,000

Annual Administration Cost: $3,383

Peak Season Savings: .... 1,883,498 gallons per day

Peak Season Levelized Cost: ..... $3.19 /ccf

11. Improve Recycle Water for Vehicle Washes

Description: Improved control of recycle water use for vehicle washing in largest accounts already using recycling for vehicle washing.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of the largest nonresidential accounts with vehicle washing use

Water Use Reduction: ..... 20% reduction in water use for vehicle washing

Direct Measure Cost: ..... $2,000 per unit

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 38

Annual Direct Measure Cost: $3,800

Annual Administration Cost: $222

Peak Season Savings: ..... 2,327 gallons per day

Peak Season Levelized Cost: ..... $14.67 /ccf

12. Recycle Water for Retail Car Washes

Description: Install water recycling system in retail car washes not already recycling wash water.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 90% of retail car wash accounts not already recycling

Water Use Reduction: ..... 50% reduction in water for car washing

Direct Measure Cost: ..... $33,000 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 10

Annual Direct Measure Cost: $16,210

Annual Administration Cost: $58

Peak Season Savings: ..... 5,882 gallons per day

Peak Season Levelized Cost: ..... $22.82 /ccf

Commercial/Process

13. Recycled Wastewater For Processes

Description: Use recycled wastewater for commercial and industrial processes by largest accounts in the heavy industry area located along Duwamish River corridor.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50 of the largest nonresidential accounts in the Duwamish corridor

Water Use Reduction: ... 100 % reduction in process water use

Direct Measure Cost: ..... $500,000 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 50

Annual Direct Measure Cost: $1,250,000

Annual Administration Cost: ..... $ 292

Peak Season Savings: ... 1,532,685 gallons per day

Peak Season Levelized Cost: ..... $6.28 /ccf

14. Switch to Air Cooling

Description: Replacement of water-cooled equipment with air cooled equipment.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 90% of nonresidential accounts with water-cooling uses

Water Use Reduction: .. 100 % reduction in water for cooling uses

Direct Measure Cost: ..... $1,000 per unit

Measure Lifetime: ..... 10 years

Technical Potential Results (Year 2020)

Accounts Participating: 5,515

Annual Direct Measure Cost: $817,531

Annual Administration Cost: ..... $ 32,170

Peak Season Savings: .... 4,297,593 gallons per day

Peak Season Levelized Cost: ..... $2.26 /ccf

15. Install Recirculating Cooling System

Description: Replacement of single-pass water cooled equipment with re-circulating water equipment

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 10% of nonresidential accounts with single-pass cooling uses

Water Use Reduction: ..... 75% reduction in water for single-pass cooling

Direct Measure Cost: ..... $500 per unit

Measure Lifetime: ..... 10 years

Technical Potential Results (Year 2020)

Accounts Participating: 336

Annual Direct Measure Cost: ..... $ 26,794

Annual Administration Cost: ..... $ 1,960

Peak Season Savings: ..... 126,057 gallons per day

Peak Season Levelized Cost: ..... $2.62 /ccf

16. Water Efficient Clothes Washers

Description: Replacing small commercial capacity clothes washers with high efficiency machines in accounts averaging 10 or more loads per day per machine.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 90% of nonresidential accounts with small capacity clothes washer use

Water Use Reduction: ..... 40% reduction in water use for clothes washing

Direct Measure Cost: ..... $500 per unit

Measure Lifetime: ..... 10 years

Technical Potential Results (Year 2020)

Accounts Participating: 88

Annual Direct Measure Cost: $82,500

Annual Administration Cost: ..... $ 513

Peak Season Savings: ..... 289,228 gallons per day

Peak Season Levelized Cost: ..... $1.65 /ccf

Residential/Domestic

1. Decrease Toilet Flushes

Description: Reduce the number of toilet flushes per person.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of households

Water Use Reduction: ..... 15% reduction in flushes per person per day

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 366,656

Annual Direct Measure Cost: $0.0

Annual Administration Cost: $108,885

Peak Season Savings: ... 1,569,377 gallons per day

Peak Season Levelized Cost: ..... $0.89 /ccf

2. Decreased Faucet Use

Description: Reduce minutes of faucet run time.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of households

Water Use Reduction: ... 15% reduction in faucet run time

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 366,656

Annual Direct Measure Cost: $0.0

Annual Administration Cost: $108,885

Peak Season Savings: .... 1,931,633 gallons per day

Peak Season Levelized Cost: ..... $0.73 /ccf

3. Decreased Shower Use

Description: Reduce showering minutes per person.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of households

Water Use Reduction: ..... 25% reduction in faucet run time

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 366,656

Annual Direct Measure Cost: $0.0

Annual Administration Cost: $108,885

Peak Season Savings: .... 2,686,274 gallons per day

Peak Season Levelized Cost: ..... $0.52 /ccf

4. Dry Sidewalk Cleaning

Description: Reduce sidewalk and drive cleaning with water by switching to sweeping.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of residential accounts using water to clean sidewalks

Water Use Reduction: ..... 100% reduction in water used for cleaning sidewalks

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 100,064

Annual Direct Measure Cost: $0.0

Annual Administration Cost: $29,716

Peak Season Savings: ..... 258,456 gallons per day

Peak Season Levelized Cost: ..... $1.48 /ccf

Residential/Domestic

5. Eliminate Partial Clothes Washer Loads

Description: Reduce the number of clothes washer loads by eliminating partial loads.

Technical Potential Inputs (Year 2020)

Participation Rate ... 50% of households with clothes washers

Water Use Reduction: ..... 10% reduction in loads per week

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 232,720

Annual Direct Measure Cost: $0.0

Annual Administration Cost: ..... $ 69,111

Peak Season Savings: ..... 865,877 gallons per day

Peak Season Levelized Cost: ..... $1.03 /ccf

6. Eliminate Partial Dish Loads

Description: Reduce the number of dishwasher loads by eliminating partial loads.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of households with dish washers

Water Use Reduction: ..... 10% reduction in loads per week

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 257,333

Annual Direct Measure Cost: $0.0

Annual Administration Cost: ..... $ 76,420

Peak Season Savings: ..... 128,724 gallons per day

Peak Season Levelized Cost: ..... $7.64 /ccf

7. Install Fill Cycle Diverters

Description: Install fill cycle diverters in 3.5 gallon per flush or higher toilets.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of residential accounts with 3.5 gallon per flush or higher toilets

Water Use Reduction: ..... 0.25 gallon per flush reduction

Direct Measure Cost: .... $5.25 per fill cycle diverter installed

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 96,998

Annual Direct Measure Cost: $45,981

Annual Administration Cost: ..... $ 28,805

Peak Season Savings: ..... 209,743 gallons per day

Peak Season Levelized Cost: ..... $3.57 /ccf

8. Improve Hot Tub Use

Description: Reduce the number of drains and fills of hot tubs through better water quality control.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of residential accounts with hot tubs

Water Use Reduction: ..... 25% reduction in hot tub water use

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 years

Technical Potential Results (Year 2020)

Accounts Participating: 22,452

Annual Direct Measure Cost: $0.0

Annual Administration Cost: $6,668

Peak Season Savings: ..... 62,689 gallons per day

Peak Season Levelized Cost: ..... $1.37 /ccf

Residential/Domestic

9. Improve Swimming Pool Use

Description: Reduce the number of drains and fills of pools by better water quality control.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of residential accounts with swimming pools

Water Use Reduction: ...25% reduction in pool water use

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 9,351

Annual Direct Measure Cost: $0.00

Annual Administration Cost: $2,777

Peak Season Savings: ..... 158,834 gallons per day

Peak Season Levelized Cost: ..... $0.23 /ccf

10. Switch To Recirculating Car Wash

Description: Reduce the water used for car washing by switching from home to recirculating commercial washes.

Technical Potential Inputs (Year 2020)

Participation Rate: 25% of households washing cars at home

Water Use Reduction:50% reduction in water use per car washed

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 year

Technical Potential Results (Year 2020)

Accounts Participating: 90,479

Annual Direct Measure Cost: $0.00

Annual Administration Cost: ..... $ 26,869

Peak Season Savings: ..... 326,511 gallons per day

Peak Season Levelized Cost: ..... $1.06 /ccf

11. Install Redesigned Toilet Flappers

Description: Install redesigned, longer life toilet flappers in leaking toilets.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of residential accounts with toilet flapper leaks

Water Use Reduction: ..... 50% reduction in flapper leaks

Direct Measure Cost: ..... $8 per installed flapper

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 293,324

Annual Direct Measure Cost: $212,930

Annual Administration Cost: $87,108

Peak Season Savings: .... 2,712,535 gallons per day

Peak Season Levelized Cost: ..... $1.06 /ccf

12. Reduce Faucet "Run Until Hot" Use

Description: Install plumbing system with re-circulating pump or on-demand close proximity water heater system to provide "instant hot" water to tap in new construction and plumbing remodel accounts.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 40% of new construction and plumbing remodel residential accounts

Water Use Reduction: . 10% reduction in faucet, bath and shower water usage

Direct Measure Cost: ..... $500 per system installed

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 81,221

Annual Direct Measure Cost: $2,030,525

Annual Administration Cost: ..... $ 24,120

Peak Season Savings: ..... 326,500 gallons per day

Peak Season Levelized Cost: ..... $52.16 /ccf

Residential/Domestic

13. Install 1.6 Gallons Per Flush Toilets

Description: Install 1.6 gallon per flush toilets to replace high flush toilets.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 95% of residential accounts with 3.5 gallon per flush toilets or higher

Water Use Reduction: ..... 2.5 gallon per flush reduction

Direct Measure Cost: .....$65 per toilet installed

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 184,297

Annual Direct Measure Cost: $1,112,358

Annual Administration Cost: ..... $ 54,730

Peak Season Savings: ... 4,131,636 gallons per day

Peak Season Levelized Cost: ..... $2.39 /ccf

14. Stormwater For Toilet Flushes

Description: Install a storm water collection and distribution system for toilet flushing for new construction.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 20% of new construction residential accounts

Water Use Reduction: .....60% reduction in water usage for toilets and urinals

Direct Measure Cost: ..... $1,500 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 7,221

Annual Direct Measure Cost: $541,696

Annual Administration Cost: $2,144

Peak Season Savings: ..... 108,649 gallons per day

Peak Season Levelized Cost: ..... $41.30 /ccf

15. Water Efficient Clothes Washers

Description: Install new water efficient clothes washers in households with conventional washers.

Technical Potential Inputs (Year 2020)

Participation Rate: . 50% of households with clothes washers

Water Use Reduction: 20 gallons per load reduction

Direct Measure Cost: ..... $100 per machine

Measure Lifetime: ..... 10 years

Technical Potential Results (Year 2020)

Accounts Participating: 221,084

Annual Direct Measure Cost: $1,658,127

Annual Administration Cost: ..... $ 65,655

Peak Season Savings: .... 3,739,016 gallons per day

Peak Season Levelized Cost: ..... $3.88 /ccf

16. Water Efficient Dish Washers

Description: Install new water efficient dish washers in households with conventional dish washers.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of households with dish washers

Water Use Reduction: ... 2 gallons per load reduction

Direct Measure Cost: .....$100 per machine

Measure Lifetime: ..... 10 years

Technical Potential Results (Year 2020)

Accounts Participating: 257,333

Annual Direct Measure Cost: $2,573,313

Annual Administration Cost: ..... $ 76,420

Peak Season Savings: ..... 257,447 gallons per day

Peak Season Levelized Cost: ..... $86.13 /ccf

Residential/Landscaping

1. Allow Lawn To Go Dormant

Description: Reducing irrigation to minimal requirements allowing lawns to go naturally dormant.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 10% of residential accounts with irrigated lawns

Water Use Reduction: ..... 90% reduction in water for lawn irrigation

Direct Measure Cost: ..... None

Measure Lifetime: ..... 1 years

Technical Potential Results (Year 2020)

Accounts Participating: 26,243

Annual Direct Measure Cost: $0.00

Annual Administration Cost: ..... $ 11,956

Peak Season Savings: ..... 621,130 gallons per day

Peak Season Levelized Cost: ..... $0.25 /ccf

2. Install Auto Rain Shut Off

Description: Install automatic rain shut-off devices for automatic irrigation systems.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of residential accounts with automatic in-ground irrigation systems

Water Use Reduction: ..... 10% decrease in irrigation use

Direct Measure Cost: ..... $50 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 63,814

Annual Direct Measure Cost: $159,534

Annual Administration Cost: $29,074

Peak Season Savings: ..... 680,192 gallons per day

Peak Season Levelized Cost: ..... $2.00 /ccf

3. Grey Water for Irrigation

Description: Install a grey water collection and distribution system for 400 sq ft of landscape irrigation for new construction.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 10% of single family new construction accounts with landscaping

Water Use Reduction: .... 100% reduction in potable water usage for 400 sq ft

Direct Measure Cost: ..... $2,000 per system

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 9,573

Annual Direct Measure Cost: $957,300

Annual Administration Cost: $4,362

Peak Season Savings: ..... 154,239 gallons per day

Peak Season Levelized Cost: ..... $38.70 /ccf

4. Install Drip/Bubbler Irrigation

Description: Install drip/bubbler irrigation systems for new construction and remodeled landscapes that would have relied on in-ground sprinkler systems.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 35% of new construction and remodeled landscapes

Water Use Reduction: ..... 50% decrease in irrigation use

Direct Measure Cost: ..... $2000 per installation

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 10,712

Annual Direct Measure Cost: ..... $ 107,120

Annual Administration Cost: ..... $ 4,880

Peak Season Savings: ..... 91,113 gallons per day

Peak Season Levelized Cost: ..... $7.99 /ccf

Residential/Landscaping

5. Improve Irrigation Scheduling

Description: Improve the efficiency of existing irrigation system through better irrigation scheduling.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of residential accounts with manual and automatic irrigation systems

Water Use Reduction: ..... 25% decrease in irrigation use

Direct Measure Cost: ..... $10 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 59,577

Annual Direct Measure Cost: $74,474

Annual Administration Cost: ..... $ 27,144

Peak Season Savings: ... 1,415,972 gallons per day

Peak Season Levelized Cost: ..... $0.70 /ccf

6. Improve Maintenance of Turf

Description: Improve turf maintenance through actions such as: thatching, aerating, over-seeding, and top-dressing.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of residential accounts with irrigated lawn

Water Use Reduction: 10% reduction in irrigation use

Direct Measure Cost: ..... $75 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 105,555

Annual Direct Measure Cost: $989,579

Annual Administration Cost: ..... $ 48,091

Peak Season Savings: ..... 279,947 gallons per day

Peak Season Levelized Cost: ..... $32.36 /ccf

7. Improve Mulching

Description: Install mulch materials in ornamental gardens.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of residential accounts with ornamental gardens

Water Use Reduction: 20% reduction in irrigation use

Direct Measure Cost: ..... $100 per account

Measure Lifetime ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 85,187

Annual Direct Measure Cost: $266,209

Annual Administration Cost: $38,812

Peak Season Savings: ..... 289,827 gallons per day

Peak Season Levelized Cost: ..... $9.55 /ccf

8. Improve Performance of Irrigation System

Description: Improve the efficiency of existing irrigation system through repair, removal, replacement, or adjustment of in-ground sprinkler system components.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 50% of residential accounts with manual and automatic irrigation systems

Water Use Reduction: ..... 40% decrease in irrigation use

Direct Measure Cost: ..... $75 per account

Measure Lifetime: ..... 5 years

Technical Potential Results (Year 2020)

Accounts Participating: 59,577

Annual Direct Measure Cost: $558,534

Annual Administration Cost: $27,144

Peak Season Savings: .... 2,265,556 gallons per day

Peak Season Levelized Cost: ..... $2.26 /ccf

Residential/Landscaping

9. Improve Soil Amendments

Description: Improve soil amendments, adding material such as compost, to new construction and remodeled landscapes.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of new construction and remodeled landscapes

Water Use Reduction: ..... 20% reduction in irrigation use

Direct Measure Cost: ..... $50 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 36,677

Annual Direct Measure Cost: $91,693

Annual Administration Cost: $16,710

Peak Season Savings: ..... 175,304 gallons per day

Peak Season Levelized Cost: ..... $4.46 /ccf

10. Install Low Water Use Plantings

Description: Replace 300 sq. ft. of lawn with plants having low water use requirements in new construction and remodeled landscapes.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 80% of new construction and remodeled landscapes

Water Use Reduction: ..... 80% reduction in the amount of irrigation water used

Direct Measure Cost: ..... $25 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 25,260

Annual Direct Measure Cost: $31,575

Annual Administration Cost: $11,509

Peak Season Savings: ..... 260,324 gallons per day

Peak Season Levelized Cost: ..... $1.32 /ccf

11. Rain Barrel Catchment

Description: Install 50 gallon irrigation barrels and systems to gutter downspouts to collect rain water for irrigation uses.

Technical Potential Inputs (Year 2020)

Participation Rate: .... 20% of single family accounts with irrigated landscaping

Water Use Reduction: ..... 100% reduction in potable water usage for 50 sq ft of irrigated landscape

Direct Measure Cost: ..... $50 per system

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 68,150

Annual Direct Measure Cost: $170,374

Annual Administration Cost: ..... $ 31,050

Peak Season Savings: ..... 135,681 gallons per day

Peak Season Levelized Cost: ..... $17.88 /ccf

12. Install Soil Moisture Sensor

Description: Install soil moisture sensors for automatic irrigation systems.

Technical Potential Inputs (Year 2020)

Participation Rate: ..... 20% of residential accounts with automatic in-ground irrigation systems

Water Use Reduction: ..... 25% decrease in irrigation use

Direct Measure Cost: ..... $150 per account

Measure Lifetime: ..... 20 years

Technical Potential Results (Year 2020)

Accounts Participating: 15,954

Annual Direct Measure Cost: $119,655

Annual Administration Cost: ..... $ 7,269

Peak Season Savings: ..... 544,167 gallons per day

Peak Season Levelized Cost: ..... $1.92 /ccf

APPENDIX 2: PACKAGE DETAILS AND MEASURES

5% Savings Package

Residential Landscape

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Allow Lawn To Go Dormant	501,923	13,122	$0.00	$1,981	$1,981	$ 0.05
Improve Irrigation Scheduling	1,144,220	29,789	$37,237	$4,498	$41,735	$ 0.42
Install Low Water Use Plantings	210,363	12,630	$15,788	$1,907	$17,694	$ 0.74
Combined Resid'l Landscape	**1,856,506**		**$53,025**	**$8,386**	**$61,410**	**$ 0.36**

Residential Domestic

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Decrease Toilet Flushes	951,137	183,328	$0.00	$18,042	$18,042	$ 0.24
Decreased Faucet Use	1,170,687	183,328	$0.00	$18,042	$18,042	$ 0.20
Decreased Shower Use	1,628,045	183,328	$0.00	$18,042	$18,042	$ 0.14
Dry Sidewalk Cleaning	156,640	50,032	$0.00	$4,924	$4,924	$ 0.40
Eli. Partial Clothes Washer Loads	524,774	116,360	$0.00	$11,451	$11,451	$ 0.28
Improve Hot Tub Use	37,993	11,226	$0.00	$1,105	$1,105	$ 0.37
Improve Swimming Pool Use	96,263	4,676	$0.00	$460	$460	$ 0.06
Switch To Recirculating Car Wash	197,885	45,240	$0.00	$4,452	$4,452	$ 0.29
Install Redesigned Toilet Flappers	1,643,961	146,662	$106,465	$14,434	$120,899	$ 0.65
Combined Resid'l Domestic	**6,407,386**		**$106,465**	**$90,952**	**$197,417**	**$ 0.32**

Commercial Landscape

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Measure Name	Peak Seas	Accounts	Equip Cost	Admin Cost	Meas Cost	($/ccf peak)
Install Low Water Use Plantings	49,169	1,398	$1,747	$1,705	$3,452	$ 0.71
Install Weather Based Irrig. Controllers	272,402	358	$26,850	$437	$27,287	$ 0.75
Combined Comm'l Landscape	**321,571**		**$28,597**	**$2,142**	**$30,739**	**$ 0.74**

Commercial Domestic

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Improve Hot Tub Use	12,004	98	$0.00	$188	$188	$ 0.20
Improve Swimming Pool Use	64,758	61	$0.00	$117	$117	$ 0.02
Install 1.0 Gallons Per Flush Urinals	247,380	3,674	$10,385	$7,069	$17,453	$ 0.73
Combined Commercial Domestic	**324,142**		**$10,385**	**$7,374**	**$17,758**	**$ 0.57**
Combined Program	**8,922,564**		**$198,543**	**$108,857**	**$307,400**	**$ 0.35**

10% Savings Package

Residential Landscape

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Allow Lawn To Go Dormant	609,836	19,682	$0.00	$4,588	$4,588	$ 0.10
Install Auto Rain Shut Off	667,825	47,861	$119,651	$11,156	$130,807	$ 1.55
Improve Irrigation Scheduling	1,390,227	44,683	$55,856	$10,416	$66,271	$ 0.51
Improve Perf. of Irrigation System	2,224,364	44,683	$418,901	$10,416	$429,316	$ 1.99
Install Low Water Use Plantings	255,590	18,945	$23,681	$4,416	$28,097	$ 0.91
Install Soil Moisture Sensor	534,273	11,966	$89,741	$2,789	$92,530	$ 1.67
Combined Residential Landscape	**5,682,116**		**$707,829**	**$43,781**	**$751,610**	**$ 1.29**

Residential Domestic

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Decrease Toilet Flushes	1,284,035	274,992	$0.00	$41,782	$41,782	$ 0.42
Decreased Faucet Use	1,580,427	274,992	$0.00	$41,782	$41,782	$ 0.34
Decreased Shower Use	2,197,861	274,992	$0.00	$41,782	$41,782	$ 0.24
Dry Sidewalk Cleaning	211,464	75,048	$0.00	$11,403	$11,403	$ 0.69
Elim.Partial Clothes Washer Loads	708,445	174,540	$0.00	$26,519	$26,519	$ 0.48
Improve Hot Tub Use	51,291	16,839	$0.00	$2,558	$2,558	$ 0.64
Improve Swimming Pool Use	129,955	7,013	$0.00	$1,066	$1,066	$ 0.11
Switch To Recirculating Car Wash	267,145	67,859	$0.00	$10,310	$10,310	$ 0.50
Install Redesigned Toilet Flappers	2,219,347	219,993	$159,698	$33,425	$193,123	$ 0.79
Combined Resid'l Domestic	**8,649,971**		**$159,698**	**$210,626**	**$370,324**	**$ 0.47**

Commercial Landscape

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Improve Irrigation Scheduling	462,376	6,834	$51,253	$12,871	$64,124	$ 1.11
Install Soil Moisture Sensors	184,947	2,734	$27,336	$5,149	$32,485	$ 1.09
Install Weather Based Irrig. Controllers	245,162	537	$40,275	$1,011	$41,286	$ 0.86
Combined Comm'l Landscape	**892,486**		**$118,864**	**$19,031**	**$137,895**	**$ 1.04**

Commercial Domestic

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Dry Sidewalk Cleaning	31,950	1,340	$0.00	$3,981	$3,981	$ 1.60
Improve Hot Tub Use	16,205	146	$0.00	$434	$434	$ 0.35
Improve Swimming Pool Use	87,423	92	$0.00	$272	$272	$ 0.04
Install 1.0 Gallons Per Flush Urinals	333,963	5,511	$15,577	$16,370	$31,947	$ 1.03
Install 1.6 Gallons Per Flush Toilets	1,101,803	6,123	$100,648	$18,188	$118,836	$ 1.00
Install Waterless Urinals	270,072	3,515	$35,146	$10,440	$45,585	$ 1.69
Combined Comm'l Domestic	**1,841,417**		**$151,370**	**$49,685**	**$201,055**	**$ 1.07**

Commercial Process

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Elimin. Single-Pass Dec. Features	17,496	3	$108	$ 9	$117	$ 0.06
Improve Perf. of Cooling Towers	941,280	1,284	$93,090	$3,832	$96,922	$ 0.87
Recycle Laundry Washwater	319,132	132	$67,485	$394	$67,879	$ 1.76
Water Efficient Clothes Washers	236,641	66	$61,875	$197	$62,072	$ 1.50
Combined Comm'l Process	**1,514,549**		**$222,558**	**$4,432**	**$226,990**	**$ 1.14**
Combined Program	**18,580,538**		**$1,360,319**	**$327,554**	**$1,687,873**	**$ 0.86**

Cost-Effective Savings Package

Residential Landscape

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Allow Lawn To Go Dormant	621,130	26,243	$0.00	$11,956	$11,956	$ 0.25
Install Auto Rain Shut Off	680,192	63,814	$159,534	$29,074	$188,608	$ 2.00
Improve Irrigation Scheduling	1,415,972	59,577	$74,474	$27,144	$101,618	$ 0.70
Improve Perf. of Irrigation System	2,265,556	59,577	$558,534	$27,144	$585,678	$ 2.26
Install Low Water Use Plantings	260,324	25,260	$31,575	$11,509	$43,084	$ 1.32
Install Soil Moisture Sensor	544,167	15,954	$119,655	$7,269	$126,924	$ 1.92
Combined Resid. Landscape	**5,787,340**		**$943,772**	**$114,095**	**$1,057,867**	**$ 1.56**

Residential Domestic

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Decrease Toilet Flushes	1,569,377	366,656	$0.00	$108,885	$108,885	$ 0.89
Decreased Faucet Use	1,931,633	366,656	$0.00	$108,885	$108,885	$ 0.73
Decreased Shower Use	2,686,274	366,656	$0.00	$108,885	$108,885	$ 0.52
Dry Sidewalk Cleaning	258,456	100,064	$0.00	$29,716	$29,716	$ 1.48
Elim. Partial Clothes Washer Loads	865,877	232,720	$0.00	$69,111	$69,111	$ 1.03
Improve Hot Tub Use	62,689	22,452	$0.00	$6,668	$6,668	$ 1.37
Improve Swimming Pool Use	158,834	9,351	$0.00	$2,777	$2,777	$ 0.23
Switch To Recirculating Car Wash	326,511	90,479	$0.00	$26,869	$26,869	$ 1.06
Install Redesigned Toilet Flappers	2,712,535	293,324	$212,930	$87,108	$300,038	$ 1.06
Install 1.6 Gallons Per Flush Toilets	4,131,636	184,297	$1,112,358	$54,730	$1,167,088	$ 2.39
Combined Resid. Domestic	**14,703,823**		**$1,325,288**	**$603,635**	**$1,928,923**	**$ 1.27**

Commercial Landscape

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Improve Irrigation Scheduling	518,033	9,112	$68,337	$33,542	$101,879	$ 1.66
Install Soil Moisture Sensors	207,209	3,645	$36,448	$13,418	$49,866	$ 1.63
Ins. Weather Based Irrig. Controllers	274,672	716	$53,700	$2,636	$56,336	$ 1.01
Combined Comm'l Landscape	**999,914**		**$158,485**	**$49,596**	**$208,081**	**$ 1.47**

Commercial Domestic

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Improve Hot Tub Use	19,807	195	$0.00	$1,132	$1,132	$ 0.74
Improve Swimming Pool Use	106,851	122	$0.00	$708	$708	$ 0.09
Install 1.0 Gallons Per Flush Urinals	408,177	7,348	$20,769	$42,661	$63,430	$ 1.78
Install 1.6 Gallons Per Flush Toilets	1,346,648	8,164	$134,197	$47,399	$181,596	$ 1.31
Install Waterless Urinals	330,088	4,686	$46,861	$27,206	$74,067	$ 2.36
Combined Comm'l Domestic	**2,211,571**		**$201,827**	**$119,106**	**$320,933**	**$ 1.49**

Commercial Process

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Elimin. Single-Pass Dec. Features	21,384	4	$144	$23	$167	$ 0.07
Improve Control of Process Water	941,749	580	$181,250	$3,383	$184,633	$ 2.23
Improve Perfor. of Cooling Towers	1,150,453	1,712	$124,120	$9,986	$134,106	$ 1.00
Recycle Laundry Washwater	390,051	176	$89,980	$1,027	$91,007	$ 1.93
Switch to Air Cooling	4,297,593	5,515	$817,531	$32,170	$849,701	$ 2.26
Water Efficient Clothes Washers	289,228	88	$82,500	$513	$83,013	$ 1.65
Combined Comm'l Process	**7,090,458**		**$1,295,525**	**$47,103**	**$1,342,628**	**$ 2.00**
Combined Program	**30,793,106**		**$3,924,897**	**$933,535**	**$4,858,432**	**$ 1.52**

Technical Potential Savings Package

Residential Landscape

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Allow Lawn To Go Dormant	621,130	26,243	$0.00	$11,956	$11,956	$0.25
Install Auto Rain Shut Off	680,192	63,814	$159,534	$29,074	$188,608	$2.00
Greywater for Irrigation	154,239	9,573	$957,300	$4,362	$961,662	$38.70
Install Drip/Bubbler Irrigation	91,113	10,712	$107,120	$4,880	$112,000	$7.99
Improve Irrigation Scheduling	1,415,972	59,577	$74,474	$27,144	$101,618	$0.70
Improve Maintenance of Turf	279,947	105,555	$989,579	$48,091	$1,037,670	$32.36
Improve Mulching	289,827	85,187	$266,209	$38,812	$305,021	$9.55
Improve Perf. of Irrig. System	2,265,556	59,577	$558,534	$27,144	$585,678	$2.26
Improve Soil Amendments	175,304	36,677	$91,693	$16,710	$108,403	$4.46
Install Low Water Use Plantings	260,324	25,260	$31,575	$11,509	$43,084	$1.32
Rain Barrel Catchment	135,681	68,150	$170,374	$31,050	$201,424	$17.88
Install Soil Moisture Sensor	544,167	15,954	$119,655	$7,269	$126,924	$1.92
Combined Res. Landscape	**6,913,452**		**$3,526,047**	**$258,000**	**$3,784,047**	**$4.45**

Residential Domestic

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Decrease Toilet Flushes	1,569,377	366,656	$0.00	$108,885	$108,885	$0.89
Decreased Faucet Use	1,931,633	366,656	$0.00	$108,885	$108,885	$0.73
Decreased Shower Use	2,686,274	366,656	$0.00	$108,885	$108,885	$0.52
Dry Sidewalk Cleaning	258,456	100,064	$0.00	$29,716	$29,716	$1.48
Elim.Partial Clothes Washer Loads	865,877	232,720	$0.00	$69,111	$69,111	$1.03
Eliminate Partial Dish Loads	128,724	257,333	$0.00	$76,420	$76,420	$7.64
Install Fill Cycle Diverters	209,743	96,998	$45,981	$28,805	$74,786	$3.57
Improve Hot Tub Use	62,689	22,452	$0.00	$6,668	$6,668	$1.37
Improve Swimming Pool Use	158,834	9,351	$0.00	$2,777	$2,777	$0.23
Switch To Recirculating Car Wash	326,511	90,479	$0.00	$26,869	$26,869	$1.06
Install Redesigned Toilet Flappers	2,712,535	293,324	$212,930	$87,108	$300,038	$1.06
Reduce Faucet “Run Until Hot” Use	326,500	81,221	$2,030,525	$24,120	$2,054,645	$52.16
Install 1.6 Gallons Per Flush Toilets	4,131,636	184,297	$1,112,358	$54,730	$1,167,088	$2.39
Stormwater For Toilet Flushes	108,649	7,221	$541,696	$2,144	$543,840	$41.30
Water Efficient Clothes Washers	3,739,016	221,084	$1,658,127	$65,655	$1,723,782	$3.88
Water Efficient Dish Washers	257,447	257,333	$2,573,313	$76,420	$2,649,733	$86.13
Combined Resid’l Domestic	**19,473,902**		**$8,174,930**	**$877,200**	**$9,052,130**	**$4.04**

Commercial Landscape

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Install Auto Rain Shut Off	301,396	14,579	$36,448	$53,667	$90,115	$2.79
Install Drip/Bubbler Irrigation	39,210	1,126	$56,315	$4,145	$60,460	$7.27
Improve Irrigation Scheduling	470,939	9,112	$68,337	$33,542	$101,879	$1.74
Improve Maintenance of Turf	83,782	10,553	$197,861	$38,847	$236,708	$19.40
Improve Perf. of Irrig. Systems	753,502	9,112	$284,738	$33,542	$318,280	$2.73
Improve Soil Amendments	79,524	4,192	$31,440	$15,431	$46,871	$4.13
Install Low Water Use Plantings	45,071	2,795	$3,494	$10,289	$13,783	$3.25
Install Soil Moisture Sensors	188,372	3,645	$36,448	$13,418	$49,866	$1.72
Storm Water For Irrigation	15,975	240	$12,000	$883	$12,883	$3.80
Install Weather Based Irrig. Cont.	249,702	716	$53,700	$2,636	$56,336	$1.02
Combined Comm’l Landscape	**2,227,474**		**$780,781**	**$206,400**	**$987,181**	**$3.03**

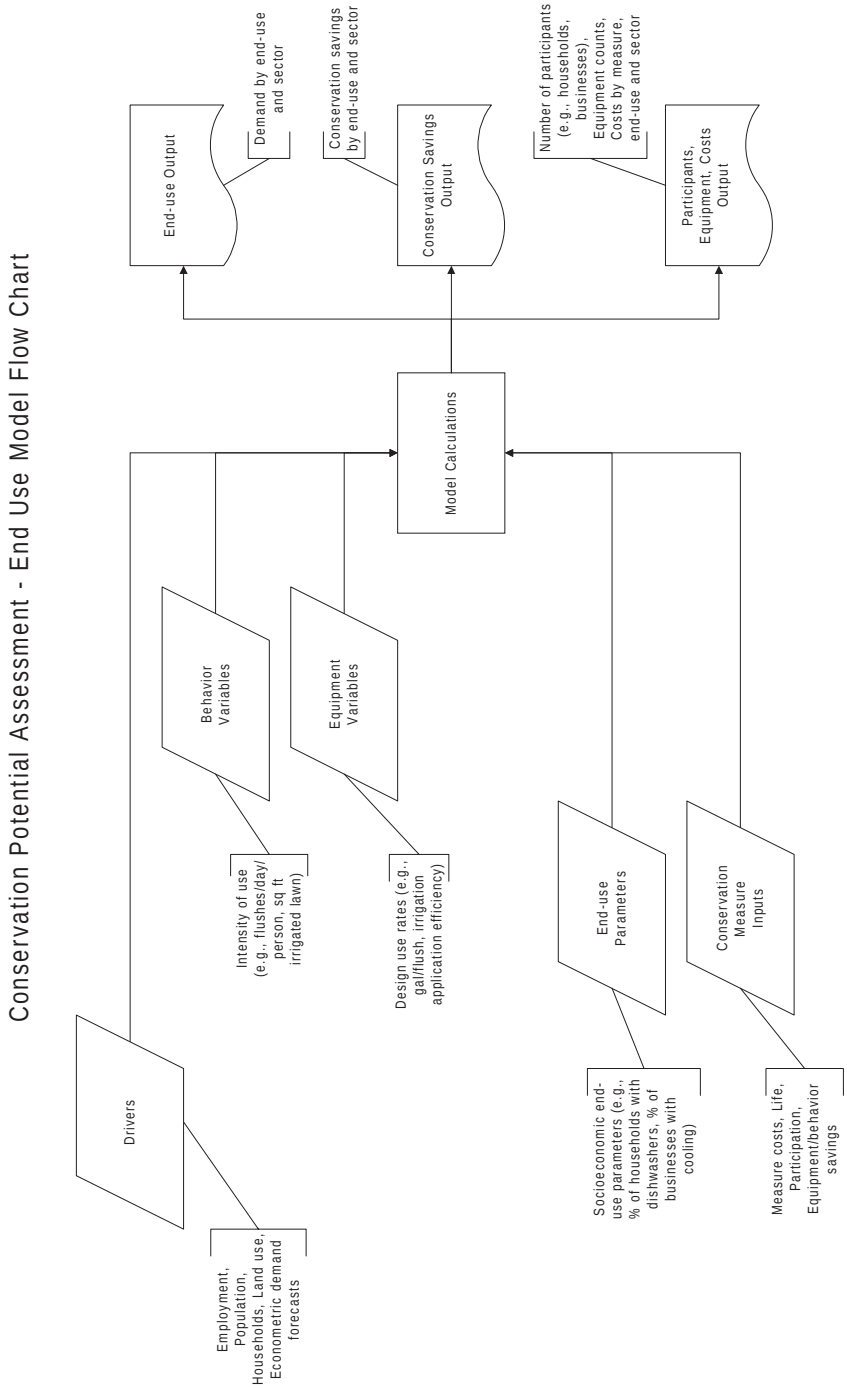
Commercial Domestic

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Dry Sidewalk Cleaning	39,050	1,787	$0.00	$10,375	$10,375	$3.42
Install Fill Cycle Diverters	34,864	2,029	$2,694	$11,780	$14,474	$5.02
Improve Hot Tub Use	19,807	195	$0.00	$1,132	$1,132	$0.74
Improve Swimming Pool Use	106,851	122	$0.00	$708	$708	$0.09
Install Redesigned Toilet Flappers	22,451	3,471	$6,960	$20,152	$27,112	$14.23
Reduce Faucet "Run Until Hot" Use	24,415	4,598	$344,877	$26,695	$371,572	$135.80
Install 1.0 Gallons Per Flush Urinals	408,177	7,348	$20,769	$42,661	$63,430	$1.78
Install 1.6 Gallons Per Flush Toilets	1,346,648	8,164	$134,197	$47,399	$181,596	$1.31
Install Waterless Urinals	330,088	4,686	$46,861	$27,206	$74,067	$2.36
Stormwater F/Toilet & Urinal Flushes	177,069	60	$300,000	$348	$300,348	$14.63
Switch To Low Flow Car Wash Equip.	7,014	128	$4,858	$743	$5,601	$9.43
Combined Comm'l Domestic	**2,516,433**		**$861,216**	**$189,200**	**$1,050,416**	**$3.93**

Commercial Process

Measure Name	Gal/day Peak Seas	Participating Accounts	Annual Equip Cost	Annual Admin Cost	Annual Meas Cost	Levelized Cost ($/ccf peak)
Comprehensive Leak Reduction	212,447	500	$62,500	$2,917	$65,417	$3.52
Elim. Single-Pass Decor. Water Feat.	21,384	4	$144	$23	$167	$0.07
Improve Disposal Usage	113,904	9,791	$68,636	$57,113	$125,749	$13.31
Improve Perf. For Steam Boilers	155,206	816	$50,996	$4,760	$55,756	$4.13
Improve Control of Process Water	941,749	580	$181,250	$3,383	$184,633	$2.23
Improve Food Prep. and Washing	211,449	9,791	$61,191	$57,113	$118,304	$6.77
Improve Dishwasher Efficiency	240,240	2,448	$348,180	$14,280	$362,460	$17.01
Improve Perf. of Cooling Towers	1,150,453	1,712	$124,120	$9,986	$134,106	$1.00
Recycle Laundry Washwater	390,051	176	$89,980	$1,027	$91,007	$1.93
Recycle Process Water	1,883,498	580	$725,000	$3,383	$728,383	$3.19
Improve Recycle Water for Vehicle Washes	2,327	38	$3,800	$222	$4,022	$14.67
Recycle Water for Retail Car Washes	5,882	10	$16,210	$58	$16,268	$22.82
Recycled Wastewater For Proc.	1,532,685	50	$1,250,000	$292	$1,250,292	$6.28
Switch to Air Cooling	4,297,593	5,515	$817,531	$32,170	$849,701	$2.26
Install Recirculating Cooling System	126,057	336	$26,794	$1,960	$28,754	$2.62
Water Efficient Clothes Washers	289,228	88	$82,500	$513	$83,013	$1.65
Combined Commercial Proc.	**11,574,154**		**$3,908,832**	**$189,200**	**$4,098,032**	**$3.35**
Combined Program	**42,705,415**		**$17,251,806**	**$1,720,000**	**$18,971,806**	**$3.86**

APPENDIX 3: CONSERVATION POTENTIAL ASSESSMENT MODEL STRUCTURE



The model calculates peak and annual average water use and conservation savings for Seattle and purveyor regions, for the years 1990 - 2020, for two residential and five non-residential customer sectors, and for 71 different water end uses.

APPENDIX 4: EXPERT PANEL REPORT

Seattle Public Utilities' Water Conservation Potential Assessment

December 1997

Introduction

Seattle Public Utilities has undertaken a research and analysis effort over the course of the last eighteen months building a water Conservation Potential Assessment (CPA) model and database. The CPA created a database and computer end-use model of more than 50 conservation practices; the model is used for ongoing analysis of conservation options for meeting future water supply needs. Consistent with regional water demand projections, the CPA provides the savings and costs of a comprehensive list of water conservation options.

This review panel was brought together by the Seattle Public Utilities to conduct a critical review of its water Conservation Potential Assessment (CPA) project. The panel is composed of five water supply and conservation experts from across the country. The panel was charged with reviewing and commenting on the quality, validity, and reliability of the project methodology, data sources, assumptions, and results of the CPA.

This review panel report contains only general comments, findings and recommendations. Specific comments are contained in the individual written comments appended to this panel report. The panel report is organized into the following sections:

- Overall Impressions
- Greatest Weakness of the CPA
- Greatest Strength of the CPA
- Findings
- Recommendations
- Biographies of expert panel members conclude this report.

Overall Impressions

In general, the review panel was impressed with both the quantity and quality of work performed under the Water Conservation Potential Assessment.

Specific comments made by panel members include:

"Overall we feel that the draft WCPA report represents an important stride forward on the part of the Seattle Public Utilities when compared to many other water utilities. Clearly a lot of good work has gone into this effort."

"I was impressed by the detail presented, and the comprehensive data collection and study that was conducted.... As a water resource planner, I would have great confidence in adopting the CPA and using it as the blue print for how water savings can be achieved at a desired level over the course of the next 20 years."

"This clearly represents a lot of analytic work. Too few water utilities treat conservation with this level of seriousness.... As good work should, the CPA will raise questions, generate controversy, and point to areas where more needs to be known. I expect that an important accomplishment of this work will be to help elevate conservation as a real and serious water resource alternative."

"This is first class, cutting edge water resource planning. …All in all, an impressive undertaking."

Greatest Weakness

A plurality of the panel believed that the existing documentation was the biggest weakness. Specific comments include:

"Regarding presentation, the draft summary report generally gives an understandable overview of the approach used. However, as one looks over the additional materials sent, in an effort to understand exactly how some results were generated, things are quite a bit harder to follow. We hope that the "Detailed CPA Model & Data Assumptions" report listed as an "available document" will be very explicit."

"Existing documentation does not provide enough handles for diverse potential audiences. The summary report, as it stands, is not accessible enough for a general audience, while insufficiently detailed for a technical audience."

"…[The report needs] to more clearly define purpose and use, and the methods and standards used to rank alternatives. Since this report seems more clearly designed as a policy-level, rather than analytical, tool, it seems to take a giant leap in terms of the readers ability to extrapolate a purpose and application for the results."

"[T]his report may satisfy supporters, but will not convince skeptics in its present form."

"There is a wealth of information in these documents, and it its present format it is hard to access…. Considerable staff effort should be spent in reducing this information down to the basics so that decision makers can make informed decisions without spending hours reading through the document"

Additional concerns, noted by the panel, include:

Identification of other benefits and cost-sharing: The current work does not go far enough in identifying the non-water-savings benefits associated with each measure. "…[These] additional costs and benefits are important because they indicate the potential for cost-sharing…the report should clearly point out that partnerships, private entrepreneurial efforts building on SPU's programs, and so on could reduce the costs to SPU of achieving full technical potential."

Calibration to econometric projections: There was concern that the calibration of end use model parameters to match econometric projections has resulted in out-year end use parameters that appear counter-intuitive.

Measures are assumed to be perfectly scalable: "My central criticism is that each project is presented as a single option with a single cost, when in fact multiple levels of implementation are available at widely varying costs. This failure to incorporate the impact of the 'level of intensity' on

project evaluation and ranking, can lead to inefficient and inappropriate investments in some cases, while neglecting cost-effective options in others."

Greatest Strength

A plurality of the panel believed that the analytic framework of the conservation potential assessment was the greatest strength. Specific comments include:

"One of the greatest strengths of the WCPA is that it has established a framework for looking at demand-side management options in great detail. The framework seems to be well suited to adding additional measures and changing assumptions as new information becomes available."

"Clearly the greatest strength of this analytic work is the systematic approach developed for empirically assessing both the quantity of water obtainable from conservation and its cost. The locus of these points constitutes, using economic nomenclature, a conservation supply curve; This cost and yield relationship, in turn, constitutes the tradeoff information needed for decision making in water resource planning. The model developed by the CPA, in my professional opinion, will provide an enduring structure for assessment of conservation's potential."

"I remain impressed by the level of detail, amount of material presented, and the evident about of analytical work performed by staff to develop the CPA…. I was impressed that there was emphasis on ensuring that measures were not double counted, and that the public involvement process consisting of input from the CPAAC and the TAG events assisted in ensuring that all potential measures were addressed."

Findings

Two of the panel reports mention no major qualifications to the immediate use of the CPA for planning purposes.

One panel report expressed concerns that the CPA may insufficiently reveal the uncertainty associated with the amount of water savings resulting from conservation. Consequently, this panel member does not have a high degree of confidence that the CPA can currently be used to validly assess and rank conservation as a resource alternative without closely integrating actual water supply constraints and opportunities.

One panel report expressed concern that more conservation measures should be examined, especially toilets, showerheads, and faucets that exceed current national plumbing efficiency standards. Due to omission of these and other measures, this report concludes that the CPA may underestimate the true conservation potential.

Recommendations

Executive Summary – The review panel uniformly felt that the single most important addition to this work would be a concise and crisp executive summary. A brief graphic presentation of no more than 15 minutes should also be developed to present this work.

Detailed CPA Model & Data Assumptions Report – The detailed report on the CPA model is needed and should be given priority. Several members of the review panel mentioned difficulty in assessing methods from the existing summary report.

Linking Measures to Alternatives – There were specific concerns and suggestions given in the individual comments for better explanation or organization of the individual conservation measures into collections of coherent alternatives.

Additional Measures – Some additional conservation measures and documentation were provided in the individual panel member comments for further research and possible inclusion.

Ongoing Review of End Use Parameters – There were several concerns expressed about the calibration of end-use parameters to match econometric projections. This "calibration" process has not been thoroughly discussed and subsequent work should make this process more explicit.

Biographies of Panel Members

Mr. Chesnutt is President of A & N Technical Services, Inc. He has developed a national reputation for his work in empirically measuring the water savings effects of water conservation programs, in explaining the use and practical import of empirical methods, in integrating conservation into a broader resource planning perspective, and in water demand and end-use modeling. He has published dozens of highly regarded reports and articles on water conservation and water management. Mr. Chesnutt holds a B.A. in Economics from Kenyon College, a M.S. in Technology and Science Policy from the Georgia Institute of Technology, and a Ph.D. in Policy Analysis from the RAND Graduate School.

Mr. Cebron is Vice President of Financial Consulting Solutions Group, Inc., a consulting firm specializing in comprehensive plan preparation for water utilities, with particular experience in the Puget Sound and Seattle area. Mr. Cebron has over eighteen years experience addressing economic and financial issues for municipal utilities. He has analyzed water conservation rates and incentives structures for dozens of cities and utilities throughout the Pacific Northwest. Mr. Cebron holds a B.S. in Engineering Sciences from Harvard University and a M.S. in Infrastructure Planning and Management from Stanford University.

Mr. Scott Chaplin and Mr. Richard Pinkham are Senior Research Associates with the Rocky Mountain Institute (RMI), a non-profit research foundation dedicated to fostering the efficient use of resources. Mr. Chaplin and Mr. Pinkham have reviewed and participated in integrated resource planning for many water agencies in North America. RMI is known for "pushing the envelope" in its approach to resource management and has published numerous scholarly research papers on water conservation and demand management. Mr. Chaplin holds a B.G.S. in Technology and Development from the University of Michigan; Mr. Pinkham holds a B.A. in Geography from Dartmouth College, and an M.S. in Natural Resources Policy from Cornell University.

Ms. Marsi A. Steirer heads the CIP Program Management for the City of San Diego's Water Department. In the conservation world, she was known as the architect and manager of San Diego's first comprehensive water conservation plan—an ambitious program with an annual budget of $2.8 million, consultant contracts of $5.4 million, and a conservation staff of 28 employees. This conservation program is an integral part of San Diego's water supply resource portfolio. Ms. Steirer holds a B.A. in Political Science from the University of California, Riverside, and an M.A. in International Development from the American University, Washington, D.C.

Comments from Individual Panel Members

Marsi A. Steirer
Review of Seattle Public Utilities
Water Conservation Potential Assessment
December 29, 1997

General Comments

Overall Impression: The report is a comprehensive assessment of conservation measures that could be adopted and implemented by the Seattle Public Utilities (SPU) to reduce overall water consumption for the planning period of 2000 - 2020. I was impressed by the detail presented, and the comprehensive data collection and study that was conducted. The staff preparing the study was astute to perform a three step process that included developing the model, conducting the technical research, and involving the public in the process.

For a utility the size of Seattle, having a current econometric demand model is essential. Many water agencies effectively use these models to predict demand in order to accurately size their water system facilities. Using the model as an important component of the Water Conservation Potential Assessment is a key element to accurately determining future water needs. The SPU staff took this one step farther by merging the demand forecast model with an end-use model to determine water usage by use-type to ultimately calculate the water savings of each potential conservation measure. They combined this with four conservation measure packages that reduced water demand by varying amounts ranging from the maximum achievable without affecting customer satisfaction or service delivery to a package providing the lowest level of conservation measures.

Greatest Strengths: Due to the scope and comprehensive nature of this study, I read through the materials several times before I began to organize my comments. I remain impressed by the level of detail, amount of material presented, and the evident amount of analytical work performed by staff to develop the CPA. I have been through a similar exercise twice: once in 1990, when the City of San Diego sought to develop a water conservation road map which could be implemented over the course of 5-10 years. This effort included an evaluation of all available measures, plus the involvement of a citizen's advisory committee. The second effort undertaken by the City of San Diego in 1996, was associated with a strategic planning effort to determine the preferred levels of local water resource development (conservation, reclamation, ground water, repurification) to reduce the deficit between projected demand in 2015 and available water supply. The adopted conservation component in this effort is to increase water savings by 5% above the present amount conserved - approximately 13,000 acre-feet of water by 2005. The measures we proposed and the level of analysis conducted pales in comparison to the effort undertaken by SPU. As a water resource planner, I would have great confidence in adopting the CPA, and using it as the blue print for how water savings can be achieved at a desired level over the course of the next 20 years.

Largest weaknesses: Having worked successfully with politicians, policy makers, and citizen representatives on developing a sound water resource strategy, the most obvious weakness of this

report is that is takes many hours to read, followed by reviewing key portions a second or third time in order to fully comprehend the impact of the measures/objectives of the section, and then add on additional time to fully digest. Key SPU decision makers probably won't take the same amount of time that members of the expert panel spent reading and reviewing this comprehensive document. Therefore, the greatest strength of this document is also its greatest weakness. The CPA is packed with excruciating detail on the process, conservation measures, the four potential packages, a lengthy bibliography, and detailed spread sheets and charts.

Considerable staff effort should be spent in reducing this information down to the basics so that the decision makers can make informed decisions without spending hours reading through the document. Selected graphs, such as baseline water demand and conservation package impacts, could be used to depict salient points. It is apparent that SPU staff spent a considerable amount of time and effort developing the CPA. The CPA will serve as the resource document for the utility. However, when this information is presented to decision makers, the press, the CPAAC, and other concerned and/or interested customers, the presentation should be easy to understand, colorful, and use graphics to illustrate key points/concepts. SPU's public information staff or consultants should be involved in this phase of the CPA. I would suggest an executive summary of the document - perhaps a stand alone document of 5 to 6 pages in length. When making presentations to the decision makers, a PowerPoint computer presentation of no more than 15 minutes in length would be the most appropriate way to present this document.

Missed sources, errors of omission and conceptual holes: I found the CPA to be a comprehensive and complete document. I was impressed that there was emphasis on ensuring that measures were not double counted, and that the public involvement process consisting of input from the CPAAC and the TAG events assisted in ensuring that all potential measures were addressed.

Reliability and validity of results: The CPA draft summary report and its attachments & appendices appear to be reliable and valid given the presentation of the facts and the research undertaken to obtain the data.

Comments on Specific Sections

Methods: The project approach and the data sources used are a blend of an established or traditional method using a demand forecast model with a more contemporary end-use data model. This is an innovative combination of these two models which has provided Seattle with the opportunity of producing not only an accurate demand forecast for 20 years hence, but also the ability to customize their water conservation response by customer class. The ability to accurately estimate the demands for specific users and how to mitigate the demand growth over the course of 20 years by implementing certain conservation measures is a powerful water resource tool, and one that will be emulated by other water agencies. This is first class, cutting edge water resource planning.

2

Comments from Individual Panel Members

Findings: The specific conservation measures listed appear to be a comprehensive list of options available to the SPU and its customers. I liked the program package approach as it provides a range of options for decision makers to evaluate and consider what conservation measures to adopt depending upon the objective(s) they wish to achieve. There is a significant difference in the amount of water savings and costs associated with adopting the four distinct packages. This "Chinese Menu" approach is innovative, and presents the policy makers with various options that can coincide with their given objectives.

Model: The model, materials presented, and summary report are strong in detail and appear to be well researched. As a water utility representative, the assumptions made are the same ones that I would expect staff to make when developing a plan to serve a large and growing service area for a 20 year planning period. The structure of the report, assuming that it will be printed and widely distributed to citizens, the media, and various community groups, should be revised to be more reader friendly and incorporate graphics to display the points that the report is attempting to get across. There is a wealth of information in these documents, and in its present format it is hard to access. All in all, an impressive undertaking.

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FCS Group Memorandum — December 12, 1997

To: Thomas Chestnutt, President
A&N Technical Services, Inc.

From: Ed Cebron

Re: Review of Seattle Conservation Potential Assessment (CPA)

The following comments are necessarily brief given the limited time (schedule, not scope) for reviewing the CPA document. As a bit of background, I am approaching this as a former commissioner at a district served (wholesale) by Seattle, as well as from the financial/economic perspective as a consultant. Therefore, I am looking not only at the analytical approach, but also (and perhaps especially) the characterization of results and their meaning.

My review to date has been somewhat superficial. The points below are therefore more questions for follow-up, rather than critique. I simply haven't had sufficient time to be more complete in my response. I intend to spend more time with this now through Tuesday, and will follow-up with revisions, additions, or fleshing out of this initial list at that time.

As an administrative detail, I will be out of the office Monday but generally around the remainder of the week. I am unavailable 12/22 and 12/23, could be available 12/24, and spotty the remainder of the year depending on need.

1) Administrative Costs - The report (pp 9-10) indicates that administrative costs are allocated to specific measures as a part of their cost. It is not clear, however, whether some portion of the administrative cost is unrelated to any measures actually occurring. For example, a minimum level of effort related to shortage response or mandatory planning might be better viewed as sunk costs and excluded from the allocation.
2) Prioritizing Projects and Marginalizing Results - The ranking of projects in Table 5 appears to ignore the Implementation Intensity Levels cited in Table 2. Alternatively, there is some common assumed level of intensity (technical potential?) for all projects. However, this seems to miss a central point of this exercise, namely: How do we determine the appropriate level of support for a given measure? As examples, a measure with a cost of $10 per ccf as technical potential may prove to be $1 per ccf at intensity level 1 (e.g. encouragement) and have a marginal cost of $100 per ccf to move from level 1 to level 2. I would have expected that, for each project, four costs would be determined, so that

marginal cost and benefit could be determined for each decision point, and a priority established based on both the measure and the intensity of implementation. As a final aside, any declines in marginal cost could be dealt with through merging of steps, so that proceeding from level 2 to 3 would not be ranked above implementing level 2.

3) Useful Lives - I am assuming, and have no reason not to believe, that the useful life of the measure is being considered in the levelized cost analysis. However, it is unclear to me how measures with 5 and 10 year lives are being equated to 2020 savings. Is there an assumption of several life-cycles in these measures? Is it assumed that such projects would not be implemented until such date that would provide 2020 savings? Also, in measures such as toilet retrofit, how are yields/savings degraded over time, given that plumbing code requirements would force these changes through replacements?

4) Utility of Measures - While the cost comparisons provide a basis for cost comparison, the report does not deal with implementation. Therefore, it can, by itself, provide misleading indicators about cost-effectiveness. For example, the utility has a forecasted supply surplus extending 15 years into the future. Therefore, implementation of a 10 year measure now has no utility as a long-term water source, and only the limited utility of increasing reliability above acceptable standards during its useful life. While this undoubtedly has value, it is clearly not at a level consistent with the marginal cost of new supplies, or the reliability standard would have been set higher.

5) Salvage Value as a Detriment to Conservation - The limited useful lives of the conservation measures, and the uncertainty of replacements, raise the issue of salvage value, especially when compared to permanent water rights and longer-lived water supply assets. Do these conservation assets continue in perpetuity? If so, through multiple life-cycles, is this appropriately considered in the present worth analysis? Is the certainty of the conservation resource greater or less than a supply source, and how does this affect what must ultimately become a comparison of resource options?

6) Measures of Yield - I have had a number of years of experience with Seattle's approach to describing yield, and confess to ongoing uneasiness with it. The annualized yield in ccf or mgd seems to ignore the issue of ability to mitigate supply constraints. It is encouraging to see Table 5 acknowledge peak season yield as a relevant variable, but the levelized cost is not based on this variable. Conservation may be unique in the opportunities it presents for peaking resources, such as through diversion of irrigation or cooling loads. If the yield of such a seasonal resource is annualized, the value may be grossly understated. Similarly, uniform year-round conservation resources would be less valuable than comparably rated supply sources which might provide heightened peak yields, such as recharge or conjunctive uses.

As I indicated, these are just ramblings at this point and not nearly as focused as I would like. I will follow-up after I have followed these thoughts through a review of the document and cover letter.

As a general criticism, I found the cover letter to be extremely dense, while the report was correspondingly sparse. It would be my observation that this report may satisfy supporters, but will not convince skeptics in its present form. I would provide more bridge language to explain process and methodology, and to interpret results vis a vis the resource planning forum. Then again, maybe this is just the engineer in me calling out "apply, apply".

I look forward to our review of this report and can't wait to see others' comments on it.

Re: Seattle Conservation Potential Assessment

Subject: **Re: Seattle Conservation Potential Assessment**
Date: Tue, 16 Dec 1997 15:35:57 -0800
From: "Thomas W. Chesnutt" <tom@antechserv.com>
Organization: A & N Technical Services
To: Edward Cebron <EdC@fcsgroup.com>

Edward Cebron wrote:

As a follow-up to my hastily drafted memo, I have reviewed the report and my comments. In general, the points made remain valid as either questions or comments. I continue to see no linkage of intensity levels to anything else in the report, including Appendix 1. Given that and the other points I raised, the end product does not satisfy me as to its ability to rank projects or compare them to other water resource options.

I also believe that the closing comment would, if anything, be expanded in terms of the need to more clearly define purpose and use, and the methods and standards used to rank alternatives. Since this report seems more clearly designed as a policy-level, rather than analytical, tool, it seems to take a giant leap in terms of the readers ability to extrapolate a purpose and application for the results.

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A&N Technical Services, Inc.

Review of Seattle Public Utilities'

Water Conservation Potential Assessment

Thomas W Chesnutt, Ph.D.
December 15, 1997

General Comments

Overall Impression

This clearly represents a lot of analytic work. Too few water utilities treat conservation with this level of seriousness. Whatever the origin of SPU's Water Conservation Potential Assessment, it is to be commended. As good work should, the CPA will raise questions, generate controversy, and point to areas where more needs to be known. I expect that an important accomplishment of this work will be to help elevate conservation as a real and serious water resource alternative.

Greatest Strength

Clearly the greatest strength of this analytic work is the systematic approach developed for empirically assessing both the quantity of water obtainable from conservation and its cost. The locus of these points constitutes, using economic nomenclature, a conservation Supply curve; this cost and yield relationship, in turn, constitutes the tradeoff information needed for decision making in water resource planning. The model developed by the CPA, in my professional opinion, will provide an enduring structure for assessment of conservation's potential. As knowledge of water end uses, participation potential, and program design improves, the model structure will be able to reflect the results of this learning. Since the reliable yield from conservation programs is an uncertain and oft disputed quantity, a flexible formal structure is required for treatment of conservation as a real resource alternative.

Greatest Weakness

The greatest weakness of the CPA is documentation. Existing documentation does not provide enough handles for diverse potential audiences. The summary report, as it stands, is not accessible enough for a general audience, while insufficiently detailed for a technical audience. I believe most decision-makers would not know what to make of the graphs and tables and would be forced to rely on such potentially spurious sources as this review panel.

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Holes

There are a few measures I would add and, no doubt, ones others would like to see added. This is an inevitable outcome. The report should identify this as a strength--the provision of a framework to make explicit the changing understanding of conservation potential.

The largest hole I see is a lack of discussion of how field impact evaluations (field measurements of changes in customer water consumption) have been used to "calibrate" the end use model parameters. End use assumptions are neither intrinsically good nor bad; they must, however be subject to validation. I am aware of some of the solid fieldwork performed by SPU; the reader should be better informed as to how this field measurement gets used to improve model parameters.

Reliability and Validity

Uncertainty and the Reliability of Estimated Potential Conservation
This is wonderful, a wonderful...start. I believe the report could benefit by two short paragraphs on the CPA as a framework for learning--as knowledge about conservation's potential improves, this can be reflected in the framework. Alternatively, the framework can be used to reflect the beliefs of differing stakeholders about conservation potential (if the potential penetration of waterless urinals were twice as great, the yield would double while the cost-effectiveness would be relatively constant. Other measures might demonstrate less/more scalability). While the existing measures give the appearance of complete independence, I do feel that this is a reasonable first step. First order effects are a prerequisite to quantifying second-order effects (second-order effects are generally defined relative to a first order effect). To the extent that interactive effects have been incorporated into collections of measures, this should be duly noted in the detailed report.

Specific Comments

Methods

The end-uses are "calibrated" to an econometric forecast. Thus conservation potential is necessarily dependent on projected demand. This is a fact and you ought to be proud of it. This fact should be made clear in the report and the concomitant (can we say this word in the water industry?) uncertainties addressed.
What is the level of confidence in

- income elasticity
- price elasticity and projected future rates?

Lest I be too obtuse, I am indeed suggesting that you mention these uncertainties and then drop the ball by saying it is not your job while pointing a finger at the econometric demand model.

Comments from Individual Panel Members

The other side of the equation presents a problem much known and little liked in the scientific community: over-parameterization. I believe you should spin the report a little more to stress that the end use model is a water use allocation model; this is a strength, uncertainty + many parameters generally equal unstable and nonrobust predictions. The day that knowledge of the end use parameters grows to the point where the end use model can out predict a long run water demand model is the day that you produce a new cover for the CPA and call it a demand model. Consistency of an end use model with a forecasting model is a desirable feature. The "calibration" of end-uses is an unenlightening and mostly mangled metaphor. (This reviewer will be the first to throw a wake upon its demise.)

Findings

Useful Life of a Measure and Binding Supply Constraints

Report could make some helpful insights about the effect of uncertainty by showing how demand uncertainty can change the arrival date of a binding supply constraint. I am struck at the small difference in slopes between supply (beta=zero) and demand (growth_rate is gradual). This implies that there is a higher payoff to assessing how quickly demand management can manage demand. This also admits of strategies for water resource planning.

- **Strategy 1:** Propose conservation funding be set as a function of distance from potentially binding supply constraint. (Deterministic world where distance from constraint is known.)

- **Strategy 2:** Value of information argument--spend more money up front for pilot programs and associated evaluation to gain the information needed to create and choose between conservation alternatives. (A gratuitous citation of Laffont and Tirole on information economics is probably called for here.)

Model

This reviewer will attempt no comprehensive critique of model connections until this reviewer can review the "Detailed CPA Model and Data Assumptions" report mentioned in the summary report (page 22). Stray thoughts include:

- Table 8: Levelized cost table Landscape appears expensive. How much is peaking the water system constraint and how much is average demand?

- Details- N.A.E.S. only contains single family households in its sample. Consequently the multiple family parameters came from small adjustments to the single family parameters. The CPA research team should be aware that, while valid as a beginning point, this can constitute a biasing anchoring effect. Evidence from impact evaluations support the hypothesis of different socioeconomic and behavioral in the multiple family sector. I predict multifamily parameters are more in need of updating than the single family parameters.

- t_o_summ.xls is not always readily interpretable. Consequently the measure assumptions of conservation yield sometimes appear as mathemagic (poof). Presumably this will be cured by the detailed report mentioned above.

Review of the Water Conservation Potential Assessment by Seattle Public Utilities

Scott Chaplin and Richard Pinkham
Rocky Mountain Institute

General Comments

Overall impression of report:

Overall we feel that the draft WCPA report represents a important stride forward on the part of Seattle Public Utilities when compared to many other water utilities in the United States. Clearly, a lot of good work has gone into this effort. The evaluation of various levels of conservation program effort is useful. At the 3rd and 4th levels, the programs are quite aggressive relative to most utilities, indicating a seriousness about evaluating conservation efforts beyond the norm.

That said, we have a few reservations about the modeling approach and some of the assumptions, particularly in the baseline forecasts, which are discussed below. Also, some conservation measures we consider reasonable are not included. We believe that some of the suggestions we have provided below might lead to the identification of several additional conservation opportunities that could save a significant amount of water without sacrificing fixture performance or customer satisfaction. We have tried to substantiate our comments as much as possible within the very limited time constraints of this review.

Regarding presentation, the draft summary report generally gives an understandable overview of the approach used. However, as one looks over the additional materials sent, in an effort to understand exactly how some results were generated, things are quite a bit harder to follow. We hope that the "Detailed CPA Model & Data Assumptions" report listed as an "available document" will be very explicit.

Greatest strengths:

One of the greatest strengths of the WCPA is that it has established a framework for looking at demand-side management options in great detail. The framework seems to be well suited to adding additional measures and changing assumptions as new information becomes available. We think that this framework can be used as an evolving tool to help SPU identify the most cost-effective options for providing water in the near future.

We were pleased to see the effort to define "technical potential" for each of the measures. Lower levels of effort imply this target as well, as they are "designed to achieve savings" of varying proportions of the technical potential. We believe it is very important for utilities to understand just how far they can go with conservation, before they cap their efforts at some arbitrary cost level or by comparison to some (often also arbitrary) supply project.

Largest weaknesses:

We believe the WCPA should look at the average costs of broader packages of demand-side measures, including additional options such as dual flush toilets, showerheads and faucets that deliver less than 2.5 gpm, and some greywater and reuse technologies (see the "Findings" section).

Another weakness is the failure to estimate the non-water-savings externalities of conservation measures. We fully realize the difficulties of making such estimates. However, additional costs and benefits are important because they indicate the potential for cost-sharing (with customers, electric utilities, environmental programs, etc.) of conservation programs. We believe the report should clearly point out that partnerships, private entrepreneurial efforts building on SPU's programs, and so on could reduce the costs to SPU of achieving full technical potential. That such savings are not included is an element of conservatism well worth mentioning. A table listing conservatisms in the report's approach and assumptions would be useful to many readers.

Also, regarding costs, the report shows a substantial jump in total costs when moving from level 3 to level 4. No doubt this reflects some concept of diminishing returns as savings increase. We're just not sure the jump would be quite so dramatic. It would be helpful to know more about the assumptions used in costing the levels of effort.[1]

Missed sources, errors of omission, and conceptual holes:

Due to the time constrains it was not possible to look into the suitability of the data sources used for the various aspects of the WCPA. Regarding omissions, the potential non-water benefits of various measures should be quantified and potential partners for cost sharing should be identified. Some conceptual holes are indicated in the "Methods" and "Model" sections.

Reliability and validity of results

We believe that most of the measures considered will deliver very reliable savings over the long term if properly implemented. For fixture replacement programs, old fixtures should be collected, destroyed and then recycled. It was difficult to make many judgments regarding the validity of the results given the limited time available, but see the comments in the "Methods" below.

[1]A thought here, one that will probably be out of SPU's comfort zone for this report but is worth considering in future efforts. That marginal costs increase as high levels of savings are approached is considered by most analysts an economic law. It is not. RMI's work in the building energy sector clearly shows that large savings can be cheaper than small ones. Put together enough energy conservation measures and you can downsize or drop out the central HVAC system, reducing total costs below the costs of less ambitious energy conservation packages, and even below the costs of conventional comfort systems without energy conservation measures at all. This phenomenon that we call "tunneling through the cost barrier" does not occur as often in water systems, but it can, particularly in commercial or industrial facilities.

Comments on Specific Sections

Methods - Project approach and data sources

We have some reservations about the extent to which the econometric model of future water demand determines what's going on inside the end-use model (the later model was calibrated to match the totals produced by the former). According to SPU staff, the necessary adjustments to the end-use model were distributed somewhat equally across the many variables in the end-use model, with some adjustments based on professional judgment. This is a reasonable adjustment approach, but some of the resulting parameter values in the baseline forecast seem odd.

First, we are puzzled that the baseline forecast shows residential shower gpm going from 2.5 in 1990 to 2.1 in 2010 and 2.0 in 2020, and faucet gpm changing from 2.3 to 2.0 to 1.9. This seems inconsistent with the conservation measures proposed for these fixtures, which only propose moving beyond the baseline by retrofitting these fixtures to 2.5 gpm by 2010.

Second, the changes in many of the average use rates are a bit troubling. Except for irrigation, all use rates are shown to be increasing, some significantly. While the increasing affluence projected by the econometric model could increase water use, it is not clear to us that this will be uniformly the case. For instance, why should toilet flushes per capita per day increase so dramatically (almost 30%)? Double-flushing of an increasing number of ULFTs could justify some of this increase, but results from the AWWARF residential end use study we have seen so far do not indicate that flushes per capita per day increase at the rate used in the SPU end use model. Conceivably an aging population could justify the increase in flushes (more gastro-intestinal problems), but the age profile of the population does not appear to have been considering in the models. In the case of more minutes of shower and faucet use per person per day, increasing affluence could justify the changes shown, but increasing age might decrease use of these fixtures (fewer multiple shower days, concern over water drying of skin, etc.). Clearly there are many possible arguments for increasing or decreasing water use rates. But in general, uniformly increasing water use is hard for us to accept, especially given increasing environmental consciousness and an aging population.

The point of this discussion is to raise a hopefully constructive level of concern about the likely accuracy of the baseline water demand forecast. The baseline affects the savings achieved by conservation measures, and thereby the water use totals for the various conservation packages, and ultimately the choices SPU may make regarding conservation and supply projects. While calibrating the out-year end use model results to the econometric model results is a reasonable approach, it may not be the most accurate approach. A bolder approach would have been to calibrate the end-use model for current water use totals, make judgments on future use rates and other parameters independently of a gross forecast, and then aggregate the "bottom-up" calculations of end-use reveal to project total water use. As SPU refines the WCPA in future iterations, we recommend careful attention be given to justifying the adjustments to end use parameters made to calibrate that model to the econometric model results, with an eye toward identifying discrepancies that could indicate flaws in the gross water demand forecasts.

On another point, the levelized costs as they are now put forth do not accurately portray the true social net costs if one includes the savings due to energy use reduction, maintenance savings, etc. For example, the levelized cost of the measure "Retrofit to Weather Based Irrigation Controllers," appears relatively high ($2+/ccf) compared to toilet retrofits (less

than $1), but the net economic picture may be much different. A new toilet may take 10 years to pay for itself from the savings, but many landscaping improvements have much faster paybacks when one considers the non-water savings. The City of Aurora, for example, installed a computer-controlled irrigation system for its 43 city-owned sites in 1988 at a cost of approximately $500,000 but saved nearly $100,000 annually on water and maintenance costs. For most hot water applications, the economic incentive for saving water is almost entirely energy related. Paybacks to users for showerhead and faucet retrofits are usually less than 1 year, yet the WCPA costs for those measures are much higher than for toilet retrofits, which have much longer consumer payback periods. Perhaps the WCPA should look at the levelized cost of measures both with and without some deduction of the cost savings due to non-water benefits. This is important because more accurate indications of true net social costs will identify opportunities for program cost sharing with other beneficiaries.

Findings - Specific conservation measures and program packages

1. We believe that the WCPA should include several additional fixture retrofits options for both the residential and commercial sector. These options are elaborated on below:

a) Showerheads that deliver less than 2.5 gpm should be considered.

As part of the Federal Procurement Challenge the Department of Energy's Federal Energy Management Program (FEMP) recommends 2.2 gpm showerheads and also lists 1.5 gpm showerheads as the "best available" technology (see attachment). FEMP estimates that replacing a conventional showerhead (4 gpm) with a 2.2 gpm model will save $50-100 per year. They also estimated that a homeowner replacing the new standard for showerheads (2.5 gpm) with 2.2 gpm showerheads would save $5 - $15 per year (about a 1-2 year payback @ about $13 showerhead), and that replacing the 2.5 gpm showerhead with a 1.5 gpm showerhead would save $15 - $50 per year (less than 1 year payback).

Experience in the industry has shown that the new 1.5 showerheads are accepted by the public. Some commercial interests are switching their recently installed 2.5 gpm showerheads for 1.5 gpm models based on the rapid payback. The 1.5 gpm Universal Spa showerhead made by Energy Technology Laboratories has been installed at the MGM Grand, Ballys Resort, and dozens of other major hotels around the world (see attachment).

We have provided 4 suggestions for additional measure description forms that contain our best guesses for the participation rate, use reductions, costs, etc. (suggestive figures based on our judgments and the values for the less ambitious measures in the WCPA). Note that we guessed a lower participation rate for the 1.5 gpm models. We urge SPU to include these options in the WCPA after running the savings calculations on the WCPA model.

b) Faucets that deliver less than 2.5 gpm should be considered.

Along similar lines as the showerheads, FEMP has also recommended the installation of 2.0 gpm faucets rather than the national standard of 2.5 (which FEMP doesn't even mention) used in the WCPA . Many commercial faucets for public restrooms are only available with flows less than 2.0 gpm. FEMP estimates that 2.0 gpm faucets will save at least $1-4 per year compared to 2.2 gpm faucets, and that 1.5 gpm faucets will save at least $4 - $16 when compared to 2.2 gpm faucets. SPU may see greater savings using the assumptions in the WCPA. Many hotels are now installing 1.5 to 2.0 gpm faucets.

The savings potential in this area can be even greater for non-kitchen sinks. Faucets are available in many different flow rates (2.5, 2.2, 2.0, 1.75, 1.5, 1.0, 0.5, and 0.25). For

most bathrooms, 0.5 gallons per minute is very sufficient with a properly designed spray head (a reduced flow with faster, more spread out streams of water seems to clean toothbrushes are razors faster). Although the public acceptance may not be as high for these faucets, we believe that there is a certain segment of the population that would be very happy with them.

We have included four Measurement Description Forms with suggestions for faucet retrofits for both the residential and commercial sectors. We urge SPU to include these options in the WCPA after running the savings calculations.

An alternate way to calculate potential savings from faucet retrofits would be to assign a certain percentage acceptance ("participation") within each sector. A hypothetical break down is below:

Hypothetical Percentage of Use of Faucets of Different Flow Rates by 2020

	2.5 gpm	2.0 gpm	1.5 gpm	0.5 gpm
Commercial	30%	30%	30%	10%
Residential	40%	30%	20%	10%

Note on terminology: We suggest that SPU replace the term "faucet aerators" with "faucets" or "faucet heads" because not all 2.5 gpm or less faucets are the aerating type. An innovative faucet developed by Omni delivers either 2.5, 2.0, or 1.0 gallons per minute using a non-aerating "laminar flow" technology rather than an aerating one. When the stream of water hits something it spreads out evenly in all directions on the object's surface, resulting in less splash and faster wetting. We have had one installed in the kitchen at RMI for several years.

c) <u>The eventual marketing of dual flush toilets should be considered.</u>

For over a decade Australia has had a toilet on the market that is approximately 40% more efficient than the current U.S. standard of 1.6 gallons per flush. They have accomplished this using basically the same technology, but adding a "dual flush" option that delivers 6 liters for a full flush and 3 liters for a partial flush. This dual flush toilet is now the national standard in Australia. They estimate that these toilets use an average of 3.8 liters per flush. A study conducted at the University of New South Wales estimated that total water use for toilet flushing throughout Australia would continuously drop between the years of 1990 and 2020 despite increasing population due to the introduction of this new toilet (a 60% decline that flattens out by 2020). The standard since the turn of the century, prior to the introduction of the "6/3," was the 11 liter (2.9) gallon per flush toilet. Therefore, we can probably expect at a minimum similar savings in the United States once this toilet is introduced and promoted.

Kohler has had similar toilets on the U.S. market, including the Kohler Lite line and the Trocadero Power Lite toilets which offer users the choice of 1.0 gallons per flush or 1.6 gallons per flush. Some of their toilets have been taken off the market, we believe, due to a lack of consumer interest or lack of promotion by utilities. Nevertheless, as concern regarding the efficiency use of water grows, we believe that we will see an increase in the use of these toilets.

We have included two Measurement Description Forms with suggestions for dual flush toilet retrofits for both the residential and commercial sectors. We urge SPU to include these options in the WCPA.

d) Reuse of water should be considered to a greater extent.

Reclamation of wastewater for use in large landscapes and for agricultural irrigation is a well proven technique for conserving water. Los Angeles has been distributing reclaimed wastewater for nearly a decade for cooling towers, ground water recharge, livestock, recreational impoundments, industrial processes, and irrigating golf courses and other large landscapes. The effluent is treated to tertiary standards and sold for 45-85% of the retail rate for potable water. By the early 1990's Los Angeles was supplying an annual average of 63 million gallons per day of reclaimed water to local customers. The city of Yelm in Washington State was proposing to do such reuse last year (see the article from Confluence, Winter 1996/1997, in the attachments). We're not sure of the status of their efforts at the moment. Reuse technologies may prove to be one of the most effective methods of addressing Seattle's particular water supply problems—low reservoirs and shortages in the late summer and fall. We strongly urge SPU to include reuse in the Conservation Potential Assessment.

e) Greywater and subsurface irrigation should be considered for some portion of the existing residential sector, not just new construction; and should be considered an option for some commercial customers as well.

Subsurface irrigation has proven to be one of the most efficient methods of irrigation for many applications (given proper timing, duration, etc.). In addition to saving water, less water on the surface leads to lower pest and weed problems and no loss of playing time on golf courses and other playing fields. With the proper precautions, greywater can work well in such systems, and can even add nutrients to the soil.

f) Advanced customer leak detection technologies should be considered.

Technologies to monitor for leaks within a house or other building are becoming available. Using these devices, which may be installed and monitored by a variety of service providers, customers or plumbers can be notified immediately as leaks develop. Implementation of this measure may be speeded by insurance companies (a potential cost share partner), which are reportedly showing a keen interest in the savings associated with rapid notification of catastrophic leaks when buildings are unoccupied.

g) Others

A few other measures that come to mind, mentioned here without elaboration due to time constraints, include use of rainwater and greywater for some commercial purposes, swimming pool covers, remote weather-based control of residential landscape irrigation systems, composting toilets in appropriate public facilities (there are already many in highway rest areas across the country, and thousands in military facilities).

2. We believe that the four packages outlined in the WCPA fall short of identifying the true potential for conservation in the Seattle area due to the lack of inclusion of some of the options we have listed above.

Just as one wouldn't judge the cost of a new reservoir by the cost of delivering the first few thousand ccf alone, one shouldn't judge the cost of conservation based on the cost of any particular measure, or narrowly defined group, in isolation. Certain measures, such as

reclamation, greywater, etc. may always appear to be too expensive if viewed in narrow terms, but when their costs are averaged in with the costs of other efficiency options, it is possible that the average cost off all the efficiency options is still lower than the cost of the cheapest supply alternative that could "deliver" the same amount of water. In short, it is important to take a "systems view" of water efficiency.

Model - Structure and assumptions

We believe that the there should be some consideration of the average age of population in the water demand forecast. While the water use projections used in the WCPA take into account an overall increase in population, they fail to look at the change in the demographic age profile that will accompany that increase. In most parts of the US the average age of the population is increasing as the baby boomers age. The elderly segment of the population generally uses less water than families with children or active young people. Retiring baby boomers will be taking fewer showers (no more before work and after the gym showers) and will be more concerned about utility bills (due to fixed incomes for most) and drying skin.

See also the comments under "Methods," above.

Miscellaneous Editorial Items

Include an Executive Summary.

Notify the reader that the water use figures in Table 1 of the Summary Report are the baseline projections.

Page 6 of Draft Summary Report, line 1: replace "seven customer classes" with the more specific language of "2 residential and 5 non-residential customer classes."

Page 7, line 2: "to a high volume toilet" should be "from a high volume toilet."

Page 13, line 2 of the "RESULTS" says 3.6 mgd is the annual average savings, but the figures in Appendix 2 show this as the peak savings.

On the Measurement Description Form for Commercial Domestic Retrofits to **2.5** gpm Faucets, the measure description says "Install **2.0** gpm faucet aerators..." The same mistake is found on the Measurement Description Forms for commercial domestic showerhead retrofits.

RMI Authors

In all references to the Conservation Expert Review Panel, please show Rocky Mountain Institute's participants as Scott Chaplin and Richard Pinkham, not Richard Pinkham alone. We are both Senior Research Associates.

For the "biography," we suggest:

> Mr. Chaplin and Mr. Pinkham are Senior Research Associates with the Rocky Mountain Institute (RMI), a non-profit research foundation dedicated to fostering the efficient use of resources. Mr. Chaplin and Mr. Pinkham have reviewed and participated in integrated resource planning for many water agencies in North America. RMI is known for "pushing the envelope" in its approach to resource management and has published numerous scholarly research papers on water conservation and demand management. Mr. Chaplin holds a B.G.S. in Technology and Development from the University of Michigan; Mr. Pinkham holds a B.A. in Geography from Dartmouth College, and an M.S. in Natural Resources Policy from Cornell University.

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Commercial Domestic

Measure Name: Retrofit to dual-flush 1/1.6 gallon per flush toilets

Measure Description: Retrofit or Install dual-flush toilets in place of 1.6 gpf or greater toilets

Key Assumptions:

- Participation: 80%
- Use Reduction Due To Measure: ≈ 3 gallons per flush
- Cost Assumptions: Same as 1.6 gpf toilets, less for retrofit flush mechanisms
- Measure Life: 20 years

2020 Results:
Accounts Participating =
Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	run model	less than $0.24
Peak	run model	less than $0.71

Potential Benefits Not Quantified:

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Residential Domestic

Measure Name: Retrofit to dual-flush 1/1.6 gallon per flush toilets

Measure Description: Retrofit of install dual flush toilets in place of 1.6 gpf or greater toilets.

Key Assumptions:

- Participation: 80%
- Use Reduction Due To Measure: ≈ 3 gallons
- Cost Assumptions: Same as 1.6 gpf toilets, less for retrofit mechanisms
- Measure Life: 20 years

2020 Results:
Accounts Participating =
Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	run model	less than $ 0.61
Peak	run model	less than $ 1.83

Potential Benefits Not Quantified:

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Commercial Domestic

Measure Name: Retrofit to 2.0 gpm faucets

Measure Description:
Install 2.0 gpm faucets in place of 2.2 gpm (or greater) faucets

Key Assumptions:

- Participation: 95%
- Use Reduction Due To Measure: 0.9 gal. per minute
- Cost Assumptions: Same as 2.5 gpm faucets
- Measure Life: Same as 2.5 gpm faucets

2020 Results:
Accounts Participating =
Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	run model	less than $1.50
Peak	run model	less than $4.00

Potential Benefits Not Quantified:

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Residential Domestic

Measure Name: Retrofit to 2.0 gpm faucets

Measure Description: Install 2.0 gpm faucets in place of 2.2 or more gpm faucets.

Key Assumptions:

- Participation: 95%
- Use Reduction Due To Measure: 0.9 gpm
- Cost Assumptions: Same as 2.5 gpm faucets
- Measure Life: Same as 2.5 gpm faucets

2020 Results:

Accounts Participating =

Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual		Less than $1.50
Peak	≈ 700,000	less than $4.00

Potential Benefits Not Quantified:

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Commercial Domestic

Measure Name: Retrofit to 0.5 gpm faucets

Measure Description: Install 0.5 gpm faucets in place of all non-kitchen faucets using 1.5 gpm or more.

Key Assumptions:

- Participation: 25%
- Use Reduction Due To Measure: 2.4 gallons per minute
- Cost Assumptions: Same as 2.5 gpm faucets
- Measure Life: Same as 2.5 gpm faucets

2020 Results:
Accounts Participating =
Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	run model	less than $1.00
Peak	run model	less than $3.00

Potential Benefits Not Quantified:

Comments from Individual Panel Members

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Residential Domestic

Measure Name: Retrofit to 0.5 gpm faucets inplace of 1.5 gpm (or greater) faucets in bathrooms.

Measure Description:

Key Assumptions:

- Participation: 50%
- Use Reduction Due To Measure: 2.4 gallons per minute
- Cost Assumptions: Same as 2.5 gpm model
- Measure Life: Same as 2.5 gpm model

2020 Results:
Accounts Participating =
Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	more than 1,000,000	less than $1.00
Peak		less than $3.00

Comments from Individual Panel Members

[RMI's Suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Commercial Domestic

Measure Name: Retrofit to 2.2 gal. per minute showerheads

Measure Description: Install 2.2 gpm showerheads in businesses with 2.5 gpm or greater showerheads.

Key Assumptions:

- Participation: 95%
- Use Reduction Due To Measure: 0.7 gal. per minute
- Cost Assumptions: same as 2.5 gpm models
- Measure Life: Same as 2.5 gal per minute models.

2020 Results:
Accounts Participating =
Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	run model	≈ $1 → 1.50
Peak	run model	≈ $4 → 4.50

Potential Benefits Not Quantified:
Energy savings

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Residential Domestic

Measure Name: Retrofit to 2.2 gal. per minute showerheads

Measure Description: Install 2.2 gpm showerheads in homes with 2.5 gpm or greater showerheads.

Key Assumptions:

- Participation: 95%
- Use Reduction Due To Measure: 0.7 gal. per minute
- Cost Assumptions: Same as 2.5 gpm showerheads
- Measure Life: Same as 2.5 gpm showerheads.

2020 Results:

Accounts Participating =

Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	≈ 600,000+	≈ $100 or less
Peak	≈ 600,000+	≈ $30 or less

Potential Benefits Not Quantified:

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Commercial Domestic

Measure Name: Retrofit to 1.5 gpm showerheads

Measure Description: Install 1.5 gpm showerheads in businesses with 2.0 gpm or greater showerheads

Key Assumptions:

- Participation: 50%
- Use Reduction Due To Measure: 1.4 gal. per minute
- Cost Assumptions: Same as 2.5 gpm models
- Measure Life: Same as 2.5 gpm models

2020 Results:

Accounts Participating =

Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	run model	≈ less than $1.00
Peak	run model	≈ less than $3.00

Potential Benefits Not Quantified:

[RMI's suggestion for an additional measure]

CONSERVATION POTENTIAL ASSESSMENT
Measure Description Form

Sector: Residential Domestic

Measure Name: Retrofit to 1.5 gal. per minute showerheads.

Measure Description: Install 1.5 gal. per minute showerheads in homes with 2.0 gpm or greater showerheads.

Key Assumptions:

- Participation: 50%
- Use Reduction Due To Measure: 1.4 gal. per minute
- Cost Assumptions: Same as 2.5 gpm showerheads
- Measure Life: Same as 2.5 gpm showerheads

2020 Results:

Accounts Participating =

Average Annual Cost =

	Flow Reduction - gal/day	Levelized Cost ($/ccf)
Annual	≈ 1,000,000	≈ $ 0.85
Peak	≈ 1,000,000	≈ $ 2.50

Potential Benefits Not Quantified:

APPENDIX 5: TECHNICAL ADVISORY GROUP FINAL REPORTS

RESIDENTIAL IRRIGATION AND LANDSCAPE TECHNICAL ADVISORY GROUP

Background

The Residential Irrigation and Landscape Technical Advisory Group was established to explore the current use of water on the residential landscape and discuss opportunities improve efficiency and reduce overall water use over the next 20 years. Participants represented development, nursery, landscape consulting, construction and research professionals as well as homeowners. (Participant list attached.)

Information gathered in this session, related staff research, and data from existing programs will be combined to provide input for the Seattle Public Utility's Conservation Potential Assessment Project. The Conservation Potential Assessment will provide a detailed analysis of all potential water conservation and efficiency measures available over the next 20 years. For more information on the CPA contact project manager Tim Skeel (206-386-9084 or tim.skeel@ci.seattle.wa.us)

Advisory Group Format

The advisory group was conducted as a facilitated brainstorming session around the following question.

> *What are the opportunities in the residential irrigation and landscape area to increase water use efficiency and conserve water over the next 20 years.*

The participants started by writing specific ideas on cards and posting them on the wall. The group then arranged and grouped the cards to represent distinct areas of opportunity including money/incentives, alternative systems, codes & regulations, irrigation systems, plants & soils and education. Participants spent the remainder of the meeting discussing and clarifying the ideas based on questions from SPU staff. A list of the ideas posted in the meeting is attached.

Discussion Summary

The breadth of the discussion reflected the diversity of the participants and available approaches to reducing residential irrigation demands. The group stressed that while significant water savings are available in the residential landscape area, achieving the savings will depend on personalized and site specific education and technical assistance because the problems and solutions vary so much from landscape to landscape.

Overall, the group indicated improved site preparation, user education, and irrigation management would result in substantial water savings. Participants reported local audit results demonstrating savings of 10-50% for larger residential landscapes. The group highlighted that

conservation messages must be simple and must encourage customers to make site specific assessments and take appropriate actions. Participants discussed a number of strategies for conveying the conservation message more effectively including the following:

- Messages must focus on specific methods that an individual can use to reduce water use rather than generalizing to the "public."
- Create a stronger link between irrigation water use, the "true" value of water and protection of environmental resources in the watersheds.
- Provide customers with examples of efficient water use and water-smart landscaping by using improved school and municipal sites as examples of excellence.
- Focus conservation efforts to specific communities and then "transfer" the successful program elements to other communities. Emphasize the peer pressure of working with neighbors and local properties.
- Link conservation message to other efforts or customer interests such as wildlife friendly plantings and pesticide free landscapes to provide a more holistic, environmental message and broaden the program appeal to a more diverse group of customers.
- Display graphic water supply messages with press and television weather reports so that customers have a constant reminder of water's value and scarcity.

The group discussed the need for a variety of incentives and disincentives to support technical and educational water conservation programs. The programs listed below include incentives for the individual and programs to benefit the local community where water savings occur.

- Provide incentives for conservation projects including direct financial or service incentives and indirect incentives such as spending savings to improve a local park for a particular community area or group.
- Implement disincentives such as "Water Waste" notices for blatant wasters who allow water to run down the street or allow irrigation systems to run during rain.
- Develop a public recognition program for residents with excellent practices.
- Provide incentives to lower the relative cost of water-smart plants so that developers do not install cheaper, water intensive plantings in an effort to save capital construction dollars.
- Provide incentives and technical assistance for older system retrofit.
- Implement more frequent billing during the summer to link the price message with the irrigation season more closely.

Participants highlighted a number of instances where education or incentives were giving the wrong messages to residential irrigators. The group discussed specific efforts to align messages with the need to conserve water as follows.

- Customers must learn to evaluate their own landscape conditions and needs. Efforts to simplify the message may have resulted in poor practices. For example, the concept of deep watering may be taken to a wasteful extreme by many customers.
- Reconsider or reword the guidance to choose native plants. Many native plants have high water requirements and some non-native plants can require minimal water. Stress the concept of "right-plant-right place."

- More education on schedule setting and the use of timers to assure that they are being used properly. (Research is needed to determine whether timers should be promoted at all.)
- Instill an understanding that landscape water demand diminishes as a landscape matures.

The group focused on technical opportunities to reduce the water use relating to appropriate site preparation, plant selection and elimination of blatant water waste. While the group agreed that developers should not bear the burden for all water conservation efforts, new developments provide an excellent opportunity to utilize best practices for design, construction and maintenance of new landscape areas.

- Improve soil preparation and maintenance for all developments. Provide incentives for developers to manage site soils in such a way so that they can be used as a soil amendment. (It should be noted that participants shared differing opinions regarding the long-term benefits of soil amendments. In general, the group agreed that amendments provide water savings following installation but those savings may degrade over time. Additional research may be necessary to resolve this question.)
- Develop/improve certification programs for landscape design, installation and maintenance contractors.
- Teach customers to use pulse or cycle-soak irrigation to facilitate infiltration and minimize runoff
- Encourage site development (location of buildings, selection of plants, and soil preparation) which takes better advantage of local conditions and plan the landscape accordingly.
- Encourage use of stormwater and graywater for irrigation. Specifically, take advantage of stormwater storage requirements and utilize water for Spring irrigation.
- Provide incentives and means for customers to link to weather stations for computerized controllers

Conclusion

While the Technical Advisory Group generated an enormous number of suggestions for reducing water use and making irrigation more efficient, no single idea or topic appears to promise substantial savings on its own. Based on this discussion, reduction of water use in this area will depend on providing customers with numerous options for reducing water use and improving efficiency. It will be the sum of these programs, mostly educational and incentive based, that lead to substantial water savings. According to the group, many of the attempts to generalize the conservation message have failed to achieve desired results. The greatest challenge may be to target the programs to individuals while keeping the message simple enough for customers to understand and adopt.

The ideas generated in this meeting will be translated into a series of specific conservation programs for the purposes of estimating conservation potential in the residential landscape area. Based on the discussion and additional research by SPU staff, water savings and program costs will be input into the water use models under development by SPU. The modeling results will be included in the Conservation Potential Assessment final report due to be completed this fall.

Residential, Irrigation, and Landscape Technical Advisory Group Participants

Participants

Joellyn Hawn, Horticultural Consulting, Inc.

Rita Hummel, WSU-Cooperative Extension

Howard Langeveld, Resident/Developer

Suzanne Leger, Cedar Grove

Hugh Morrison, University of Washington (student)

Peter Orser, Quadrant Corporation

Debbie Rannfeldt, Woodinville Water District

Mary Robson, WSU-Cooperative Extension

Gene Peterson, RH2 Engineering

Rod Sakrison, Department of Ecology

Bill Smith, Briggs Nursery

Ladd Smith, In-Harmony

Doug Snyder, Highridge Corp.

Roselee Warren, Molbaks Nursery

Rod White, University of Washington (Irrigation Managment)

SPU Staff

Matt Chadsey

Al Dietemann

Rich Gustav

Mary Larson

Morgan Lewis

Nota Lucas

Tim Skeel

Nora Smith

Residential Irrigation and Landscape

Technical Advisory Group

Conservation Ideas & Barriers

(Unedited List from Session)

Education

- Talk/write to homeowner associations and Realtors to emphasize the necessity of conservation
- Home owners association management program
- Show homes (as in Street of Dreams) that stress conservation and sustainability
- Why should we honor consumption as is done now
- Side by side demo with soil preparation and without - demonstration in neighborhood
- Aesthetics are a perceived problem - people still think Xeriscaping = zero landscape
- Let people know what conservation means now. Percent of savings over past 10 years. Be clear about the 2007 deadline one decade ago
- Comprehensive ecological lawn care program with catchy message
- Education which clearly relates to $and water use
- Residential - keep it simple - like to save money - immediate results
- Garden club organized towards demo gardens - weird but it might influence some people
- People don't make changes unless they are convinced of the value to them of changing.
- If you want heat in a European hotel you have to feed money into the meter. If water meters wouldn't work with deposits, wow!
- Park grasses not being obviously sprinkled - maybe this is already happening - civic consistency.
- Consistent public education media messages on conservation: questions - what percent of people really believe we are a water short region?
- Barrier in that people perceive there is a lot of excess water to go around.
- Work with local weathermen, have water conservation be a part of summer weather report
- i.e. they give examples of how much water would have been used by key plant species at the end of each week.
- Visual presentation - big (on space needle maybe) - of percent of water saved during a program.
- Library and community center based irrigation programs.
- Big signs plopped in landscaped that waste water - mock water cops.
- Block water cops with clamps to shut off street waterers.

- More training for landscape install and maintenance crews.
- Certification program for lawn maintenance firms providing water conserving and other conservation measures. Work with landscape associations on certification . Utilities publicize.
- Free phone call for water wasters to get called into
- Publicize diversity or brown is better than green lawns in summer.
- School landscaping, garden soil prep programs.
- Partner with schools - Demo Gardens and workshops.

Plants and Soils

- Improving soil structure for better drainage - better water holding capacity
- Cultural techniques - soils - application methods & Rates - Planting Techniques, “basin or rim” around planting holes.
- Mulches
- Regulations for proper soil prep prior to landscape installation
- Use compost in soil mixes to reduces water usage and hold moisture.
- Best Management Practice - soil grading - cover crop instead of straw
- Tech available to user at $relevant to savings.
- Nursery - Pulse irrigation (not overwater) water more often shorter duration till soil is “full.” 65% of water wasted in nursery operation.
- Matching sprinkler system to soil type - education - how to get info.

Irrigation

- Incentives to promote drip irrigation and timers in garden beds
- Use of in ground moisture meters or sensors to regulate irrigation
- Deduct Meters
- Separate landscape metering & control. During times of aridity, rationing could be confirmed to landscape use.

Codes

- Landscape code apply to all new construction (i.e., single family)
- code changes for residential soil prep and water budget
- Code amendment affordable
- No regulations w /o enforcement - equality
- Low flow hose

Alternative Systems/Grey Water

- Use of stormwater retention - link to irrigation - congruency
- Gray water regulations need clarifying - California model is a good one
- Change code to require rainwater storage 1 gal/sq. for roof for toilets or irrigation.
- Cistern systems retrofitting older homes to collect roof water.
- We need attractive workable ways to capture winter water on site. For instance the 1900 vintage homes in Seattle have no way to collect.
- Change code to require grey water irrigation where there is enough land.
- Use alternative sources - rain barrels - stormwater - infiltration.

Money/Incentive

- Financial rebates for low water use
- Utility rebate program - installation of specific features - lower use incentives
- Technical fix - incentiveIncentives go to community - water quality - environmental quality
- Conservation based on award
- Marketing barrier inhibiting reduction of plant materials that use a lot of water like grass.
- Graduated rates over targeted amount for size of household
- Neighborhood contests with awards. Dollars for most decrease of water use.
- Targeting audiences i.e. “green folks” - mini-can subscribers
- Sewer rates - as incentive to conserve
- Discount on compost products for use in low water use landscape/lawn installations
- Help fund submetering of apartments
- Pricing strategies that penalize “higher in summer” but also recognize true cost of water (higher in general and also incentify - rebates for use of low use plants or lower than average use.)
- Implement conservation program for total region (Seattle + Purveyors)

Discussion Notes

- Eliminate automatic timers, use electronic sensors
- keep it simple - affordable
- residents expect immediate results, i.e., quick kick-back, rebate after audit
- address specific landscape
- good site development from the beginning, diversity of plants
- good visual consistently in summer
- educate that non-drought year is when you can make changes
- find something than works - e.g., one day less per week

- link the messages, both the “why” and the “how”
- use water rebate for solid waste usage, i.e. link/trade
- choose messengers carefully
- weather forecasters
- “conserver of the week” message
- broad based conservation program with direct reward
- direct reward or stick
- consistent message that incremental choices add up
- summer bill while use is high
- land use planning - i.e. denser development
- need political constituency for good practices/leadership
- message about care of/for environment not just horticulture
- Individual landscape assessments (in my own work, calculations thus far show a 38% to 58% average water savings in the two areas in which I have worked)
- Landscaping audits coupled with savings from nurseries for drought tolerant plants.
- Revising how we use green spaces - eliminate wasteful water use not green spaces or plantings.
- Reduce Lawn
- Shrink amount of turf:
    - site planning - incentives - house design - “sod tax”
    - Shrink lot sizes per King County Comp Plan
    - Reduce lawn areas - increase knowledge of watering lawns to generate healthy lawns
    - Revamp golf courses into wildlife corridors if on potable water.
- Change Plants:
    - Future: Mandate a water conserving plant palette
    - Nursery promotions of selected appropriate plants - a theme like “not just rhodendrens”
    - Plant selection Encourage people to plant water conservative plants. Street trees.
    - Resource manual of drought tolerant plants appropriate to residential landscapes.
    - Plantings, eco-lawns and mulches
    - change of plant species used in area homes
    - Subsidize low water use plant at nurseries

DOMESTIC WATER USE TECHNICAL ADVISORY GROUP

Background

The Domestic Water Use Technical Advisory Group (TAG) was established to explore the current use of water for domestic purposes (toilet flushing, washing, bath/shower, etc.) in both residential and commercial buildings and discuss opportunities to improve efficiency and reduce overall water use over the next 20 years. Participants offered expertise in conservation consulting, local health requirements, metering technology, public housing management and program marketing.

Information gathered in this TAG, related staff research, and data from existing programs will be combined to provide input for the Seattle Public Utility's Conservation Potential Assessment Project. The Conservation Potential Assessment will provide a detailed analysis of all potential water conservation and efficiency measures available over the next 20 years. For more information on the CPA contact project manager Tim Skeel (206-386-9084 or tim.skeel@ci.seattle.wa.us)

Advisory Group Format

The advisory group was conducted as a facilitated brainstorming session around the following question.

> *What are the opportunities in the domestic water use area to increase water use efficiency and conserve water over the next 20 years?*

The participants started by writing specific ideas on cards and posting them on the wall. The group then arranged and grouped the cards to represent distinct areas of opportunity including codes & regulations, design, incentives, education and skills, and maintenance. Participants spent the remainder of the meeting discussing and clarifying the ideas and answering questions from SPU staff. A list of the ideas posted in the meeting is attached.

Discussion Summary

The Domestic Water Use Technical Advisory Group focused the discussion in two areas, customer ethic/behavior and technical improvements to domestic fixtures. Generally, strengthening customer perception of water's value would be used to get customers to be more attentive to their water use and apply some of the technical and maintenance opportunities described below. The group felt that the current cost of water is relatively low and does not fully represent its intrinsic value. On the technical side of the discussion, participants described a number of measures which, applied to all domestic water users, would result in substantial regional savings.

The group discussed a number of specific technical and educational measures including the following.

- With enhanced sub-metering technology, provide customers with an "itemized" water bill

reflecting the cost of using each fixture in the building. Modeled after the phone bill, this sub-metering would relate water use to specific activities for customers.

- Implement school programs to teach the conservation "ethic" and to promote children helping to identify conservation opportunities within the home.
- Provide for more frequent billing to link use with bills more directly, especially during summer. Educate customers on the relationship between their water use and wastewater charges.
- Eliminate flat rate sewer charges in purveyor areas and ensure that all customers have volume-based wastewater charges.
- Provide customers with more information regarding the installation of water saving fixtures and maintenance of existing equipment.
- Educate/require multifamily building operators to conduct regular maintenance of fixtures and not to wait until tenant changes which may not occur for many years.
- Improve or eliminate the current toilet flapper technology which is prone to extensive leaks. As many as 20% leak in the first year following installation while 65% are estimated to leak by year 3. Both regular maintenance and development of alternative technology with manufacturers was discussed.
- Improve availability of hot water by reducing the size of hot water pipes, installing flash heaters near fixtures, and installing alternative hot water distribution systems. Improved hot water access may reduce household consumption by 10-15%.
- Install leak detection meters and sensors and train customers to identify and repair leaks.
- Provide incentives for customers to purchase and install new clothes washer technology which saves up to 50% of water compared with existing units.
- Institute submetering of multi-family facilities and provide feedback and direct billing to individual users regarding their water consumption.
- Modify plumbing codes to reduce pipe sizing to better reflect current water use patterns

Conclusion

As the largest water use sector in SPU's service area, domestic water use provides a significant opportunity for improved conservation efficiency and water savings. The discussion in the Domestic Water Use TAG indicates that substantial savings are available but that they depend, to a large extent, on education and personal initiative of the customers to maintain or replace their fixtures appropriately. A powerful drive for increased awareness will be an increase in the cost of water and the resulting financial incentive for customers to save water. In fact, participants searched for a way to describe and calculate the substantially higher "intrinsic" value of water. In addition, technological advances in metering and fixture design will undoubtedly continue to drive water use down over the next 20 years.

For the purposes of the Conservation Potential Assessment, SPU staff will group these topics discussed during the meeting and estimate costs and projected water savings for CPA analyses. Additional programs and ideas raised by TAG members outside of the February 26th meeting and by others in the CPA process may also be included in the program development and modeling. The final CPA report will be available in the fall of this year.

Domestic Water Use
Technical Advisory Group Participants

Industry Professionals

Jim Hendrickson, Seattle/King County Health

Terry Heritta, Seattle Housing Authority

Sharon Howard, Howard Rosen Productions

Pete Jarling, Noland NW

Hugh Morrison, University of Washington (Student)

Bill Noland, Noland NW

Gene Peterson, RH2 Engineering

Mike Ringer, Aqua Meter

Mike Rosen, Pacific Rim Resources

Jack Sharrow, Cascade Conservation

SPU Staff

Matt Chadsey

Al Dietemann

Mary Larson

Morgan Lewis

Preeti Shridhar

Tim Skeel

Nora Smith

Domestic Water Use
Technical Advisory Group
Conservation Ideas & Barriers
(Undedited List from Session)

Technology

- Water Management Systems - programmed uses
- Waterless toilets
- Hot water recirculation line
- Reuse grey water
- Computerized domestic plumbing appliances that warn if leaking or water is wasting.
- Instant hot and cold H20
- Point of use hot water heater
- Shut flow shut off valves
- Recapture indoor water
- Residential storm water reuse
- Device on toilets that instantly recycles

- Smaller bath tubs
- Reduced flow faucet fixtures
- Faucets with auto shut off
- Put $ into changing fixtures instead of incentives and education over many years
- Meters with leak detection devices
- Pressure compensating aerators and showerheads
- Water coolers in businesses so drinking fountains don't waste water - exact amount dispensed
- Flapperless toilets
- Individual meters with 1/8 gal detection that would indicate leaks
- Domestic water recycling from washers/dishwashers
- Replace or upgrade toilets
- Get rid of flapper toilets - pressure system
- Codes - drain sizing
- People often run water to "clean" pipes. Upgrade pipes so water will not have to run before drinking
- Computer tech - distribute use to low use time of day - direct feedback on uses to modify behavior
- Toilets and aerators easy to identify - do it right now/
- Gray water how to make feasible
- Plumbing Code
- Reduce pipe size - use less water to get how water - sized appropriate to fixtures
- Disposals - 3-4 gal/hh per? - downstream costs
- Pricing - effective behavior
- Phone bill analogy
- replace fixtures sooner
- how they use water
- advocate cost of ownership vs. start up.

Translation to behavior +/or Technology

- Washers (Department of Energy)
- Well defined target numbers
- New test spec water plus energy use
- New machines use 30-40% of water used by current machines

- Average 45-47 gal/load average
- Range 38 gal/load - 62 gal/load
- New 14 gal/load
- Savings $60-80/machine (energy+water)
- 2 1/2 yr. payback

Codes & Regulations

- Efficient washer code for retail manufacture
- Plumbing system like spider home -run
- New developments required to meet efficiency standards
- Hot water technology
- Codes for sizing pipes to newer fixture sizes
- Mandated recycled water for all hot tubs, Jacuzzis
- Reduce flow bath room faucets
- Stop kitchen disposals

Pricing

- If customer uses below a certain amount money is refunded
- Increase water and sewer rates
- More frequent meter reading and billing
- Encourage purveyor to use volume based water and sewer rates
- More info on billing by itemizing uses
- Price keep by use but not as incentive
- Lower permit fees for retrofit meter applications and related applications
- Submeter program - submeter all domestic use

Incentives

- Residential rebates package deal toilets, washers etc.
- Tax incentives
- Building water system rep or repl asst.
- Luxury tax on water used for indoor pools, hot tubs etc.

Education

- Promote leak detection and resolution
- Convince people not to wash dishes before using dishwasher
- Public must be convinced that supply and demand will meet 2007 - perception is that water is available
- Water conservation education for the general public
- Don't lose purveyors
- Spend more money
- Washing machines - education on value of resource - ethic concept of life sustaining children's education & impact
- Eco-team - grassroots sharing and education-
- current single family some awareness increase multi-family awareness
- combine w/ethic change
- Ad campaign to increase awareness of the need to conserve
- Tie conservation to life sustaining value of water
- Change the ethic
- Get over cost effective start home education in schools so that kids change adult behavior
- Educate on life cycle costs and ethic
- Freeze alert - running faucets corrected - insulate
- Maintenance on toilet flappers and flushometers
- Eco team among group of home owners to build awareness
- Spend more money
- Bill monitoring as an indication of leaks and problems
- Info on how much water individual uses cost - add wastewater treatment cost
- Growth as disincentive to conserve - what if we don't want the growth - why conserve
- Strong targeted education campaign to reduce teen shower time
- Water Quality issues - lead and copper -implication - incentives
- Ed campaign targeting indoor use
- Multi-Family housing problems fixed usually only with tenant change - little routine maintenance because of tenant notice.

COMMERCIAL IRRIGATION AND LANDSCAPE TECHNICAL ADVISORY GROUP

Background

The Commercial Irrigation and Landscape Technical Advisory Group was established to explore the current use of water in the commercial irrigation and landscape industry and discuss opportunities to improve efficiency and reduce overall water use over the next 20 years. Participants represented design, installation and maintenance professionals as well as users of commercial landscapes irrigating with potable water. (Participant list attached.) Common commercial irrigation sites include schools, municipal parks, business parks, golf courses, multi-family buildings and streetside plantings.

Information gathered in this session, related staff research, and data from existing programs will be combined to provide input for the Seattle Public Utility's Conservation Potential Assessment Project. The Conservation Potential Assessment will provide a detailed analysis of all potential water conservation and efficiency measures available over the next 20 years. For more information on the CPA contact project manager Tim Skeel (206-386-9084 or tim.skeel@ci.seattle.wa.us)

Advisory Group Format

The advisory group was conducted as a facilitated brainstorming session around the following question.

> *What are the opportunities in the commercial irrigation and landscape area to increase water use efficiency and conserve water over the next 20 years?*

The participants started by writing specific ideas on cards and posting them on the wall. The group then arranged and grouped the cards to represent distinct areas of opportunity including codes & regulations, design, incentives, education and skills, and maintenance. Participants spent the remainder of the meeting discussing and clarifying the ideas and answering questions from the SPU staff. A list of the ideas posted in the meeting is attached.

Discussion Summary

Overall, the Commercial Irrigation and Landscape TAG participants suggested that substantial water savings and efficiencies were available in their industry at reasonable cost.

Specifically, participants stated that water savings in the range of 50% of today's usage could be achieved by improving the link between design, installation and maintenance practices.

The inter-relationship of design, installation and maintenance of irrigation systems was described as a triangle with money at the center, effecting all sections. Weakness in any of the three phases

could lead to an installation that fails to achieve an efficiency of 60%+, commonly considered representative of a well designed, functional irrigation system. Too often when something needs to be cut from a construction budget or project timeline, it's vital landscape components. Some estimated that 70-80% of all installations have major faults and resulting inefficiencies.

The group identified the need to raise the level of accountability for all irrigation professionals through both education and improved codes & regulations. A number of specific measures were discussed to improve the design, installation and maintenance process and to pressure "low budget" professionals to improve their practices.

- Improve landscape and irrigation design, installation, operation and maintenance training for professionals throughout the industry to ensure that the best practices resulting in maximum water use efficiency are utilized. Many professionals currently have a superficial knowledge of truly water inefficient irrigation system design and installation.
- Utilize audit software and plan review to demonstrate that irrigation designs will meet efficiency standards prior to installation and conduct system audits of newly completed systems to demonstrate that targeted efficiency was achieved.
- Improve design specifications and include efficiency targets in bid documents.
- Expand certification of industry professionals to reduce the instances of unqualified low bidders winning jobs and installing inefficient irrigation systems.
- Implement regional standards for irrigation efficiency and proper design, installation and maintenance so that standards and best practices can be applied by all local operators. Participants suggested that the Bellevue Landscape Code, in spite of implementation problems, had improved the quality and efficiency of landscape and irrigation installations in that area by "weeding out" unqualified contractors.
- Promote (or require) "water managers" or irrigation project managers to coordinate management of design, installation and maintenance of landscapes and irrigation systems. Water managers could act as landscape and irrigation advocates when project managers look to cut overall budgets and timelines at the expense of the landscape.

Participants were asked to identify measures that would provide the greatest water savings for existing irrigation systems from all of the ideas discussed. The group identified replacing older controllers, properly scheduling all controllers and increasing access to weather station data as the most promising opportunities. *Participants estimated that improved control alone would reduce overall water use by approximately 20%*.

Another thread of the discussion explored awareness of irrigation efficiency issues. The group estimated that a very small percentage of all landscape designers and irrigation professionals are proficient in water efficient irrigation system development. The group identified a number of approaches to improve the customer and professional understanding of proper design and installation.

- Educate industry professionals and customers regarding the importance of understanding and using measures of lifecycle cost when making irrigation system decisions. Demonstrate that the savings from cutting important irrigation systems components to save capital costs is dwarfed by the resulting long-term maintenance and water expenses.
- Create some sort of financial link between the initial project developer and long-term owner to

assure that appropriate, cost-effective lifecycle decisions are made during development and installation. Educate property owners to evaluate O&M requirements of an irrigation system in the same way that they evaluate energy costs.

- Several participants suggested raising water rates is the most powerful way to get owners and operators to take more of an interest in improving the efficiency of their irrigation systems and in valuing proper landscape and irrigation system construction on newly purchased property.
- Develop mechanisms to better link long term costs with initial cost and design requirements.
- Investigate the costs and benefits of the Bellevue Landscape Code and irrigation efficiency regulations and codes in other states including Arizona, California and New Jersey.

A number of the participants explored opportunities to reduce water use by modifying landscape designs to be more irrigation friendly, by installing low water landscapes, and by using alternative water resources. The group discussed several specific opportunities including the following.

- Eliminate or modify parking lot islands and parking strips which are too narrow to irrigate. Install drip irrigation for islands and strips which are constructed.
- Ensure that landscape codes that have plant requirements also address appropriate and efficient irrigation for those requirements. Landscape code must also be technically sound.
- Provide incentives for large irrigation customers to use recycled wastewater and/or capture and reuse stormwater.
- Continue to improve the availability and quality of drip irrigation.
- Continue research into more water efficient grasses, tall fescue, to replace local perennial rye grass.

Conclusion

With the exception of expanding the use of weather-based controllers and improved clocks the majority of measures discussed in the meeting were procedural and regulatory, focusing on the process of installing, maintaining and using irrigation systems. For the purposes of the Conservation Potential Assessment, SPU staff will group these topics discussed during the meeting and estimate costs and projected water savings for CPA analyses. Additional programs and ideas raised by TAG members outside of the February 25th meeting and by others in the CPA process may also be included in the program development and modeling. The final CPA report will be available in the fall of this year.

Commercial Irrigation and Landscape Technical Advisory Group Participants

Industry Professionals

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Don Blackwell, Advanced Irrigation

Martin Bohanan, King County Parks

Ted Boyd, Evergreen Services

Gregg Brower, Berger Partnership

Johnny Burrow, Seattle School District

Lisa Douglass, West Point WWTP

Tim Gellatly, Gellatly Irrigation

Wayne Kennedy, Synergy Water Management

Russ Perron, United Pipe and Supply

Gene Peterson, RH2 Engineering

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Nora Smith

Commercial Irrigation and Landscape

Technical Advisory Group

Conservation Ideas & Barriers

(Unedited List from Session)

Maintenance

- P.R.S. heads on commercial sites cut waste when broken
- Thicker bark, longer lawns
- Cycle and soak - cuts run time 15-25%
- Overspray
- Broken heads & Lines
- Soil moisture prevent overwater
- Equipment
    - A. uniformity
    - B. maintenance training
    - C. irrigation heads that are easy to maintain
    - D. H2O audit

Codes & Regulation

- Tighten existing landscape codes and requirements
- regulations about distribution uniformity can conflict with ease of maintenance and use long term.
- Solve by allowing zoning.
- No mixing of zones
- Introduce codes & minimal requirements for landscape irrigation.
- Parking strips and medians use drip
- Higher scrutiny of newer construction
- Clarify/simplify regulations regarding - impervious surfaces vs. landscape.
- Streamline/facilitate legal & public perception about water reuse. Design systems to accommodate it in future.
- make designers accountable for efficiency of irrigation designs.
- Audit irrigation before installation of computer.
- Irrigation inspectors for installation.
- Comprehensive regional consistency

Design

- Timed demand meters
- Central control is becoming more affordable and should make it's way into commercial applications more.
- New software will have better reporting capabilities
- Delete round beds @ hardscaping and cut overspray.
- Delete small parking island landscape or 2 trees w/bubblers
- Xeriscaping
- Water use equal to plant need
- Use of drought tolerant trees, shrubs, groundcover
- Use drought resistant grass species
- Mulch
- Polymers
- Better control of controllers i.e. use ET and or historical weather data
- Min std for all new systems = D.U., = Zoning

Incentives

- Raise rates rather than give discounts for conservation
- Offer incentives for construction/design/maintenance C.E.U.'s
- Sub surface irrigation for sports fields and golf courses
- Offer central control tie ins for smaller lower budget sites.
- Payback for design and water savings.
- Public accountability
- Work with large water users to partner with/landscape maintenance contractors in coming up and achieving savings.
- Equal water distribution at construction (regulatory) & money for retrofit/redesign.
- Upgrade current commercial systems
- Use effluent large commercial sites
- Make efficient water more available with more pipelines
- New technology - GeoFlow

Maintenance Education & Skills

- Certify people as SPU water managers
- Conduct water audits of plans and finished installation

- Increase use of central control systems
- Class for maintenance company on clock setting
- Provide weekly et values translated into inches/week terms
- Designer education
- Contractor education & Skills
- Increase public awareness of need
- Educate public on irrigation run time per zone
- Research soil profile for sport fields should include properties of good drainage and water retention.
- Commercial awareness for water management
- Start a citizen award for conscientious water use
- Provide small catchment devices for homeowners to use for measurement.

Discussion Ideas

- Hardware /design/ preparation
- Management scheduling and maintenance
- Hardware + design + soils - 50% savings on an ideal system (over non-ideal)
- 70% distributions - “ideal system”
- Only 5-10% of current systems installed are “ideal”
- Majority of installers - low bid
- Bellevue code effective in getting “efficient” irrigation
- How to account for life cycle costs?
- people who run building site are different from those who build it.
- Cut 40-60% irrigation costs on golf course maintenance
- Construction admin. important part of proper installation
- 3rd party review of design
- educate customers - identify long term cost effectiveness of retrofits/improvements.
- Key Improvements: Audit, Controller, Water Manager
- Future: wireless controllers, No irrigation systems, improvements in control and management technologies - electronics, hardware - uniformity, central control, drip irrigation

COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL (CII) TECHNICAL ADVISORY GROUP

Background

The Commercial, Industrial and Institutional (CII) Technical Advisory Group was established to explore the current use of water in the commercial area and discuss opportunities to improve efficiency and reduce overall water use over the next 20 years. Participants included water users and consultants with extensive expertise in the following water use areas, manufacturing, cooling, boilers, food service, medical, transportation, laundry, waste treatment and hazardous waste. (Participant list attached)

Information gathered in this session, related staff research, and data from existing programs will be combined to provide input for the Seattle Public Utility's Conservation Potential Assessment Project. The Conservation Potential Assessment will provide a detailed analysis of all potential water conservation and efficiency measures available over the next 20 years. For more information on the CPA contact project manager Tim Skeel (206-386-9084 or tim.skeel@ci.seattle.wa.us)

Advisory Group Format

The advisory group was conducted as a facilitated brainstorming session around the following question.

> *What are the opportunities in the commercial, industrial and institutional area to increase water use efficiency and conserve water over the next 20 years?*

The participants started by writing specific ideas on cards and posting them on the wall. The group then arranged and grouped the cards to represent distinct areas of opportunity including codes & regulations, technology, incentives, and education. Participants spent the remainder of the meeting discussing and clarifying the ideas and answering questions from the SPU staff. A complete list of the ideas posted in the meeting is attached.

Discussion Summary

While the participants in the CII Technical Advisory Group represented a broad range of interests and expertise, the group seemed to reach a good consensus on opportunities for water use reduction as well as issues and opportunities common to commercial users. Much of the discussion described the need for better process control and submetering data and for better information on new technology, lifecycle costs and best management practices. The group sent a strong message that local cities and utilities could play an important role in facilitating research and development, code modifications and transferring technology to new users.

A significant proportion of the discussion covered the two common end uses, cooling and boiler feed. Participant's suggested that many users could operate their systems more efficiently resulting in water saving in the range of 10-20%. A smaller percentage have very poor practices and could reduce current water use up to 80%. As might be expected, operators who are conscientious about their maintenance and operations tend to have the best efficiency. Overall, participants agreed that the greatest opportunity in the CII area was cooling. The group suggested a number of specific measures to improve cooling and boiler feed practices as follows.

- Automate system operations and monitoring to standardize operationing procedures, collect better operational data and reduce operator error.
- Regularly monitor water quality to ensure that maximum cycles are reached in cooling towers.
- Treat water to protect equipment and increase cycles and efficiency.
- Meter blowdown, condensate return and feed rates to identify malfunctions early.
- Replace single pass cooling for small equipment and compressors with air cooled units or cooling loops.
- Implement penalty pricing for customers exceeding a "standard" efficiency for specific processes.

The group shifted gears to discuss water use in the food service industry. The industry is undergoing a significant evolution to commissary-type central kitchens from distributed, stand-alone facilitates. The larger kitchens prepare food and distribute to satellite restaurants or cafeterias. While the larger kitchens should provide a better opportunity for targeted conservation programs, the discussion indicated that the food industry in general has made little effort to develop and communicate water conservation information to its facilities. Cooling and dish washing offer the greatest opportunity for water savings. Water treatment and recycling equipment can allow water to be reused before discharge.

A more general discussion of the water conservation benefits of water treatment and recycling followed. Many industries including food processing, laundry, photoprocessing, electronics, vehicle washing and manufacturing can benefit from improvements in recycling technology. These technologies have an especially strong benefit when they result in a reduction in wastewater charges for the customer.

In a related discussion thread, treatment and reuse of wastewater effluent and stormwater were mentioned as an important opportunity for larger facilities. Stormwater control projects provide opportunities for customers to utilize the same infrastructure for collection and reuse of either stormwater or treated wastewater effluent and reduce their impact on the local environment. The use of recycled wastewater could provide an opportunity to offset potable water use for cooling and process water.

The participants provided a lengthy list efforts which could be sponsored by SPU and local purveyors to facilitate improved water use efficiency in CII facilities. The list included the following,

- Provide CII customers with financial incentives to implement submetering and real time monitoring to improve understanding and control of water use. Many customers have no idea where water is used especially in older, more complex facilities.
- Implement a "most-favored customer" project for facilities which have implemented extensive conservation providing recognition and monetary incentives.
- Provide customers with tools and technical assistance to evaluate lifecycle costs of conservation measures.
- Sponsor forums and provide written information on new treatment equipment, process control and water use efficiency. CII customers do not have the time and/or expertise to keep up with new advances.
- Sponsor a program to "share the risk" with CII facilities taking a chance by installing efficiency equipment which may impact their core business activities. (The mechanics of this type of program were not discussed.)
- Develop a "fast-track" permitting process to help conservation projects move through the approval process more quickly and, perhaps, for less expense.
- Sponsor an education program for financial institutions funding conservation projects to increase their comfort and confidence in the financial benefits and dependability of conservation projects.
- Create a CII conservation library and resource center to provide case studies, technical information and contacts for project development.
- Provide for more regular contact with customers to provide technical support and incentives for conservation projects.
- Advertise the availability of financial incentives more widely.

Conclusion

From the CII Technical Advisory Group discussion it appears that water use in this sector will be trending down for the foreseeable future due to improvements in process control, recycling technology and increasing water and sewer rates. Improved cooling/boiler practices and expanded metering provide the best opportunities for additional savings. Outside forces such as wastewater regulations and process efficiency improvements will create additional incentives to use water efficiently. The drivers to facilitate these changes include financial incentives and improved information transfer regarding new equipment and water management practices.

For the purposes of the Conservation Potential Assessment, SPU staff will group these topics discussed during the meeting to estimate costs and projected water savings for CPA analyses. Additional programs and ideas raised by TAG members outside of the March 5Th. meeting and by others in the CPA process may also be included in the program development and modeling. The final CPA report will be available in the fall of this year.

Commercial, Industrial and Institutional Technical Advisory Group Participants

Industry Professionals

David Beagle, Holland America

Mori Day, Omega Medical Mechtronics

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Douglas Hallam, Aqueous Engineering

Brad Helms, Stevens Hospital

Brian Horman, University of Washington (Project Engineer)

Hugh Morrison, University of Washington (Student)

Gene Peterson, RH2 Engineering

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Commercial, Industrial and Institutional Technical Advisory Group Conservation Ideas & Barriers

Education

- Information Resource Center - Library of available research/results data, brochures
- List of qualified consultants
- Equipment availability list
- Improve lab water use practices
- Barrier - lack of knowledge on equipment plus water usage (potential savings)
- Better education for business that show cost/justification and reliability actual savings and improvements

- Promote lower water use equipment
- Increase awareness of separation and filtration processes available for recycling
- Workshop for industry re: water conservation. should be industry specific. i.e. presentation, technology vendors, consultants, success story businesses

Technology

- Effective steam maintenance program - distribution of steam
- Running steam boilers at higher cycles of concentration through the use of water softeners and a strict chemical plan
- Recycle for reuse: a) gray water, b) waste water, c)production water - 1. Through advanced membrane technologies. 2. Combination of membrane technology and multi media filters. 3. Advanced waste treatment systems.
- Total water usage evaluation - advanced recycling technology evaluation.
- Reduce cooling tower blowdown
- Dust control - reduce water use through surfactants
- Redesign water using equipment to produce same end result with less liquid. Example: horizontal loaded washers vs. present vertical loading - cubic design is best
- Cooling tower daily monitoring - proper chemical levels to avoid slime build-up
- Boiler systems: increased cycles - condensate return
- Demineralize make up water for low pressure boilers to reduce blow down

- Reuse in: boilers, cooling towers, wash downs, manufacturing, irrigation, process water
- Cooling towers: increased cycles through increased control
- Use of water meters tied into building control system with set of parameters and alarms when flow exceeded set point
- Upgrade restroom fixtures
- Replace old fixtures with low flow (commercial)
- Closed-loop water recovery systems for vehicle washing: detail shops, fleets, dealerships etc. These are obviously for small scale application; not the same as commercial car wash facilities
- Water recycling within process in steam plants, laundries, food process

- Use of grey water
- Reuse of grey water in commercial equipment - A system
- Large plants utilize rainfall in parking areas - divert from storm drains, treat and use for non-potable applications, i.e. quenching, cooling, blasting, washing
- Look for recycle opportunities
- Efficient irrigation equipment and patterns of use
- Prefilter water to remove algae before softening
- Improve irrigation practices
- Utilization of air cooled compressors that are working together
- Smaller/few kitchens/less water more commissaries
- Paint booth filter & recycle water
- Dust control: reduce water use through surfactants
- Redesign water using equipment to produce same end result with less liquid. Example horizontal loaded washers vs. present vertical loading -cubic design is best
- Use of water meters tied into building control system with set parameters and alarms when flow exceed set point
- Hospital & research lab equipment that is water intensive: autoclaves/sterilizes, Bulk washers needs: steam, process water, cooling (down the drain)
- Considerations: cooling condensers - holding tanks- condensate return - redesign process cycles
- Problems: bio-hazard waste - cost - codes - temp of discharge
- Eliminate once through cooling equipment
- Identify and eliminate once through systems, i.e. compressors

Rates/Incentives

- Increase economic incentives to conserve/recycle water
- Method to quantify why an establishment should make changes
- Incentives need to result in attractive return on investment
- Distribution of water smart brochure
- Incentives to motivate establishments to make a change - financial
- Barrier: No incentive for water savings since water is so cheap (i.e. cold storage evap condensers)
- Same federal grants for proven systems foundation moneys for experimental systems
- Use of air cooled equipment instead of water cooled - incentives for purchase of air-cooled
- Understanding of where use occurs “submetering”

- Regarding reuse: make best integrated system design for specific use
- Mother nature is best way: Sedimentation, filtration, carbon treatment, ozonation, UV treat
- Equal pure water
- Water deptartment needs to develop ways to support water equipment and related companies in making sale of efficient products and programs.
- Solve the problem of getting people to act on putting conservation into place
- Implement an “easy” planning process to bring companies into program

Codes & Regulations

- New building codes for restroom facilities as in flushometers and pulse taps or vacuum @ 3 gal employee use
- Develop better ways to use less than potable water and remove barriers

APPENDIX 6: BIBLIOGRAPHY OF DATA AND RESEARCH SOURCES

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