SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

I. WATER RESOURCES

APPENDIX A

OFFICIAL YIELD ESTIMATE AND LONG-RANGE WATER DEMAND FORECAST

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May 2006
Official Yield Estimate and
Long-Range Water Demand Forecast

Inputs and Assumptions for the Firm Yield Estimate

Firm yield of the water supply system is estimated using a simulation model developed by Seattle Public Utilities called the Conjunctive Use Evaluation (CUE) model. Additional details of the model and inputs are documented in the final report titled *Firm Yield of Seattle's Existing and Alternative Water Supply Sources*, April 2006, prepared by Seattle Public Utilities.

Model Inputs and Assumptions

- ⇨ Firm yield is based on the **98% reliability standard**—one shortfall occurs in the 76 years of historic record.
- ⇨ **Historic weekly inflows** reconstructed for water year 1929 through 2004 are used.
- ⇨ **Total system demand** is shaped on a monthly demand pattern based on the average of actual deliveries from calendar year 1994 to 2000.
- ⇨ **Sources of supply are operated conjunctively as a single system.**
- ⇨ **Operational assumptions include:**
  - Cedar River System:
    Meet Cedar River Habitat Conservation Plan instream flow commitments below Landsburg, assuming flashboards in place on Overflow Dike.
    Fixed rule curve of Chester Morse Lake 1550'/Masonry Pool 1546' for November-February; 1560' both for May-August.
    Minimum levels for Chester Morse Lake: 1532'; Masonry Pool: 1510'
  - South Fork Tolt System:
    Meet instream flows from 1988 Tolt Settlement Agreement (with treatment project).
    Fixed rule curve 1754' for October-January; 1765' for March-August.
    Minimum level for South Fork Tolt Reservoir: 1710'
    Treatment/Transmission capacity: 120 MGD
  - Seattle Well Fields:
    10 MGD withdrawn for 14 weeks as needed from July-December.
    5 MGD recharged for 14 weeks from January-March.

Results

Based on the above, **the system-wide firm yield is 171 million gallons per day**.

Inputs and Assumptions for the Water Demand Forecast Model

Seattle Public Utilities has developed a new water demand forecast model for the water system planning process now underway. Following a literature review of demand forecast models used by other utilities, SPU settled on a "Variable Flow Factor" approach. As with simpler fixed flow factor models, current water demand flow factors are calculated by sector (single and multi-family residential, non-residential) for Seattle and each individual wholesale customer. However, like an econometric model, the Variable Flow Factor model reflects the impacts of variables such as price, income, and conservation on water flow factors for each sector over time. This approach takes advantage of past econometric analysis to provide estimates of how some of the variables (price and income) affect demand. SPU's Conservation Potential Assessment (CPA) Model is then used to estimate the impacts of code and programmatic conservation on the flow factors over time. The structure of the model is summarized in the flow chart on the next page while the model inputs and assumptions are outlined, below.

Model Inputs and Assumptions

⇨ **Weather adjusted base year consumption:**

By sector
- single family residential
- multifamily residential
- manufacturing non-residential
- non-manufacturing non-residential

By service area
- Seattle-inside city limits
- Seattle-outside city limits
- Individual wholesale customers

Base Year
- Retail: 2004
- Wholesale: 2003

Sources: SPU billing data, Annual Purveyor Surveys, NOAA

⇨ **Demographics: Historical and projected single- and multi-family households and employment:** The model uses Puget Sound Regional Council (PSRC) 2004 TAZ-level forecasts of population, households and employment to 2030 apportioned to Seattle and individual wholesale service areas. (These are the most recent forecasts available though PSRC is expected to release a new forecast in 2006.) A straight line extrapolation of average annual growth between 2010 and 2030 is used to forecast beyond 2030.

In the first table below is displayed PSRC's forecast of population, households, and employment in King County. The tables that follow contain these forecasts as they have been apportioned into water service areas. Separate tables are provided for SPU's entire service area, the retail service area and the wholesale service area. The last two tables further split the wholesale service area between those wholesale customers with block contracts and those without.

PSRC Forecasts of Population, Households, and Employment

King County

		Households			
	Population	Single Family	Multifamily	Total	Employment
2000	1,737,034	453,437	257,479	710,916	1,188,577
2010	1,869,479	475,497	306,573	782,070	1,351,220
2020	2,039,480	503,483	365,957	869,440	1,516,898
2030	2,202,366	522,084	437,423	959,507	1,670,793
2000-2030					
Growth	465,332	68,647	179,944	248,591	482,216
% Change	27%	15%	70%	35%	41%
Annual %	0.8%	0.5%	1.8%	1.0%	1.1%

As Apportioned to SPU's Retail and Wholesale* Service Area

		Household			
	Population	Single Family	Multifamily	Total	Employment
2000	1,238,645	318,628	206,184	524,812	952,618
2010	1,323,892	326,829	247,924	574,752	1,075,996
2020	1,443,404	341,413	298,168	639,581	1,204,694
2030	1,565,848	350,809	359,322	710,131	1,321,282
2000-2030					
Growth	327,203	32,181	153,138	185,319	368,664
% Change	26%	10%	74%	35%	39%
Annual %	0.8%	0.3%	1.9%	1.0%	1.1%

As Apportioned to SPU's Retail Service Area

		Household			
	Population	Single Family	Multifamily	Total	Employment
2000	618,323	151,070	128,604	279,674	557,005
2010	655,391	151,746	152,082	303,828	624,648
2020	711,171	154,352	182,669	337,021	682,243
2030	780,336	157,758	221,071	378,829	730,053
2000-2030					
Growth	162,013	6,688	92,467	99,155	173,048
% Change	26%	4%	72%	35%	31%
Annual %	0.8%	0.1%	1.8%	1.0%	0.9%

As Apportioned to SPU's Wholesale* Service Area

	Population	Household Single Family	Household Multifamily	Household Total	Employment
2000	620,322	167,558	77,580	245,139	395,614
2010	668,501	175,083	95,841	270,924	451,349
2020	732,233	187,061	115,499	302,560	522,452
2030	785,512	193,051	138,252	331,303	591,229
2000-2030					
Growth	165,190	25,492	60,672	86,164	195,616
% Change	27%	15%	78%	35%	49%
Annual %	0.8%	0.5%	1.9%	1.0%	1.3%

As Apportioned to SPU's Wholesale Service Area WITH Block Contracts

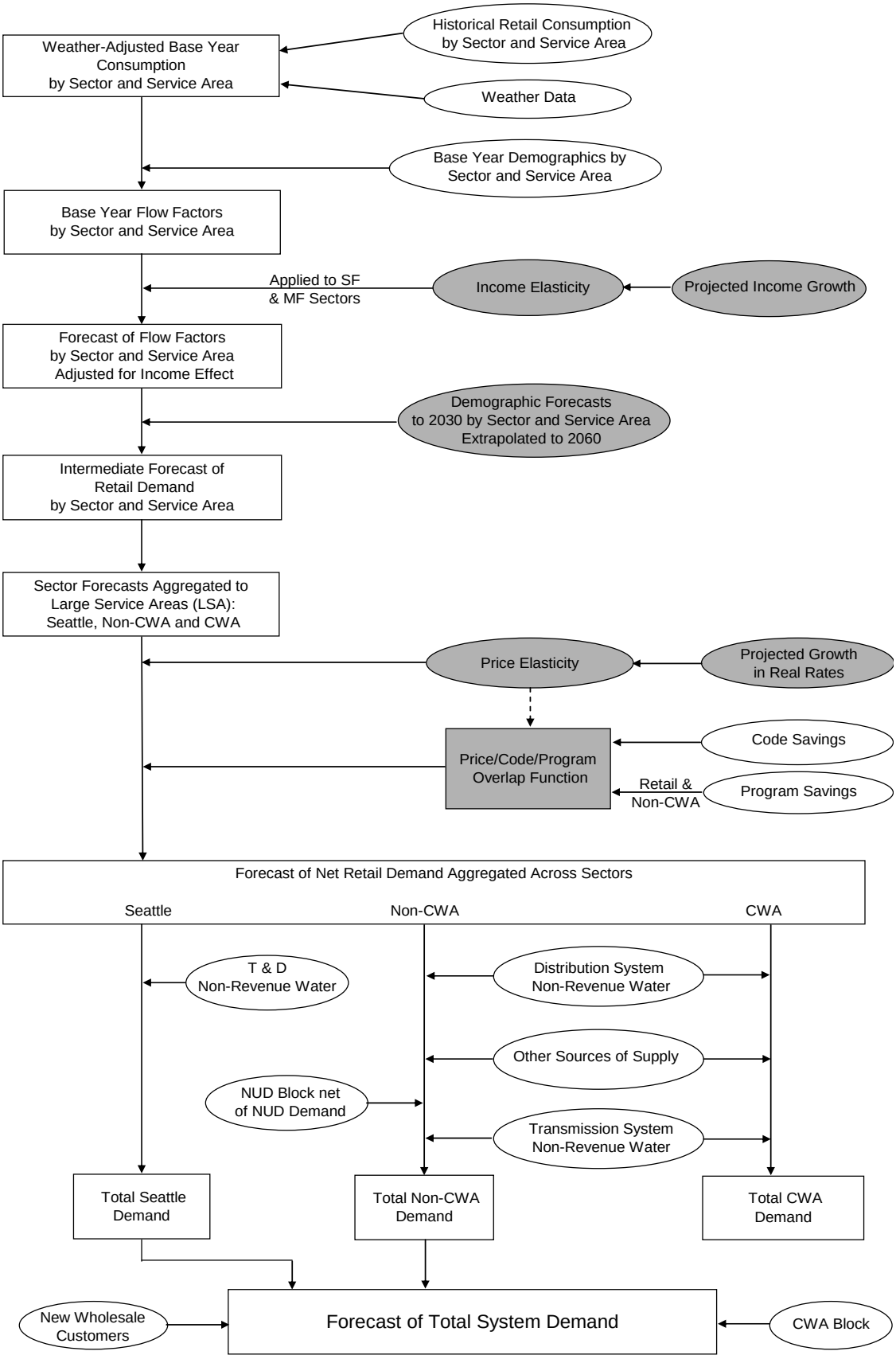
	Population	Household Single Family	Household Multifamily	Household Total	Employment
2000	270,823	71,372	41,073	112,444	272,184
2010	302,791	77,016	52,127	129,143	317,344
2020	333,075	81,504	64,079	145,583	368,456
2030	360,462	83,391	78,500	161,890	414,488
2000-2030					
Growth	89,639	12,019	37,427	49,446	142,304
% Change	33%	17%	91%	44%	52%
Annual %	1.0%	0.5%	2.2%	1.2%	1.4%

As Apportioned to SPU's Wholesale* Service Area WITHOUT Block Contracts

	Population	Household Single Family	Household Multifamily	Household Total	Employment
2000	349,498	96,187	36,507	132,694	123,429
2010	365,709	98,066	43,715	141,781	134,005
2020	399,158	105,557	51,420	156,977	153,995
2030	425,050	109,660	59,752	169,412	176,741
2000-2030					
Growth	75,551	13,473	23,245	36,718	53,312
% Change	22%	14%	64%	28%	43%
Annual %	0.7%	0.4%	1.7%	0.8%	1.2%

* Note that for demand forecasting purposes, the wholesale service area does not include Edmonds, Lake Forecast Park, or Renton.

WATER DEMAND FORECAST MODEL STRUCTURE



- **Base Year Flow Factors:** Base year flow factors are obtained by dividing the weather-adjusted base year consumption for each sector (e.g. single family residential) and service area (e.g. Bothell) by the corresponding number of households or employees in the base year.

- **Elasticity of residential demand to changes in real (inflation adjusted) household income:** Household income is generally expected to have a positive effect on water demand. A review of the literature revealed a range of estimated income elasticities. An elasticity value of **0.27**, representing the middle of this range, was chosen. (This means that a 10% increase in household income would be expected to cause a 2.7% rise in residential demand.)

  Source: Results of literature review

- **Forecast of annual growth in real mean household income:** A growth rate of **1.7%** was chosen based on national and local time series data on mean household income between 1960 and 2004.

  Sources: U.S. Bureau of Economic Analysis, Dick Conway & Associates.

- **Elasticity of demand to changes in real water prices:** A considerable body of literature has developed concerning the effect of price upon water demand and the inverse relationship predicted by economic theory is now well established. However, a number of complications summarized in the literature review (complex rate structures, conservation impacts, etc.) have made it difficult to estimate price elasticity with much confidence. As a result, there's a wide range of estimates in the literature but as with the income elasticity, values towards the middle of the range have been chosen for this model. These are shown below. (The value of -0.20 for single family households means that given a 10% increase in water prices, demand would be expected to decline by 2%.)

	Single Family	Multifamily	Non-Residential
Price Elasticity	**-0.20**	**-0.10**	**-0.225**

  Sources: Results of literature review, Seattle's 1992 econometric model.

- **Forecast of annual growth in real water prices**: Seattle and its wholesale customers have different water rates and different rate structures. Most customers face different marginal rates depending on whether they're residential or non-residential, what consumption block they fall in and what season it is. There is no single price of water. However, the model abstracts from all these complexities by using the system average price of water, i.e., total annual system revenue requirements (net of CWA's share) divided by annual retail and non-CWA billed consumption.

  The model assumes that the average system price increases by **1%** per year in real terms. This is less than the average historical rate of growth of about 2% since 1950 but is based on the assumption that revenue requirements double by 2060 adjusting for inflation. The growth rate for prices used in the demand model is slightly higher than that implied by the financial model through 2030. The financial model predicts that inflation-adjusted (real) rates will increase at about 1% annually through 2020 and then begin to decline so that by 2030, the average annual growth rate over the entire period is 0.3%. (This is the rate path for capital expenditures that includes "unanticipated needs" as described in Part II, Chapter

2.) The impact of this difference on demand is small and well within the uncertainties discussed below.

Sources: SPU revenue requirements forecast model and demand forecast model.

- **Conservation - Reductions in Water Use due to Code Savings:** Some conservation savings occur each year without SPU intervention due to federal and state plumbing codes that require that only low volume showerheads, toilets and aerators be sold or installed. As old fixtures are replaced with new ones in existing buildings and new fixtures are installed in new construction, water use efficiency improves and conservation savings accrue. The Conservation Potential Assessment (CPA) model was used to estimate these savings through 2030. These estimates are based on the assumption that showerheads, aerators and toilets are, on average, replaced every 15, 25 and 28 years, respectively. Code savings are expressed as percent reductions in the unadjusted[1] forecasts of consumption by sector and are shown in the table, below. Beyond 2030, cumulative code savings are assumed to continue growing but at a rapidly decreasing rate.

	Single Family	Multifamily	Non-Residential
2010	**-3.5%**	**-5.1%**	**-3.7%**
2020	**-7.4%**	**-10.9%**	**-7.1%**
2030	**-9.4%**	**-13.9%**	**-8.7%**

Source: Conservation Potential Assessment (CPA) model.

- **Conservation - Reductions in Water Use due to Programmatic Savings:** It is assumed that the remainder of the programmatic MGD targets is met by 2010. This along with the "Everyone Can Save" program and accelerated I-63 savings amounts to **6.8** mgd of programmatic savings from 2005 to 2010. Based on the January 2006 decision by the Seattle Regional Water System Operating Board, the forecast assumes **15** mgd of combined price-induced and programmatic conservation savings between 2011 and 2030, by reducing demand by 0.75 mgd each year in the 20-year period. These conservation savings are only applied to Seattle's retail and current non-CWA wholesale customers. There is assumed to be no additional programmatic conservation after 2030.

- **Price/Code/Programmatic Conservation Overlap:** Total conservation savings is adjusted downwards to account for the overlap between the different types of conservation. It is assumed that half of the price effect overlaps with code and programmatic savings as long as the total amount of overlap represents less than half of total code and programmatic conservation (as is the case over the forecast period). However, if the price effect exceeds combined code and programmatic conservation, the amount of overlap is capped at 50%.

- **Non-Revenue Water:** Combined transmission and Seattle distribution system non-revenue water is assumed to decrease from **12** mgd to **9** mgd between 2000 and 2015 as in-city reservoirs are covered. From that point on however, non-revenue water is projected to gradually increase, reaching **15.5** mgd by 2060. This increase is expected to be caused by the growing number of leaks that will probably occur as the distribution system ages. SPU's Waverider optimal pipe repair/replacement model was used to estimate pipeline leakage rates over the forecast period.

[1] i.e., prior to adjusting demand for the impacts of income growth, price increases, and programmatic conservation.

⇨ **Wholesale Customer Demands:**

- Wholesale customer distribution system non-revenue water is assumed to be a constant **6%** of retail water demand in the wholesale service area over the forecast period. This is added to the forecast of wholesale customers' retail demand.

  Source: Annual Surveys of Wholesale Customers, 1994-2004.

- Water that wholesale customers expect to obtain from other sources of supply is subtracted from their demand from the SPU system. This amount is currently about **5** mgd (which is split about evenly between CWA and Non-CWA customers) and is projected to reach **8** mgd by 2030.

  Sources: 2004 Survey of Wholesale Customers, direct communication with individual wholesale customers.

- Contract with the Cascade Water Alliance (CWA). Under the CWA contract, Seattle will provide a fixed block of **30.3** mgd to CWA through 2023. The block will be reduced by **5** mgd in 2024 and by another 5 mgd in 2030. Additional 5 mgd reductions will occur every 5 years thereafter through 2045, leaving a final block of **5.3** mgd. This has been incorporated into the forecast by subtracting the projected demand of CWA members that are currently Seattle wholesale customers, and adding the CWA block. The following cities and districts are members of CWA:

  - Bellevue
  - Covington
  - Kirkland
  - Issaquah
  - Redmond
  - Sammamish Plateau
  - Skyway
  - Tukwila

- Block contract with Northshore Utility District (NUD). Under a new contract with NUD, Seattle will reserve a fixed block of **8.6** mgd for NUD through the contract period which terminates in 2060. This has been incorporated into the forecast by subtracting NUD's projected demand and adding the NUD block. Note that current NUD demand is about 3 mgd less than its block. By 2060, actual NUD demand is expected to be approximately equal to its block.

- Forecasts of demand from potential new wholesale customers are based on data provided by them on their projected demand and existing supplies. Potential new wholesale customers included in the forecast are:

  - Ames Lake
  - North Bend
  - Sallal

  …with total demand ramping up to **1.4** mgd by 2040.

  Source: direct communication with Executive Director of East King County Regional Water Association (EKCRWA).

- It is assumed that Edmonds will continue to buy all its water from Alderwood.

⇨ **Environmental Block:** Unlike the 2004 official demand forecast, the set-aside for the Environmental Block is not included as a component of water demand in the current forecast because this requirement will be met through other mechanisms. The Environmental Block, as defined in the I-63 Settlement Ordinance, is water dedicated to environmental benefits for salmon that increases over time from 2 MGD in 2001 to as much

as 12 MGD in 2015. That commitment is now intended to be met through the 2006 agreement with the Muckleshoot Indian Tribe, in which the City agrees to leave 20 MGD of its perfected water right in the Cedar River.

- **Weather-Induced Demand Variability:** Because the base year flow factors are calculated from weather-adjusted consumption data, the forecast represents demand under average weather conditions. However, in any one year, actual demand may be higher or lower than forecast due to variation in summer weather. Analysis of daily consumption data back to 1982 shows a maximum variability of about plus or minus 5%. In other words, an extremely hot dry summer would be expected to increase annual consumption *in that year* by up to 5% above the average trend.

Results

Given the assumptions described above, the water demand forecast is considerably lower than the last official forecast and remains considerably below SPU's current firm yield of 171 mgd until well after 2060. Total demand is forecast to decline from **140** mgd in 2005 to **129** mgd in 2030. Additional reductions in the CWA block is expected to keep demand relatively flat over the following 15 years. Once the CWA block has been reduced to its minimum level in 2045, water demand is forecast to begin rising again, finally reaching current levels by about 2050 and **159** mgd by 2060.

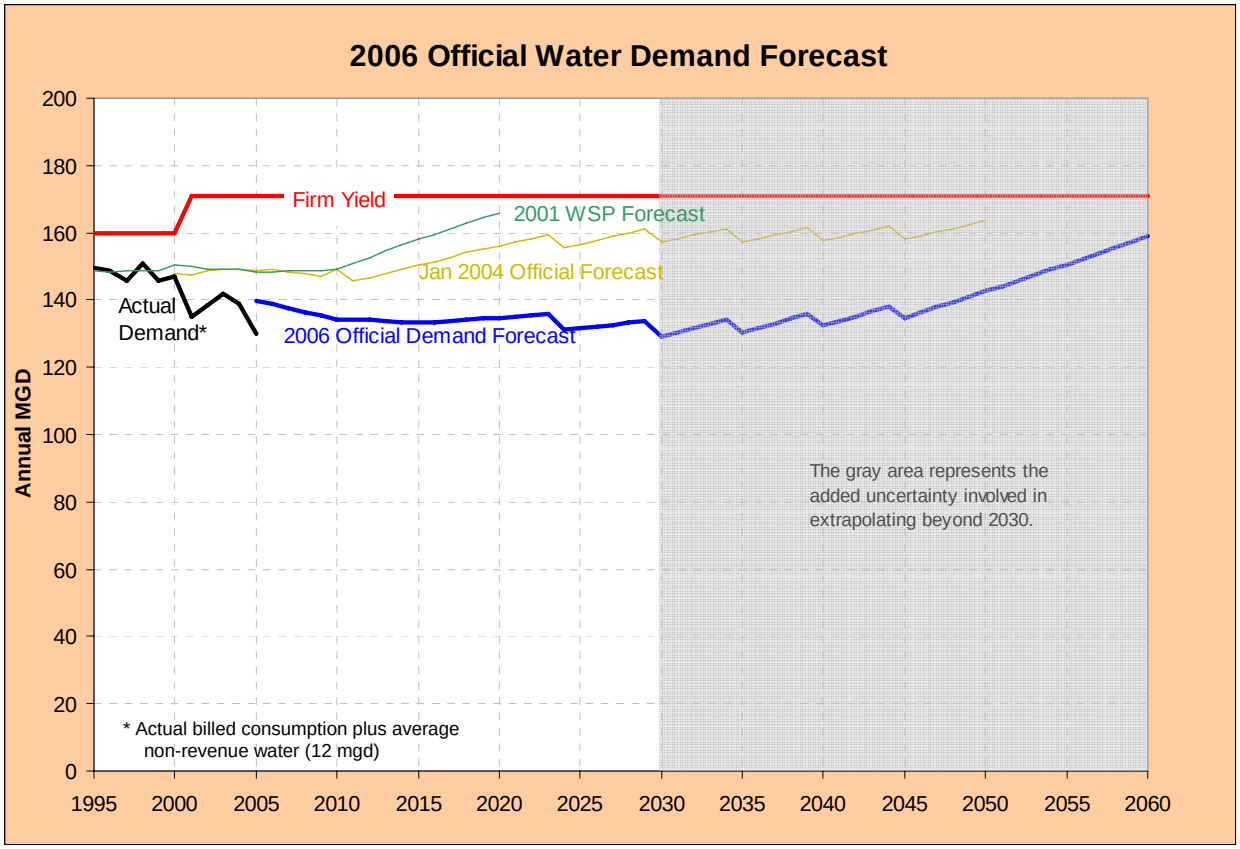
The first graph on the following page shows the forecast of demand and supply out to 2060. The gray area between 2030 and 2060 represents the additional uncertainty involved in forecasting out more than 25 years. The previous official forecast is also shown.

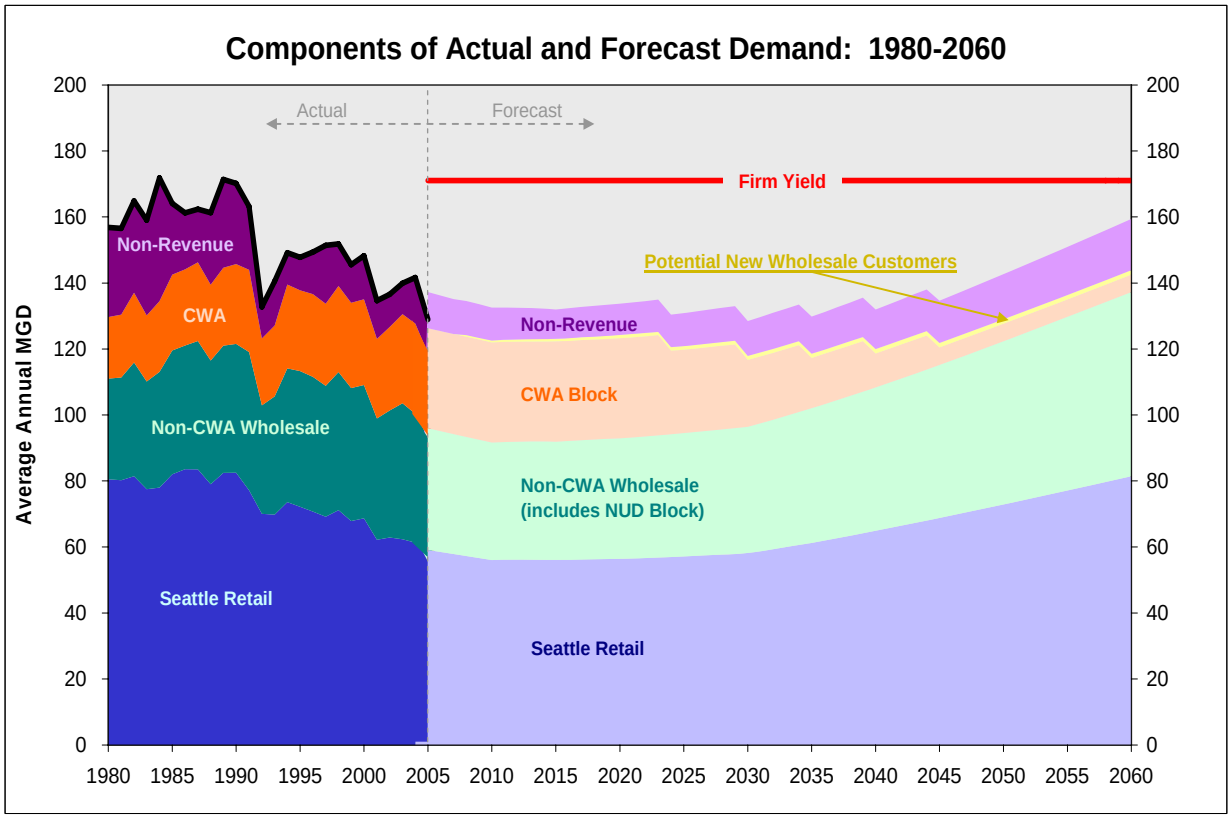
Although the methodology used in the current forecast is very different than that used in earlier versions, the primary reason the new forecast is so much lower than the previous official forecast has to do with changes in planned programmatic conservation. The old forecast assumed the 1% Conservation Program would keep demand flat from 2000 through 2010 and very little programmatic conservation would occur after 2010. The new forecast reflects a planned 6.8 mgd of additional 1% program savings from now through 2010 and another 15 mgd of programmatic and price-induced conservation between 2011 and 2030. The table below and the second graph on the next page show the components of actual and forecast water demand.

Components of Actual and Forecast Water Demand
All figures in millions of gallons per day (MGD)

	Year	Billed Demand								Non-Revenue Water	Total System Demand	
		Seattle Retail				Wholesale					Annual Average[4]	Peak Day[5]
		SF Res	MF Res	Non-Res	Subtotal	Non-CWA[1]	CWA[2]	New[3]	Subtotal			
ACTUAL	2000	26.9	14.5	27.7	69.0	40.5	25.9	-	66.4	12.8	148.2	241.9
	2001	24.0	13.6	24.6	62.2	36.8	24.1	-	60.9	11.5	134.6	204.0
	2002	24.8	13.4	24.6	62.8	38.5	25.4	-	63.8	9.9	136.5	222.6
	2003	24.9	12.8	24.6	62.3	41.4	26.9	-	68.3	9.3	139.9	250.2
	2004	24.2	12.5	24.6	61.3	39.0	27.4	-	66.4	14.0	141.7	246.8
	2005	22.6	12.1	23.4	58.1	35.4	25.5	-	60.9	7.7	126.7	210.4
FORECAST	2005	23.4	12.2	23.5	59.1	39.5	30.3	0.0	69.8	11.0	139.9	229.2
	2006	23.0	12.3	23.2	58.5	39.2	30.3	0.0	69.5	10.8	138.7	227.3
	2007	22.7	12.3	22.9	57.9	38.8	30.3	0.0	69.1	10.6	137.6	225.5
	2008	22.3	12.3	22.6	57.3	38.0	30.3	0.5	68.8	10.4	136.5	223.7
	2009	22.0	12.4	22.3	56.7	37.7	30.3	0.5	68.6	10.2	135.4	221.9
	2010	21.6	12.4	22.0	56.1	37.4	30.3	0.6	68.3	10.0	134.3	220.1
	2011	21.5	12.6	22.0	56.1	37.4	30.3	0.6	68.3	9.8	134.2	219.9
	2012	21.4	12.8	22.0	56.1	37.3	30.3	0.7	68.3	9.6	134.0	219.6
	2015	21.0	13.2	21.8	56.0	37.1	30.3	0.8	68.2	9.0	133.2	218.2
	2020	20.5	14.2	21.7	56.4	37.5	30.3	1.0	68.8	9.5	134.7	220.7
	2025	20.1	15.3	21.7	57.1	38.2	25.3	1.1	64.6	10.0	131.7	215.8
	2030	19.9	16.5	21.7	58.1	39.0	20.3	1.2	60.5	10.6	129.2	211.6
	2035	20.4	18.3	22.5	61.2	41.3	15.3	1.3	57.8	11.3	130.3	213.6
	2040	21.1	20.4	23.4	64.9	43.8	10.3	1.4	55.4	12.0	132.3	216.8
	2045	21.8	22.6	24.4	68.8	46.5	5.3	1.4	53.1	12.8	134.7	220.8
	2050	22.5	25.0	25.4	72.9	49.3	5.3	1.4	56.0	13.7	142.5	233.6
	2055	23.3	27.5	26.3	77.1	52.3	5.3	1.4	58.9	14.6	150.6	246.7
	2060	24.1	30.0	27.3	81.4	55.3	5.3	1.4	61.9	15.5	158.8	260.2

1. The forecast of non-CWA demand includes the Northshore Utility District (NUD) block while the historical consumption data contains NUD's actual demand. NUD's block exceeded its actual demand by 3.4 mgd in 2005.
2. The forecast of Cascade Water Alliance (CWA) demand is equal to its block while the historical consumption data reflects water actual purchased from SPU by CWA members. The CWA block exceeded the actual consumption of CWA members by 4.8 mgd in 2005.
3. Potential new wholesale customers.
4. The forecast of Total System Demand includes the NUD and CWA blocks while the historical consumption data reflects SPU water actually purchased by NUD and CWA.
5. The forecast of peak day demand is based on a peak day factor of 1.64, the average ratio of peak day to average annual demand for the period 1999 through 2005.


2006 Official Water Demand Forecast
Annual MGD
Firm Yield
2001 WSP Forecast
Jan 2004 Official Forecast
Actual Demand*
2006 Official Demand Forecast
The gray area represents the added uncertainty involved in extrapolating beyond 2030.
* Actual billed consumption plus average non-revenue water (12 mgd)


Components of Actual and Forecast Demand: 1980-2060
Average Annual MGD
Actual
Forecast
Firm Yield
Non-Revenue
CWA
Non-CWA Wholesale
Seattle Retail
Potential New Wholesale Customers
Non-Revenue
CWA Block
Non-CWA Wholesale (includes NUD Block)
Seattle Retail

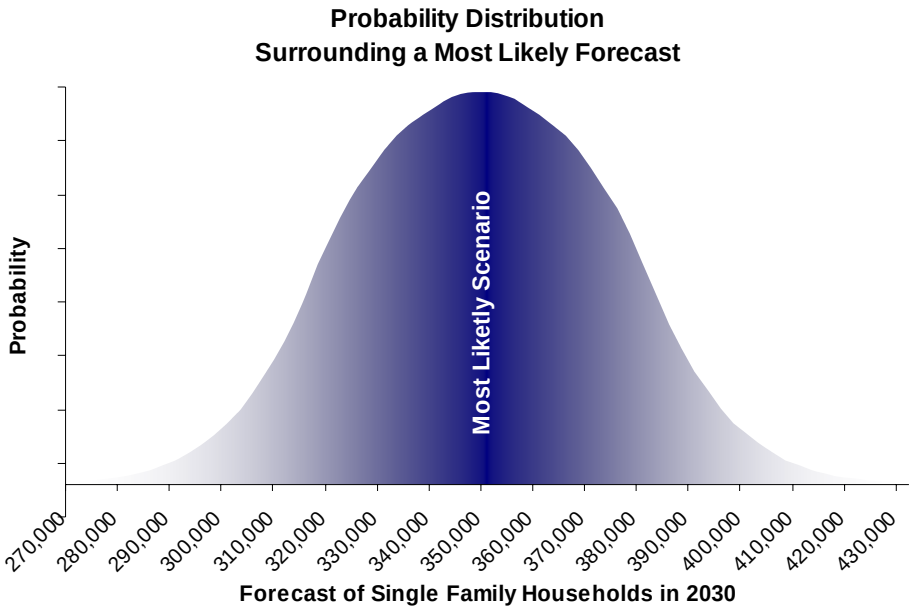
Forecast Uncertainty

What is most certain about a forecast out to 2060 is that it will be wrong. Actual demand in 2040 or 2060 is highly unlikely to be exactly what was forecast back in 2006. The official water demand forecast is itself based on forecasts of income, water prices, households and employment – all subject to uncertainty. Additional uncertainty surrounds the forecast model's assumptions about price and income elasticities, future conservation, wholesale customers' other sources of supply, and whether SPU will gain new customers and/or lose existing customers.

The Official Demand Forecast represents both SPU's policy intentions and its expectations of the future. However, it is prudent, especially in long-term planning, to consider the many uncertainties that could cause demand to be different from what's projected in the official forecast. These uncertainties fall into two categories – discrete and continuous – and are handled in two different ways.

The first category refers to those uncertainties that result from discrete events that produce significant and sometimes abrupt changes in customer demand. Discrete uncertainties represent occurrences that either happen or don't. They're on or off, yes or no (though there can be more than two conditions). An example of a discrete uncertainty is whether or not the Weyerhaeuser water right is developed. If it isn't, SPU continues to serve Woodinville and Northshore. If the project is developed, Woodinville and Northshore have a new supply source and demand from SPU is reduced by 12 to 13 mgd. This and other discrete uncertainties are thought to be best handled by running individual "what-if scenarios" through the demand forecast model.

The second category consists of the continuous uncertainty that surrounds the various inputs to the model. An example would be the forecast of household growth. Actual growth over the forecast period could turn out to be lower or higher than forecast. These types of uncertainties can be represented by a continuous probability distribution around a mean or most likely value as illustrated below.



Modeling Continuous Uncertainty

A number of model inputs were identified as being subject to continuous uncertainty. (These are shown in the model structure flowchart on page 2 shaded in gray.) They include forecasts of single and multi-family households and employment; average annual growth rates for water prices and household income; price and income elasticities; and the extent to which price-induced conservation overlaps with code and programmatic conservation. Each uncertainty was modeled by specifying a probability distribution around the mean value of each variable. Many sources were consulted to define the range of uncertainty[2] and the shape of the distributions. The sources and assumptions used to characterize continuous uncertainties are outlined below.

Forecasts of Households and Employment: Two different sources were consulted to establish uncertainty ranges around the forecasts of long term demographic growth. The Washington State Office of Financial Management (OFM) produced high and low forecasts of population by county based on historical variability in net migration rates. Dick Conway and Associates developed high and low alternatives around the PSRC long term regional forecasts of population and employment (but not households) based on optimistic and pessimistic scenarios for the local and national economies[3]. The greater geographical specificity of the OFM forecasts was combined with the more rigorous methodology and wider range between low and high provided by Dick Conway's analysis. The ranges of uncertainty around the projections of households, employment and population used in the demand forecast model are shown in the table, below. The forecast number of multifamily households in 2060, for example, is 35% less than the baseline forecast in the low growth scenario and 54% higher in the high growth scenario.

Uncertainty Ranges Around Mean Values
Associated with High and Low Demographic Growth Scenarios

	2030		2060	
	Low	High	Low	High
Single Family Households	-8%	12%	-15%	24%
Multifamily Households	-24%	37%	-35%	54%
Employment	-12%	19%	-20%	30%
Population*	-14%	22%	-25%	38%

* The number of single and multi-family households rather than population is used in the demand forecast model.

The ranges around single and multi-family households were derived from the reported high and low population values and the assumption that variability around the single family forecast is less than for the forecast of multifamily households. Note that the potential variation from forecast values is expected to be greater on the high side than on the low side.

Growth in the Price of Water: System water rates are obtained by dividing each year's projected revenue requirement by projected demand. Uncertainty about future water prices derives from variability in both of these terms. The baseline assumption is that revenue requirements will double in real (inflation-adjusted) terms between now and 2060. This combined with the baseline water demand forecast implies increases in real water prices of about 1% per year over the forecast period. The range of uncertainty around this is

[2] Each range is characterized by a high and low value representing two standard deviations from the mean.
[3] Scenarios developed by DRI-WEFA (now known as Global Insights, Inc.)

assumed to be **plus or minus 80%** resulting in projected annual growth rates in real prices of between **0.2%** and **1.8%**. This range corresponds to the assumption that real revenue requirements could grow by as little as 25% by 2060 or triple by that time.

The model handles the impact on price of different levels of projected demand in a different way. Given the same set of revenue requirements, lower demand results in higher water prices and vice versa. That means that price effects would be expected to amplify swings in demand. For example, higher-than-projected demographic growth would cause demand to be higher than the official forecast, resulting in reduced prices and an additional boost in demand. The amount of the boost is determined by the price elasticity of demand and the amount by which prices fall. Incorporating this demand-price-demand-etc. feedback loop explicitly into the model isn't feasible because, as is explained in more detail below, the uncertainty analysis involves running 10,000 iterations of the demand model. However, the feedback loop has been approximated by widening the range of uncertainty around growth in households and employment. The amounts by which the ranges have been increased are **4.9%** on the high side and **6.4%** on the low side[4].

Price Elasticity: The uncertainty ranges around price elasticity represent a synthesis of the various estimates of price elasticity reported in the literature review. These are **plus or minus 50%** for single and multi-family elasticities and **plus or minus 33%** around the non-residential elasticity.

Uncertainty Ranges Around Mean Price Elasticities

	Single Family	Multi-Family	Non-Residential
Low	-0.10	-0.05	-0.15
Mean	-0.20	-0.10	-0.225
High	-0.30	-0.15	-0.30

Growth in Real Household Income: Historical income data at both national and local levels revealed very little variation in real income growth when averaged over long (30 year) periods of time. Therefore, a relatively narrow uncertainty band of **plus or minus 18%** was placed around the projected 1.7% annual rate of income growth resulting in annual growth rates between **1.4%** and **2.0%**.

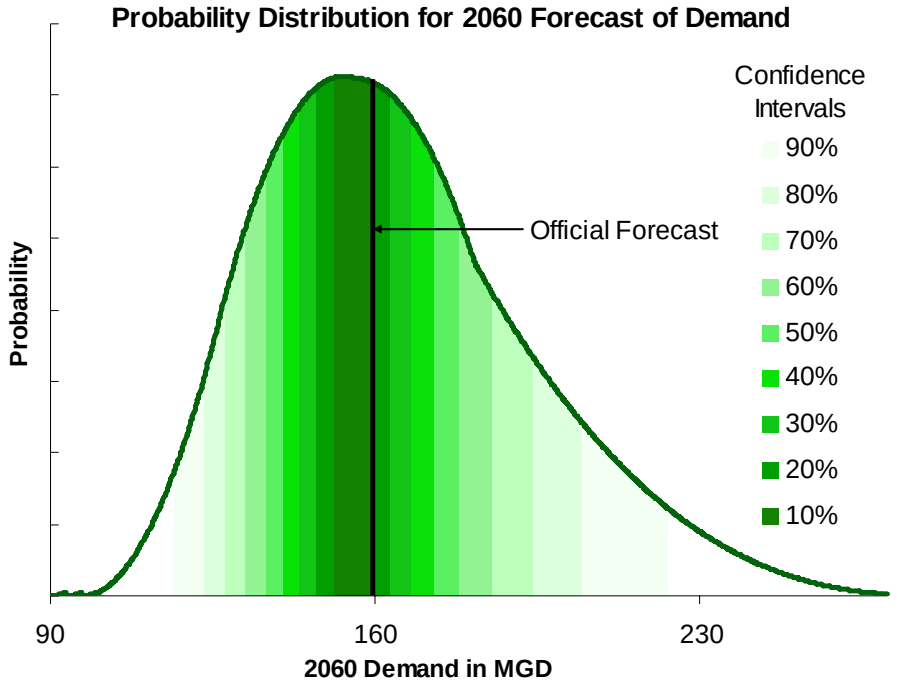
Income Elasticity: As with price elasticity, the uncertainty band around income elasticity was derived from the various estimates of income elasticity in the literature review. A range of income elasticities from **0.19** to **0.35** (i.e., **plus or minus 30%**) around the mean value of 0.27 was chosen.

Conservation Savings: The price/code/programmatic conservation overlap function is used to introduce an element of uncertainty to overall conservation savings. The baseline assumption is that 50% of the price effect overlaps with code and programmatic conservation. Assuming a higher level of overlap produces a smaller amount of total conservation savings, and vice versa. A range of conservation savings are obtained in the model by varying the overlap parameters between **25%** and **75%**.

[4] These percents were obtained by calculating the percent changes in 2060 water prices that would result from the high and low growth scenarios relative to the baseline scenario and multiplying them by the average price elasticity.

Modeling Uncertainty with @Risk: The uncertainty ranges described above are assumed to have normal or log-normal distributions,[5] with the endpoint values representing two standard deviations from the mean. These probability distributions become inputs to an aggregate uncertainty model using @Risk software (an add-in to Excel) which employs Monte Carlo simulation to characterize uncertainty around the official demand forecast. During each individual run of the Monte Carlo simulation, a value is randomly selected for each input variable based on the probability density function specified for that variable[6]. Then, the complete set of input values for that iteration is used to produce a water demand forecast. The simulation procedure performs a large number (10,000) of independent iterations, each generating a separate demand forecast. These forecasts are then pooled to obtain a probability distribution of forecast water demand through 2060.

The results of the Monte Carlo simulation are displayed in the graph on the next page. The green bands indicate the range of uncertainty around the official forecast with each band representing a 5% change in probability. For example, the bottom of the lowest band represents the 5th percentile. That means it's estimated there's a 5% chance actual demand will be below that point (and, thus, a 95% chance it will be above). The top band is the 95th percentile which corresponds to an estimated 95% probability that actual demand will be below that point. Taking a cross-section of the graph at 2060 produces the probability distribution around the official forecast shown below.



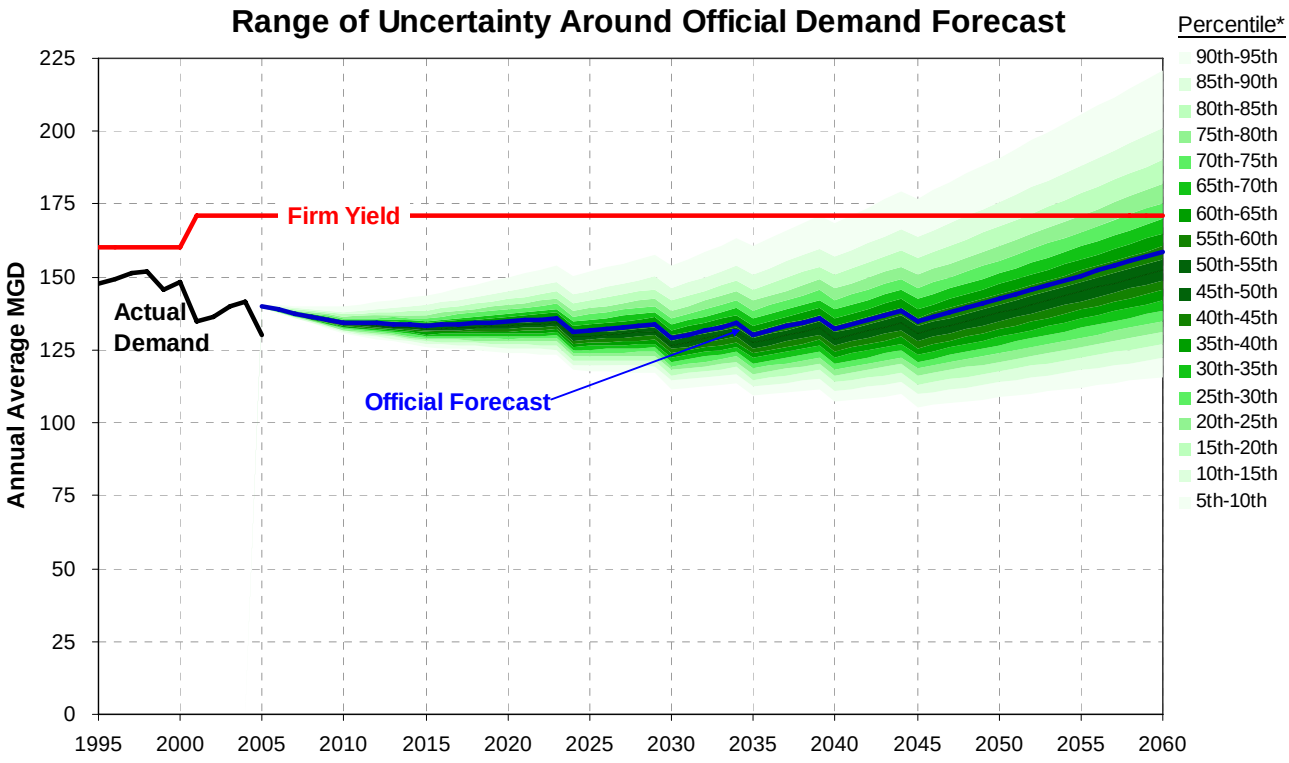
The uncertainty model represents a significant refinement over simply compounding all the high or all the low assumptions to create extreme high and extreme low scenarios. In the extreme high scenario, everything that could possibly cause demand to be higher than forecast is assumed to happen at the same time. The extreme low scenario is just the opposite with all low side assumptions applied simultaneously. These extreme scenarios overstate the actual

[5] Log normal distributions are used for the uncertainty around household and employment growth because the high and low ranges exhibit positive skewness (i.e., the highs are higher than the lows are low).

[6] All variables with uncertainty are assumed to be independent except for growth in households and employment. These are linked in the model because they would be expected to move together.

uncertainty surrounding demand because they represent two highly unlikely combinations of events with essentially zero probability of occurring. The Monte Carlo simulation provides narrower bands of uncertainty and information about their estimated probabilities.

Implications: Given the current firm yield estimate for SPU's existing supply resources and the official demand forecast, a new source of supply will not be needed until well after 2060. Taking demand uncertainty into consideration, there's still more than a 70% probability that a new source will not be necessary before 2060. At an even higher level of confidence, the uncertainty analysis implies a 90% probability that existing sources will be sufficient to meet demand through at least 2048. This analysis does not explicitly calculate the possible impact of the "discrete" category of uncertainties mentioned in the introduction. However, none of the discrete uncertainties that have been identified (development of Weyerhaeuser water right, changes in the CWA contract, new federal standards for washing machines, etc.) would shift the forecast of demand beyond the range calculated for continuous uncertainties and shown in the graph, below.



* Percentiles represent the probability that demand is less than the value shown. Ranges reflect uncertainty in projected household, employment, price and income growth; price and income elasticities; and conservation. Note that the Official Forecast is at about the 57th percentile.

SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

I. WATER RESOURCES

APPENDIX B

WATER CONSERVATION PLAN 2007 - 2012

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Seattle Public Utilities
Water Conservation Plan 2007-2012
Technical Appendix
July 2006

Water conservation is integral to how Seattle Public Utilities (SPU) is preparing for the uncertainty of climate change, managing its water resources for people and fish, and helping customers reduce their bills.

SPU and its regional partners – building on two decades of experience and achievement – have made a commitment to water conservation through the year 2030. Significant water savings will be realized from a combination of water rates, the plumbing code, system efficiencies, and programmatic efforts.

The six-year water conservation goal articulated in this plan is expected to reduce demand by over 13 million gallons a day (mgd) of average annual savings from 2007-2012. Key components include:

- Continuation of the regional 1% Conservation Program and the Seattle-only I-63 Settlement Ordinance Program through 2010; and
- Regional baseline conservation program commitment from 2011-2030.

This appendix details the analysis and approach that support SPU's conservation plan.

Evaluation of Cost-Effective Conservation

In order to evaluate conservation for its *2007-2012 Water Conservation Plan*, SPU updated its *1998 Conservation Potential Assessment* (CPA) in 2004 and revised it in 2006. The *2006 Conservation Potential Assessment (2006 CPA)* is included as an attachment to this appendix and contains details of the assessment.

The *2006 CPA* calculates and reports on water savings and levelized costs[1] for both average annual demand and peak season demand for 135 conservation measures. The CPA analysis also calculates other benefits obtained by the conservation measures including savings from reductions in demand for electricity, stormwater and wastewater. The CPA incorporates efficiencies expected from the State Building Code relative to plumbing fixtures. The code savings are used to calculate the savings in Exhibit 2, below, and are also incorporated into SPU's water demand forecast.

Cost-effectiveness for the 1% Program intended to operate through 2010 is based on the marginal cost of new supply – described as "avoided cost." This was used because conservation was being implemented as a source of supply that could be compared to other sources of supply that might be constructed to bring new water into the system. Because the current demand forecast does not indicate that a new source of supply is needed until sometime after 2060, and much can change prior to when a new source is developed, no single alternative was selected as the next preferred source for which to compare baseline conservation costs. Without a set level of avoided cost, this was not used as a measure of cost-effectiveness for selecting conservation measures beyond 2010.

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

In 2006, SPU completed an analysis using its new water supply planning model[2] . This model evaluates the unit costs of new future water supply alternatives, including additional conservation programs, along with a "value score" that captures the non-monetary benefits of each alternative. Preferred alternatives are selected based on costs and value-added, and not costs alone. Alternative selection is based on providing the highest value at the lowest cost, with recognition that tradeoffs in value and costs are policy decisions.

The *2006 CPA* ranks all of the conservation measures according to the marginal cost of achieving a unit of water savings. The *2006 CPA* analysis was used to:

- Incorporate CPA findings into the regional 1% Water Conservation Program (1% Program) to fine-tune the measures for the 2007-2010 portion of the Conservation Goal;
- Package groups of measures for the *Conservation Drivers Analysis* to evaluate eight program alternatives of varying intensity to set the level for the 2011-2012 portion of the Conservation Goal termed "Regional Baseline Conservation 2011-2030"; and
- Analyze three "Technical Potential" packages for the *SPU Water Supply Planning Model*. They were selected for use in analyzing future water supply alternatives to represent options for a new source of supply that achieves a high volume of savings, and does so at an acceptable annual and marginal cost.

Regional 1% Water Conservation Program (2007-2010)

The regional Water Conservation Program (1% Program) will generate the majority of savings in the 2007-2012 Conservation Plan. The 1% Program was created in 1999 and expanded to include the entire SPU service region in 2000, however, Cascade Water Alliance (CWA) member utilities no longer participate in this conservation program. The program will operate through 2010.

The 1% Program is sponsored by the Saving Water Partnership that includes SPU and a group of 17 utilities purchasing wholesale water from SPU. SPU administers the 1% Program in collaboration with these utilities, under the terms of long-term water supply contracts.

In 1999, as noted previously, impetus for the 1% Program was a demand forecast that illustrated the need for a new source of supply by 2013 without conservation. The long-term goal was to keep water demand by the end of 2010 at the same level as it was in 1999, despite growth in population and economic activity.

Two performance targets were set for the 1% Program from 2000-2010:

- Reduce annual per capita consumption 1% per year; and
- Achieve a programmatic conservation savings of 14.5 million gallons a day (mgd) peak season savings (11.0 mgd annual average)[3].

[2] CH2M Hill, *SPU Water Supply Planning Model*, April 2006.

[3] 2004 target and years thereafter adjusted down from the original 18 mgd peak season savings target to reflect withdrawal of Cascade Water Alliance utilities from the 1% Program.

The conservation savings target roughly corresponded to the forecasted growth in water demand in the service region over this same time period.

Program design, conservation measures and performance by sector, consumption analysis, and projects and technologies by water provider is provided in the *2002 Ten Year Conservation Program Plan* and the *Saving Water Partnership Regional 1% Water Conservation Program, 2004 Annual Report.* Both of these documents are provided as attachments to this appendix. As a routine part of operating the 1% Program, SPU adds and deletes measures based on market advances, customer preferences, collaboration opportunities with energy utilities and other agencies, and savings achieved. The measures implemented in the 1% Program are based on the evaluation in the *1998 CPA*, the *2004 CPA Update*, and the *2006 CPA*. The most recent assessment indicates diminishing opportunities over time with hardware-related measures (e.g., rebates for low-flow toilets) and an opportunity to increase savings from customer behavioral changes (e.g., landscape watering).

A listing of recently implemented conservation projects and technologies is located in the *Regional 1% Water Conservation Program, 2004 Annual Report* Chapter 5 "Rebate Program Activity by Water Provider." This report is provided as part of this appendix.

Seattle Ordinance 120532 (I-63 SO) (2007-2010)

In 2001, the City of Seattle adopted Ordinance No. 120532, sometimes referred to as the Initiative 63 Settlement Ordinance (I-63 SO). The I-63 SO commits the City of Seattle to pursue conservation beyond the 1% Program in the SPU direct service area. As shown in Exhibit 2, below, depending on cost effectiveness and other considerations, savings in 2007-2010 from implementation of the I-63 SO conservation provisions will come from:

- Retrofit of low-income housing through the "Everyone Can Conserve Program;"
- Reclaimed water projects;
- Reservoir covering and other system efficiencies; and
- Conservation investments in City of Seattle facilities and system operations.

Pursuant to the requirements of Ordinance 120532, SPU revised its conservation program plan to include I-63 SO provisions. The Mayor and City Council approved the City of Seattle Supplement to the Ten Year Conservation Program Plan in 2003 (Resolution 30584). The Seattle City Council directed SPU to complete a next phase implementation strategy for the "Everyone Can Conserve Program" in 2004.

Through the "Everyone Can Conserve Program" nearly 14,500 low-income housing units have been upgraded with high efficiency toilets, showerheads, faucet aerators, and common area laundry facilities since 2002. SPU's goal will be to retrofit 50 percent of the remaining, eligible, low-income housing units by 2010 targeting non-subsidized low-income housing and self-certified recruitment of low-income single family households.

Regional Baseline Conservation (2011-2012)

The 2011-2012 portion of the 2007-2012 conservation goal is based on SPU's regional baseline conservation 2011-2030 target.

As the demand forecast illustrates, SPU is not projected to need a new source of supply until sometime beyond 2060. Since conservation is not currently needed as a source of supply, SPU has undertaken two efforts to determine the appropriate regional water conservation target from 2011-2030. They included:

- Conservation Drivers Analysis: A qualitative review and rating of risks related to future water conservation alternative goals; and
- *2006 Conservation Potential Assessment* (described above).

Two questions the efforts set out to answer included:

- What are the reasons to provide water conservation programs from 2011-2030 if not to offset the need for new supply?
- How much savings might be needed to meet those objectives and what would the cost be?

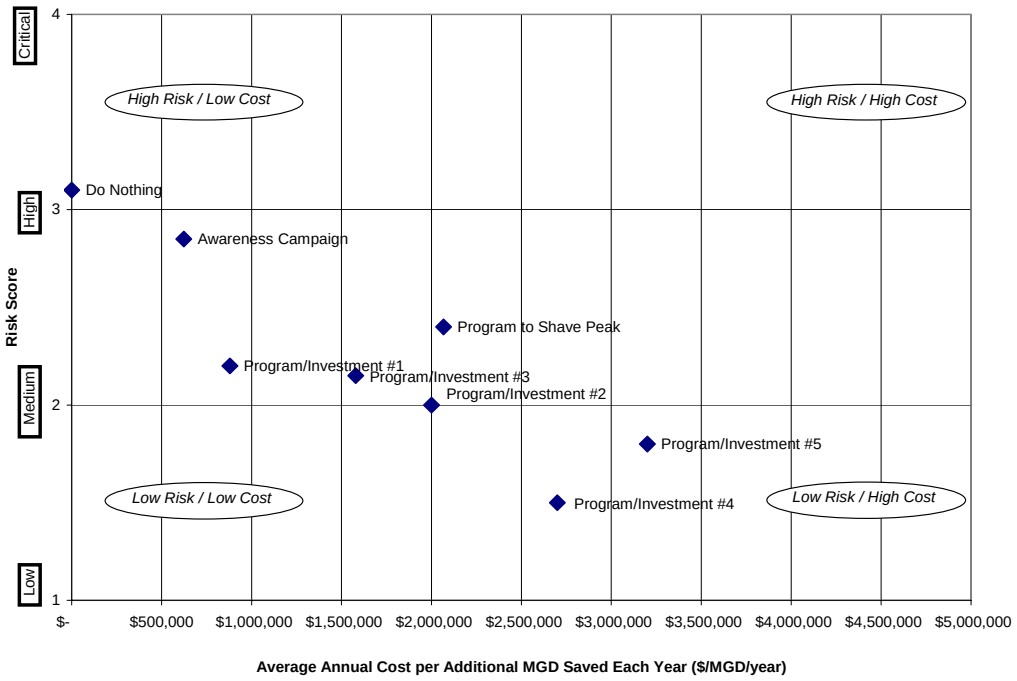
To answer the first question, risks were analyzed including public trust concerns, regulatory issues, asset and service reliability, legal concerns, environmental issues, financial ramifications, workforce issues, social and public health concerns. These risks were ranked relative to eight conservation alternatives of varying intensity. The results are shown in Attachment 1, "Assessment by Risk Categories."

To answer the second question, the Seattle Water Supply System Operating Board (Operating Board) reviewed eight alternative baseline strategies including "Do Nothing," "Awareness Campaign," "Program to Shave Peak," and "Variable Intensity Options" that ranged from efforts less intensive than the current 1% Program to greater intensity than the 1% Program. Five alternatives were selected to represent a reasonable range of future conservation investments for the "Variable Intensity Options;" other possible alternatives were not selected because of the very high marginal cost of additional supply (see Table 9 in the *2006 CPA*). For each of the eight alternatives, calculations of water savings and costs were defined based on the CPA analysis. Attachment 2 provides a summary matrix of program options, costs and risk ratings.

The *Risk Score vs. Average Cost per Annual Savings* analysis, shown by the graph in Exhibit 1 below, indicates that a 2011-2030 conservation goal of 15 mgd of cumulative average annual savings (Program/Investment #1/#2) has the lowest risk and lowest cost while serving all customer classes. This level of conservation was adopted by the Operating Board as the Regional Baseline Conservation program from 2011-2030.

SPU will participate in the 2011 - 2030 Program along with most of its wholesale customers. The 2011-2030 Program will include both public education and customer incentives for water efficient equipment (hardware) that targets both indoor and outdoor conservation measures. It will serve all customer classes and offer a broad array of measures based on the CPA, customer research, market advances, and staff expertise. In comparison to the 1% Program, there will be increased savings from customer behavioral changes (e.g., landscape watering, shorter showers, elimination of partial loads in dishwashers and clothes washers, etc.). SPU is also exploring the interaction of its conservation programs and price induced water savings.

Exhibit 1
Risk Score vs. Average Cost per Annual Savings



Measures to be included in the 2011-2030 Program will be selected based on cost and benefit as the time draws nearer to implementation. The CPA will be updated next in 2008. Exhibit 2 provides estimates of how savings will be achieved to meet the conservation goal.

Exhibit 2
Water Conservation Goals and Other Savings
Average Annual Savings in Millions of Gallons Per Day (MGD)

	2007	2008	2009	2010	2011	2012
Conservation Goals						
Regional 1% Program	1.12	1.12	1.12	1.12	--	--
Seattle Ordinance 120532 (I-63 SO)*	0.63	0.63	0.63	0.63	--	--
Regional Baseline Conservation 2011-2030	--	--	--	--	0.75	0.75
Total Conservation Goal	**1.75**	**1.75**	**1.75**	**1.75**	**0.75**	**0.75**
Other Savings						
Plumbing Code	0.69	0.66	0.64	0.62	0.60	0.58
Price Savings**	0.20	0.20	0.20	0.20	--	--
Total Other Conservation	**0.89**	**0.86**	**0.84**	**0.82**	**0.60**	**0.58**
TOTAL SAVINGS	**2.63**	**2.61**	**2.59**	**2.57**	**1.35**	**1.33**

* Savings are from SPU's direct service area and include the "Everyone Can Conserve" program, reclaimed water projects, reservoir covering and other system efficiencies, and conservation investments in City of Seattle facilities.

** After 2010, included in Baseline Conservation.

Exhibit 3 below provides details on the water savings targets, schedule from 2007 - 2012 and funding for the implementation of the 1% Program and as well as the conservation efforts that are occurring just within the City of Seattle.

Exhibit 3
Water Saving Partnership (1% Program) and Seattle Only* Implementation Targets, Schedule and Funding (in mgd and million $)

Water Savings Sector	2007	2008	2009	2010	2011	2012
Landscape	0.16	0.2	0.1	0.16	0.1	0.1
Commercial, Industrial, Institutional	0.35	0.4	0.5	0.5	0.25	0.25
Residential Domestic	0.50	0.5	0.5	0.44	0.4	0.4
Total Ave Annual Savings	1.1	1.1	1.1	1.1	0.75	0.75
Regional Funding	$4.06	$4.16	$4.51	$4.36	$1.30	$1.30

Note: Table includes Baseline Regional Conservation after 2010.

Seattle Only* Savings	0.63	0.63	0.63	0.63	none	none
	0.69	0.66	0.64			
Seattle Only* Funding	$1.84	$2.0	$1.84	$1.84	none	none

* "Seattle Only" refers to programs under the Seattle Ordinance 120532 (I-63 SO)

Other Savings

As shown in Exhibit 2, SPU anticipates water savings beyond its own conservation programs, as described below.

Plumbing Code (2007-2012)

Efficiencies are expected from implementation of the State Building Code as the result of installation of new plumbing fixtures. These code savings are displayed in Exhibit 2 and incorporated into the demand forecast.

Price Savings (2007-2012)

Savings related to SPU's rate structure and price signals are also anticipated. Rate related savings from price elasticity parameters in Exhibit 2 were calculated using *SPU's Demand Forecast Model*.

Municipal Water Law Conservation Checklist

As part of the Municipal Water Law water utilities are being asked to complete a conservation checklist. SPU has completed the checklist and it is provided below.

Water Conservation Program Requirements Checklist

Required Conservation Measures[4]	Measure Included	
1. Program Promotion	Yes __√___	No _____
2. Install Source Meters	Yes __√___	No _____

All recommended measures listed below must be evaluated for implementation in the conservation plan to meet the minimum requirements in the Conservation Planning Requirements.

Recommended Conservation Measures	Measure Evaluated	
3. School Outreach	Yes _√____	No _____
4. Speakers Bureau	Yes _√____	No _____
5. Theme Shows and Fairs	Yes _√____	No _____
6. Purveyor Assistance	Yes _√____	No _____
7. Customer Assistance	Yes _√____	No _____
8. Conduct Technical Studies	Yes _√____	No _____
9. Utilize Bill Showing Consumption History	Yes _√____	No _____
10. Install Service Meters	Yes _√____	No _____
11. Develop Unaccounted Water/Leak Detection Program	Yes _√____	No _____
12. Single-Family/Multi-Family Kit Distribution Program	Yes _√____	No _____
13. Development of Nurseries/Agricultural Conservation Program	Yes _√____	No _____
14. Development of Landscape Management/Xeriscaping Program	Yes __√___	No _____
15. Conservation Pricing	Yes __√___	No _____
16. Utility Financed Retrofit	Yes __√___	No _____
17. Seasonal Demand Management	Yes __√___	No _____
18. Water Recycling/Reuse	Yes __√*__	No _____

* SPU currently does not provide reclaimed water to any of our customers, but many of our customers recycle or reuse water within their facilities.

Other Requirements Contained In the Conservation Planning Requirements

In addition to developing a conservation plan as delineated above, the state's Conservation Planning Requirements also require that all public water systems preparing a water system plan identify existing rate schedules (include schedules for various customers classes if they are different), and inventory major potential sources and uses for reclaimed water. The demand forecast section of the body of the *2007 Water System Plan* discusses issues regarding customer rates. As noted below, SPU has completed an inventory of sources and uses for reclaimed water as part of the *2007 Water System Plan.*

Other Requirements	Information Included	
1. Inventory of Sources and Uses for Reclaimed Water.[5]	Yes __√___	No _____

[4] Program promotion is required to be implemented for all public water systems. Source metering is required to be implemented by all systems prior to receiving additional water rights. If additional water rights are not being sought, this measure must be evaluated and implemented if cost effective. If unaccounted for water is greater than 20 percent, a leak detection program must be initiated.

[5] A list of potential sources and uses of reclaimed water is contained in the Conservation Planning Requirements. Only those systems with more than 25,000 service connections will be required to evaluate water reuse as a conservation measure.

ASSESSMENT BY RISK CATEGORIES
Water Conservation Drivers Analysis
Baseline Water Conservation: 2011-2030

Public Trust
1. Utilities' reputation as credible managers of the resource
2. Utilities' reputation as credible financial managers
3. Perception that the Utilities are responsive to public needs for reducing bills
4. Relationship and credibility with the In-stream Flow Commission
5. Ally and partner with other utilities and private sector contractors regarding conservation programs

Regulatory
1. FERC determination of Tolt water rights during 2025 re-licensing
2. Compliance with WA State Dept. of Health water conservation regulations
3. Consistent with Cedar River Habitat Conservation Plan
4. Compliance with I-63 Settlement Ordinance requiring SPU implement all cost-effective conservation
5. Bills considered by WA State legislature
6. Federal Clean Water Act regulations

Asset and Service Reliability
1. Uncertainty of climate patterns
2. Certainty of customer behavioral changes to conserve water (vs. investment in hardware related conservation)
3. Risk of curtailment and rate surcharges
4. Loss of "risk free" way of adding supply = savings account for growth, tribal issues, and climate disruption
5. Insurance if CWA seeks more water from SPU

Legal
1. Lawsuits filed by environmental groups or tribes
2. Initiatives filed by citizens

Environmental
1. In-stream flows for fish, animals, and plants (aquatic and riparian habitat)
2. Amount of pesticide run-off from irrigation
3. Leverage for recycling, energy conservation, and reductions in storm water and wastewater flows

Financial
1. Revenue stability related to conservation savings
2. Amount of surplus water to sell

Work Force
1. Cost of ramping up conservation expertise
2. Availability of conservation experts during droughts and emergencies

Social
1. Impact on requirements for customer behavior changes

Public Health
1. Improper use of gray and recycled water by customers and employees
2. Improper sanitation due to less frequent toilet flushing

Note: This risk assessment document was created on 12/21/05.

WATER CONSERVATION DRIVERS ANALYSIS: 2011-2030

Risk Assessment for Water Conservation Baseline Strategies

Purpose: Set 2011-2030 baseline water conservation level for 2007 Water System Plan Update and Demand Forecast

		20 Year Savings (Cumula-tive)	20 Year Savings (Cumula-tive)	Total Annual Budget										
Alternative Conservation Baseline Strategies	**Program Description**	Annual MGD Savings by 2030	Peak Season MGD Savings by 2030	O&M+ CIP= TOTAL '000 of $ per Year	Public Trust Concerns (20%)	Regulatory Concerns (10%)	Asset and Service Reliability Concerns (15%)	Legal Concerns (10%)	Environmental Concerns (10%)	Financial Concerns (15%)	Workforce Concerns (5%)	Social Concerns (10%)	Public Health Concerns (5%)	**Key Points**
Do Nothing	* No messaging or incentives	0	0	0	Critical	Critical	Critical	Critical	High	Low	High	Low	Low	* Access of future decision-makers to conservation as resource * Legal or political external pressure from stakeholders
Awareness Campaign	* Messaging to change behavior * Savings from dormant lawns * No incentives * Less intense than current 1% program	13 MGD	18 MGD	$405 $0 $405	High	Critical	High	High	Medium	Medium	High	High	Medium	* Campaign to change behavior at time of surplus = mixed message
Program to Shave Peak	* Outdoor conservation only * Focus on dormant lawns and drought tolerant plants * Messaging plus incentives for measures such as rainbarrels and swimming pools * Less intense than current 1% program	3 MGD	10 MGD	$205 $105 $310	High	High	Medium	Medium	Low	Medium	High	High	Low	* Revenue loss during summer season * All conservation measures for outdoor use
Program/Investment #1	* Both messaging and incentives for indoor and outdoor conservation * Hardware incentives range from cooling/process improvements to showerheads * Savings from dormant lawns * Less intense than current 1% program	15 MGD	19 MGD	$315 $345 $660	Medium	High	High	Medium	Low	Medium	High	Medium	Medium	* State DOH's public goal setting process may find SPU's efforts inadequate
Program/Investment #2	* Includes messaging and incentives for indoor and outdoor conservation * Hardware incentives spread across more customer classes than Low Intensity #1 (above) * No reliance on savings from dormant lawns * Less intense than current 1% program	14 MGD	14 MGD	$510 $890 $1400	Medium	High	Medium	Medium	Low	Medium	Medium	Medium	Medium	*Too much reduction in conserv ation effort
Program/Investment #3	* Includes messaging and incentives for indoor and outdoor conservation * Outdoor savings from dormant lawns, car washes, and swimming pools * Relies more on behavior related measures than "Program/Investment #4" (below) * Less intense than current 1% program	19 MGD	23 MGD	$400 $1,100 $1,500	Medium	Medium	High	Low	Low	High	Medium	High	Medium	* Ability to achieve this level of behavioral savings would require City leaders' messaging
Program/Investment #4	* Includes messaging and incentives for indoor and outdoor conservation * Outdoor savings from dormant lawns, car washes, and swimming pools *Similar intensity to current 1% program	20 MGD	27 MGD	$570 $2,130 $2,700	Medium	Low	Low	Low	Low	Medium	Low	Medium	Medium	* Meets external expectations
Program/Investment #5	* Similar to "Program/Investment #4" (above) coupled with additional outdoor savings from incentives for irrigation hardware and low-water use plants *Greater intensity to current 1% program	25 MGD	33 MGD	$800 $3,200 $4,000	High	Low	Low	Low	Low	Medium	Low	Medium	High	* Limited external pressure to increase level of savings from current efforts

Note: This Water Conservation Driver's Analysis document was created in December 2005.

The following documents are references to this appendix:

- Water Conservation Potential Assessment, Revised May 2006
- Ten Year Conservation Program Plan, September 2002
- Regional 1% Water Conservation Program, 2004 Annual Report

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Water Conservation Potential Assessment

Updated December 2004
Revised May 2006

Seattle Public Utilities

This report is available on the Seattle Public Utilities website, www.seattle.gov/util/services/. Many of the referenced documents are also available on that website.

HDR

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Acronyms

ccf	Cubic feet
CPA	Conservation Potential Assessment
CSO	Combined Sewer Overflow
CWA	Cascade Water Alliance
MF	Multifamily
mgd	(million gallons per day)
NR	Non-residential
O&M	Operation and Maintenance
PSRC	Puget Sound Regional Council
SCL	Seattle City Light
SF	Single Family
SPU	Seattle Public Utilities
SSO	Sanitary Sewer Overflow

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A. Definitions of Water Supply Planning "Stepping Stones"
B. Understanding the CPA Model – Supplemental Information
C. Measure Definitions
D. Indirect Benefits Methodology

Executive Summary

This executive summary provides an overview of the purpose, methodology, and results of the conservation potential assessment (CPA) analysis.

Purpose

The 2006 CPA Report is an analysis of the cost, volume, and reliability of water conservation opportunities available within Seattle Public Utilities' (SPU) retail service area and a portion of its wholesale service area through 2030. The CPA is a planning model that helps integrate demand management into SPU's regional water supply planning process. The CPA analysis is integral to the following three elements of water supply planning:

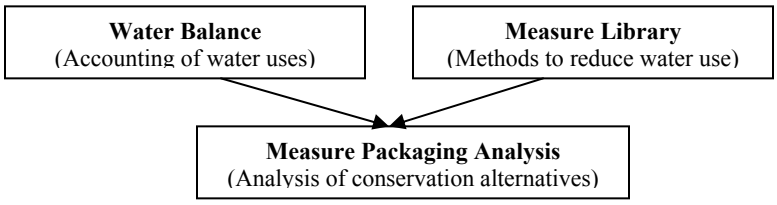
1. **Demand Forecast** – The CPA forecasts data related to conservation goals from 2005 through 2010, as well as projected plumbing code savings through 2030.
2. **Conservation Drivers Analysis** – The CPA provides cost/benefit information related to seven alternatives ranging from an "awareness only" campaign to a program intensity greater than current conservation efforts. The timeframe for the options is from 2011 through 2030.
3. **Water Supply Planning Model** – The CPA provides scenarios for the Drinking Water Supply Planning Model related to conservation as a source of supply. Conservation measures are packaged and analyzed for saving potential over various timeframes.

Methodology

The 2006 CPA Report is based on a computer model (CPA Model) that has three main components: the water balance, measure library, and measure packaging analysis. The relationship among these components is shown in Figure ES-1.

- The **water balance** is an accounting of all water uses and is comprised of end uses (methods of using water), demographics, and demands.
- The **measure library** contains 135 individual conservation measures that could be implemented by customers to decrease their water use.
- The **measure packaging analysis** analyzes desired conservation alternatives by combining a water balance and selected measures from the measure library.

Figure ES-1
CPA Components



Seven packages were analyzed for this report using the Measure Packaging Analysis. Table ES-1 displays the packages. The Commitments Through 2010 package reflects SPU's current commitments. Packages #2 - #7 each add savings to the Commitments Through 2010 package.

Table ES-1
Packages Analyzed

Package Name	Purpose	Applicable Years	Maximum % of Direct Cost Paid by SPU[1]	Savings Goal	Measures Included
1. Commitments Through 2010	Demand Forecast – Commitments Already Made	2006-2010	50%	Approximately 9 mgd peak	All
2. Drivers Analysis "Awareness"	Demand Forecast - Baseline Conservation	2011-2030	50%	Approximately 13 mgd annual	Behavior oriented
3. Drivers Analysis "Shave the Peak"				Approximately 3 mgd annual	End uses that peak sharply
4. Drivers Analysis "Varying Intensity"				Range of approximately 15-25 mgd annual	All
5. Technical Potential "Regular"	Water Supply Planning Model	2011-2030	100%	Technical Potential	All
6. Technical Potential "Ends Early"		2011-2020			
7. Technical Potential " Late Start"		2021-2030			

1 i.e., SPU rebate.

Results

The results for the seven analyzed packages are shown in Table ES-2. As described in Section 2.4, the CPA Model analyzes 11 "package intensities" for each package. The package intensities represent the range of all possible combinations of measures for each package, ranging from the lowest to highest marginal cost. The package intensities determined to best represent each package are included in Table ES-2. In some cases, this may be more than one package intensity.

Table ES-2 Package Results					
Package Name	**Package Intensity**	**Annual Savings (mgd)**	**Peak Season Savings (mgd)**	**Utility Average Annual Cost**	**Marginal Cost Per ccf**
Commitments Through 2010[1]	6	6.81	8.27	$4,150,303	$2.99
Drivers Analysis "Awareness"	4	13.79	18.48	$404,972	$0.91
Drivers Analysis "Shave the Peak"	4	2.63	7.86	$90,000	$1.54
	5	3.49	10.40	$308,174	$3.49
Drivers Analysis "Varying Intensity"	3	14.68	18.85	$654,475	$0.33
	4	19.05	23.75	$1,497,562	$0.79
	5	21.44	27.22	$2,689,353	$1.91
	6	25.85	32.55	$3,945,075	$4.63
Technical Potential "Regular"	6	34.17	45.96	$16,315,798	$20.78
Technical Potential "End Early"	3	8.66	10.69	$3,175,443	$0.78
	4	11.45	14.06	$6,738,867	$2.20
	5	15.37	20.74	$14,141,953	$6.20
	6	15.88	21.43	$15,762,091	$17.47
Technical Potential "Late Start"	3	9.39	11.48	$3,402,350	$0.81
	4	11.82	14.72	$7,493,556	$2.17
	5	16.12	21.78	$14,220,465	$5.82
	6	16.68	22.57	$15,440,311	$15.61

1. All other packages build on the Commitments Through 2010 package, which means their savings are above and beyond the savings obtained by the Commitments Through 2010 package.

The CPA analysis does not recommend one preferred conservation alternative. Rather, the various packages provide information inputs to multiple planning efforts. The Commitments Through 2010 package helps confirm that conservation commitments made through 2010 are achievable at reasonable costs. It can also assist conservation program staff make adjustments to current programs, if appropriate. The Drivers Analysis packages provide input for incorporating conservation into the demand forecast, including ensuring that programs are equitable across customer classes. The Technical Potential packages provide valuable input for SPU's new water supply planning model. Table ES-2 shows that the chosen Drivers Analysis packages, which were used to determine the baseline conservation included in the demand forecast, have a marginal cost lower than the Technical Potential "Regular" package.

SPU anticipates continued use of the CPA Model to explore newly formulated conservation measures and packages in future years.

Section 1
Introduction

1.1 Introduction to the 2006 Conservation Potential Assessment Report

In 1998, Seattle Public Utilities (SPU) completed a *Water Conservation Potential Assessment* (1998 CPA Report) at the request of the Seattle City Council. A subsequent City of Seattle Ordinance (Number 120532, September 2001) specified an update to the CPA every four years beginning in 2004. An update was published in 2004 (2004 CPA Report Update): this *Water Conservation Potential Assessment* (2006 CPA Report) supersedes that publication.

The 2006 CPA Report is an analysis of the cost, volume, and reliability of water conservation opportunities available within SPU's retail service area and a portion of its wholesale service area through 2030 (see Section 2.2 for a discussion of which purveyors are included).

The Seattle Ordinance also requires that the CPA should quantify best estimates of other benefits obtained by water conservation measures, including savings relating to reductions in demand for electricity use, along with wastewater and stormwater discharges. The 2006 CPA Report includes a description of the methodology used for valuing those indirect benefits and provides calculations for each measure and selected groupings (packages) of water conservation measures.

The 2006 CPA Report details enhancements to the 1998 CPA Report and 2004 CPA Report Update, defines the CPA's role in the SPU Water System Planning process, documents results of the CPA model runs, and describes SPU's use of the CPA for a variety of applications.

The CPA is based on a computer model (CPA Model) that provides analytical power and flexibility for SPU and the Seattle Water System Operating Board, interested stakeholders, water economists and analysts, and program planners. The CPA Model: 1) calculates water savings potential for 135 conservation measures based on various cost or savings policy criteria; 2) estimates the impacts of code and programmatic conservation for the SPU water demand forecast and *2007 Water System Plan Update* (2007 WSP); and 3) assists SPU program planners in designing programs to meet policy goals.

This 2006 CPA Report presents analysis for 135 conservation measures that are significant in terms of their water saving potential and have been tested by research and field experience.

The CPA uses 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 are considered curtailment rather than conservation, and are therefore not included in the CPA. However, letting lawns go dormant was included as a voluntary conservation measure as a reflection of common customer practice.

The CPA approach could be used by other water utilities. However, the CPA Model as configured by SPU incorporates inputs (e.g., demographics, cost estimates, etc.) that are relevant

only to SPU's service area. The results of this CPA are SPU-specific and should not be used directly by other water utilities.

The 2006 CPA Report is part of a trio of related documents:

1. The **2006 CPA Report** presents results of an analysis of conservation opportunities related to various goals.
2. The **CPA User Guide** provides step-by-step directions on how to use the CPA Model – it can be thought of as user documentation.
3. The **CPA Technical Documentation** documents the programming of the CPA Model.

1.2 The 2006 CPA Report: Revised Analysis

The 1998 CPA Report laid the foundation for the 2006 CPA Report analytical effort along with the field experience of SPU conservation experts and market research. However, it should be noted that direct comparisons between conservation measures in the 1998 CPA Report and the 2006 CPA Report may not be applicable since underlying assumptions, such as costs or target audiences, may have changed.

The 2006 CPA Report calculates and reports on water savings and levelized costs for both average annual demand and peak season demand for 135 measures. The 1998 CPA Report reported only peak season demand and levelized cost for 65 measures. Also noteworthy is the fact that the 1998 CPA Report was able to identify a cost-effective package or group of measures that were less than the cost of the next new supply – described as "avoided cost".

In 2006, SPU completed analysis using its new water supply planning model[1], which evaluates the unit costs of new water supply alternatives along with a "value score" that captures the non-monetary benefits of each alternative. Preferred alternatives are selected based on costs and value-added, and not costs alone, so the concept of marginal cost is not used as the basis for selecting new sources of supply, including conservation. Because the demand forecast used in the analysis does not indicate that a new source of supply is needed until sometime after 2060, and much can change prior to when a new source is developed, no single alternative was selected for the next source for which to compare conservation. Therefore the analysis does not establish an avoided cost.

New also since the 1998 CPA Report are calculations of other benefits obtained by the conservation measures including savings from reductions in demand for electricity, stormwater, and wastewater.

The CPA is a tool that enables SPU to conduct detailed analysis and develop policies for the future role of conservation in its portfolio of supply options. The CPA should be viewed as a planning model to help integrate demand management into SPU's regional water supply planning process.

[1] CH2M HILL, "SPU Water Supply Planning Model," April 2006.

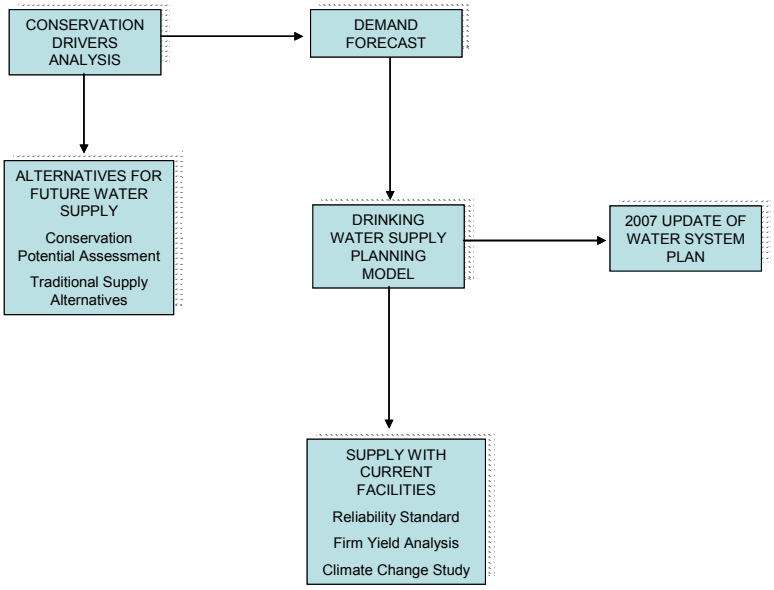
1.3 The 2006 CPA Report and Regional Water Planning

SPU provides drinking water to nearly 1.3 million people in its retail and wholesale service areas in the greater Seattle region. Prior to the 1980's, SPU's water supply planning and development followed a predictable path of acquisition of an incremental new water source based on a projected demand forecast. During the 1980's and more intensively in the 1990's, SPU recognized and utilized water conservation as a complementary strategy to meeting long term water supply needs.

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 along with enhancements in system efficiency. This portfolio approach provides decision-makers with many options to meet growing water demand efficiently and reliably.

The 2006 CPA Report provides analysis and conservation inputs to the 2007 WSP. Figure 1 illustrates the front-end position of the CPA within the context of the current regional planning process. Appendix A defines the individual components of the "Stepping Stones to Water Supply Strategy".

Figure 1
Stepping Stones to Water Supply Strategy



The CPA analysis was integral to the following three planning efforts:

1. Demand Forecast – CPA forecasted data related to conservation goals from 2005 through 2010 (see "Commitments through 2010" package in Section 3.2) as well as projected plumbing code savings through 2030.
2. Conservation Drivers Analysis (2011 through 2030) – CPA provided cost/benefit information related to seven alternatives ranging from an "awareness only" campaign to a program intensity greater than the current "1%" effort. The timeframe for the options is from 2011

through 2030. The analysis included cost/benefit data from the CPA as well as a risk assessment. See Section 3.3 for supporting documentation.

3. Drinking Water Supply Planning Model – CPA provided scenarios for the Drinking Water Supply Planning Model related to conservation as a source of supply. Results are displayed in Section 3.4. Combinations of conservation measures were packaged and analyzed for water saving potential over various timeframes.

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Section 2
Understanding the CPA Model

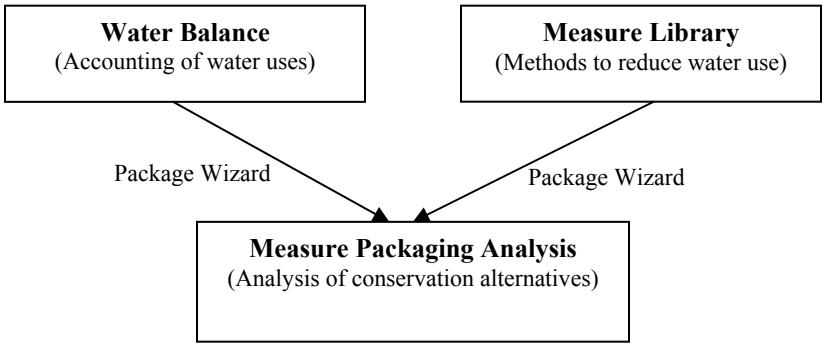
2.1 Overview

This section is presented in order to provide background information on the how the CPA Model functions and how the results discussed in Section 3 were generated. More detailed information is contained in Appendix B. Readers desiring a comprehensive explanation of CPA Model functions should consult the CPA User Guide, prepared separately from this report.

The CPA Model has three main components: the water balance, measure library, and measure packaging analysis. The relationship among these components is shown in Figure 2.

- The **water balance** is an accounting of all water uses and is comprised of end uses (methods of using water), demographics, and demands.
- The **measure library** contains a set of individual conservation measures that could be implemented by customers to decrease their water use. A conservation measure is defined as a change in water-using hardware or behavior that results in reduced water consumption. Measures that can be implemented by a utility, such as watermain leak repair, rate structures, or changes to the current plumbing codes, are not actions that customers can take, and thus they are not included in the measure library.
- The **measure packaging analysis** analyzes desired conservation alternatives by combining a water balance and selected measures from the measure library. This is performed by a tool called the Package Wizard, which allows analysis of multiple measures in combination with each other, and sharing of marketing costs between measures.

Figure 2
CPA Components



2.2 Water Balance

The water balance is an accounting of all water uses and has three main components: 1) end uses, 2) demographics, and 3) demands, as shown in Table 1. The information is presented in 5-year time increments from 1995 through 2030. For the historical time period (1995 through

2005), water was initially allocated to each end use based on the 1998 CPA Report, with updates from more recent national and local research and experience. Then the water balance was calibrated to match actual historical demands. For the future time period (2010 through 2030), water was allocated to each end use based on 2005 use patterns and then combined with forecasted demographics to calculate a demand forecast. All water balance data is divided into three main sectors: single family (SF), multifamily (MF), and non-residential (NR).

Table 1
Water Balance Components

Time Period	End Uses	Demographics[2]	Demands
Historical (1995 through 2005)[1]	Based on 1998 CPA Report, with updates from more recent national and local research and experience. Then calibrated to match actual historical demands.	U.S. Census data apportioned to water service areas. PSRC forecasts by TAZ and FAZ. Regional projections from Dick Conway and Associates.	Actual demands from SPU billing records and annual purveyor survey.
Future (2010 through 2030)	Based on 1998 CPA Report, with updates from more recent national and local research and experience.	PSRC forecasts by TAZ, FAZ.	Model calculates based on end uses and demographics.

1. 2005 was included in the historical time period through extrapolations of data from 2001 through 2004.
2. PSRC is the Puget Sound Regional Council. TAZ and FAZ are Traffic and Forecast Analysis Zones, which are geographic areas for which the PSRC presents demographic projections.

Data in the water balance covers SPU's entire retail service area and a portion of its wholesale service area, which is collectively called the "combined service area." SPU provides wholesale water service to a total of 25 purveyors. Only the 17 purveyors that participate in SPU's regional conservation program are included in the CPA Model. Table 2 lists which purveyors are included in the CPA Model and those that are not. The CPA Model was designed to allow separate analysis of the retail and wholesale service areas. However, the CPA Model is currently used for analysis in the combined service area.

There are three different water balances as follows:

- **Master Water Balance Without Code** - This water balance is the original water balance and does not incorporate efficiencies expected from the State Building Code relative to plumbing fixtures. This water balance is used only to estimate the expected code savings, which is calculated by comparing this water balance to the Master Water Balance With Code.
- **Master Water Balance With Code –** This water balance includes efficiencies expected from the code. This water balance was created by copying the Master Water Balance Without Code and adjusting the end uses to reflect shifts to more efficient hardware based on new construction and estimated fixture replacement rates for existing customers. This water balance is used for any analysis that seeks to include code efficiencies but exclude savings anticipated from SPU's 2006 through 2010 conservation commitments (see below).
- **Master Water Balance With Commitments Through 2010 –** This water balance incorporates savings expected from SPU's conservation commitments from 2006 through 2010, as well as the code savings. The conservation commitments include the regional 1% Water Conservation Program and the requirements for Accelerated Conservation from the City of Seattle I-63 Settlement Ordinance Number 120532, referred to as I-63 SO. This water balance was created by copying the Master Water Balance With Code and adjusting the end uses based on a Measure Packaging Analysis designed to achieve the committed

savings. This water balance is used for any analysis that seeks to include these committed savings.

Table 2
Purveyor Relationship to the CPA Model

#	Purveyor	Relationship to the CPA Model
1	Bellevue, City of	Excluded: Part of Cascade Water Alliance (CWA), which is no longer part of the Saving Water Partnership.
2	Bothell, City of	Included.
3	Cedar River Water & Sewer District	Included.
4	Coal Creek Utility District	Included
5	Duvall, City of	Included.
6	Edmonds, City of	Excluded: Participates in Everett's conservation programs.
7	Highline Water District	Included.
8	King County Water District 20	Included.
9	King County Water District 45	Included.
10	King County Water District 49	Included.
11	King County Water District 90	Included.
12	King County Water District 119	Included
13	King County Water District 125	Included.
14	Kirkland, City of	Excluded: Part of CWA.
15	Lake Forest Park, City of	Excluded: SPU provides only backup supply for fire flow.
16	Mercer Island, City of	Included.
17	Northshore Utility District	Included.
18	Olympic View Water & Sewer District	Included.
19	Redmond, City of	Excluded: Part of CWA.
20	Renton, City of	Excluded: SPU only provides supply to Boeing.
21	Shoreline Water District	Included.
22	Skyway Water & Sewer District	Excluded: Part of CWA.
23	Soos Creek Water & Sewer District	Included.
24	Tukwila, City of	Excluded: Part of CWA.
25	Woodinville Water District	Included.

25 total purveyors:17 included in CPA, 5 excluded related to CWA (Cascade Water Alliance), 3 excluded for other reasons.

2.3 Measure Library

The measure library contains information on conservation measures that could be implemented by customers to decrease water use. Conservation measures act on end uses, shifting customers from less efficient to more efficient equipment or behaviors. A measure can be applied only to one sector. Therefore, there are three versions of many measures: one for single family (SF), one for multifamily (MF), and one for non-residential (NR). Currently, the CPA Model is configured to apply all measures to the combined service area.

The conservation measures are listed in Table 3. Each measure is defined in Appendix C. There are 135 measures: 39 for the single family sector, 40 for the multifamily sector, and 56 for the non-residential sector. The table includes the end use the measure acts on.

Table 3 Measure List				
	Sector[1]			
Measure	SF	MF	NR	End Use
Air Cooling			X	Once Through
Boiler Performance Improvement			X	Boilers
Car Wash Low Flow Equipment			X	Vehicle Washing - Business With Own Equipment
Car Wash Recycle Improvement			X	Vehicle Washing - Retail Car Wash
Car Wash Replacement Water			X	Vehicle Washing - Retail Car Wash
Catchment in Detention System			X	Irrigation - Sprinkler In Ground Auto
Catchment in Rain Barrel	X			Irrigation - Hose & Sprinkler
Clotheswasher Efficient Model (Common Area)		X		Clotheswasher - Residential Capacity In Common Area
Clotheswasher Efficient Model (In Unit)	X	X		Clotheswasher - Residential Capacity In Unit
Clotheswasher Efficient Model			X	Clotheswasher - Laundromat
Clotheswasher Eliminate Partial Loads (Common Area)		X		Clotheswasher - Residential Capacity In Common Area
Clotheswasher Eliminate Partial Loads (In Unit)	X	X		Clotheswasher - Residential Capacity In Unit
Clotheswasher Ultra Efficient Model (In Unit)	X	X		Clotheswasher - Residential Capacity In Unit
Cooling Tower Performance Improvement			X	Other Equipment Towers
Dishwasher Efficient Model	X	X		Dishwashing – Machine Residential Capacity
Dishwasher Efficient Model			X	Dishwashing – Machine Commercial Capacity
Dishwasher Eliminate Partial Loads	X	X		Dishwashing – Machine Residential Capacity
Dishwasher Eliminate Partial Loads			X	Dishwashing – Machine Commercial Capacity
Disposal Use Decrease	X	X		Disposal - Residential Capacity
Disposal Use Decrease			X	Disposal - Commercial Capacity
Drip Irrigation	X	X	X	Irrigation - Sprinkler In Ground Auto
Faucet Aerator 0.5 gpm (Bath Flow)			X	Faucet - Bathroom by Flow
Faucet Aerator 1.5 gpm (Bath Flow)	X	X		Faucet - Bathroom by Flow
Faucet Flow Control (Kitchen Flow)			X	Faucet - Kitchen by Flow
Faucet Run Until Hot Recirculate (Bath Flow Customer)			X	Faucet - Bathroom by Flow
Faucet Run Until Hot Recirculate (Bath Flow Employee)			X	Faucet - Bathroom by Flow
Faucet Run Until Hot Recirculate (Bath Flow)	X	X		Faucet - Bathroom by Flow
Faucet Run Until Hot Recirculate (Kitchen Flow Employee)			X	Faucet - Kitchen by Flow
Faucet Run Until Hot Recirculate (Kitchen Flow)	X	X		Faucet - Kitchen by Flow
Faucet Use Decrease (Bath Flow Customer)			X	Faucet - Bathroom by Flow
Faucet Use Decrease (Bath Flow Employee)			X	Faucet - Bathroom by Flow
Faucet Use Decrease (Bath Flow)	X	X		Faucet - Bathroom by Flow
Faucet Use Decrease (Kitchen Flow Employee)			X	Faucet - Kitchen by Flow
Faucet Use Decrease (Kitchen Flow)	X	X		Faucet - Kitchen by Flow
Food Preparation and Washing Improvements			X	Food Processing
Fountain Efficiency	X	X	X	Leaks - Landscape
Hot Tub Use Improvement	X	X	X	Hot Tub
Irrigation Controllers Weather Based	X	X	X	Irrigation - Sprinkler In Ground Auto
Irrigation Scheduling Improvement	X	X	X	Irrigation - Sprinkler In Ground Auto
Irrigation System Performance Improvement	X	X	X	Irrigation - Sprinkler In Ground Auto
Laundry Wash Water Recycle			X	Clotheswasher - Industrial Capacity
Lawn Dormant (Auto)	X	X	X	Irrigation - Sprinkler In Ground Auto
Lawn Dormant (Hose & Sprinkler)	X	X		Irrigation - Hose & Sprinkler
Lawn Dormant (Manual)	X	X		Irrigation - Sprinkler In Ground Manual
Leak Reduction (Cooling)			X	Leaks - Cooling
Leak Reduction (Domestic)	X	X	X	Leaks - Domestic
Leak Reduction (Food Service)			X	Leaks - Food Service
Leak Reduction (Landscape)	X	X	X	Leaks - Landscape
Leak Reduction (Other)			X	Leaks - Other

Table 3 (cont.) Measure List				
	Sector			
Measure	SF	MF	NR	End Use
Leak Reduction (Process)			X	Leaks - Process
Leak Reduction (Recreation)			X	Leaks - Recreation
Plants Low Water Use	X	X	X	Irrigation - Sprinkler In Ground Auto
Process Water Control Improvements (Labs)			X	Laboratories
Process Water Recycle			X	Process Washing
Shower Run Until Hot Recirculate (Employee)			X	Shower
Shower Run Until Hot Recirculate	X	X		Shower
Shower Use Decrease (Customer)			X	Shower
Shower Use Decrease (Employee)			X	Shower
Shower Use Decrease	X	X		Shower
Showerheads 1.5 GPM	X	X	X	Shower
Showerheads 2.0 GPM	X	X	X	Shower
Sidewalk Cleaning by Broom	X	X	X	Sidewalk Washing
Soil Amendment Improvements	X	X	X	Irrigation - Sprinkler In Ground Auto
Soil Moisture Sensors	X	X	X	Irrigation - Sprinkler In Ground Auto
Sprinkler Rain Shutoff	X	X	X	Irrigation - Sprinkler In Ground Auto
Swimming Pool Use Improvement	X	X	X	Pool
Toilet 1.2 GPF	X	X		Toilet
Toilet 1.6 GPF	X	X	X	Toilet
Toilet 1.6 GPF Longlife	X	X	X	Toilet
Toilet Flush Decrease	X	X		Toilet
Toilet Flushes by Rainwater	X	X	X	Toilet
Urinal 0.5 GPF			X	Urinal
Urinal 1.0 GPF			X	Urinal
Urinal Flushes by Rainwater			X	Urinal
Urinal No Water			X	Urinal
Water Use Alerting	X	X	X	Leaks - Domestic
Total	39	40	56	

1. SF = single family; MF = multifamily; NR = non-residential.

For each conservation measure, the measure library contains information on estimated water savings, customer acceptance, costs, and other issues. Sources for this information include extensive input from SPU conservation staff, the original 1998 CPA Report, and local and national conservation research.

Measures were identified and included in the CPA Model based on four criteria: 1) no measure can negatively impact customer satisfaction or service; 2) all measures must provide reliable water savings; 3) measures must be proven in the marketplace; 4) the measures must meet regulatory or code requirements, where applicable. Some of the measures from the 1998 CPA Report were omitted from the CPA Model because they did not meet these four criteria or it was discovered since 1998 that they had significant implementation barriers (code or legislative restrictions, operation and maintenance issues, etc).

2.4 Measure Packaging Analysis

The CPA Model analyzes combinations of multiple conservation measures, using the measure packaging analysis. The measure packaging analysis allows for two main functions during a packaging optimization process. First, multiple measures can be simultaneously analyzed. Second, marketing costs can be shared among measures, when appropriate. In many cases,

measures would be implemented together, which would reduce marketing costs since those costs would be shared across multiple measures. The measure packaging analysis pulls data from both the water balance and measure library described above.

Package optimization is the process by which the CPA Model generates 11 "package intensities", representing the range of all possible packages from the lowest to the highest marginal cost. The lowest marginal cost package intensity will generally contain only one measure. The package intensities with higher marginal costs spend greater portions of their marketing budgets, allowing more measures to be included.

Each package intensity has a different quantity of savings, annual cost, and marginal cost. If the goal is to save a certain amount of water, then the package intensity with savings closest to the savings goal would be selected. If the goal is to match an annual budget, then the package intensity with the budget closest to the budget goal would be selected. If the goal is to stay under a certain marginal cost, then the package intensity with the marginal cost closest to the marginal cost goal would be selected.

For a detailed description of the package optimization process, please refer to the CPA Users Guide.

Section 3
CPA Analysis Results

3.1 Packages Description Overview

Seven packages were analyzed for this report, using the Measure Packaging Analysis process previously described. Table 4 shows the following selected aspects for each of the seven packages: the associated water balance; the applicable years; the maximum percent of the direct cost paid by SPU (i.e., the rebate); the savings goal; and, the measures included. Packages #2 - #7 each build on the Commitments Through 2010 package, which mean their savings are above and beyond the savings obtained by the Commitments Through 2010 package.

Table 4
Packages Analyzed

Package Name	Water Balance	Applicable Years	Maximum % of Direct Cost Paid by SPU	Savings Goal	Measures Included
1. Commitments Through 2010	Master Water Balance With Code	2006-2010	50%	Approximately 9 mgd peak	All
2. Drivers Analysis "Awareness"	Master Water Balance With Commitments Through 2010	2011-2030	50%	Approximately 13 mgd annual	Behavior oriented
3. Drivers Analysis "Shave the Peak"				Approximately 3 mgd annual	End uses that peak sharply
4. Drivers Analysis "Varying Intensity"				Range of approximately 15-25 mgd annual	All
5. Technical Potential "Regular"	Master Water Balance With Commitments Through 2010	2011-2030	100%	Technical Potential	All
6. Technical Potential "Ends Early"		2011-2020			
7. Technical Potential " Late Start"		2021-2030			

There are three main categories of packages, each used for a particular purpose.

The first package category is the Commitments Through 2010 package, which is the package that best represents the conservation commitments SPU and wholesale customers have made through 2010 including the 1% Water Conservation Program and savings requirements from the I-63 SO. Since this package begins prior to 2010, the Master Water Balance With Code is used in order to exclude savings anticipated from SPU's 2006 through 2010 conservation commitments. The package was run for five years from 2006 through 2010. The Maximum Percent of Direct Cost Paid by SPU is 50%, to reflect the fact that SPU generally only pays a portion of the direct cost and expects the customer to cost-share with the utility. All measures are analyzed for this package.

The second package category is the Drivers Analysis packages, which represent the alternatives for the baseline level of conservation SPU expects to pursue beyond 2010 and include in its

demand forecast. There are three versions of the Driver's Analysis package. The first version, "Awareness", is considered the minimal level of investment and analyzes only behavior oriented measures. The second version, "Shave the Peak", is aimed at reducing the peak season demand and analyzes only measures for end uses that peak sharply in the summer months. The third version, "Varying Intensity", analyzes all measures. All three versions run for 20 years from 2011 through 2030. Since these packages begin after 2010, they use the Master Water Balance Commitments Through 2010 in order to capture the savings anticipated by 2010. The Maximum Percent of Direct Cost Paid by SPU is 50%, to reflect the fact that SPU generally only pays a portion of the direct cost and expects the customer to cost-share with the utility.

The third package category contains the Technical Potential packages, which represent savings beyond that included in the demand forecast, savings which can be considered for future supply alongside traditional supply alternatives in SPU's water supply planning model. These packages are in some ways similar to the packages analyzed in the 1998 CPA Report. However, the reader is cautioned not to compare these results directly to the 1998 CPA Report, since many of the underlying assumptions have changed. There are three versions of these packages, each running for a different time period. The first version, Technical Potential "Regular", runs 20 years from 2011 through 2030. The second version, "Technical Potential Ends Early", runs 10 years from 2011 through 2020. The third version, Technical Potential "Late Start", runs 10 years from 2021 through 2030. Since these packages begin after 2010, they use the Master Water Balance Commitments Through 2010 in order to reflect the savings anticipated by 2010. The Maximum Percent of Direct Cost Paid by SPU is 100%, since the intent is to determine the technical potential, regardless of whether SPU or the customer pays the cost.

It may be helpful to explain the term "technical potential" since it is a common, but sometimes misinterpreted, term. The term does not mean the absolute highest level of conceivable savings. Rather, it is the highest *reasonable and achievable* level of savings attainable, given parameters such as customer acceptance and fiscal responsibility.

The results for the seven analyzed packages are presented in the following sections. For each package, the 11 package intensities resulting from the CPA Model's package optimization process are provided. As discussed in Section 2.4, the 11 package intensities represent all possible package intensities ranging from the lowest to the highest marginal cost. The lowest marginal cost package intensity will generally contain only one measure. The package intensities with higher marginal costs have more measures that spend greater portions of their marketing budgets. More detailed information is provided for two packages with wide applications, Commitments Through 2010 and Technical Potential "Regular."

3.2 Commitments Through 2010 Package

This package category best represents the conservation commitments SPU and wholesale customers have made through 2010 including the 1% Water Conservation Program and savings requirements from the I-63 SO. The 11 package intensities for the Commitments Through 2010 package are shown in Table 5 and plotted in Figure 3. Package intensity #6, which is shaded in the table, was chosen to best represent the package since it achieves nearly the requisite volume of savings, and does so at acceptable annual and marginal costs. By 2010, package intensity #6 achieves 6.81 mgd of savings on an average annual basis and 8.27 mgd on a peak season basis. The utility average annual cost from 2006 through 2010, which includes all utility costs such as overhead, marketing, and rebates, is $4,150,303. Costs used herein are represented in 2005

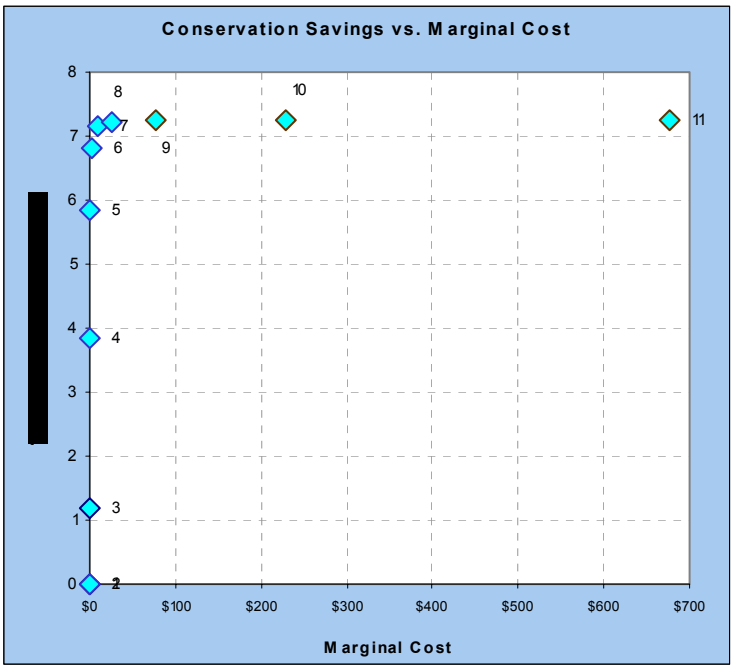
dollars. The marginal cost, which is the cost of the last unit of water saved, is $2.99 per 100 cubic feet (ccf).

Table 5
Commitments Through 2010
Package Intensities

Intensity	Annual Savings (mgd)[1]	Peak Season Savings (mgd)[1]	Utility Average Annual Cost	Marginal Cost Per ccf[2]
1	0.01	0.01	$20,092	$0.01
2	0.01	0.01	$20,092	$0.04
3	1.19	1.19	$220,452	$0.12
4	3.86	4.87	$863,981	$0.34
5	5.85	6.99	$3,078,706	$1.01
6	6.81	8.27	$4,150,303	$2.99
7	7.17	8.75	$4,924,509	$8.84
8	7.23	8.84	$5,294,060	$26.14
9	7.25	8.87	$5,415,977	$77.33
10	7.249	8.875	$5,462,627	$228.74
11	7.250	8.875	$5,476,577	$676.64

Shaded row is the package intensity chosen to best represent this package.
1. mgd = million gallons per day
2. ccf = 100 cubic feet

Figure 3
Commitments Through 2010
Package Intensities



The labels next to each data point represent the package intensity.

Details for the measures in package intensity #6 are shown in Table 6, including the average annual savings, the peak season savings, and the utility average annual cost. The table is sorted alphabetically by measure name.

Table 6 Commitments Through 2010 Package Intensity #6 Details			
Measure Name	**Annual Savings (mgd)**	**Peak Season Savings (mgd)**	**Utility Average Annual Cost**
Air Cooling CNR	.1083	.1083	$58,400
Car Wash Low Flow Equip CNR	.0137	.0137	$10,447
Car Wash Recycle Improvement CNR	.019	.019	$12,667
Car Wash Replacement Water CNR	.0238	.0238	$22,667
Clotheswasher Efficient Model (Common Area) CMF	.0807	.0807	$48,150
Clotheswasher Efficient Model CNR	.0177	.0177	$20,100
Clotheswasher Efficient Model CSF	.055	.055	$173,260
Clotheswasher Eliminate Loads (Common Area) CMF	.0574	.0574	$11,100
Clotheswasher Eliminate Loads (In Unit) CMF	.1694	.1694	$11,100
Clotheswasher Eliminate Partial Loads CSF	.3096	.3096	$12,000
Clotheswasher Ultra Efficient Model CSF	.3375	.3375	$554,575
Cooling Tower Performance Improvement CNR	.0117	.0233	$12,000
Dishwasher Efficient Model CNR	.1609	.1609	$145,983
Dishwasher Eliminate Partial Loads CMF	.009	.009	$11,100
Dishwasher Eliminate Partial Loads CNR	.1128	.1128	$10,833
Dishwasher Eliminate Partial Loads CSF	.013	.013	$12,000
Disposal Use Decrease CMF	.0197	.0197	$17,500
Disposal Use Decrease CNR	.2236	.2236	$10,000
Disposal Use Decrease CSF	.0643	.0643	$21,500
Faucet Aerator 0.5 gpm (Bath Flow) CNR	.0641	.0641	$19,897
Faucet Aerator 1.5 gpm (Bath Flow) CMF	.0785	.0785	$30,383
Faucet Aerator 1.5 gpm (Bath Flow) CSF	.1321	.1321	$41,408
Faucet Flow Control (Kitchen Flow) - CNR	.03	.03	$15,900
Faucet Use Decrease (Bath Flow C) CNR	.0007	.0007	$8,501
Faucet Use Decrease (Bath Flow E) CNR	.0018	.0018	$8,510
Faucet Use Decrease (Bath Flow) CMF	.0869	.0869	$11,100
Faucet Use Decrease (bath Flow) CSF	.1236	.1236	$12,000
Faucet Use Decrease (Kitchen Flow E) CNR	.0013	.0013	$8,500
Faucet Use Decrease (Kitchen Flow) CMF	.0333	.0333	$11,100
Faucet Use Decrease (Kitchen Flow) CSF	.0245	.0245	$12,000
Food Preparation and Washing Improvements CNR	.227	.227	$10,833
Laundry Wash Water Recycle CNR	.0122	.0122	$20,500
Lawn Dormant (Auto) CMF	.02	.0598	$22,500
Lawn Dormant (Auto) CNR	.0517	.1546	$32,500
Lawn Dormant (Auto) CSF	.1051	.3143	$20,833
Lawn Dormant (Hose & Sprinkler) CSF	.363	1.0855	$20,833
Lawn Dormant (Man) CSF	.1154	.3452	$20,833
Leak Reduction (Domestic) CMF	.0115	.0115	$33,293
Leak Reduction (Domestic) CNR	.0166	.0166	$26,160
Leak Reduction (Domestic) CSF	.2959	.2959	$88,650
Leak Reduction (Process) CNR	.1089	.1089	$17,600

Table 6 (cont.) Commitments Through 2010 Package Intensity #6 Details			
Measure Name	**Annual Savings (mgd)**	**Peak Season Savings (mgd)**	**Utility Average Annual Cost**
Process Water Control Improve (Labs) CNR	.0297	.0297	$25,000
Process Water Recycle CNR	.0135	.0135	$20,000
Shower Use Decrease CMF	.2179	.2179	$27,500
Shower Use Decrease CSF	.2757	.2757	$30,000
Showerheads 1.5 GPM CMF	.1014	.1014	$34,526
Showerheads 1.5 GPM CNR	.0062	.0062	$9,782
Showerheads 1.5 GPM CSF	.153	.153	$38,076
Showerheads 2.0 GPM CMF	.0765	.0765	$44,049
Showerheads 2.0 GPM CNR	.0041	.0041	$9,809
Showerheads 2.0 GPM CSF	.0907	.0907	$48,323
Sidewalk Cleaning by Broom CSF	.0081	.0163	$13,500
Swimming Pool Use Improvement CNR	.0071	.0212	$9,000
Swimming Pool Use Improvement CSF	.0625	.1868	$19,500
Toilet 1.6 gpf Longlife CMF	.3288	.3288	$581,279
Toilet 1.6 gpf Longlife CNR	.2292	.2292	$283,177
Toilet 1.6 gpf Longlife CSF	.6221	.6221	$1,121,720
Toilet Flush Decrease CMF	.189	.189	$27,500
Toilet Flush Decrease CSF	.5786	.5786	$30,000
Urinal 0.5 GPF CNR	.072	.072	$12,000
Urinal 1.0 GPF CNR	.0248	.0248	$83,201
Urinal No Water CNR	.0095	.0095	$13,144
Total	**6.81**	**8.27**	**$4,150,303**

The pie charts in Figures 4 through 6 provide useful characterization of package intensity #6. As shown in Figure 3, slightly over half of the savings, 55%, are attributed to the single family sector, 22% to multifamily, and 24% to non residential. As shown in Figure 5, the majority of the savings, 88%, are derived from indoor measures, while 12% are from outdoor measures. As shown in Figure 6, the majority of the savings, 89%, are associated with measures without strong peaking characteristics, while 11% are from measures that save water primarily during periods of peak demand. These findings using the CPA Model are consistent with SPU's empirical experience that recent program savings, and expected savings through 2010, are primarily obtained through residential indoor- and hardware oriented programs.

Figure 4
Commitments Through 2010
Package Intensity #6 Sector Savings

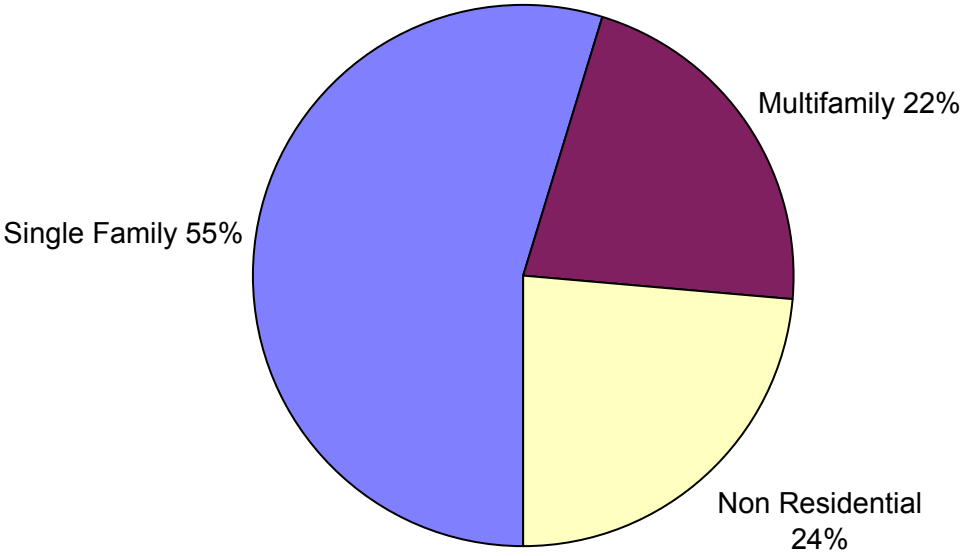


Figure 5
Commitments Through 2010
Package Intensity #6
Indoor vs Outdoor Savings

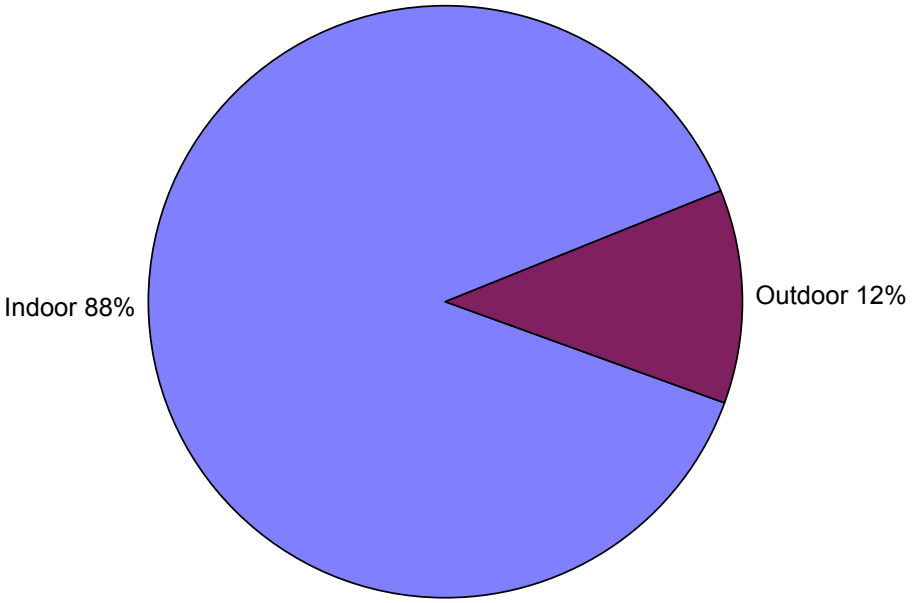
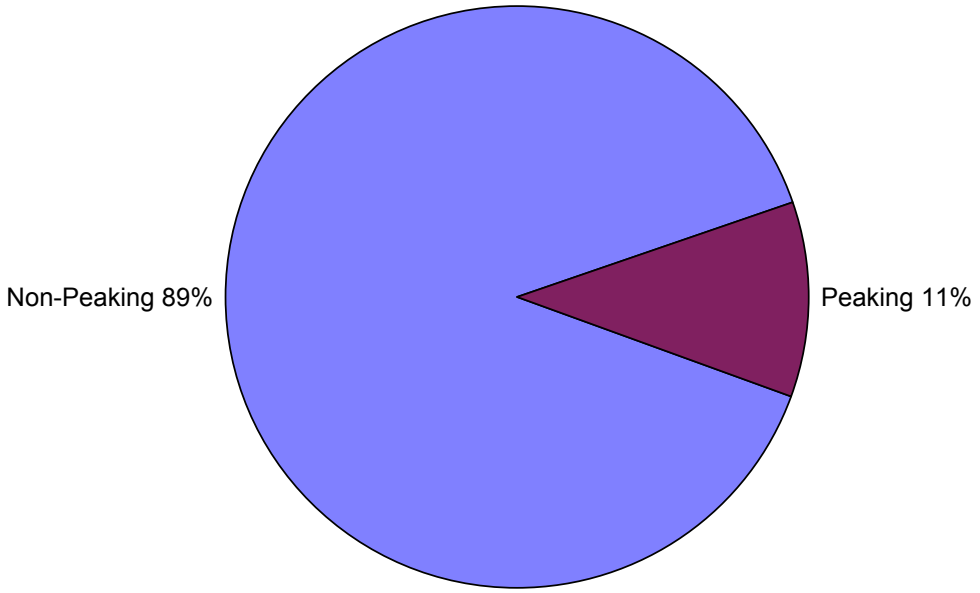


Figure 6
Commitments Through 2010
Package Intensity #6
Savings from Peaking and Non-Peaking Measures



3.3 Drivers Analysis Packages

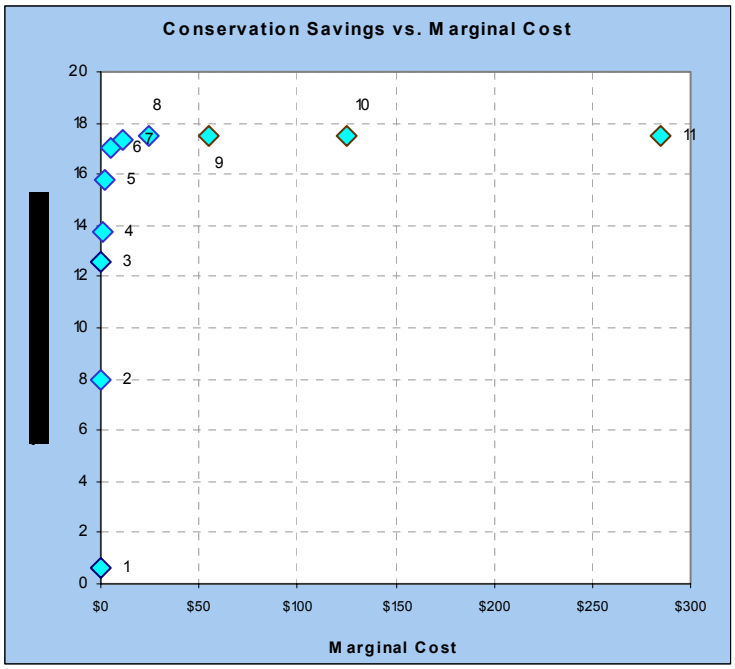
3.3.1 Awareness Package

This section contains results for the Drivers Analysis "Awareness" package model run. This run is considered the minimum level of investment and analyzes only behavior-oriented measures (not hardware measures). The 11 package intensities are shown in Table 7 and plotted in Figure 7. Package intensity #4, which is shaded in the table, was chosen to best represent the package since it was determined to provide adequate savings at a reasonable cost and comes just before a jump in the marginal cost. By 2030, package intensity #4 achieves 13.79 mgd of savings on an average annual basis and 18.48 mgd on a peak season basis. The utility average annual cost from 2011 through 2030, which includes all utility costs such as overhead, marketing, and rebates, is $404,972. The marginal cost, which is the cost of the last unit of water saved, is $0.91 per ccf.

Table 7 Drivers Analysis "Awareness" Package Intensities				
Intensity	Annual Savings (mgd)[1]	Peak Season Savings (mgd)[1]	Utility Average Annual Cost	Marginal Cost Per ccf[2]
1	0.60	0.60	$34,000	$0.08
2	8.00	11.62	$208,500	$0.18
3	12.57	16.74	$338,509	$0.40
4	13.79	18.48	$404,972	$0.91
5	15.75	21.63	$596,852	$2.08
6	17.06	23.65	$853,586	$4.72
7	17.35	24.13	$989,029	$10.70
8	17.47	24.36	$1,083,367	$24.30
9	17.52	24.47	$1,131,093	$55.17
10	17.530	24.482	$1,160,190	$125.24
11	17.531	24.484	$1,173,217	$284.33

Shaded row is the package intensity chosen to best represent this package.
1. mgd = million gallons per day
2. ccf = 100 cubic feet

Figure 7
Drivers Analysis "Awareness"
Package Intensities



The labels next to each data point represent the package intensity.

3.3.2 "Shave the Peak" Package

This section contains results for the Drivers Analysis "Shave the Peak" package model run. This run is aimed at reducing peak season demand, and analyzes only measures for end uses that peak sharply in the summer months. The 11 package intensities are shown in Table 8 and plotted in Figure 8. Package intensities #4 and #5, which are shaded in the

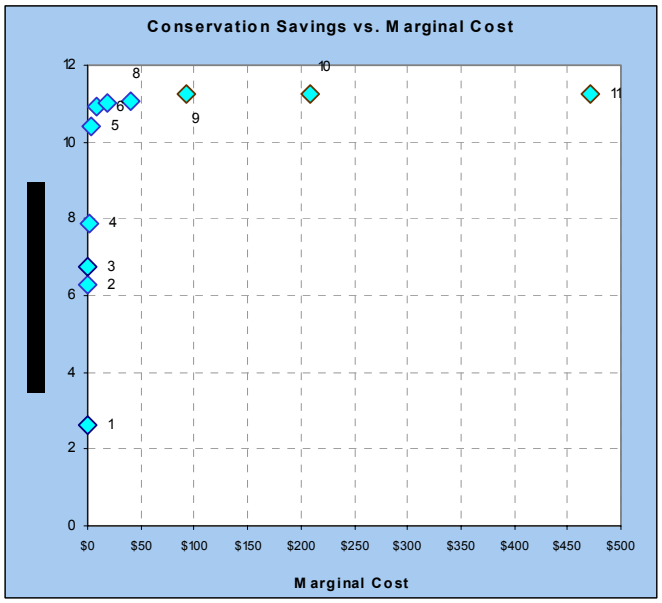
table, were chosen to best represent reasonable savings just prior to a significant increase in the marginal cost. Their savings on an average annual basis range from 2.63 mgd to 3.49 mgd by 2030. Their savings on a peak season basis range from 7.86 mgd to 10.40 mgd by 2030. Their utility average annual costs from 2011 through 2030, which includes all utility costs such as overhead, marketing, and rebates, range from $90,000 to $308,174. Their marginal costs, which is the cost of the last unit of water saved, range from $1.54 per ccf to $3.49 per ccf.

Table 8
Drivers Analysis "Shave the Peak"
Package Intensities

Intensity	Annual Savings (mgd)[1]	Peak Season Savings (mgd)[1]	Utility Average Annual Cost	Marginal Cost Per ccf[2]
1	0.88	2.64	$32,500	$0.13
2	2.10	6.27	$47,500	$0.30
3	2.26	6.77	$52,500	$0.68
4	2.63	7.86	$90,000	$1.54
5	3.49	10.40	$308,174	$3.49
6	3.69	10.93	$379,949	$7.90
7	3.72	11.00	$402,537	$17.91
8	3.75	11.08	$432,175	$40.56
9	3.80	11.23	$461,675	$91.90
10	3.805	11.238	$468,675	$208.20
11	3.806	11.240	$472,675	$471.67

Shaded rows are the package intensities chosen to best represent this package.
1. mgd = million gallons per day
2. ccf = 100 cubic feet

Figure 8
Drivers Analysis "Shave the Peak"
Package Intensities



The labels next to each data point represent the package intensity.

3.3.3 "Varying Intensity" Package

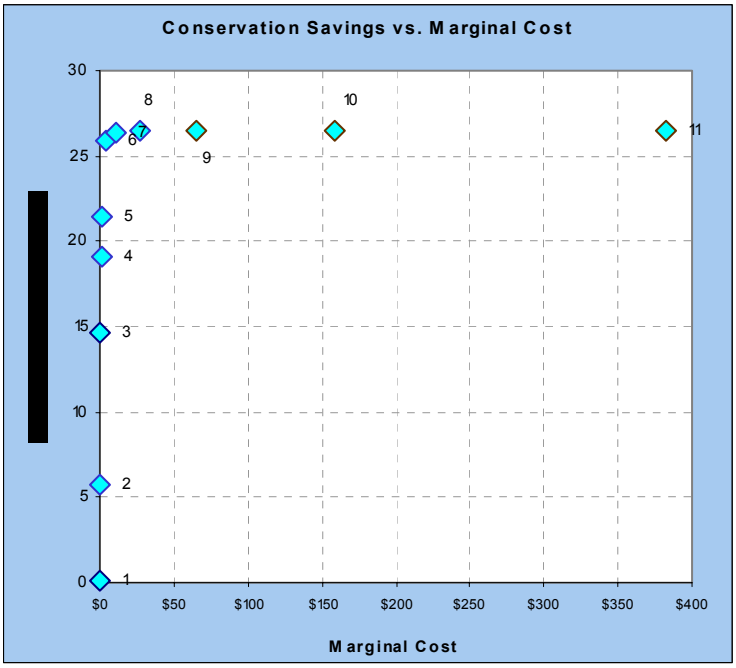
This section contains results for the Drivers Analysis "Varying Intensity" package model run. This run analyzes all measures. The 11 package intensities are shown in Table 9 and plotted in Figure 9. Package intensities #3 - #6, which are shaded in the table, were selected as they represent significant savings just prior to a large increase in the marginal cost. Their savings on an average annual basis range from 14.68 to 25.85 mgd by 2030. Their savings on a peak season basis range from 18.85 to 32.55 mgd by 2030. Their utility average annual costs from 2011 through 2030, which includes all utility costs such as overhead, marketing, and rebates, range from $654,475 to $3,945,075. Their marginal costs, which is the cost of the last unit of water saved, range from $0.33 per ccf to $4.63 per ccf.

Table 9
Drivers Analysis "Varying Intensity"
Package Intensities

Intensity	Annual Savings (mgd)[1]	Peak Season Savings (mgd)[1]	Utility Average Annual Cost	Marginal Cost Per ccf[2]
1	0.12	0.12	$10,500	$0.06
2	5.72	7.48	$171,500	$0.14
3	14.68	18.85	$654,475	$0.33
4	19.05	23.75	$1,497,562	$0.79
5	21.44	27.22	$2,689,353	$1.91
6	25.85	32.55	$3,945,075	$4.63
7	26.31	33.19	$4,351,794	$11.19
8	26.47	33.49	$4,625,248	$27.06
9	26.49	33.54	$4,699,279	$65.42
10	26.495	33.546	$4,730,252	$158.17
11	26.496	33.549	$4,746,097	$382.45

Shaded rows are the package intensities chosen to best represent this package.
1. mgd = million gallons per day
2. ccf = 100 cubic feet

Figure 9
Drivers Analysis "Varying Intensity"
Package Intensities



The labels next to each data point represent the package intensity.

3.4 Technical Potential Packages

3.4.1 Technical Potential "Regular" Package

The 11 package intensities for the Technical Potential "Regular" package are shown in Table 10 and plotted in Figure 10. This package runs from 2011 through 2030. Package intensity #6, which is shaded in the table, was chosen to best represent the package since it achieves a high volume of savings, and does so at acceptable annual and marginal costs. Beyond package intensity #6, the marginal cost is higher than what might be considered fiscally responsible to pursue. Package intensity #6 achieves 34.17 mgd of savings on an average annual basis and 45.96 mgd on a peak season basis by 2030. The utility average annual cost from 2011 through 2030, which includes all utility costs such as overhead, marketing, and rebates, is $16,315,798. The marginal cost, which is the cost of the last unit of water saved, is $20.78 per ccf.

Details for the measures in package intensity #6 are shown in Table 11, including the average annual savings, the peak season savings, and the utility average annual cost. The table is sorted alphabetically by measure name. The list allows for a comparison to the Commitments Through 2010 package to show where the Technical Potential "Regular" package achieves additional conservation. The additional savings come from three sources. First, through higher participation in the same measures due to paying a 100%

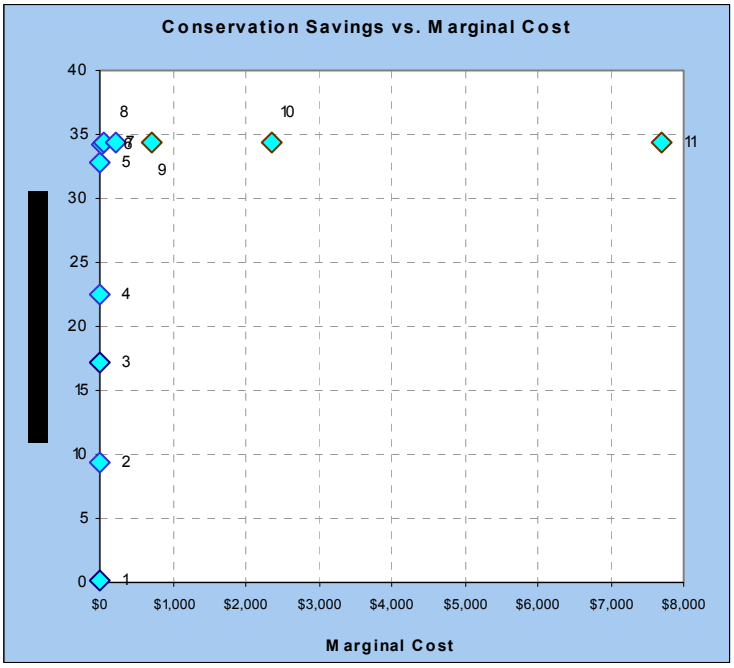
rebate. Second, from the same measures applied to new customers built after 2010. Third, from employing additional measures in all three sectors.

Table 10
Technical Potential "Regular"
Package Intensities

Intensity	Annual Savings (mgd)[1]	Peak Season Savings (mgd)[1]	Utility Average Annual Cost	Marginal Cost Per ccf[2]
1	0.12	0.12	$10,500	$0.06
2	9.41	13.03	$324,166	$0.18
3	17.24	21.74	$1,171,962	$0.60
4	22.48	28.70	$4,726,665	$1.95
5	32.74	44.21	$11,944,137	$6.36
6	34.17	45.96	$16,315,798	$20.78
7	34.34	46.27	$16,904,361	$67.84
8	34.36	46.33	$17,251,768	$221.50
9	34.37	46.33	$17,368,097	$723.23
10	34.366	46.336	$17,393,489	$2,361.41
11	34.366	46.336	$17,396,666	$7,710.23

Shaded row is the package intensity chosen to best represent this package.
1. mgd = million gallons per day
2. ccf = 100 cubic feet

Figure 10
Technical Potential "Regular"
Package Intensities



The labels next to each data point represent the package intensity.

Table 11 Technical Potential "Regular" Package Intensity #6 Details			
Measure Name	Annual Savings (mgd)	Peak Season Savings (mgd)	Utility Average Annual Cost
Air Cooling CNR	.5158	.5158	$144,433.33
Boiler Performance Improvement CNR	.0641	.0641	$28,053.56
Car Wash Low Flow Equip CNR	.0663	.0663	$11,356.73
Car Wash Recycle Improvement CNR	.0734	.0734	$16,083.33
Car Wash Replacement Water CNR	.1366	.1366	$53,333.33
Catchment in Detention System CNR	.0582	.1741	$19,950.00
Catchment in Rain Barrel CSF	.3327	.9949	$130,686.67
Clotheswasher Efficient Model (Common Area) CMF	.3516	.3516	$69,958.82
Clotheswasher Efficient Model (In Unit) CMF	.32	.32	$199,880.35
Clotheswasher Efficient Model CNR	.0703	.0703	$25,698.97
Clotheswasher Efficient Model CSF	.5883	.5883	$331,147.79
Clotheswasher Eliminate Loads (Common Area) CMF	.2983	.2983	$11,500.00
Clotheswasher Eliminate Loads (In Unit) CMF	.9006	.9006	$11,500.00
Clotheswasher Eliminate Partial Loads CSF	1.0738	1.0738	$12,500.00
Clotheswasher Ultra Efficient Model (In Unit) CMF	1.27	1.27	$977,086.33
Clotheswasher Ultra Efficient Model CSF	2.2581	2.2581	$1,448,095.61
Cooling Tower Performance Improvement CNR	.0589	.1178	$10,833.33
Dishwasher Efficient Model CMF	.1305	.1305	$216,085.31
Dishwasher Efficient Model CNR	.8619	.8619	$351,073.78
Dishwasher Efficient Model CSF	.1882	.1882	$304,796.15
Dishwasher Eliminate Partial Loads CMF	.0475	.0475	$11,500.00
Dishwasher Eliminate Partial Loads CNR	.5076	.5076	$10,000.00
Dishwasher Eliminate Partial Loads CSF	.0496	.0496	$12,500.00
Disposal Use Decrease CMF	.1225	.1225	$23,500.00
Disposal Use Decrease CNR	1.0703	1.0703	$10,000.00
Disposal Use Decrease CSF	.2515	.2515	$25,500.00
Drip Irrigation CMF	.0429	.1281	$39,410.25
Drip Irrigation CNR	.0649	.1941	$76,483.62
Drip Irrigation CSF	.0903	.2699	$149,867.67
Faucet Aerator 0.5 gpm (Bath Flow) CNR	.0532	.0532	$20,405.50
Faucet Aerator 1.5 gpm (Bath Flow) CMF	.3767	.3767	$44,759.57
Faucet Aerator 1.5 gpm (Bath Flow) CSF	.4623	.4623	$56,777.17
Faucet Flow Control (Kitchen Flow) - CNR	.1494	.1494	$19,500.00
Faucet Run Til Hot Recirc (Bath Flow Cust) CNR	.0018	.0018	$9,854.15
Faucet Run Til Hot Recirc (Bath Flow Employ) CNR	.005	.005	$11,266.77
Faucet Run Til Hot Recirc (Bath Flow) CMF	.083	.083	$110,409.97
Faucet Run Til Hot Recirc (Bath Flow) CSF	.0541	.0541	$137,289.16

Table 11 (cont.) Technical Potential "Regular" Package Intensity #6 Details			
Measure Name	Annual Savings (mgd)	Peak Season Savings (mgd)	Utility Average Annual Cost
Faucet Run Til Hot Recirc (Kitchen Flow E) CNR	.0036	.0036	$9,767.14
Faucet Run Til Hot Recirc (Kitchen Flow) CMF	.0627	.0627	$142,294.40
Faucet Run Til Hot Recirc (Kitchen Flow) CSF	.0328	.0328	$148,664.43
Faucet Use Decrease (Bath Flow C) CNR	.0049	.0049	$9,835.47
Faucet Use Decrease (Bath Flow E) CNR	.0133	.0133	$9,863.00
Faucet Use Decrease (Bath Flow) CMF	.4265	.4265	$11,500.00
Faucet Use Decrease (bath Flow) CSF	.4368	.4368	$12,500.00
Faucet Use Decrease (Kitchen Flow E) CNR	.0095	.0095	$9,833.33
Faucet Use Decrease (Kitchen Flow) CMF	.1705	.1705	$11,500.00
Faucet Use Decrease (Kitchen Flow) CSF	.0896	.0896	$12,500.00
Food Preparation and Washing Improvements CNR	1.1176	1.1176	$10,000.00
Hot Tub Use Improvement CNR	.0123	.0123	$13,500.00
Hot Tub Use Improvements CSF	.1185	.1185	$21,500.00
Irrigation Controllers Weather Based CMF	.0341	.1019	$20,183.63
Irrigation Controllers Weather Based CNR	.0516	.1544	$28,188.73
Irrigation Controllers Weather Based CSF	.0729	.218	$38,083.83
Irrigation Scheduling Improvement CMF	.0797	.2383	$76,245.61
Irrigation Scheduling Improvement CNR	.2058	.6153	$188,545.98
Irrigation Scheduling Improvement CSF	.1678	.5017	$238,159.23
Irrigation System Performance Improvement CMF	.0507	.1514	$107,151.43
Irrigation System Performance Improvement CNR	.0767	.2294	$291,308.99
Irrigation System Performance Improvement CSF	.1076	.3217	$393,001.41
Laundry Wash Water Recycle CNR	.0702	.0702	$29,074.85
Lawn Dormant (Auto) CMF	.1968	.5884	$12,500.00
Lawn Dormant (Auto) CNR	.2974	.8893	$12,500.00
Lawn Dormant (Auto) CSF	.4534	1.3555	$11,666.67
Lawn Dormant (Hose & Sprinkler) CMF	.0204	.0611	$12,500.00
Lawn Dormant (Hose & Sprinkler) CSF	1.4905	4.4566	$11,666.67
Lawn Dormant (Man) CMF	.0147	.0441	$12,500.00
Lawn Dormant (Man) CSF	.4949	1.4796	$11,666.67
Leak Reduction (Cooling) CNR	.0359	.0359	$22,455.76
Leak Reduction (Domestic) CMF	.0734	.0734	$32,401.82
Leak Reduction (Domestic) CNR	.1138	.1138	$49,651.44
Leak Reduction (Domestic) CSF	1.1931	1.1931	$118,634.05
Leak Reduction (Food Service) CNR	.0286	.0286	$25,077.60
Leak Reduction (Other) CNR	.0247	.0247	$23,243.92
Leak Reduction (Process) CNR	.5389	.5389	$23,161.47
Plants Low Water Use CMF	.1753	.5241	$155,390.00

Table 11 (cont.) Technical Potential "Regular" Package Intensity #6 Details			
Measure Name	**Annual Savings (mgd)**	**Peak Season Savings (mgd)**	**Utility Average Annual Cost**
Plants Low Water Use CNR	.2652	.7929	$291,515.00
Plants Low Water Use CSF	.4019	1.2016	$515,686.67
Process Water Control Improve (Labs) CNR	.1487	.1487	$36,730.46
Process Water Recycle CNR	.0925	.0925	$44,000.00
Shower Run Til Hot Recirculate (Employ) CNR	.0014	.0014	$9,594.96
Shower Run Til Hot Recirculate CMF	.1519	.1519	$180,766.34
Shower Run Til Hot Recirculate CSF	.0322	.0322	$50,704.64
Shower Use Decrease CMF	1.0929	1.0929	$32,500.00
Shower Use Decrease CSF	.9592	.9592	$32,500.00
Showerheads 1.5 GPM CMF	.5614	.5614	$48,966.80
Showerheads 1.5 GPM CNR	.0303	.0303	$9,807.19
Showerheads 1.5 GPM CSF	.6343	.6343	$47,029.36
Showerheads 2.0 GPM CMF	.4094	.4094	$67,149.71
Showerheads 2.0 GPM CNR	.0204	.0204	$9,856.04
Showerheads 2.0 GPM CSF	.37	.37	$63,158.06
Sidewalk Cleaning by Broom CSF	.0535	.1071	$21,500.00
Soil Amendment Improvements CNR	.0451	.1348	$139,400.00
Soil Amendment Improvements CSF	.0542	.1621	$172,216.67
Soil Moisture Sensors CMF	.0292	.0874	$28,750.24
Soil Moisture Sensors CNR	.0443	.1323	$47,511.62
Soil Moisture Sensors CSF	.0433	.1296	$51,271.27
Sprinkler Rain Shutoff CMF	.0146	.0437	$15,025.38
Sprinkler Rain Shutoff CNR	.0221	.0662	$20,088.74
Sprinkler Rain Shutoff CSF	.0217	.0648	$28,085.62
Swimming Pool Use Improvement CNR	.061	.1825	$11,500.00
Swimming Pool Use Improvement CSF	.2867	.8573	$25,500.00
Toilet 1.6 gpf Longlife CMF	.3726	.3726	$787,939.00
Toilet 1.6 gpf Longlife CNR	.2376	.2376	$334,676.50
Toilet 1.6 gpf Longlife CSF	.6989	.6989	$1,583,150.00
Toilet Flush Decrease CMF	.9474	.9474	$32,500.00
Toilet Flush Decrease CSF	1.9137	1.9137	$32,500.00
Toilet Flushes by Rainwater CNR	.0975	.0975	$477,500.00
Toilet Flushes by Rainwater CSF	.6284	.6284	$2,741,000.00
Urinal 0.5 GPF CNR	.3281	.3281	$11,250.00
Urinal 1.0 GPF CNR	.0211	.0211	$95,139.00
Urinal Flushes by Rainwater CNR	.05	.05	$252,250.00
Urinal No Water CNR	.05	.05	$14,383.00
Water Use Alerting CMF	.0502	.0502	$39,455.67
Water Use Alerting CNR	.1134	.1134	$82,550.89
Water Use Alerting CSF	1.1931	1.1931	$319,394.02
Total	**34.17**	**45.96**	**$16,315,798**

The pie charts in Figures 11 through 13 provide useful characterization of package intensity #6. As shown in Figure 11, approximately half of the savings, 51%, are attributed to the single family sector, 26% to multifamily, and 23% to non residential. As shown in Figure 12, the majority of the savings, 81%, are derived from indoor measures, while 19% are from outdoor measures. As shown in Figure 13, the majority of the savings, 83%, are associated with non-peaking measures, while 17% are from measures that are associated with peak water uses.

Figure 11
Technical Potential "Regular"
Package Intensity #6
Sector Savings

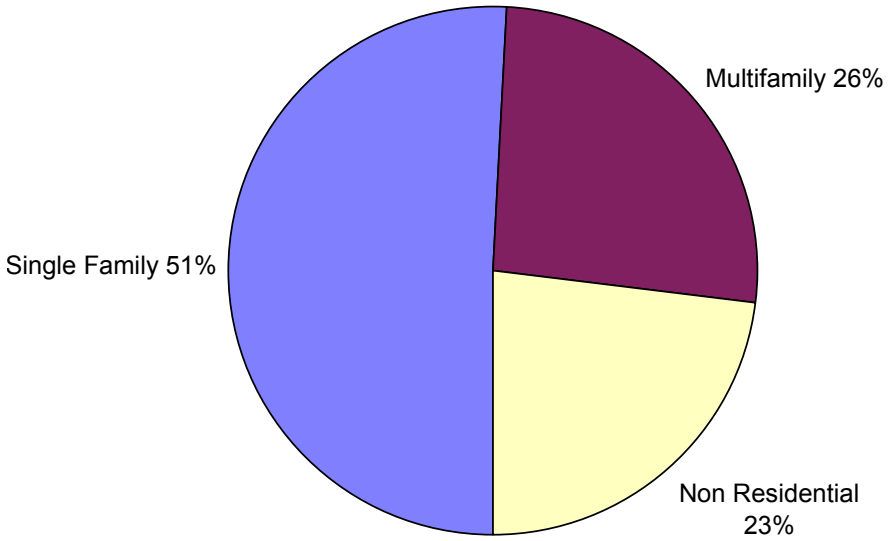


Figure 12
Technical Potential "Regular"
Package Intensity #6
Indoor vs Outdoor Savings

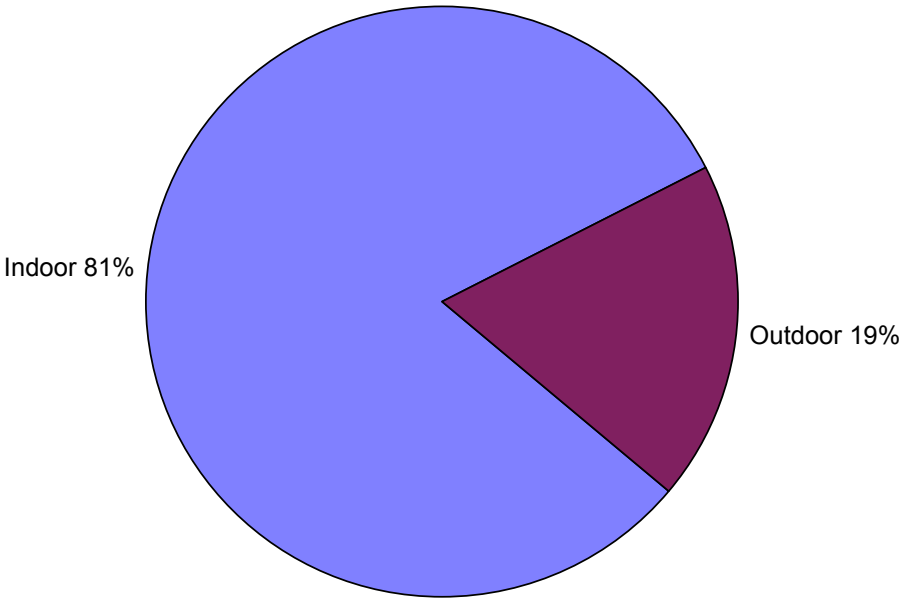
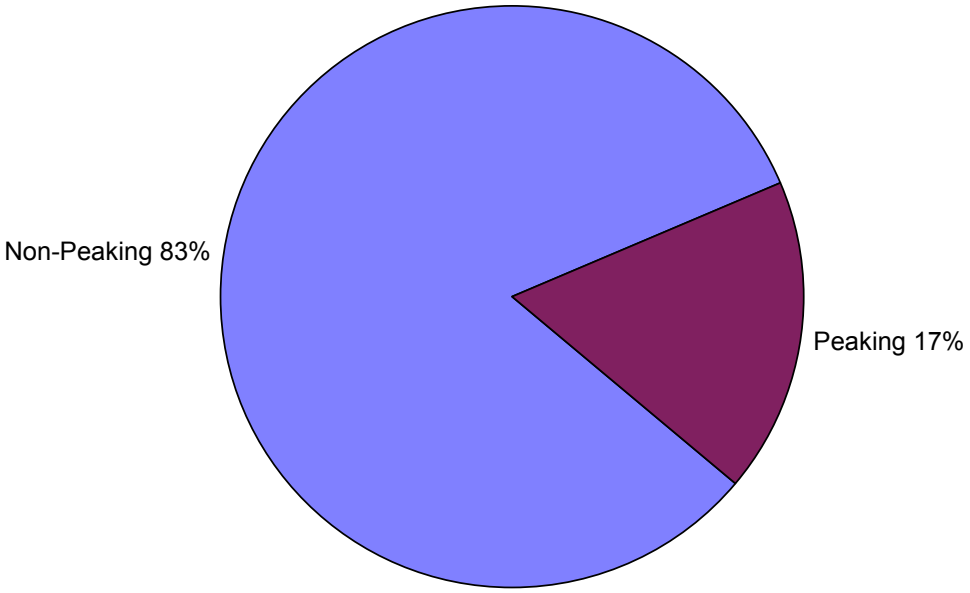


Figure 13
Technical Potential "Regular"
Package Intensity #6
Savings from Peaking and Non-Peaking Measures



3.4.2 Technical Potential "Ends Early" Package

This section contains results for the Technical Potential "Ends Early" package model run. This package represents technical potential running for a shortened time period, from 2011 through 2020. The 11 package intensities for the Technical Potential "Ends Early" package are shown in Table 12 and plotted in Figure 14.

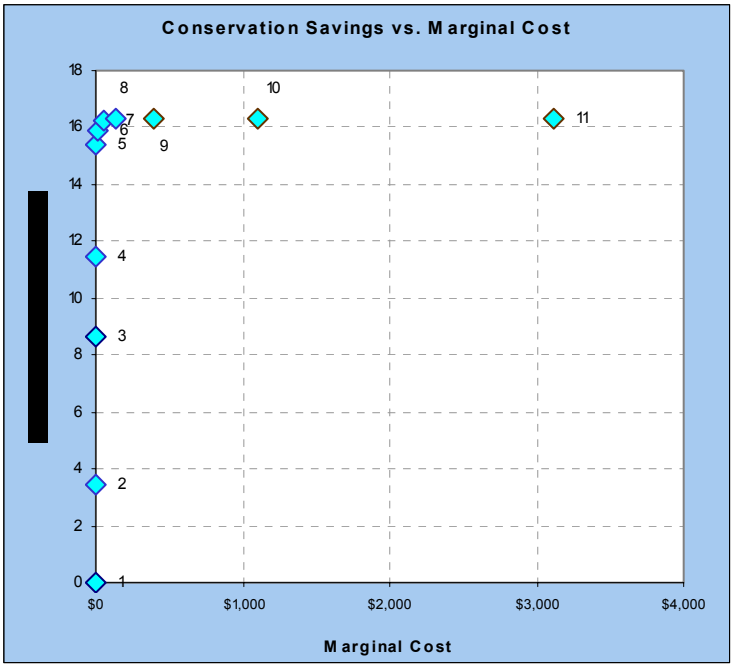
Package intensities #3 - #6, which are shaded in the table, were chosen to best represent the package since the marginal cost is significantly lower than #7 with similar savings to #7 - #11. The savings on an average annual basis ranges from 8.66 to 15.88 mgd by 2020. The savings on a peak season basis ranges from 10.69 to 21.43 mgd by 2020. The utility average annual cost, which includes all utility costs from 2011 through 2020 such as overhead, marketing, and rebates, ranges from $3,175,443 to $15,762,091. The marginal cost, which is the cost of the last unit of water saved, ranges from $0.78 per ccf to $17.47 per ccf.

Table 12
Technical Potential "Ends Early"
Package Intensities

Intensity	Annual Savings (mgd)[1]	Peak Season Savings (mgd)[1]	Utility Average Annual Cost	Marginal Cost Per ccf[2]
1	0.02	0.02	$11,226	$0.10
2	3.42	4.28	$747,417	$0.28
3	8.66	10.69	$3,175,443	$0.78
4	11.45	14.06	$6,738,867	$2.20
5	15.37	20.74	$14,141,953	$6.20
6	15.88	21.43	$15,762,091	$17.47
7	16.27	21.88	$18,987,150	$49.26
8	16.28	21.89	$19,076,302	$138.87
9	16.29	21.92	$19,316,120	$391.50
10	16.293	21.922	$19,344,253	$1,103.73
11	16.293	21.922	$19,355,796	$3,111.63

Shaded rows are the package intensities chosen to best represent this package.
1. mgd = million gallons per day
2. ccf = 100 cubic feet

Figure 14
Technical Potential "Ends Early"
Package Intensities



The labels next to each data point represent the package intensity.

3.4.3 Technical Potential "Late Start" Package

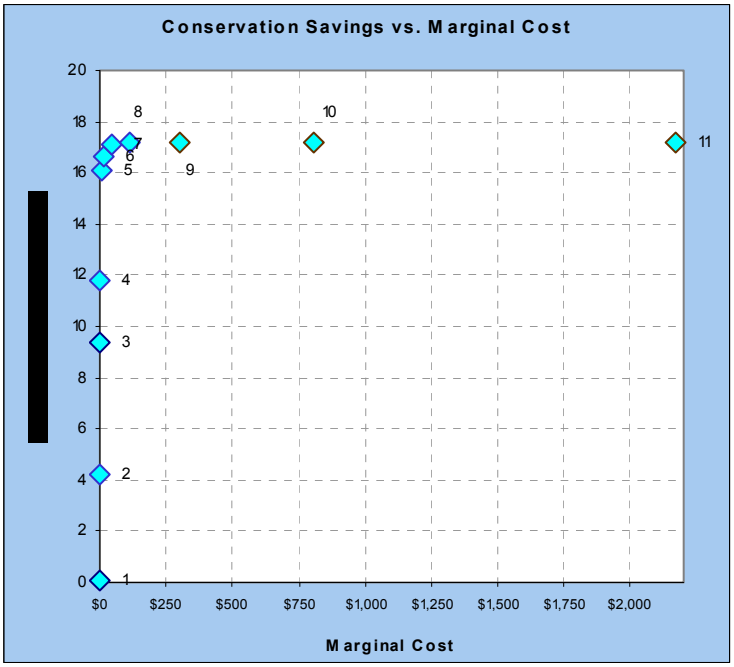
This section contains results for the Technical Potential "Late Start" package model run. This package represents technical potential running for a shortened time period, from 2021 through 2030. The 11 package intensities for the package are shown in Table 13 and plotted in Figure 15.

Package intensities #3-#6, which are shaded in the table, were chosen to best represent the package since they show significant savings at a range of reasonable marginal costs. The savings on an average annual basis ranges from 9.39 to 16.68 mgd by 2030. The savings on a peak season basis ranges from 11.48 to 22.57 mgd by 2030. The utility average annual cost for 2021 through 2030, which includes all utility costs such as overhead, marketing, and rebates, ranges from $3,402,350 to $15,440,311. The marginal cost, which is the cost of the last unit of water saved, ranges from $0.81 per ccf to $15.61 per ccf.

Table 13 Technical Potential "Late Start" Package Intensities				
Intensity	Annual Savings (mgd)[1]	Peak Season Savings (mgd)[1]	Utility Average Annual Cost	Marginal Cost Per ccf[2]
1	0.06	0.06	$10,500	$0.11
2	4.23	5.63	$777,153	$0.30
3	9.39	11.48	$3,402,350	$0.81
4	11.82	14.72	$7,493,556	$2.17
5	16.12	21.78	$14,220,465	$5.82
6	16.68	22.57	$15,440,311	$15.61
7	17.14	23.10	$19,276,968	$41.88
8	17.15	23.11	$19,307,881	$112.34
9	17.16	23.14	$19,224,417	$301.36
10	17.160	23.143	$19,242,573	$808.39
11	17.160	23.144	$19,258,051	$2,168.52

Shaded rows are the package intensities chosen to best represent this package.
1. mgd = million gallons per day
2. ccf = 100 cubic feet

Figure 15
Technical Potential "Late Start"
Package Intensities



The labels next to each data point represent the package intensity.

3.5 Incorporation of Indirect Benefits

The 1998 CPA Report noted that many of the conservation measures have additional economic and environmental benefits beyond water savings. For example, installation of water recycling

systems in industrial applications can reduce energy use as well as wastewater and stormwater discharges. Similarly, more efficient clotheswashers reduce energy use and wastewater discharges in both residential and commercial sectors.

The 1998 CPA Report identified which water conservation measures had indirect benefits but did not quantify the benefits. The 2006 CPA Report presents a methodology for analyzing these benefits along with calculations. This analysis meets a requirement of the City of Seattle's Ordinance Number 120532, that the CPA should quantify "best estimates of other benefits obtained by conservation measures, including savings relating to reduced demand for electricity, sewer, stormwater, etc."

The indirect benefits from water conservation for energy[2], wastewater, and stormwater were determined to be: 1) energy savings to customers for reduced hot water usage ; and 2) a delay in the construction of Sanitary Sewer Overflow (SSO) and Combined Sewer Overflow (CSO) facilities by Seattle Public Utilities and King County. Impact to King County wastewater facilities and operations was considered as an indirect benefit, but was ultimately not incorporated per the reasons discussed in Appendix D. Benefits to improved water quality and habitat protection from reduced irrigation were not easily quantified and are therefore not included.

Determining the indirect benefits for measures and/or packages is a three step process.

- The first step is to ascribe a positive, negative or neutral wastewater, stormwater, and energy indirect benefit to each measure. This characterization is shown in Table 14. Appendix D describes the methodology and assumptions used to determine those characterizations.
- The second step is to calculate a unit value for each indirect benefit category. The wastewater/stormwater benefit was defined as the annual average savings to utilities from a delay in the need to invest in CSO/SSO storage facilities valued at $10/gallon. The annual average energy benefits are the energy savings from reduced hot water usage. Energy savings for the region were based on the avoided cost of electricity valued by Seattle City Light (SCL) at $36/kwh.[3]
- The third step is to calculate the indirect benefit over the life of the measure, based on the volume of water saved by the measure or package and the unit value for each indirect benefit category.

[2] The Ordinance reference to "electricity" was interpreted more broadly as "energy" – including both natural gas and electricity.
[3] SCL avoided cost or marginal cost of electricity is the utility wholesale rate. Based on conversation with Michael Little and Debra Tachibana of SCL in Nov 2004.

Table 14 Measure Indirect Benefits Characterization							
	Sector			Indirect Benefits			
Measure	SF	MF	NR	Waste Water	Storm Water	Energy	% Hot Water
Air Cooling			X	Positive	Neutral	Negative	0%
Boiler Performance Improvement			X	Positive	Neutral	Positive	100%
Car Wash Low Flow Equip			X	Positive	Neutral	Positive	75%
Car Wash Recycle Improvement			X	Positive	Neutral	Positive	75%
Car Wash Replacement Water			X	Positive	Neutral	Positive	75%
Catchment in Detention System			X	Neutral	Neutral	Neutral	0%
Catchment in Rain Barrel	X			Neutral	Neutral	Neutral	0%
Clotheswasher Efficient Model (Common Area)		X		Positive	Neutral	Positive	50%
Clotheswasher Efficient Model (In Unit)	X	X		Positive	Neutral	Positive	50% MF, 35% SF
Clotheswasher Efficient Model			X	Positive	Neutral	Positive	50%
Clotheswasher Eliminate Partial Loads (Common)		X		Positive	Neutral	Positive	50%
Clotheswasher Eliminate Partial Loads (In Unit)	X	X		Positive	Neutral	Positive	50% MF, 35% SF
Clotheswasher Ultra Efficient Model (In Unit)	X	X		Positive	Neutral	Positive	50% MF, 35% SF
Cooling Tower Performance Improvement			X	Positive	Neutral	Negative	0%
Dishwasher Efficient Model	X	X		Positive	Neutral	Positive	100%
Dishwasher Efficient Model			X	Positive	Neutral	Positive	100%
Dishwasher Eliminate Partial Loads	X	X		Positive	Neutral	Positive	100%
Dishwasher Eliminate Partial Loads			X	Positive	Neutral	Positive	100%
Disposal Use Decrease	X	X		Positive	Neutral	Neutral	0%
Disposal Use Decrease			X	Positive	Neutral	Neutral	0%
Drip Irrigation	X	X	X	Neutral	Neutral	Neutral	0%
Faucet Aerator 0.5 gpm (Bath Flow)			X	Positive	Neutral	Positive	20%
Faucet Aerator 1.5 gpm (Bath Flow)	X	X		Positive	Neutral	Positive	20%
Faucet Flow Control (Kitchen Flow)			X	Positive	Neutral	Positive	20%
Faucet Run Til Hot Recirculate (Bath Flow Cust)			X	Positive	Neutral	Positive	100%
Faucet Run Til Hot Recirculate (Bath Flow Employ)			X	Positive	Neutral	Positive	100%
Faucet Run Til Hot Recirculate (Bath Flow)	X	X		Positive	Neutral	Positive	100%
Faucet Run Til Hot Recirculate (Kitchen Flow Employ)			X	Positive	Neutral	Positive	100%
Faucet Run Til Hot Recirculate (Kitchen Flow)	X	X		Positive	Neutral	Positive	100%
Faucet Use Decrease (Bath Flow Cust)			X	Positive	Neutral	Positive	20%
Faucet Use Decrease (Bath Flow Employ)			X	Positive	Neutral	Positive	20%
Faucet Use Decrease (Bath Flow)	X	X		Positive	Neutral	Positive	20%
Faucet Use Decrease (Kitchen Flow Employ)			X	Positive	Neutral	Positive	70%
Faucet Use Decrease (Kitchen Flow)	X	X		Positive	Neutral	Positive	70%
Food Preparation and Washing Improvements			X	Positive	Neutral	Positive	20%
Fountain Efficiency	X	X	X	Neutral	Neutral	Neutral	0%
Hot Tub Use Improvement	X	X	X	Positive	Neutral	Positive	100%
Irrigation Controllers Weather Based	X	X	X	Neutral	Neutral	Neutral	0%

Table 14 (cont) Measure Indirect Benefits Characterization							
	Sector			Indirect Benefits			
Measure	SF	MF	NR	Waste Water	Storm Water	Energy	% Hot Water
Irrigation Scheduling Improvement	X	X	X	Neutral	Neutral	Neutral	0%
Irrigation System Performance Improvement	X	X	X	Neutral	Neutral	Neutral	0%
Laundry Wash Water Recycle			X	Positive	Neutral	Positive	50%
Lawn Dormant (Auto)	X	X	X	Neutral	Neutral	Neutral	0%
Lawn Dormant (Hose & Sprinkler)	X	X		Neutral	Neutral	Neutral	0%
Lawn Dormant (Man)	X	X		Neutral	Neutral	Neutral	0%
Leak Reduction (Cooling)			X	Neutral	Positive	Positive	10%
Leak Reduction (Domestic)	X	X	X	Neutral	Neutral	Neutral	0%
Leak Reduction (Food Service)			X	Neutral	Positive	Positive	10%
Leak Reduction (Landscape)	X	X	X	Neutral	Neutral	Neutral	0%
Leak Reduction (Other)			X	Neutral	Positive	Positive	10%
Leak Reduction (Process)			X	Neutral	Positive	Positive	10%
Leak Reduction (Recreation)			X	Neutral	Positive	Positive	75%
Plants Low Water Use	X	X	X	Neutral	Neutral	Neutral	0%
Process Water Control Improvements (Labs)			X	Positive	Neutral	Neutral	0%
Process Water Recycle			X	Positive	Neutral	Neutral	0%
Shower Run Til Hot Recirculate (Employ)			X	Positive	Neutral	Positive	100%
Shower Run Til Hot Recirculate	X	X		Positive	Neutral	Positive	100%
Shower Use Decrease (Cust)			X	Positive	Neutral	Positive	75%
Shower Use Decrease (Employ)			X	Positive	Neutral	Positive	75%
Shower Use Decrease	X	X		Positive	Neutral	Positive	75%
Showerheads 1.5 GPM	X	X	X	Positive	Neutral	Positive	75%
Showerheads 2.0 GPM	X	X	X	Positive	Neutral	Positive	75%
Sidewalk Cleaning by Broom	X	X	X	Neutral	Positive	Neutral	0%
Soil Amendment Improvements	X	X	X	Neutral	Neutral	Neutral	0%
Soil Moisture Sensors	X	X	X	Neutral	Neutral	Neutral	0%
Sprinkler Rain Shutoff	X	X	X	Neutral	Neutral	Neutral	0%
Swimming Pool Use Improvement	X	X	X	Positive	Neutral	Positive	100%
Toilet 1.2 GPF	X	X		Positive	Neutral	Neutral	0%
Toilet 1.6 GPF	X	X	X	Positive	Neutral	Neutral	0%
Toilet 1.6 GPF Longlife	X	X	X	Positive	Neutral	Neutral	0%
Toilet Flush Decrease	X	X		Positive	Neutral	Neutral	0%
Toilet Flushes by Rainwater	X	X	X	Positive	Positive	Neutral	0%
Urinal 0.5 GPF			X	Positive	Neutral	Neutral	0%
Urinal 1.0 GPF			X	Positive	Neutral	Neutral	0%
Urinal Flushes by Rainwater			X	Positive	Positive	Neutral	0%
Urinal No Water			X	Positive	Neutral	Neutral	0%
Water Use Alerting	X	X	X	Neutral	Neutral	Neutral	0%

When applied to the Technical Potential "Regular" Package Intensity #6, the results for indirect benefits are as follows:

$1,100,000	Stormwater and Wastewater Benefit to Utilities
+$6,900,000	Energy Benefit to Customers
$8,000,000	Total Annual Average Indirect Benefit (at end of program in 2030).

Most of the benefits are energy savings to customers. Although the CSO/SSO benefits are not insignificant, it is unlikely that utilities will delay investments in CSO/SSO based on expectations for water conservation. The assumption that they would delay their investments was made for analysis purposes only.

Section 4
Conclusion

The CPA Model provides a valuable tool for SPU to analyze a wide range of conservation alternatives. The results presented in this report will be used in ongoing regional planning activities for water supply, including the 2007 Seattle Public Utilities Water System Plan, as described in Section 1.3. SPU anticipates continued use of the CPA Model to explore newly formulated conservation measures and packages in future years.

Appendix A
Definitions of Water Supply Planning "Stepping Stones"

- **Conservation Drivers Analysis** – An SPU analysis of external commitments and customer expectations related to its water conservation efforts. The analysis helps answer the following questions: 1) What are the reasons SPU provides water conservation programs if it is not to offset the need for additional water supply?; and 2) What volume of savings is needed to meet those objectives? The result of this work, informed by the CPA, sets SPU's baseline level of conservation to feed into the demand forecast, and form the foundation of SPU's policy direction for conservation in the *2007 Water System Plan Update.*

- **Alternatives for Future Water Supply** – There are two components:

  1) Conservation Potential Assessment: The CPA's primary purpose is to zero in on the most desirable conservation opportunities. It is a rigorous analysis of the cost, volume, and reliability of water conservation opportunities available within Seattle's wholesale and direct service areas through 2030.

  2) Traditional Supply Alternatives: SPU has updated information on alternative supply sources other than conservation that may be developed to meet future water demands. The supply alternatives include ways to make more use of the current sources and development of new sources of supply. Information used to evaluate the different alternatives available to SPU includes up-to-date estimates of firm yield and costs, as well as assessments of environmental impacts, implementation issues, and operational criteria.

- **Demand Forecast Model** – SPU has developed a Variable Flow Factor Demand Forecast Model that projects demand through 2060. Water demand flow factors by sector (single and multi-family residential, commercial, etc.) for Seattle and each wholesale customer has been developed based on current consumption, demographic and weather data. Rather than keeping the flow factors constant over the forecast period, the factors are adjusted over time to reflect the impacts on consumption of conservation and changes in water/sewer prices and household income. The CPA Model is used to estimate the impacts of code and programmatic conservation on the flow factors over time.

- **Drinking Water Supply Planning Model** – SPU has created a planning model to help make water supply investment decisions that consider risks and uncertainties associated with future demands and supplies. The model includes both a decision tree model to evaluate cost risks and a weighted criteria model to incorporate the environmental and social aspects of alternatives that are not easily converted to monetary units. The demand forecast, firm yield of current and alternative sources of supply, and the CPA provide information to the planning model. This model is used to compare supply alternatives, including conservation.

- **Supply with Current Facilities** – SPU currently supplies water to its customers from its surface water facilities on the Cedar River and the South Fork Tolt River, as well as from its well fields south of Seattle. These sources can supply up to 171 million gallons per day on an average annual basis at 98% reliability. SPU periodically updates the firm yield estimates for its supply sources to account for recent hydrologic events, changes in regulations and instream flow requirements, and other factors. Recently, SPU has studied the potential impacts that climate change could have on its sources, and considers this information in its water supply planning efforts.

- **2007 Update of Water System Plan** – Every six years SPU is required to update its comprehensive water system plan, which provides guidance for the different aspects of utility functions. Meeting future demand is a key element of the plan, along with maintaining reliability in delivering water, continuing to meet water quality regulations, and sustaining a financially sound position for ratepayers. To address how SPU will meet future demand, SPU must prepare a demand forecast, an analysis of yield and supply alternatives, and an evaluation of conservation as a source of supply. The CPA provides the analysis of conservation alternatives for this exercise.

Appendix B
Understanding the CPA Model – Supplemental Information

This appendix includes further details on the CPA Model to supplement information presented in the main report. The following five subsections are included:

- Water Balance - End Uses Component
- Water Balance - Demographics Component
- Water Balance - Demand Component
- Measure Library - Measure Costs
- Measure Library - Measure Optimization

Water Balance - End Uses Component

The end uses component of the water balance consists of 60 end uses, which are ways customers use water such as toilet flushing, irrigation, and boiler operation. The 60 end uses, and their peak factor, are listed in Table B-1. The peak factor is the ratio of peak season demand to average annual demand. The peak season is 4 months (May 15 to September 15) and is characterized by increased demand due to increased seasonal uses such as irrigation. An end use with a peak factor of 1.0, such as toilets, is considered "non-peaking" since its consumption is the same year-round. In contrast, an end use with a peak factor larger than 1.0 (e.g., 2.99), such as irrigation, is considered "peaking" since its consumption is higher in the peak season.

For several of the end uses, the number of fixtures per customer is important since it can factor into the cost of conservation measures associated with those end uses. For example, the cost of a conservation measure replacing showerheads in single family households depends on the number of showerheads in single family households. Table B-2 shows the average number of fixtures per customer for the relevant end uses. These numbers are from the 1998 CPA Report or updated with more recent information from local or regional research, if available.

Table B-1 End Uses					
#	End Use	Peak Factor	#	End Use	Peak Factor
1	Animal Care	1	31	Irrigation - Sprinkler In Ground Auto	2.99
2	Bath	1	32	Irrigation - Sprinkler In Ground Manual	2.99
3	Boilers	1	33	Jacuzzi	1
4	Canning/Bottling	1	34	Laboratories	1
5	Child's Play	2.99	35	Leaks - Cooling	1
6	Clotheswasher – Industrial Capacity	1	36	Leaks - Domestic	1
7	Clotheswasher – Laundromat	1	37	Leaks - Food Service	1
8	Clotheswasher – Res. Capacity in Common Area	1	38	Leaks - Landscape	2.99
9	Clotheswasher – Res. Capacity In Unit	1	39	Leaks - Other	1
10	Construction	1	40	Leaks - Process	1
11	Dishwashing – Machine Comm. Capacity	1	41	Leaks - Recreation	1
12	Dishwashing – Machine Res. Capacity	1	42	Material Transport	1
13	Disposal – Comm. Capacity	1	43	Once through	1
14	Disposal – Res. Capacity	1	44	Other Equip Towers	1.4
15	Distillation	1	45	Other Food Prep	1
16	Dry Cleaning	1	46	Other Food Washing	1
17	Dust Control	1	47	Other Washing	1
18	Faucet – Bathroom by Flow[1]	1	48	Pollution Scrubbers	1
19	Faucet – Bathroom by Vol[1]	1	49	Pool	2.99
20	Faucet - Kitchen by Flow[1]	1	50	Process Washing	1
21	Faucet - Kitchen by Vol[1]	1	51	Product Input	1
22	Film Processing	1	52	Quenching/Dipping	1
23	Food Processing	1	53	Refrigerators	1
24	Fountains	1	54	Shower	1
25	Hot Tub	1	55	Sidewalk Washing	2
26	HVAC Towers	2	56	Toilet	1
27	Ice-Makers	1	57	Urinal	1
28	Irrigation - Drip / Soaker	2.99	58	Vehicle Washing - Business W/ Own Equip	1
29	Irrigation - Hand Held	2.99	59	Vehicle Washing - Hose	2
30	Irrigation - Hose & Sprinkler	2.99	60	Vehicle Washing - Retail Car Wash	1

[1] Faucets are designated as either "flow" or "volume." The "flow" version is when the reason for water use occurs simultaneously with water flowing down the drain, such as with dish washing and teeth brushing. Conservation is applicable to "flow" faucets since the reason for water use can be accomplished while also reducing the flow rate and/or duration of use. The "volume" version is when the reason for water use is associated with obtaining a specific volume of water, such as filling a cooking pot or glass of water. Conservation is not applicable to "volume" faucet use since the use is consumptive.

Table B-2 Average Number of Fixtures per Customer			
Fixture	Single Family Households	Multifamily Households	Non-Residential Customers
Toilets	2.35	1.10	5.22
Showerheads	1.94	1.20	0.83
Faucets - All	n/a	n/a	4.72
Faucets - Bathroom	2.47	1.50	3.52
Faucets - Kitchen	1.00	1.00	1.20
Urinal	n/a	n/a	1.30

Every end use has a volume and a behavior. The volume is an indication of how efficient the equipment is (e.g., 3.5 gallons per flush, for a toilet). The behavior is an indication of how intensively the end use is employed (e.g., 5 flushes per day per person, for a toilet). There are several options for each end use's volume and behavior (e.g., 4.5, 3.5, and 1.6 gpf). Each option is allocated a percent, which is the percent of customers having that option (e.g., 10% with 4.5 gpf, 40% with 3.5 gpf, and 50% with 1.6 gpf). In the CPA Model, the volume and behavior options generally remain constant over the time period analyzed. However, the percentages often shift from higher (less efficient) options to lower (more efficient) options due to code savings and conservation programs.

Water Balance - Demographics Component

The demographics component of the water balance consists of demographic data such as the number of households, businesses, people per household, employees, etc. Table B-3 details the demographic data listed by service area and sector. For the historical time period (1995 through 2005), the numbers are based on data and analysis from the U.S. Census, the Puget Sound Regional Council (PSRC), and Dick Conway and Associates. For the future time period (2010 through 2030), the numbers are based on data from PSRC.

Table B-3 Demographics											
		Single Family		Multifamily				Non-Residential			
Service Area	Year	Households	Persons Per Household	Households	Complexes	Households Per Complex	Persons Per Household	Businesses	Employees	Employees Per Business	Customers Per Business
Direct	1990	146,890	2.58	110,539	5,527	20.00	1.72	12,222	495,144	40.51	134.62
Direct	1995	148,964	2.59	119,226	5,961	20.00	1.73	13,268	524,842	39.56	133.98
Direct	2000	151,070	2.61	128,604	6,430	20.00	1.74	14,379	557,005	38.74	133.42
Direct	2005	151,363	2.62	138,705	6,935	20.00	1.75	14,684	559,598	38.11	131.75
Direct	2010	151,746	2.59	152,082	7,604	20.00	1.73	16,622	624,648	37.58	130.33
Direct	2015	153,043	2.58	166,673	8,334	20.00	1.72	17,505	652,810	37.29	130.28
Direct	2020	154,352	2.58	182,669	9,133	20.00	1.72	18,426	682,243	37.03	130.24
Direct	2025	156,045	2.57	200,952	10,048	20.00	1.71	19,195	705,738	36.77	130.24
Direct	2030	157,758	2.56	221,071	11,054	20.00	1.70	19,998	730,053	36.51	130.24
Purveyor	1990	102,541	2.93	35,033	1,752	20.00	1.83	2,842	106,244	37.38	91.78
Purveyor	1995	107,854	2.94	38,794	1,940	20.00	1.83	3,379	123,059	36.42	91.65
Purveyor	2000	113,633	2.93	43,196	2,160	20.00	1.83	4,056	144,572	35.64	91.54
Purveyor	2005	113,253	2.93	46,029	2,301	20.00	1.83	3,937	136,483	34.66	89.88
Purveyor	2010	116,095	2.91	51,272	2,564	20.00	1.82	4,649	157,467	33.87	88.54
Purveyor	2015	120,180	2.90	55,514	2,776	20.00	1.81	5,083	168,475	33.15	87.73
Purveyor	2020	124,525	2.89	60,137	3,007	20.00	1.81	5,546	180,387	32.53	87.05
Purveyor	2025	126,682	2.89	64,822	3,241	20.00	1.80	6,033	192,483	31.91	86.47
Purveyor	2030	128,976	2.88	69,889	3,494	20.00	1.80	6,572	205,627	31.29	85.97
Combined	1990	249,432	2.72	145,572	7,279	20.00	1.75	15,064	601,388	39.92	126.54
Combined	1995	256,818	2.74	158,020	7,901	20.00	1.76	16,647	647,901	38.39	125.38
Combined	2000	264,703	2.75	171,800	8,590	20.00	1.76	18,435	701,577	38.06	124.21
Combined	2005	264,616	2.76	184,734	9,237	20.00	1.77	18,621	696,081	37.38	122.89
Combined	2010	267,841	2.73	203,354	10,168	20.00	1.75	21,271	782,115	36.77	121.20
Combined	2015	273,224	2.72	222,187	11,109	20.00	1.75	22,588	821,285	36.36	120.71
Combined	2020	278,877	2.72	242,806	12,140	20.00	1.74	23,971	862,630	35.99	120.24
Combined	2025	282,727	2.71	265,774	13,289	20.00	1.73	25,227	898,221	35.60	119.77
Combined	2030	286,734	2.70	290,960	14,548	20.00	1.73	26,570	935,680	35.22	119.29

Water Balance - Demand Component

The demand component of the water balance consists of model-calculated demands generated by combining demographics, end use options, and percentages for end use options. The CPA Model calculates demand for all time periods. For the historical time period (1995 through 2005), the model-calculated demand has been calibrated to match actual historical demand. For the future time period (2010 through 2030), the model-calculated demand provides a demand forecast. Table B-4 shows the actual historical demands

Table B-4 Actual Historical Demand (mgd)							
Service Area	Year	Single Family		Multifamily		Non-Residential	
		Annual	Peak	Annual	Peak	Annual	Peak
Direct	1995	26.54	32.78	14.35	15.07	30.75	34.75
Direct	2000	26.69	33.06	14.39	15.16	27.14	30.76
Direct	2005	23.39	28.90	12.22	12.84	23.47	26.53
Purveyor	1995	23.87	31.76	6.47	7.54	6.55	8.92
Purveyor	2000	24.72	33.87	7.07	8.29	7.51	10.52
Purveyor	2005	22.83	29.71	6.82	8.02	6.86	9.73
Combined	1995	50.41	64.54	20.82	22.61	37.30	43.67
Combined	2000	51.41	66.93	21.46	23.45	34.65	41.28
Combined	2005	46.22	58.61	19.04	20.86	30.33	36.26

Measure Library - Measure Costs

The cost of a measure is comprised of four components: direct cost, operation and maintenance (O&M) cost, overhead cost, and market saturation cost. Each of these costs is discussed below.

Direct Cost: This is the direct cost to implement the measure, regardless of whether SPU (via a rebate) or the customer pays. Depending on the measure, this category could include hardware purchases, installation fees, the cost of audits, or other costs. Cost is per household or business and therefore includes the cost of all fixtures (e.g., 1.94 showerheads per single family household). Direct costs are not shared with other measures when using the Package Wizard.

The direct costs that are included in a measure depend on two assumptions. The first assumption is whether the customer is ready to purchase new equipment, whether SPU is accelerating that purchase, or whether the customer never would have purchased the equipment on their own. The second assumption is whether the customer can purchase only efficient models or whether they have the choice of purchasing non-efficient models as well. Table B-5 summarizes this information.

Table B-5 Direct Cost Components		
Situation	**Cost Components**	**Example**
1. Customer Ready to Purchase.		
1a. Option exists to purchase regular and efficient models.	Difference between efficient and regular model.	Clotheswasher.
1b. Can only purchase efficient model.	No cost.	1.6 gpf toilet, if not accelerating.
2. SPU Accelerating Purchase (assume equipment is at 50% of its life).		
2a. Option exists to purchase regular and efficient models.	50% depreciation on old equipment + difference between efficient and regular model.	1.2 gpf toilet.
2b. Can only purchase efficient model.	50% depreciation on old equipment.	1.6 gpf toilet.
3. Customer Would Never Purchase on Own.	Full cost of new equipment.	Stormwater for toilet flushing.

O&M Cost: This is the annual cost to the customer for any operating and maintenance costs such as increased energy (e.g., switching from water cooling to air cooling) or increased labor (e.g., more frequent maintenance). Most measures do not have an O&M cost.

Overhead Cost: This is the annual overhead cost to SPU, which was estimated by SPU staff to be $7,500 for every measure ($4,500 for staff + $3,000 for furniture, phone, rent, etc.).

Market Saturation Cost: This is the annual cost to deliver information about the measure to every targeted customer. This includes both marketing and variable administration costs. The market saturation cost for each measure assumes that it is the only measure implemented. However, the Package Wizard allows this cost to be shared by multiple measures. For example, low-flow showerheads and faucet aerators may be given away together in an indoor retrofit kit. Even though they will share marketing and variable administration costs, the market saturation cost for each assumes it is the only measure implemented.

Measure Library - Measure Optimization

Measure optimization is the process by which the CPA Model determines the appropriate marketing budget and rebate level, with the goal of achieving the largest water savings. Measures can be optimized on two bases: participation rates and annual budget. In both cases, the CPA Model analyzes spending different percentages of the Market Saturation Cost and different rebate levels. When optimizing based on participation rates, the model selects the combination of Market Saturation Cost spent and rebate that results in the highest possible participation rate, which is always the highest marketing budget and rebate level. When optimizing based on an annual budget, the CPA Model does the same process but within the limits of a particular budget.

For a detailed description of the measure optimization process, please refer to the CPA Users Guide.

Appendix C
Measure Definitions

(Note: SF means single family, MF means multifamily, and NR means non-residential.)

Air Cooling (NR) - Convert equipment from a water-cooled flow-through system to an air-cooled system with external heat exhaust coil. Examples include ice machines and refrigeration equipment.

Boiler Performance Improvement (NR) - Improve water quality control and increase boiler cycles. For some boilers, this may also include steam condensation recovery. Direct costs includes chemicals and increased monitoring.

Car Wash Low Flow Equipment (NR) - Convert car washing from hose and bucket technique to more efficient techniques such as on-site power washers or switch to commercial car washes.

Car Wash Recycle Improvement (NR) - Install equipment that treats and recycles wash water for use in washing other vehicles. Does not completely eliminate the need for potable water, but reduces it to approximately 10 to 20% for make up water.

Car Wash Replacement Water (NR) - Substitute non-potable water (such as reclaimed water) for potable water used for car washing.

Catchment in Detention System (NR) - Substitute stormwater for potable water for non-potable uses, such as irrigation, by making use of water in stormwater detention ponds. This measure differs from Catchment in Rain Barrels since it has larger volumes and uses water for automatic irrigation systems rather than for hand-held watering.

Catchment in Rain Barrel (SF) - Substitute rainwater for potable water for hand-held irrigation by directing gutters to small barrels. Use is restricted to customers with very small irrigation needs (10 gallons a day or less) since rainfall in the Seattle area limits barrel filling to under 10 times in an "average" summer.

Clotheswasher Efficient Model (Common Area) (MF) - Replace inefficient clotheswashers with more efficient models. These machines are located in a common area of an apartment building, serve multiple apartments, and are usually coin-operated.

Clotheswasher Efficient Model (In Unit) (SF, MF) - Replace inefficient clotheswashers with more efficient models. These machines are located in individual units, whether a single family house, condo, townhouse, or apartment. For SF, the machine is usually owned by the occupant, unless the occupant is a renter. For MF, the machine is usually not owned by the occupant.

Clotheswasher Efficient Model (NR) - Replace inefficient clotheswashers with more efficient models. These machines are located in laundromats, institutions, dorms, or at non-residential sites. They are usually coin-operated machines serving many users.

Clotheswasher Eliminate Partial Loads (Common Area) (MF) - Decrease the frequency of use by encouraging customers to load machines to full capacity, rather than doing a series of smaller loads. These machines are located in a common area of an apartment building, serve multiple apartments, and are usually coin-operated.

Clotheswasher Eliminate Partial Loads (In Unit) (SF, MF) - Decrease the frequency of use by encouraging customers to load machines to full capacity, rather than doing a series of smaller loads. These machines are located in individual units, whether a single family house, condo, townhouse, or apartment.

Clotheswasher Ultra Efficient Model (In Unit) (SF, MF) - Replace inefficient clotheswashers with ultra efficient models (water factor less than 6.0). These machines are located in individual units, whether a single family house, condo, townhouse, or apartment. For SF, the machine is usually owned by the occupant, unless the occupant is a renter. For MF, the machine is usually not owned by the occupant.

Cooling System Performance Improvement (NR) - This measure covers all water cooling applications except conversion from water-cooling to air-cooling. It includes: (1) adding monitoring equipment to adjust feed water and increase concentration cycles (less purge water and less drinking water make-up); (2) periodic inspection for water overflows and other maintenance issues related to water use; and (3) converting single pass cooling to a loop system.

Dishwasher Efficient Model (SF, MF, NR) - Replace inefficient dishwashers with more efficient models. For SF and MF, the machines are residential capacity. For NR, the machines are commercial capacity.

Dishwasher Eliminate Partial Loads (SF, MF, NR) - Decrease the frequency of use by encouraging customers to load the machine to full capacity, rather than doing a series of smaller loads.

Disposal Usage Decrease (SF, MF, NR) - Decrease the frequency of use by encouraging pre-screening and removal/composting of certain types of food waste.

Drip Irrigation (SF, MF, NR) - Use soaker hoses or micro-irrigation technology that delivers water close to the root zone of plants and reduces losses associated with evaporation and runoff.

Faucet Aerator 0.5 gpm (Bath Flow) (NR) - Replace less efficient bathroom faucet aerators with 0.5-gpm models, which the code specifies for new commercial construction.

Faucet Aerator 1.5 gpm (Bath Flow) (SF, MF) - Replace less efficient bathroom faucet aerators with 1.5-gpm models.

Faucet Flow Control (Kitchen Flow) (NR) - Replace less efficient pre-rinse sprayheads in commercial kitchens with 1.6-gpm models.

Faucet Run Until Hot Recirculate (Bath Flow Customer) & (Bath Flow Employee) (NR) - Install a recirculating system that returns cold water to the hot water tank via the cold water line

instead of disposing it down the drain while waiting for hot water. This consists of a pump, thermal sensor, and plumbing. Depending on the size of the business, more than one system per business may be required to address all fixtures (bathroom faucets, kitchen faucets, showers). Since the model restricts a measure to only one end use, the cost of a recirulating system is spread across all these fixtures. Therefore, all Run Till Hot Recirculate measures within a sector must be implemented together.

Faucet Run Until Hot Recirculate (Bath Flow) (SF, MR) - Install a recirculating system that returns cold water to the hot water tank via the cold water line instead of disposing it down the drain while waiting for hot water. This consists of a pump, thermal sensor, and plumbing. One system per household addresses all fixtures (bathroom faucets, kitchen faucets, showers). However, since the model restricts a measure to only one end use, the cost of a recirulating system is spread across all these fixtures. Therefore, all Run Till Hot Recirculate measures within a sector must be implemented together.

Faucet Run Until Hot Recirculate (Kitchen Flow Employee) (NR) - Install a recirculating system that returns cold water to the hot water tank via the cold water line instead of disposing it down the drain while waiting for hot water. This consists of a pump, thermal sensor, and plumbing. Depending on the size of the business, more than one system per business may be required to address all fixtures (bathroom faucets, kitchen faucets, showers). Since the model restricts a measure to only one end use, the cost of a recirulating system is spread across all these fixtures. Therefore, all Run Till Hot Recirculate measures within a sector must be implemented together.

Faucet Run Until Hot Recirculate (Kitchen Flow) (SF, MR) - Install a recirculating system that returns cold water to the hot water tank via the cold water line instead of disposing it down the drain while waiting for hot water. This consists of a pump, thermal sensor, and plumbing. One system per household addresses all fixtures (bathroom faucets, kitchen faucets, showers). However, since the model restricts a measure to only one end use, the cost of a recirulating system is spread across all these fixtures. Therefore, all Run Till Hot Recirculate measures within a sector must be implemented together.

Faucet Use Decrease (Bath Flow Customer) & (Bath Flow Employee) (NR) - Decrease bathroom faucet run time by turning off water while hand washing, shaving, brushing teeth, cleaning items, etc.

Faucet Use Decrease (Bath Flow) (SF, MF) - Decrease bathroom faucet run time by turning off water while hand washing, shaving, brushing teeth, cleaning items, etc.

Faucet Use Decrease (Kitchen Flow Employee) (NR) - Decrease kitchen faucet run time by greater use of automatic dishwasher without pre-wash and/or use of sink and stopper.

Faucet Use Decrease (Kitchen Flow) (SF, MF) - Decrease kitchen faucet run time by greater use of automatic dishwasher without pre-wash and/or use of sink and stopper.

Food Preparation and Washing Improvement (NR) - Convert from common commercial kitchen practice of thawing frozen food under running water to thawing food in the refrigerator.

Fountain Efficiency (SF, MF, NR) - Improve maintenance and operation of outdoor fountains and ponds to minimize leaks, overflows, and evaporation.

Hot Tub Use Improvement (SF, MF, NR) - Reduce the number of times pools are drained and the amount of make-up water needed by better use of chemical treatment to maintain high quality water. This also involves proper maintenance of refill valves and hot tub side cleanup.

Irrigation Controllers Weather Based (SF, MF, NR) - Install automatic irrigation timer systems that adjust watering schedules to meet weather-adjusted plant water needs.

Irrigation Scheduling Improvement (SF, MF, NR) - Provide on-site recommendations or self-auditing checklists to decrease the frequency or duration of watering. This requires periodic manual adjustment of automatic controllers, as opposed to automatic adjustments as done in the case of Irrigation Controllers Weather Based.

Irrigation System Performance Improvement (SF, MF, NR) - Improve the efficiency of irrigation systems by adjusting spray patterns, repairing leaks, and reducing the number and location of sprayheads.

Laundry Wash Water Recycle (NR) - Install equipment that treats and recycles wash water so a portion of it can be used again in another cycle or load. This can involve ozone or other treatment methods.

Lawn Dormant (Auto) (SF, MF, NR) - Near elimination of lawn watering by customers who normally water their lawn with in-ground sprinkler systems with automatic controllers. This does not completely eliminate watering since a small amount is necessary as maintenance water.

Lawn Dormant (Hose & Sprinkler) (SF, MF) - Near elimination of lawn watering by customers who normally water their lawn with a hose and moveable sprinkler. This does not completely eliminate watering since a small amount is necessary as maintenance water.

Lawn Dormant (Auto) (SF, MF) - Near elimination of lawn watering by customers who normally water their lawn with in-ground sprinkler systems with manual controllers. This does not completely eliminate watering since a small amount is necessary as maintenance water.

Leak Reduction (Cooling) (NR) - Identify and repair leaks associated with cooling equipment.

Leak Reduction (Domestic) (SF, MF, NR) - Identify and repair -leaks associated with toilets, shower, and faucets.

Leak Reduction (Food Service) (NR) - Identify and repair leaks associated with food service equipment.

Leak Reduction (Landscape) (SF, MF, NR) - Identify and repair leaks associated with irrigation equipment.

Leak Reduction (Other) (NR) - Identify and repair leaks associated with uses other than cooling, domestic, food service, landscape, process, or recreation.

Leak Reduction (Process) (NR) - Identify and repair leaks associated with process water.

Leak Reduction (Recreation) (NR) - Identify and repair leaks associated with recreation equipment.

Plants Low Water Use (SF, MF, NR) - Low water use landscaping including proper design (right plant/right place), soil preparation, plant installation, and periodic care. This type of landscaping typically lacks an in-ground irrigation system, since extensive watering is not necessary after plant establishment. This measure is best suited to new construction and re-landscaping.

Process Water Control Improvements (Labs) (NR) - Modify or add equipment or practices in laboratories, such as reverse washing technology.

Process Water Recycle (NR) - Install equipment that treats and recycles used process water to be used again for another non-potable use.

Shower Run Until Hot Recirculate (Employee) (NR) - Install a recirculating system that returns cold water to the hot water tank via the cold water line instead of disposing it down the drain while waiting for hot water. This consists of a pump, thermal sensor, and plumbing. Depending on the size of the business, more than one system per business may be required to address all fixtures (bathroom faucets, kitchen faucets, showers). Since the model restricts a measure to only one end use, the cost of a recirulating system is spread across all these fixtures. Therefore, all Run Till Hot Recirculate measures within a sector must be implemented together.

Shower Run Until Hot Recirculate (SF, MR) - Install a recirculating system that returns cold water to the hot water tank via the cold water line instead of disposing it down the drain while waiting for hot water. This consists of a pump, thermal sensor, and plumbing. One system per household addresses all fixtures (bathroom faucets, kitchen faucets, showers). However, since the model restricts a measure to only one end use, the cost of a recirulating system is spread across all these fixtures. Therefore, all Run Till Hot Recirculate measures within a sector must be implemented together.

Shower Use Decrease (Customer) & (Employee) (NR) - Decrease shower run time (about 10% less time per person per shower) by using a shower timer or other visual reminder.

Shower Use Decrease (SF, MF) - Decrease shower run time (about 10% less time per person per shower) by using a shower timer or other visual reminder.

Showerheads 1.5 gpm (SF, MF, NR) - Replace less efficient showerheads with ultra efficient models using only 1.5 gpm. These models save more water per shower than the 2.0-gpm model, but have lower customer acceptance.

Showerheads 2.0 gpm (SF, MF, NR) - Replace less efficient showerheads with 2.0-gpm models.

Sidewalk Cleaning by Broom (SF, MF, NR) - Convert from washing sidewalks with a hose to using a broom instead.

Soil Amendment Improvements (SF, MF, NR) - Use of proper soil preparation including aeration, compost, and soil conditioning, so plants develop healthy and drought-tolerant root systems and soils can hold more moisture. This measure is best suited to new construction and re-landscaping.

Soil Moisture Sensors (SF, MF, NR) - Install sensors that override automatic irrigation system controllers and prevent irrigation if the soil moisture indicates plants do not need water.

Sprinkler Rain Shutoff (SF, MF, NR) - Install rain shutoff sensors that override automatic irrigation system controllers and prevent irrigation if the sensor detects recent rainfall.

Swimming Pool Use Improvement (SF, MF, NR) - Reduce the number of times pools are drained and the amount of make-up water needed by better use of chemical treatment to maintain high quality water. This also involves proper maintenance of refill valves and pool-side cleanup

Toilet 1.2 GPF (SF, MF) - Replace less efficient toilets with dual flush toilets. Dual flush toilets use a smaller flush volume for liquid waste than for solid waste and average flushes use 1.2 gallons per flush.

Toilet 1.6 GPF (SF, MF, NR) - Replace less efficient toilets with standard 1.6-gpf models. These standard models require periodic flapper replacement to retain their savings. This measure assumes code-acceleration.

Toilet 1.6 GPF Longlife (SF, MF, NR) - Replace less efficient toilets with long life 1.6-gpf models. These long life models do not require frequent flapper replacement to retain savings and are designed so the volume per flush will not increase significantly if an improper replacement flapper is installed. This measure includes, but is not limited to, flapperless toilet designs.

Toilet Flush Decrease (SF, MF) - Decrease the frequency of toilet flushing by not flushing after every liquid-only toilet use. This measure is not appropriate for commercial settings.

Toilet Flushes by Rainwater (SF, MF) - Substitute rainwater for potable water to flush toilets. This requires plumbing permits, storage, dual plumbing, and frequently added energy use for pumping the water. This can require increased maintenance and use of potable water for flushing during periods of low rainfall or freezing.

Urinal 0.5 gpf (NR) - Convert less efficient urinals to use only 0.5 gpf by modifying the flush valve. This conversion will work in most cases; however, in some cases the entire urinal must be replaced.

Urinal 1.0 gpf (NR) - Replace less efficient urinals with 1.0-gpf models.

Urinal Flushes by Rainwater (NR) - Substitute rainwater for potable water to flush urinals. This requires plumbing permits, storage, dual plumbing, and frequently added energy use for pumping the water. This can require increased maintenance and use of potable water for flushing during periods of low rainfall or freezing. This measure must be combined with Toilet Flushes by Rainwater, since it would not be done independently.

Urinal No Water (NR) - Replace water-using urinals with urinals not requiring water. These urinals use a neutralizing fluid to reduce odors.

Water Use Alerting (SF, MF, NR) - Install a metering device that warns users and/or cuts off water flow at levels set to avoid waste. Equipment may include alarms or volume or time measurement. If the water is not automatically shut off (for example, a spring-loaded faucet or solenoid), the alert stimulates the water user to take specific water saving measures.

Appendix D
Indirect Benefits Methodology

The following describes the methodology and assumptions used to ascribe a positive, negative or neutral wastewater, stormwater, and energy indirect benefit to each of the water conservation measures.

Wastewater

An indirect benefit from water conservation on wastewater is a reduction in the sizing of SSO/CSO facilities by Seattle Public Utilities.

The allocation of wastewater benefits was allocated to each of the measures in the following manner:

- All landscaping measures are neutral (except for "grey water for irrigation") since this water would not have gone to the sewer system.
- Most non-landscaping measures are positive since this water would have gone to the sewer system.
- A few exceptions exist where the water would have not have gone to the sewer system and therefore are classified as neutral. This is the case for leaks, outdoor sweeper, and dry sidewalk cleaning.

Reduction in sewer volume may have an impact on capacity issues in King County's wastewater system in three ways:

1. Impact capacity constraints on the conveyance system.
2. Change operations at treatment facility.
3. Delay date of bringing new King County Brightwater treatment plant on-line.

Reduction in sewer volume going to sewage treatment facility was assumed to have no benefit to King County, since it was indeterminate whether a reduction in volume of water was a positive or negative impact on King County operations, and has not been quantified. The reduction in volume going to King County facilities may have little impact since sizing of the facility is driven by peak flows from storm water, and from solids loading[4]. Reduction in the volume of wastewater from north Seattle being sent to King County may delay the bringing on of the Brightwater plant, but the benefit was not quantified. No indirect benefit was attributed to King County treatment from water conservation by the City of Seattle.

[4] Email from Karen Huber of King County 11/17/2004

Stormwater

An indirect benefit from water conservation on stormwater is a reduction in the sizing of SSO/CSO facilities by local stormwater/wastewater utilities.

The allocation of stormwater benefits was allocated to each of the measures in the following manner:

- All landscaping measures are neutral since landscape water is used during the summer, and the reduction in sizing of CSO and SSO facilities is based on winter flows
- Most non-landscaping measures are neutral since this water would not have gone to the stormwater system
- A few exceptions exist where water would have gone to the stormwater system and therefore are classified as positive. This is the case for leaks, outdoor sweeper, dry sidewalk cleaning, and toilet/urinal flushing with stormwater.

Assumptions in CSO/SSO benefit calculation:

- $10/gallon was an estimate of CSO/SSO detention construction costs (including hard and soft costs), but cost depends on project size and can range from $6/gallon for large projects to $10+/gallon to smaller ones
- By instituting a water conservation measure, it was assumed that a utility investment in CSO/SSO detention could be delayed until the end of the program life. The benefit from the delay was estimated from the annual payment that would be made on the investment
- Discount rate is 3% and project life of CSO/SSO projects was estimated at 100 years
- The final mgd savings at the end of program life was the amount of water used to calculate SSO/CSO storage needs
- CSO/SSO benefits were overestimated since benefits were ascribed regionwide, regardless of whether the basin is experiencing a CSO/SSO overflow problem
- A reduction in water usage will most likely increase the maintenance cost of sewer systems, since water volumes help to keep sewer systems functioning optimally. This increased cost was not quantified in this analysis.

Energy

The allocation of energy benefits was allocated to each of the measures in the following manner:

- Any measure with a hot water percentage is positive, otherwise it is neutral
- A few exceptions exist for measures that will now require more energy and are therefore identified as negative. This is the case for air cooling, recirculating cooling systems, and cooling tower improvements
- Energy was valued at $36/kWh, the estimated future marginal cost of electricity to Seattle City Light.

Water heaters are fueled by natural gas and electricity and are supplied in the region by Puget Sound Energy and Seattle City Light

Assumptions in energy benefit calculation:

- 3412 BTU = 1 kWh
- 722.8 BTUs per gallon to raise from 55° to 120° at 75% efficiency of water heaters (regardless of water's enduse – hot tub, dishwasher, shower etc.)[5]

The difference in cost per BTU between natural gas and electricity was not considered.

[5] "Technical Memorandum – Water Conservation Audit, Washington Corrections Center for Women, Pierce County, Washington" January 2002, Economic and Engineering Services, Inc.

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Ten Year Conservation Program Plan

September 2002

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City of Edmonds
City of Kirkland
City of Mercer Island
City of Redmond
City of Tukwila
Coal Creek Utility District
Highline Water District
King County Water District No. 20
King County Water District No. 45
King County Water District No. 49
King County Water District No. 85
King County Water District No. 90
King County Water District No. 119
King County Water District No. 125
Lake Forest Park Water District
Northshore Utility District
Olympic View Water & Sewer District
Seattle Public Utilities
Shoreline Water District
Skyway Water & Sewer District
Soos Creek Water & Sewer District
Woodinville Water District

TEN YEAR CONSERVATION PROGRAM PLAN

Water conservation (Conservation) is integral to how Seattle Public Utilities (SPU) and its purveyor partners' plan to meet future water demands and fulfill the role of environmental steward. Conservation is an economically and environmentally responsible way to accommodate competing demands for drinking water to meet long-term population growth and at the same time protect instream flows needed for fish. As a proven water resource, conservation has demonstrated reliable savings that are expected to continue over the next 20 years.

The 2001 Water System Plan Update (WSP) established a vision for conservation in the SPU regional service area that includes rates, codes, system reductions and programmatic conservation working together to achieve significant savings. The WSP outlined how codes, rates and system efficiencies will be implemented to generate expected savings. It also affirmed the 1% Conservation Program (1% Program) as the approach to programmatic conservation in the SPU regional service area. The 1% Program is based on direction from the Seattle Mayor and City Council following completion of the Conservation Potential Assessment by SPU in 1998. It was approved as a regional program by purveyor partners in 2000. While the WSP identified the savings goal and direction for the 1% Program, it did not specify how the program savings would be achieved.

The 1% Program has served as a basis for discussion with stakeholders on various supply and conservation issues, which resulted in several other conservation commitments. The purpose of this plan is to describe how SPU intends to meet its various conservation commitments through 2010, and more generally until 2020. Most of the Plan applies to both retail and wholesale parts of the regional service area, but clarifies where additional commitments have been made in the retail service area. This plan is a compilation of thinking on what strategies would be used to achieve programmatic conservation savings through the 1% Program as well as how other conservation commitments will be met. The plan may evolve over time as program evaluation leads to refinement in strategies or timing due to changes in customer preferences and advances in technology. Nonetheless, this plan serves as a general blueprint for the future, showing the overall direction of conservation in the SPU regional service area.

I. THE ROLE OF CONSERVATION

While the Puget Sound region appears to have abundant water, the quantity and seasonal nature of our rain does not coincide with the use pattern. Additionally, growth pressures and environmental constraints have put significant burdens on the available supplies causing them to be limited. The City of Seattle is committed to an integrated strategy for water supply that includes maximizing efficiency of our existing water resources while evaluating new sources of supply that can be developed in an environmentally sensitive manner. Water conservation is a key component of that strategy.

I.A. The Relationship of Conservation to Regional Water Management

Reliance on any one water supply option to meet future demand is increasingly risky. To increase the level of water supply certainty, Seattle has adopted a diverse portfolio of options that includes water conservation, reuse, system efficiencies, and new resources. These supply options are planned and frequently exercised simultaneously. By planning and mobilizing several options at a time, Seattle and its utility partners intend to meet the projected needs of the regional service area.

In an ideal world, development of these supply options would be prioritized and sequenced just ahead of when they are needed. In reality, sequencing and implementation is impaired by delays and restrictions related to regulatory, environmental, jurisdictional and financial reasons.

Interrelationships form around many of these supply-planning strategies, such that one can't be done in isolation or in exclusion of the others. For example, regulators often will not permit a new source of supply unless the utility has completed significant water conservation measures and tightened system operations.

The degree to which conservation's role fits into a water supply planning strategy depends on the support and confidence decision-makers have in these programs for producing and maintaining long-term water savings. Seattle's successes demonstrate that long-term conservation can be a reliable way of meeting long-term water demands. Successful selection and implementation of conservation measures requires the integration of financial planning, system reliability, customer acceptance, and proper packaging and sequencing of the measures to be taken.

I.B. Historic Success

Annual average water consumption has dropped from 170 (mgd) in 1990 to below 150 mgd today. Consumption today is below what it was in 1980, despite the fact that the population served has grown by more than 20% since that time. Current water demand in the SPU service area is estimated to be more than 30 mgd less than projected without conservation. By encouraging sustainable improvements in resource efficiency without negative impacts on lifestyles or the economy, water consumption per capita has fallen by over 20% in the SPU service area since 1990. This historic success, and existing conservation infrastructure, forms a strong foundation for meeting our future long-term conservation commitments.

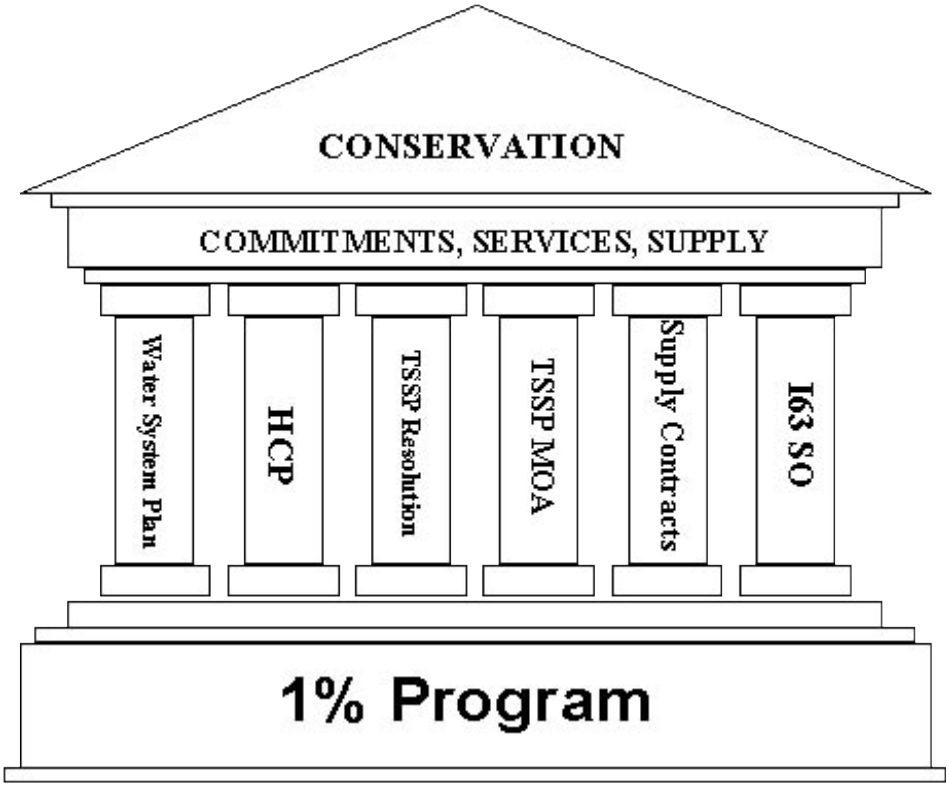
II. COMMITMENTS TO CONSERVATION

In the past two years, SPU has made commitments to conservation that have been negotiated with key stakeholders as part of several agreements, resolutions and ordinances. These obligations help to shape conservation program implementation over the next decade and are spelled out in six documents:

- 2001 Water System Plan Update (WSP)
- Cedar River Watershed Habitat Conservation Plan (HCP)
- Tacoma Second Supply Project (TSSP) Resolution
- Memorandum of Agreement between the TSSP partners and the Washington State Departments of Health (DOH) and Ecology (DOE)
- New wholesale supply contracts
- Initiative 63 Settlement Ordinance (I-63 SO)

Each of these commitments builds on the 1% Program, differing mostly in who is involved and the extent of water savings over time. In effect, each conservation commitment affirms (HCP, Water System Plan, New Supply Contracts), refines (TSSP Partners, DOH, and DOE Memorandum of Agreement), and/or expands the 1% Program (TSSP Resolution, I-63 SO). Some of these obligate SPU to more rigorous implementation of programs than was originally intended in the 1% Program. These commitments establish the framework for conservation that is being implement by SPU and its partners. Exhibit 1 depicts how these commitments, along with the 1% Program, shape SPU's overall conservation effort.

Exhibit 1



II.A. Seattle's 1% Conservation Program

The City created the 1% Program in 1999 and expanded it to include purveyor participation in 2000. It was based on conservation measures identified in the 1998 Conservation Potential Assessment (CPA) that were cost effective (i.e., less than or equal to Seattle's avoided cost of new supply). These measures were incorporated into the 1% Program that was designed to reduce personal and business water consumption in the Seattle regional service area by 1% each year through 2010. This savings goal roughly corresponds to the forecasted growth in water demand over the same time period. Achieving this goal will hold water demand in the SPU service area at the end of 2010 to approximately the same level as in 1999.

The 1% goal was selected to achieve a number of objectives, including:

Keeping up with demand. If each person and business in the region became 10% more water efficient over the next ten years, the region would save approximately 18 million gallons of drinking water per day. This amount of water will meet the needs of 130,000 people or approximately the amount of projected growth within the Seattle service region over the next ten years.

Resource stewardship and endangered species protection. Leveling out the impact of growth on the region's water supplies means there is no need for additional river diversions, preserving more water for salmon, other aquatic life, recreation, water quality, and other important purposes. The federal Endangered Species Act (ESA) listing of the Chinook salmon has added emphasis to these goals for governmental agencies whose operations may have impacts on the Chinook.

Cost effective extension of existing supply. The measures identified in the 1% Program are less costly on a per unit basis than developing traditional new sources of water supply. This benefits customers by keeping rates lower than they would be if a new source of supply were added to the system to meet demand in lieu of reducing demand through conservation.

Customer service. Conservation provides a direct benefit to participating customers by giving them more control over their individual water bills. Participation in conservation measures has other benefits including lower wastewater, electric, and gas utility bills, convenience, labor savings, and in some cases like clothes washing, improved performance.

Reliability. Developing traditional new water supply sources have lengthy regulatory approval processes. Conservation programs can be implemented quickly by utilities without permits, approvals, or revisions to comprehensive plans. Furthermore, because these programmatic savings are largely technology based, savings can be obtained with certainty.

II.A.1. Conservation Potential Assessment

SPU's Conservation Potential Assessment (CPA) provides an expansive toolbox of conservation measures that can produce reliable, long-term water savings. To provide a rigorous analysis of the cost, volume, and reliability of conservation opportunities available within Seattle's wholesale and direct service areas through 2020, SPU completed the CPA in 1998. Over seventy customer-based water savings measures were assessed. Conservation measures were defined as changes in water-using hardware or behaviors resulting in reduced water consumption. None that would result in a loss of service or satisfaction for the customer were identified or analyzed. For example, Water shortage actions such as irrigation bans that would reduce customer service were not considered.

The CPA was the result of a substantial review of literature and applied research into customer water use habits and conservation measures. A detailed, accurate regional water use and demographics baseline was developed that could be easily updated for changing conditions. The information used to prepare the CPA was the latest and best available for residential and commercial water use.

The CPA found that substantial water savings from conservation programs, up to 31 million gallons per day (mgd), could be achieved over the next 20 years. The CPA savings estimates are considered 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 non-water benefits such as energy savings, process control improvements, and reduced sewer costs that would likely make the conservation measures more cost-effective to implement.

II.A.2 Customer Perspective

Over the years, SPU and its wholesale customers have systematically conducted quantitative and qualitative market research with their residential customers to track various indicators and assess program acceptance and success. The most recent results show increasing customer understanding of the importance of conservation and their ability to help solve water supply problems. Ninety-four percent of the customers surveyed believed it was important for their household to actively conserve. Eighty-eight percent of customers believed it was important for their water utility to provide conservation programs.

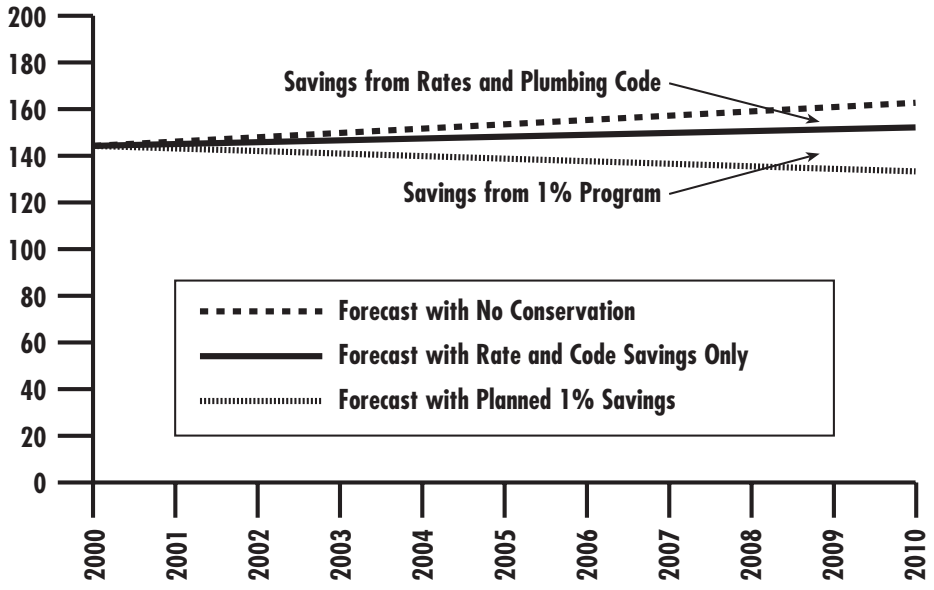
Overall, three-quarters of customers felt they could save more water in their households, and their projections of how much they could save were just slightly less than in earlier surveys. Thus, even though they have reduced use (58% reporting they have reduced their use in the past year), they believed they could save more. Protecting the environment continues to be rated as the strongest component in customer's motivation to save water, although saving money was also high on their list.[1]

[1] SPU and Purveyor 2001 Water Conservation Survey, prepared by: Dethman & Tangora Llc. The survey was fielded in November 2001. The draft report was written January 2002.

II.A.3. Conservation Effects on Forecasted Demand through 2010

Exhibit 2 shows forecasted water demand in SPU's regional service area (retail and wholesale) with no conservation, with conservation savings from water rates and plumbing codes only, and with savings from the 1% Program. Savings from rates and plumbing codes are expected to reach 11 million gallons per day (mgd) by 2010. The 1% Program is expected to achieve an additional 18 mgd by 2010. While this plan focuses on 1% Program efforts, the savings from rates and codes are also important, although they would be achieved without programmatic conservation efforts.

Exhibit 2: Water Demand and Conservation



II.B. 2001 Water System Plan Update

The WSP identifies the 1% Conservation Program as SPU's adopted water conservation program. Savings from the 1% Program were incorporated in the demand forecast contained in the WSP. The WSP was approved by City Council in December 2001. The Plan was also approved by DOH who requires SPU to implement the plan and amend it if significant revisions are made. The plan cites the Conservation Potential Assessment and the 1996 Long-Range Conservation Plan as the basis for the program.

II.C. Habitat Conservation Plan

In 1999, SPU finalized its Habitat Conservation Plan for the Cedar River Watershed. One commitment in this agreement (City of Seattle Resolution 30091) was that SPU implement the 1% Program based on the 1998 CPA. In addition, SPU committed to limited funding for conservation promotion efforts related to fish protection.

II.D. Tacoma Second Supply Project Resolution

In 2000, the Mayor and City Council included conservation commitments in City of Seattle Resolution No. 30259, which was passed in conjunction with the ordinance authorizing SPU to enter into the Tacoma Second Supply Project agreement (TSSP). The resolution:

- Directed SPU to conduct conservation efforts along with the TSSP partners that would save 10% over ten years in the combined service areas of the TSSP partners.
- Directed SPU to include the 1% Program through 2010 and cost-effective conservation through 2020 in its new wholesale supply contract negotiations.
- Directed SPU to develop a work plan for implementing measures beyond the CPA definition of cost-effective to include the cost of the TSSP.
- Directed SPU to work with the Central Puget Sound Water Suppliers' Forum to create a regional water conservation entity.

Since that resolution was adopted, Tacoma and Seattle were not able to resolve certain terms of the agreement that are fundamental to Seattle. As a result, Tacoma and the other partners chose to move forward with the project without Seattle's participation. Nonetheless, SPU will continue to work on fulfilling the relevant commitments identified in the resolution.

II.E. TSSP Memorandum of Agreement

The TSSP resolution also committed SPU to complete a Memorandum of Agreement between the TSSP parties, DOH and DOE that was already being negotiated for the purpose of extending Tacoma's second diversion water right. This agreement, signed in October 2001, included water conservation and planning elements that:

- Encompasses the region covered by the five TSSP partners
- Commits the parties to an aggregate 10% demand reduction by 2010
- Defines regular reporting and evaluation periods.
- Establishes a baseline for conservation.

Since the TSSP participation has changed, the basic precept of the commitments made in the MOA no longer apply. SPU is discussing this with DOH and DOE to determine what responsibility remains for fulfillment of the MOA.

II.F. I-63 Settlement Ordinance

In October, 2001, the Mayor and City Council adopted City of Seattle Ordinance No. 120532, otherwise known as I-63 Settlement Ordinance (I-63 SO), as a settlement agreement to a citizen-sponsored initiative. The ordinance commits SPU to:

- Increase conservation savings in Seattle's retail service by 3 mgd more than the 1% Program goal (9 mgd) by 2010 for a total of 12 mgd by 2010
- Increase funding for conservation in low-income housing
- Review and possibly restructure rates for commercial customers
- Set aside specified quantities of water for fish

Exhibit 3 summarizes and compares the commitments made in these different resolutions and ordinances.

EXHIBIT 3: SUMMARY OF CONSERVATION COMMITMENTS

Document/ Year	Conservation Commitment to 2010		Conservation Commitment after 2010		Other Conservation Commitments
	Goal	Area Involved	Goal	Area Involved	
2001 Water System Update	1% per year	Retail and wholesale	All cost-effective conservation programs identified in CPA.	Retail	None
Habitat Conservation Plan (1999)	1% per year	Retail and wholesale areas	None	None	Funding of conservation messages related to fish
TSSP Resolution (2000)2	10% over 10 years	Retail and in new wholesale contracts.	All cost-effective conservation identified in CPA.	Retail and in new wholesale contracts.	1. Participate in Central Puget Sound Water Suppliers Forum Conservation Work Group 2. Develop Conservation Entity 3. Update CPA every 5 years
	Consider conservation beyond cost-effective as defined in CPA	Retail service area only			
TSSP MOA (2001)2	10% over 10 years	Combined savings with other utilities party to the agreement. All of Seattle's and Tacoma's service area	None	None	1. Work with Central Puget Sound Water Suppliers Forum on conservation measures and evaluation
I-63 SO (2001)	Additional 3 mgd	Retail only	All cost-effective conservation	Retail only	1. Implement low-income housing retrofit program 2. Develop conservation incentive rates for commercial customers 3. Update CPA every 4 years

[2] Since the resolution and MOA were adopted, the TSSP project agreement no longer includes Seattle. Nonetheless, SPU will continue to work on fulfilling most of the commitments identified in those documents.

III. IMPLEMENTATION

Conservation programs, whether based on technological fixes or behavioral changes, evolve as new information emerges, regulations are adopted, and programs are evaluated. For that reason, the programs and timelines described here portray the delivery strategy based on what we know today. The specifics of this plan could change as information, circumstances, technology, and customer preference change. While the details of the plan may evolve, conservation commitments will continue to be met and programmatic conservation will continue to be prominent in how SPU meets future water demand.

The 1% Program goal is to achieve 18 mgd savings by 2010. These savings will be obtained from three types of customer-based water uses: domestic, landscape and commercial/industrial/institutional processes. Within the 2010 timeframe, there are more than 25 measures that are expected to produce the 18 mgd from customer-based program measures. This does not include savings from I-63 SO provisions.

After 2010, the official SPU forecast includes savings from implementing the remaining CPA cost-effective programs within the retail portion of the SPU service area. This would involve continuing programs implemented before 2010, and adding new programs. Actual conservation goals after 2010, however, will be determined in the future for the entire service area, serving both retail and wholesale customers.

III.A. Purveyor Involvement

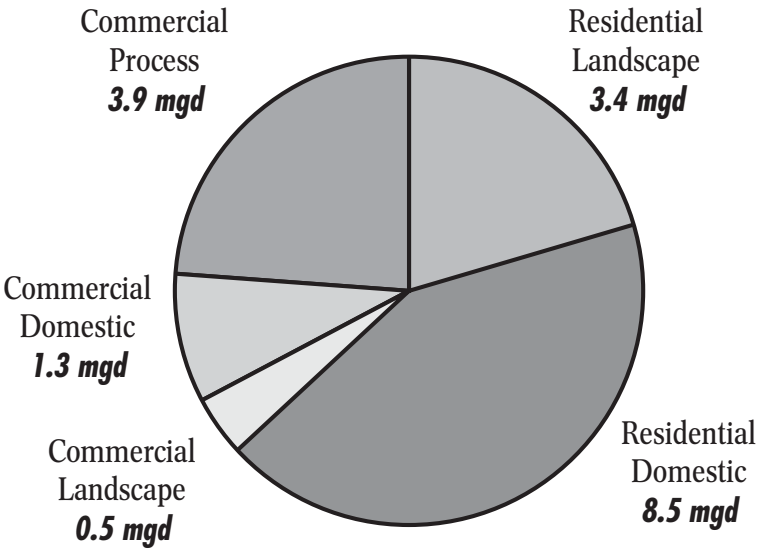
Twenty-six of SPU's wholesale customers, or purveyors, were involved in the preparation of the CPA and have been intensively involved in the ramp-up of 1% Program implementation. Purveyors supported the Conservation element of the 2001 WSP Update, which identified the 1% Program as the approach to reducing demand over the next ten years.

Purveyors are, and continue to be, active partners with SPU in program planning, design, implementation, and evaluation of the 1% Program. The Purveyor Conservation Committee meets monthly to discuss conservation progress and issues. Six Working Groups have been formed within the Conservation Committee that provide in-depth input into strategy development and implementation for the areas of Youth Education, Marketing, Residential Indoor, Residential Landscape, Commercial/ Industrial/ Institutional and overall 1% Program evaluation. The working groups officially formed in 2000, although some were active years before, and plan to remain active throughout the lifetime of the program. Each working group has been developing program delivery strategies for 1% Program implementation across all customer sectors, as well as program tracking and evaluation.

III.B. 1% Program Measures & Strategies

Achieving the goals of the 1% Program requires significant conservation savings across all customer sectors and end uses. Exhibit 4 describes each customer sector's contribution to the total conservation goal. Implementation is proceeding through the development of a series of program delivery strategies that focus on each of the different customer sectors and types of use: residential domestic, residential landscape, commercial domestic, commercial landscape, commercial process, youth education, and overall marketing. Each strategy includes program activities specifically designed to reach a particular type of customer. The different strategies are woven together by an overall marketing effort that promotes a conservation ethic and establishes an identity for the entire 1% Program. Detailed program delivery strategies have been developed in separate reports.

Exhibit 4: Savings by Program Area - MGD



Achieving the first 18 mgd of the 1% Program by 2010, has been estimated to cost $54 million. Spending is projected to increase gradually from 2002 through 2010 to build the 18 mgd savings. This level of investment is necessary to produce the gradual increase in savings associated with customer lifestyle changes and timing of hardware retrofits. Roughly $6 million has been spent for the combined years of 2000 and 2001.

Exhibit 5 summarizes total savings and costs over the ten-year period from 2001 to 2010 for 1% Program implementation in each of the five customer sectors.

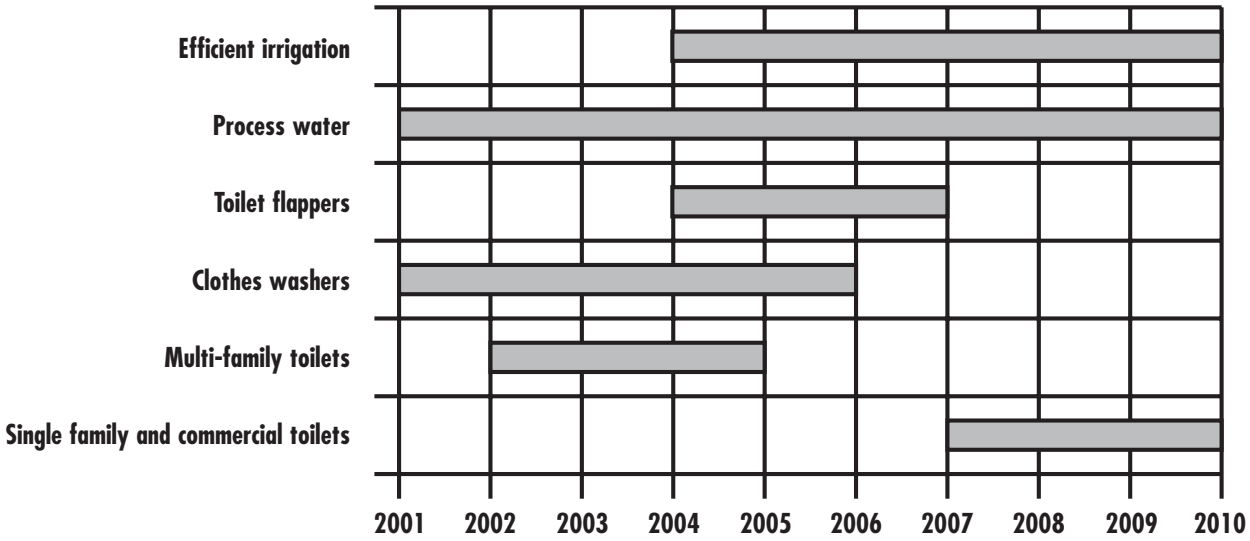
Exhibit 5: 1% Program Implementation Summary of Savings and Costs 2001-2010

Customer Sector	Examples of Measures	Savings (mgd)	Cost
Residential Domestic	Toilet, faucet, and showerhead retrofits; efficient clothes washers	8.5	$22M
Residential Landscape	Irrigation systems and scheduling efficiencies; natural lawns and gardens	3.4	$14M
Commercial Process	Air cooling; process water and cooling tower efficiencies; laundry wash water recycling	3.9	$14M
Commercial Domestic	Low flush toilets and urinals; waterless urinals; swimming pool & hot tub efficiencies	1.3	$2M
Commercial Landscape	Weather-based irrigation; Irrigation system and scheduling efficiencies; soil moisture sensors	0.5	$2M
Total	Implementation of 70 cost-effective conservation measures	**18 mgd**	**$54M**

mgd= million gallons a day

A schedule for reaching these conservation goals has also been developed. While both the programs and their timing could change over time, Exhibit 6 shows the approximate schedule for implementing major conservation measures through 2010.

Exhibit 6: Implementation Schedule for Major Conservation Measures



III.B.1. Residential Landscape

Program emphasis in the near-term will encourage savings through an integrated multi-resource conservation education effort that combines water, waste reduction and stormwater pollution prevention. This approach leverages partnerships with, and funding resources from, other utilities, agencies, and the landscape industry while building natural lawn and garden themes.

The Natural Lawn and Garden concept is the cornerstone of the 1% Program's approach to residential landscape savings. Six printed guides cover the full range of SPU's resource protection priorities for landscaping that includes building healthy soils, choosing the right plants and watering smart. They are available and being distributed to customers in the regional service area.

A convincing, repetitive long-term customer message over many years is needed to gradually change residential practices and the attitudes driving those practices. Most customers tend to remodel and change their landscapes slowly. Furthermore, market transformation to a new landscaping ethic is a long-term educational effort, where short-term savings are more difficult to achieve and small increments of long-term savings are built over time.

From 2002 to 2004 program development efforts will focus on selected landscape watering devices that will be connected with landscape behavior messages. Opportunities to encourage water efficient landscapes in new construction are being developed. In 2002 and 2003, incentive programs will include soaker hoses, mulch mowers, and compost. In addition, extensive field application projects will help identify the best irrigation devices, landscape practices, and delivery strategies for major incentive programs in 2004 and beyond.

Residential landscape savings will come from customers adopting numerous efficiency measures. These savings will be achieved if 30% of the customers who irrigate in the Seattle regional service area improve irrigation scheduling, 30% of customers with automatic irrigation systems improve the performance of those systems, and 50% install automatic rain shut-off devices. Other measures implemented would need to have similar adoption rates to achieve desired savings.

III.B.2. Residential Domestic

For the near term, program emphasis in this sector will be in washing machine and toilet upgrades. The WashWise residential laundry program will use progressively scaled-back incentives and increased promotion to convince as many customers as possible to purchase a more efficient machine prior to the scheduled change of federal efficiency codes in 2004 and 2007. Capture of these early years of savings will result in higher overall value per dollar invested since customers tend to have limited purchasing opportunities. The average customer keeps their machine for 14 years.

The multi-family residential customer sector will emphasize toilet, showerhead and faucet aerator replacements. Multi-family replacements have large water savings potential per toilet replaced and the slowest natural replacement rates. Toilet replacements are promoted by offering financial incentives to customers. Due to rapid changes in how multi-family owners bill tenants for water use by sub-metering or utility cost allocation systems, motivation for multi-family toilet replacement by property owners is steadily declining. Accelerating multi-family toilet replacement thus represents a major opportunity for water savings.

A financial incentive program for low-income multi-family housing in the region is being conducted, with a higher financial incentive than for other multifamily customers in order to achieve participation targets. Initial emphasis will be placed on public housing authorities and large non-profit low-income housing providers.

For the single-family sector, the toilet program will consist of an active education and information effort, with the possibility of a financial incentives program in later years. Because of the overwhelming success of the 2001 toilet round-up events, some limited single family toilet rebate promotions may be included in the early years depending on funding availability.

Replacement toilet flappers (devices that close the flush valve after the tank has emptied) will be promoted to customers who have potential leaks and are not yet ready to make a new toilet investment.

This program is timed before 2007 to avoid overlap and duplication with single family toilet incentives, and to capture the lowest cost savings first. An extensive education and information program will focus on both the how and why of conservation, using broadcast and targeted marketing, youth education, and partnerships with other agencies and organizations.

Achieving the savings goals for these residential programs requires that 60% of customers with high flush toilets will install ultra-low flush toilets, 30% will install water efficient clothes washers, and 30% will decrease unnecessary faucet use. Other measures implemented would need to have similar adoption rates to achieve desired savings.

III.B.3. Commercial Landscape

To reduce landscape water use for this sector, there will be continuing emphasis on site assessments and irrigation audits, and incentives for upgrading existing irrigation systems. Work in this sector will target site owners, facility managers and landscape and irrigation industry professionals. No-cost technical assistance will be offered to customers that help them make changes in irrigation system operation and landscape management. Professional landscape and irrigation auditors will visit sites, check an irrigation system's performance and plant location, and make recommendations for improving efficiency. Opportunities will be pursued related to new irrigation technologies and applications, development of model regulations, and field studies to improve new construction and new irrigation system water and resource efficiency. In later years, or sooner as opportunities arise, emphasis will be on development of efficiency standards to regulate new systems.

Education and training will emphasize natural lawn and garden themes. A network of partnerships with the landscaping and irrigation industry will be built to promote efficient irrigation. Training workshops will target facilities managers to increase their knowledge about the costs and benefits of efficiently managed systems and how to qualify for financial incentives for irrigation upgrades. In 2002, the Business and Industry Resource Venture, an integrated resource conservation partnership with the Greater Seattle Chamber of Commerce, is helping to recruit business participants.

Commercial landscape savings will come from customers adopting numerous efficiency measures. These savings will be achieved if 30% of the customers who irrigate in the Seattle regional service area improve irrigation scheduling, 30% of customers with automatic irrigation systems improve the performance of those systems, and 50% install weather-based irrigation controllers. Other measures implemented would need to have similar adoption rates to achieve desired savings.

III.B.4. Commercial Domestic

In the area of commercial domestic use, restroom upgrades to more efficient fixtures will be emphasized through information outreach in early years and through incentives in later years. In years 2004-2006, a replacement flapper distribution program will complement the information and education effort. Whenever possible, a strong effort will be made to integrate domestic fixture upgrades for customers who are already participating in commercial cooling and process water projects. This helps avoid repetition of multiple program measures and staff contacts over time with the same customer.

Achieving the savings goals for these commercial programs requires that 60% of customers with high flush toilets and urinals will install ultra-low flush fixtures, along with other measures implemented with similar adoption rates.

III.B.5. Commercial Process

In the area of commercial cooling and process water use, efficiency measures will be emphasized that are relatively easy to implement, and where the customer is indicating motivation to invest resources. Less motivated customers, who, for a variety of reasons do not see water conservation as a priority, will be the focus of more intensive marketing in the years 2007-2010. It is expected that in later years, more marketing will be needed to obtain the same annual level of participation and savings. Future water and sewer rates will also be an important factor. Program marketing in the early years will emphasize standard business perspectives like return on investment, and public relations (i.e. being good environmental stewards).

During the first five years, commercial conservation efforts will concentrate on conversion of inefficient water use practices known to be widespread in the commercial sector. Examples include ice machine cooling conversion, elimination of other pass-through cooling applications, cooling tower upgrades, process water used for cleaning and washing, commercial clothes washers, and water-using medical equipment upgrades. Partnerships with other agencies, such as school districts, governments, and energy and wastewater utilities will continue to leverage both program dollars and multiple program benefits.

In order to achieve the savings goals in the commercial sector, 45% of the largest customers with cooling towers will have to improve tower performance by 2010. Thirty percent of the largest customers with process water use will have to recycle the water used in those systems. In addition, 55% of commercial customers with water-cooled equipment will have to replace that equipment with air-cooled equipment. Other measures with similar adoption rates would also be implemented to reach savings goals in this area.

III.B.6. Overall Marketing and Youth Education

Underlying the success of implementing the conservation measures of the 1% Program is the Overall Marketing Strategy and Youth Education Program. Marketing a conservation ethic forms the foundation for behavior changes that result in real savings. The aim of these efforts is to maintain increasingly strong, positive customer attitudes toward conservation and to strengthen the belief that our customers can affect whether there is enough water to meet future water needs. Over time, messages will transition from awareness to action messages that respond to evolving trends in customer preferences. This messaging will also be designed to maintain conservation behaviors as they are adopted over time. Repetition of messages, and building customer awareness of the need for, and how-to's of conservation is key to long-term sustained program success. Customer reaction following the 2001 drought may also require addressing the relationship between utility rates and conservation.

Youth education plays an important role in creating and sustaining future savings. Annual investments in youth education pay long term dividends in the attitudes of the future adult population. These programs also reach parents of those students, which generates more immediate potential savings.

III.C. 1% Program Implementation Schedule and Budget

Ten implementation criteria drive the 1% Program plan and schedule:

1) Balance the level of investment and savings potential from specific efficiency measures analyzed in the Conservation Potential Assessment (CPA) over the ten year life of the program.
2) Produce a dependable stream of water savings at a relatively constant cost to reduce utility revenue fluctuations and minimize rate and budget impacts.
3) Incorporate realistic staffing limits for program managers, consultants, purveyor and agency partners, and other utility staff.
4) Reduce the impact of customers who would have participated without an incentive by appropriate program sequencing.
5) Take advantage of emerging codes and regulations by following a progressive strategy of information, education, incentives, and limited regulation.
6) Sequence measures that provide the greatest savings at the lowest cost first, building up to the more expensive measures later.
7) Time conservation investment opportunities to take advantage of water rate increases when customers will be more motivated to reduce their water bill.
8) Recognize regional customer equities and the need to spread conservation opportunities between customer sectors as well as geographically and demographically.
9) Package conservation measures identified in the CPA into logical customer programs to reduce delivery and marketing costs, and to maximize customer participation opportunities.
10) Increase customer participation levels. Obtaining customer participation rates shown on the implementation table will be very challenging. This level of customer participation is pushing the envelope of what other utilities have been able to achieve. In the last years of the program (2007-2010), much greater emphasis may need to be placed on increasing customer participation, particularly in the area of changing customer behaviors.

A detailed estimate of costs for and water savings from implementing the 1% Program as envisioned by this plan for each year between 2001 and 2010 is shown in Exhibit 7. The actual investment and resulting savings may vary depending on the budget adopted each biennium. The dollars shown in the table are in thousands of 2001 dollars, and some totals may not exactly match due to rounding. The water savings are shown in thousands of gallons per day. In addition, the participation rates reflect the percent participation expected to be achieved within the eligible customer accounts in order to meet the program savings goals in the different customer sectors.

Exhibit 7: Water Saving Partnership (1% Program) Implementation Schedule and Funding- Working Draft (shaded areas denoting program emphasis)
(Dollars noted are in thousands; water savings are noted in thousands of gallons per day)

	"Ramp Up" 2-Year Total	2002	2003	2004	2005	2006	2007	2008	2009	2010	Totals	% Customer Participation
Residential Landscape												**40%**
Naturals theme, specific behavior messaging	425	180	300	300	300	300	300	350	400	450	3,305	
Product (Hardware) Design and Selection	50	100	700	200	100	100	100			-	1,350	
Hardware Device Incentives (new programs)	125	100	100	700	800	1,000	1,000	1,000	1,000	1,000	6,825	
Umbrella, general behavior, partnerships, evaluation	530	200	200	200	200	200	200	200	200	200	2,330	
Residential Landscape Total $'s	**$1,130**	**$580**	**$1,300**	**$1,400**	**$1,400**	**$1,600**	**$1,600**	**$1,550**	**$1,600**	**$1,650**	**$13,810**	
Residential Landscape Water Savings	400	100	320	350	350	380	380	380	380	380	3,420	
Residential Domestic												**90%**
Multi-family toilets	15	1,000	1,000	900	300	200	100	100	100	100	3,815	
Single family toilets	390	150	200	200	300	300	1,350	1,450	1,550	1,650	7,540	
Flappers		-	100	300	600	400	100				1,500	
Washwise laundry	1,241	450	800	600	700	800	200				4,791	
Behavior, youth education, partnerships, marketing, evaluation**	650	120	300	300	400	400	400	600	700	800	4,670	
Residential Domestic Total $'s	**$2,296**	**$1,720**	**$2,400**	**$2,300**	**$2,300**	**$2,100**	**$2,150**	**$2,150**	**$2,350**	**$2,550**	**$22,316**	
Residential Domestic Water Savings	1,150	610	950	900	900	860	770	770	780	780	8,470	
Commercial Landscape												**50%**
Landscape Audits and Incentives, New Codes	370	200	200	200	200	200	200	300	400	450	2,720	
Specific Commercial Marketing & Behavior, Evaluation**												
Commercial Domestic												
Restroom Upgrades	175	50	200	200	200	200	300	400	400	300	2,425	
Specific Commercial Marketing & Behavior, Evaluation**	50	25	25	25	25	25	25	25	25	250		
Commercial Process												
Cooling, Process and Other Incentives	1,850	1,000	800	800	800	1,000	1,200	1,300	1,400	1,600	11,750	
Specific Commercial Marketing & Behavior, Evaluation**	240	200	50	50	50	50	50	50	50	50	840	
Commercial Total $'s	**$2,635**	**$1,600**	**$1,300**	**$1,300**	**$1,300**	**$1,500**	**$1,800**	**$2,100**	**$2,300**	**$2,450**	**$18,285**	
Commercial Total Water Savings	1,250	410	380	380	380	380	380	610	700	730	5,710	
TOTAL PROGRAM $'s	**$6,061**	**$3,900**	**$5,000**	**$5,000**	**$5,000**	**$5,200**	**$5,550**	**$5,800**	**$6,250**	**$6,650**	**$54,411**	
TOTAL PROGRAM Water Savings	2,800	1,120	1,730	1,710	1,710	1,660	1,730	1,790	1,890	1,950	18,090	

* Savings are based upon Conservation Potential Assessment estimates - assumes O&M budget at CPA required levels for savings to be achieved.
** CPA development and program evaluation are included in evaluation items.

III.D. Implementation of Other Conservation Commitments

The other conservation commitments contained in the resolutions and ordinances described in Section II have goals that are either linked to or expand on the 1% Program. Consequently, implementation of some of these commitments are within the scope of the 1% Program. Some of them entail further effort. This section describes how these other commitments will be met.

III.D.1. Habitat Conservation Plan

The 1% Program budget contains funds for overall marketing. Some of those funds will be used to promote the value of conserving to help the environment. This covers the commitment made in the HCP.

III.D.2. TSSP Resolution and Memorandum Of Agreement

As the ramifications of changes to the TSSP agreement partnership unfold, SPU's approach to the commitments in both the MOA and Resolution will likely change. The following discussion describes activities SPU anticipates leading in relation to the commitments made.

The TSSP Resolution directs SPU to examine conservation alternatives that go beyond the cost–effective definition in the CPA. Efforts were underway to meet this commitment when the I-63 Settlement Ordinance was passed by City Council. That ordinance commits SPU to conserve an additional 3 mgd by 2010. Implementation of that ordinance will essentially accomplish the results intended by this requirement in the TSSP Resolution.

SPU is directed to work with Tacoma and the other TSSP partners to develop a plan for meeting an aggregate 10% conservation commitment. If this were to be implemented, it would not likely change what SPU is doing in its 1% Program, except possibly the timing or intensity of implementation activities based on partnering opportunities that might develop. Since the TSSP participation has changed, the basic precept of the commitments made in the MOA no longer apply. SPU is working with the Department of Ecology to determine what responsibility remains for fulfillment of the agreement.

The Conservation Entity called for in the TSSP Resolution is in the formative development stage. SPU is working with other regional leaders and stakeholders to define the Entity's mission, objectives and scope of responsibilities. The Entity is anticipated to be established by the end of 2002, although its role will evolve over time.

In addition to these efforts, SPU has negotiated new wholesale customer contracts that contain a commitment to participate in SPU's 1% Program. The first of these contracts were signed in May of 2001. As negotiations with other wholesale customers continue over the next few years, staff will continue to seek the same commitments for conservation.

III.D.3. I-63 Settlement Ordinance

The plan for obtaining the additional 3 mgd of water conservation in SPU's retail service area by 2010 will be developed by March 2003. It will likely include system efficiency savings and the additional increment of savings from implementing the low income housing component of I-63 SO.

An implementation plan has been prepared specifically for the low-income housing program. It outlines a strategy for achieving desired savings, although it will evolve as opportunities arise and more is learned about the constraints and costs of implementing such a program. Initially, large public housing providers will be targeted. The primary focus will be given to the installation of toilets, showerheads, and faucet aerators. In addition, extremely low-income and very low-income single-family households, as defined in the ordinance, will also be served during the first phase of the low-income

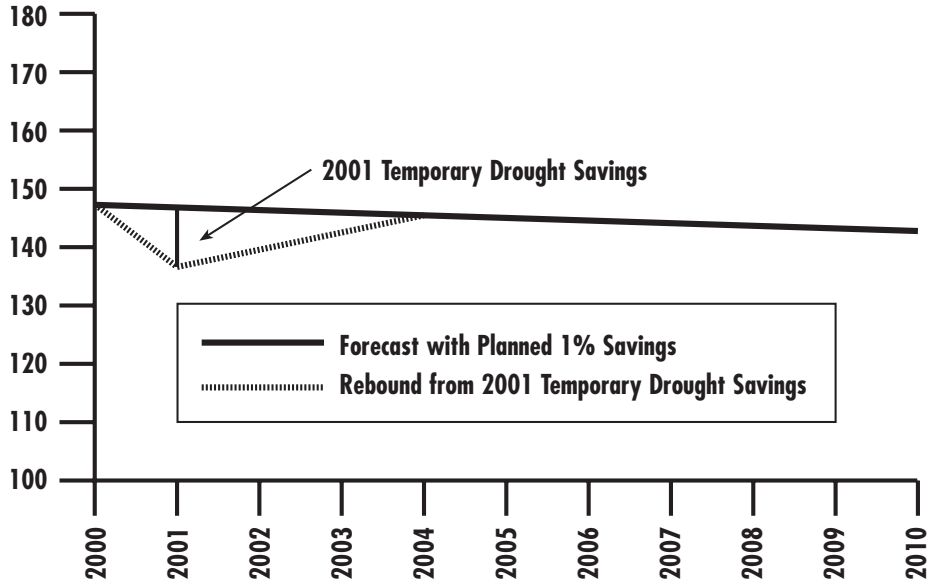
housing conservation program. Efforts in the later years will focus on smaller housing providers, and larger housing providers not yet participating in the program. Conservation retrofits will include toilets, showerheads, faucet aerators, irrigation systems and washing machines.

III.E. 2001 Drought Impact on Conservation Commitments

The winter of 2001 turned out to be the driest in 70 years. A statewide drought was declared and SPU asked customers throughout its regional service area to voluntarily curtail water use by 10% during the spring and summer months. Customers responded enthusiastically, generating a dramatic one-year decline in water use. Savings in 2001 are estimated to be 10 mgd. Of those savings, 5 mgd are short-term transitory drought savings, 2 mgd are savings from ongoing price and code affects that were expected for 2001, 2 mgd are from new long-term programmatic savings, and 1 mgd is from extra, one-time system water savings.

Following the 1992 drought, water consumption steadily rebounded until the transitory savings disappeared and demand resumed its long-term downward trend. This was successfully accomplished by continuing investments in long-lived hardware, fixture and technology programs and behavior maintenance programs. Exhibit 8 shows that demand from 2001 will gradually rebound from the temporary savings that were associated with customers' response to the 2001 drought. SPU expects that these temporary savings will disappear by 2004, similar to the experience following the 1992 drought.

Exhibit 8: Rebound in Water Demand from 2001 Drought



This rebound could be faster without the planned conservation efforts.

III.F. Revenue and Rate Impacts

The demand reduction resulting from planned, long-term conservation programs is built into the demand forecast. Conservation savings are thereby factored into the revenue requirements of the utility and addressed during the rate setting process. Unanticipated reductions from drought occurrences or other emergency curtailment of water use, however, may cause temporary declines in revenue that have not been factored into revenue requirements.

IV. PLAN EVALUATION AND UPDATES

Since SPU's first conservation efforts over twenty years ago, there have been significant changes and additions to conservation measures and methods. Changes in available technology have made it possible to secure reliable demand reductions by changing out old water using fixtures with newer, more efficient ones. Building codes have changed, requiring water efficient hardware or providing landscape guidelines that have increased water efficiency. Some programs became cost-efficient because multiple benefits with electric or drainage and wastewater programs lowered SPU costs for implementation.

Other opportunities in the future will likely stimulate changes in the types of measures that should be implemented. Water reuse, which has benefits for wastewater treatment, stormwater management, and aquatic habitat protection as well as water supply, may prove to be one such opportunity. These changes will be considered during evaluation and refinement of conservation measure implementation over the planning horizon.

There are some key milestones at which the program will be evaluated and refined based on SPU's commitments and WSP requirements. They include annual reporting, update of the CPA and the Water System Plan update. The commitments are described in the sections below and shown in Exhibit 9. The evaluation and report schedule is shown in Exhibit 10.

Exhibit 9: Evaluation Commitments

Commitment	Source
CPA every 5 years, beginning in 2003	TSSP Resolution
Evaluate progress every two years	TSSP Resolution MOA
CPA every 4 years, beginning in 2004	Conservation Ordinance
Annual Tracking	Conservation Ordinance
Conservation Plan Update every 6 years	Water System Plan Update

Exhibit 10: Evaluation and Report Schedule

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Mile-stone	Annual Report	Annual Report	Annual Report -CPA Update	-Annual Report	Annual Report	-Annual Report -WSP Update	-Annual Report -CPA Update	-Annual Report	Annual Report

IV.A. Annual Evaluation and Reporting

Evaluation is essential to measuring the success of the 1% Program and its component parts. Evaluation will track implementation progress, help direct resource allocation, and identify needed program refinements. An important component of overall program evaluation will be ongoing customer research to gauge the attitudes and preferences of our customers in order to encourage the greatest participation at the least cost. Through the annual evaluation, it will also be possible to track participation rates and other assumptions to determine what program refinements are necessary to achieve the 2010 savings goal.

The first annual report on the progress of 1% Program implementation was completed in May 2002. The report includes the status and results of overall and individual program implementation. Data has been presented on current and cumulative savings toward achievement of the 2010 goal, including savings achieved in 2001. The annual report fulfills SPU's reporting commitments made in the TSSP Resolution & MOA, and I-63 SO.

IV.B. Conservation Potential Assessment Update

The CPA will be updated periodically to re-analyze existing conservation measures and analyze new potential conservation measures to determine their cost and savings. It will also review participation rates and assumptions about implementation costs for different conservation measures so that strategies can be reviewed and revised appropriately. This will provide data for revising the Conservation Plan to reflect changes in technology and information. To meet the commitment in the I-63 SO, the next CPA update will be in 2004 and every four years thereafter.

IV.C. Water System Plan Update

A conservation plan is one of the required elements of a Water System Plan (WSP). The WSP sets overall direction for how conservation fits into the water supply and demand picture. In doing so, information from the CPA update is considered. If there were no change in policy direction in the next WSP Update, then the WSP would reference this Conservation Program Plan. Likewise, this program plan would be updated according to any changes in direction set in the WSP. The next WSP update is due to DOH in 2007.

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Regional 1% Water Conservation Program

2004 Annual Report
June 2005

Saving Water Partnership

Seattle and Participating Area Water Utilities

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Saving Water Partnership Regional 1% Water Conservation Program

2004 Annual Report
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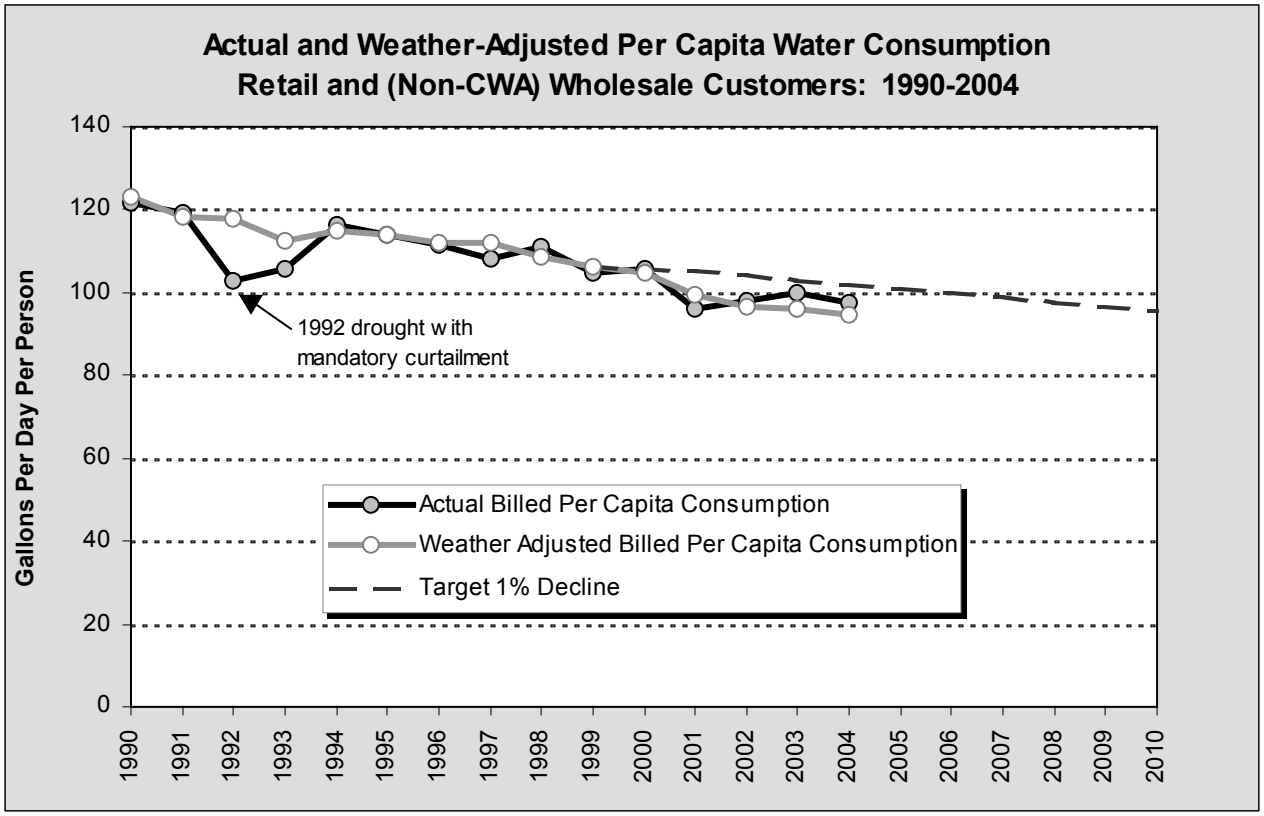
1. Summary of 2004

The decade-plus trend of excellent progress on regional water conservation continues. Regional per capita use is continuing to decline when normalized for variation in weather conditions. Chart 1 shows how a combination of factors, including the 1% Program, have affected per capita use since 1990. The strong dip seen in the chart in 1992 was due to a mandatory lawn watering ban in that drought year. Voluntary curtailment of water use associated with a second drought contributed to another notable decline in water use in 2001. More detail about Chart 1 is provided in Chapter 4.

Chart 1: Billed Per Capita Water Use — 1% Program Utilities

Annual Average



This report reviews annual progress of the regional 1% Water Conservation Program (1% Program). This document is the fourth of an annual series of reports designed to inform and guide the program toward its objectives. The regional 1% Water Conservation Program (1% Program) was initiated in 2000 and is sponsored by the Saving Water Partnership (SWP). This Partnership includes the City of Seattle and a group of 17 utilities purchasing wholesale water from the City of Seattle. The City of Seattle administers the 1% Program in collaboration with these utilities, under terms of long-term water supply contracts.

For this review, the 'region' refers to all customers served by the Seattle Public Utilities (SPU) water supply system who participated in the 1% Program in 2004. Cascade Water Alliance (CWA) utilities who were part of the program from 2000-2003, left the 1% Program in 2004 and 1% Program savings targets were reduced accordingly.

The long-term goal of the 1% Program is to keep water demand by the end of 2010 at the same level as it was in 1999, despite growth in population and economic activity. To achieve this goal, based on the forecasted growth rates at the time of Program initiation, three specific target objectives were developed to monitor progress:

- Reduce annual per capita consumption 1% per year from 2000 to 2010;
- Achieve a total programmatic conservation savings as adjusted following the departure of CWA utilities of 14.5 million gallons per day (MGD) peak season savings (11.0 MGD annual average) in the ten years from 2000 to 2010;
- Achieve annual programmatic conservation savings targets. The target was 1.2 MGD peak season savings (0.9 MGD annual average) in 2004.

Since ramp-up of the program in year 2000, savings goals and accomplishments have been expressed as gallons per day of peak season water reductions. Peak season savings have the greatest value to the program sponsors in deferring expensive new capital projects. However, water demand forecasting and long-range supply planning are done using annual average units of water consumption. As a result, reporting conservation savings as peak savings has often been confusing and difficult to compare to the more traditional average annual numbers. To avoid confusion, “ballpark” conversions between peak and annual average savings are shown in parentheses in this report. These conversions reflect the fact that the various types of programs produce savings that are distributed throughout the year in different patterns (e.g., only in peak season, uniformly throughout the year, or in another pattern).

In 2004, the region continued to make good cumulative progress in reducing per capita water demands. Total cumulative regional water savings of the 1% Program since its inception is very close to target. Per capita demands continue to track lower than target, due to a combination of 1% Program savings, changing demographics and economy, and other long-term water savings produced from rates, codes, water system efficiencies, and Seattle’s low-income water conservation programs.

In 2004 the 1% Program achieved savings somewhat below target because savings from behavior message campaigns fell below expectations. Hardware replacement savings were close to but slightly below target. However, weather-adjusted peak season consumption for customers continued to decline, consistent with the expectations of the 1% Program.

The year 2004 experienced an early, exceptionally warm and dry spring and summer with high peak season irrigation water demands. A pattern of warm dry weather began in April and continued through most of the summer before ending abruptly on August 21. The result has been peak season consumption looking much like 2003, except that it was not as high and it began earlier and ended earlier. As in 2003, a strong summer water supply reduced the need for an expensive, highly visible summer education message, possibly resulting in a lapse of customer attention to conservation. Public awareness of the need for conservation was not emphasized in 2004, however, a highly visible campaign about the negative impacts of overwatering lawns did take place, with an emphasis on both summer watering and recruitment of residential customers to make changes to their in-ground irrigation systems.

While the focus of this report is the 1% Program, efforts other than 1% will be discussed in order to describe total savings in the water system. Based on consumption analysis, 1% Program efforts helped customers implement equipment replacement and conservation behaviors that produced 0.9 million gallons per day (MGD) in new long-term peak season savings (0.7 MGD in annual average savings) in 2004, 76% of the 1% Program target of 1.2 million gallons of peak savings per day (78% of the target annual average savings):

- The cumulative 1% Program (years 2000 to 2004) has now achieved 40% (or 5.8 MGD) of the 2010 peak season savings target of 14.5 MGD (or 4.4 MGD of the 2010 annual average savings target of 11.0 MGD), very close to the revised cumulative five-year target;
- Cumulative cost of the Program to date is $17.6 million, or $3.02 million per MGD of peak season savings;
- 0.76 MGD of the 2004 1% peak season savings (0.65 MGD of annual average savings) was from new fixtures and equipment;
- The remaining 0.15 MGD of peak season savings (0.05 MGD of annual average savings) was generated by new permanent conservation behaviors

The Regional 1% Program

The 1% Program was created in 1999 and expanded to include the entire Seattle service region in 2000. The 1% Program is based on conservation measures identified in the *Conservation Potential Assessment* (CPA, Seattle Public Utilities, 1998) as cost effective (i.e., less than or equal to Seattle's avoided cost of new supply). These measures have been incorporated into the 1% Program and are designed to reduce personal and business water consumption in the regional service area by 1% each year through 2010. When the program was conceived a total peak season savings target of 18 MGD (13.6 MGD annual average) was set that included Cascade Water Alliance utilities. This savings target roughly corresponded to the forecasted growth in water demand in the service region over this same time period. Achieving the 1% target was intended to hold water demand in the Seattle service region at the end of 2010 to approximately the same level as in 1999. Since the departure of the five Cascade Water Alliance (CWA) utilities at the end of 2003, the total savings target has been adjusted to 14.5 MGD of peak season savings (11.0 MGD annual average savings). CWA's block contract with Seattle takes into account conservation savings for CWA, so the reduction would produce the same net savings target of 18 MGD peak season savings by the end of 2010.

The 1% target was selected to achieve a number of objectives, including:

- *Keeping up with demand.* If each person and business in the region became 10% more water efficient over the next ten years, the region will save approximately 14.5 million gallons of drinking water per day in the peak season (11.0 MGD of annual average gallons).
- *Resource stewardship and endangered species protection.* Leveling out the impact of growth on the region's water supplies means there is less need for additional river diversions, preserving more water for salmon, other aquatic life, recreation, water quality, and other important purposes. The federal Endangered Species Act (ESA) listing of the Chinook salmon has added emphasis to these goals for governmental agencies whose operations may have impacts on the Chinook.
- *Cost-effective extension of existing supplies.* The measures identified in the 1% Program are less costly on a per unit basis than developing most traditional new sources of water supply. This benefits customers by keeping rates lower than they would be if a new source of supply were added to the system to meet demand in lieu of reducing demand through conservation.

- *Customer service.* Conservation provides a direct benefit to participating customers by giving them more control over their individual water bills. Participation in conservation measures has other benefits including lower wastewater, electric, and gas utility bills, convenience, labor savings, and in some cases like clothes washing, improved performance.
- *Reliability.* Developing traditional new water supply sources has lengthy regulatory approval processes. Conservation programs can be implemented quickly by utilities without permits, approvals, or revisions to comprehensive plans. Furthermore, because these programmatic savings are largely technology based, savings can be obtained with certainty.

A *Ten Year Water Conservation Program Plan* (Seattle Public Utilities, 2002) was completed in 2002, detailing program budgets, savings targets and implementation strategies through 2010. The regional program began in 2000. The first two years were ramp-up years for program measures, staffing, and funding. Accordingly, the savings targets for 2000 and 2001 were lower than 2002-2010.

2004 Goals and Strategies

The 1.71 MGD target shown in the *Ten Year Water Conservation Program Plan* (Seattle Public Utilities, 2002) was adjusted to 1.2 MGD peak season savings (0.9 MGD annual average), in early 2004 to reflect budget availability and the departure of Cascade Water Alliance utilities from the 1% Program. The targets for subsequent years identified in the *Ten Year Water Conservation Program Plan* have also been adjusted. The adjusted targets are shown in Table 3 (page 9).

The 1% Program fixture and equipment rebate programs for residential and commercial customers expanded upon 2003 efforts and customer contacts. Rebates were re-tooled in some instances, new incentives were introduced, and new utility partnerships were formed to leverage resources and increase services to customers. 1% Program outreach and technical assistance was expanded for large and small commercial customers, and for vendors and contractors.

Marketing strategies to increase rebates and long-term conservation behaviors focused on target recruitment of different types of customers for specific conservation programs. These strategies employed mass media, direct mailings, new program materials, new web and hotline resources, seminars and workshops, agency and trade association partnerships and a host of targeted promotions.

2004 Program Performance

Total 1% Program long-term savings remain very close to target in relation to the *Ten Year Water Conservation Program Plan* (Seattle Public Utilities, 2002). Table 1 shows estimated long-term savings in 2004, with more detailed analysis provided in Chapter 4. New water savings achieved in 2004 include both long-term savings and transitory, or temporary savings. **Long-term** savings include both the direct and indirect impacts from implementation of the 1% Program – these savings are the focus of this report. Long-term savings in addition to 1% Program savings also come from higher water rates and plumbing fixture codes. **Transitory** savings are short-term in duration and come from above-normal utility system savings (non-revenue water reductions), from temporary drought curtailment actions and the residual effects of these actions, and from changes in economic

activity in the regional service area. All long-term savings are included in Seattle Public Utilities' demand forecast, whereas transitory savings are not.

Table 1: New Water Savings Achieved in 2004 (in MGD)

	New Long-Term Customer Savings						Other Savings		Total
	1% Conservation Program		1% Program Total	Rates	Code	Seattle Low Income	Economy	System	
	Hardware	Behavior							
Residential Indoor	**0.27**[1]		**0.27**	0.1	0.5	0.03			
Residential Landscape	**0.01**	**0.15**	**0.16**	0.1					
Commercial Non-Landscape	**0.48**		**0.48**	0.1	0.3				
Commercial Landscape	**<0.1**	**<0.1**	**<0.1**	0.1					
Other Savings								-4.6[3]	**-4.6**
2004 Total 1% Program Peak Season Savings	**0.76**	**0.15**	**0.91**						**0.91**
2004 Total Annual Avg Savings[2]	**0.65**	**0.05**	**0.70**	**0.4**	**0.8**	**0.03**	**0.0**	**-4.6**	**-2.67**

[1] 1% Program sector savings are reported as peak season savings.
[2] See text on page 2, and in Chapter 2, page 13 for conversion of peak season savings into annual average numbers.
[3] Much of the higher than usual non-revenue water use was believed to be due to reservoir overflowing for water quality purposes.

Also shown in Table 1, but not part of the 1% Program, are savings for rates, codes, Seattle low-income projects, transitory economy-related savings, and system non-revenue water savings. Table 2 shows 1% Program performance relative to expenditures, savings goals and targets for each customer sector, by hardware (equipment), and by behavioral incentives and outreach efforts.

Hardware Incentive Savings include new fixtures and equipment upgrades that were supported with program incentives, as well as accelerated fixtures (beyond rates and code) that were upgraded without rebates. Based on program records, these savings are estimated to be .76 MGD peak season, (or 0.65 MGD annual average) in 2004.

Behavioral Incentives and Outreach Savings include permanent conservation achieved with and without incentives from changes in customer water-using behaviors. These savings are estimated to be 0.15 peak season (or 0.05 MGD annual average) in 2004. These estimates are explained in greater detail in Chapter 4.

Table 2: 2004 Performance

PROGRAM SECTOR	EXPENDITURES ($1,000)	2004 WATER SAVINGS Peak Season[1] (1,000 GPD)	
		Goal	Conservation Achieved
Residential Indoor	**$1,258**	**520**	**271**
Behavioral & Outreach	130		0
Hardware Incentives	1,128		271
Res. Landscape	**$442**	**290**	**156**
Behavioral & Outreach	232		150
Hardware Incentives	210		6
Comm Process & Domestic	**$1,298**	**340**	**484**
Hardware Incentives	1,298		484
Comm Landscape	**$249**	**50**	**0.5**
Behavioral & Outreach			<1
Hardware Incentives	249		0.5
CPA and Research	**$172**		
Youth Education, Annual Report, 684-SAVE, Savingwater.org, Administration	**$182**		
Totals	**$3,601**	**1,200**	**912**
Behavioral & Outreach	544		150
Hardware Incentives and CPA	3,057		762

[1]For annual average savings see description in text above.

Sector Highlights

Residential indoor

- The residential indoor sector achieved strong water savings in 2004. The WashWise program continued at a brisk pace, processing nearly 6,400 rebates for efficient clothes washers.
- The Multifamily Toilet program served 143 buildings, replacing more than 4,000 inefficient fixtures. Staff designed a new incentive for the Multifamily Toilet program that will offer customers a choice of a higher rebate or free toilet in 2005.
- Evaluation of toilet flapper replacement incentives was also completed in 2004, documenting savings from 2003 pilot program efforts and providing valuable information for future program design.

Residential landscape

- This sector developed a new message campaign and expanded on existing messages and promotions. The residential landscape sector developed new supporting materials with specific and highly relevant information to enable customers to make wise choices to save water. The new 'Overwatering' message campaign was highly visible, appearing on buses and airing on the radio during the summer.
- Staff combined partnerships with nine area nurseries, five widely known garden writers, and newspaper and radio advertising to create a 'Plant Right For Your Site' campaign. This campaign focused on plant selection and reinforced the *Better Way to Beautiful* campaign from last year and introduced a new brochure, *The Plant List*, to an enthusiastic audience.
- Another milestone for the landscape sector was development of an agreement with the non-profit Irrigation Water Management Society, which set the stage for development of a web site with real-time evapotranspiration rate data and an irrigation calculator, which customers can use to determine how to set their irrigation systems to deliver the right amount of water for current weather conditions.
- In addition, the Northwest Natural Yard Days promotion was expanded to include a month of compost sales at discounted prices in September. Retailers offered discounted prices on compost, and the SWP promoted the sales.

Commercial, industrial and institutional

- Facilities implemented more than 70 financial incentive projects in 2004. A focus on medical sterilizers contributed to this success, as did a commercial sprayhead retrofit program. Significant incentive projects included the University of Washington (campus toilet retrofit, laundry water recycling system and cooling tower study), King County Metro Bus Maintenance Facility (water-cooled air compressors), Seattle Police Department (water reuse) and two car wash water reclaim systems in wholesale service areas.
- Significant outreach and technical assistance to the business community included a direct mailing to 800 small businesses and completion of more than 20 facility audits and assistance visits at commercial facilities such as Bunge Foods, Trident Seafoods, Fairmont Olympic Hotel, Alaska Airlines, Cabrini Medical Tower, King County South Transit Base, and the Washington State Trade and Convention Center.
- Promotional and workshop presentations were made to facilities managers and targeted trade group audiences.
- Articles were published in several newsletters, and water conservation remained a main feature on the Resource Venture's website. The SWP collaborates with the Resource Venture, a non-profit affiliate of the Greater Seattle Chamber of Commerce, to conduct outreach to businesses.
- A small number of conservation projects were completed by facilities without financial incentives as a direct result of the 1% Program's information and outreach to businesses.

Commercial landscape

- This sector emphasized customer irrigation efficiency audits and customized rebate projects for large commercial landscapes.
- In 2004 workshops were conducted for landscape and irrigation professionals, property managers and other irrigation customers to educate them about the costs of poorly managed systems, efficiency opportunities, and how to qualify for financial incentives. Low customer recruitment resulted in low program participation and low water savings achieved. At year's end, the program was assessed to determine a more cost-effective approach for achieving savings in this sector. The new approach will encourage and enable contractors

to provide auditing services and to pursue the Irrigation Association Auditor certification, thereby improving professional irrigation skills.

Youth education activities provided education and customer recruitment support for measurable savings achieved by the residential indoor and landscape conservation programs. Accomplishments included:

- Development of a revised home water savings kit.
- Creation of a TV advertisement for the interactive 'Waterbusters' on-line educational tool.
- Revised web page.
- Distribution of materials to school groups.
- Water education event sponsorship.

The Seattle Water System Wholesale Customer Conservation Technical Forum met throughout the year to discuss the implementation of Residential Indoor, Landscape, Marketing, Commercial/Industrial/Institutional, and Education programs.

1% Program Total Savings to Date

The *Ten Year Water Conservation Program Plan* (Seattle Public Utilities, 2002) savings goal is to save 18 million gallons per day of peak season demand (13.6 MGD of annual average) by the end of 2010. The savings is to come from both the City of Seattle and the wholesale customers of Seattle who participate in the regional Saving Water Partnership (SWP). On January 1, 2004, five Seattle wholesale water utilities left the SWP as part of Seattle's new contract with the Cascade Water Alliance (CWA). Program savings from these CWA utilities prior to January 1, 2004, were counted in the 2003 Annual Report. The savings yet to be obtained from the remaining SWP Utilities has been adjusted, resulting in a savings goal of 14.5 million gallons per day (11.0 MGD annual average) for the regional 1% Program by the end of 2010. Table 3 on the next page shows the cumulative 1% Program savings to date, and the savings targets for years 2005-2010. This table is laid out similarly to the long-term savings table presented in the *Ten Year Water Conservation Program Plan* (Seattle Public Utilities, 2002).

Table 3: 1% Conservation Program Savings to Date (1,000 GPD peak)

	2000-01 "Ramp-Up" 2-Year Total	2002	2003	2004	2005	2006	2007	2008	2009	2010
Residential Indoor	1,150	386	349	272						
Residential Landscape	400	304	103	157						
Commercial Domestic, Process, Landscape	1,250	525	452	474						
Actual Annual Savings	***2,800***	***1,215***	***904***	***912***						
Target Annual Savings*	2,100	1,120	1,500	1,200*	1,200	1,500	1,500	1,500	1,480	1,434
Actual Savings Cumulative	***2,800***	***4,015***	***4,919***	***5,831***						
Target Savings Cumulative	2,100	3,220	4,720	5,920*	7,120	8,620	10,120	11,620	13,100	14,534

*2004 target and years thereafter adjusted 27% to reflect withdrawal of Cascade Water Alliance utilities from 1% Program. See text for description of conversion to annual average savings.

Looking Ahead

In March of 2005, Seattle Mayor Greg Nickels declared a water shortage advisory, activating the first stage of Seattle Public Utilities' Water Shortage Contingency Plan. Water shortage conditions may create challenges for program implementation such as staff reassignments to shortage-related priorities and may add a level of difficulty to determining 1% Program savings for 2005. Analysis of 2005 water consumption may need to distinguish long-term savings attributable to the 1% Program from transitory savings that were brought about by the shortage but that will erode over time, similar to the situation in 2001. Also in 2005, the regional Conservation Potential Assessment update will be finalized, assisting the 1% Program with program targeting and design.

The 2005 1% Program will continue to build on the success of ongoing program implementation and will try new approaches in several programs:

- National research results about toilet performance will enable a narrowing of rebate eligibility for both the Multifamily Toilet Rebate Program and the Water Smart Technology program, and establish a foundation for the launch of a single family toilet replacement program.
- Limited customer testing of residential showerhead replacement will take place.
- A messaging campaign encouraging residents to wash full loads of clothes will be developed.

- Experience with residential irrigation system rebates will lead to expansion of this effort in 2005 with an increased focus on landscape contractors and equipment vendors.
- Launch of a web site that contains real-time evapotranspiration data and an irrigation calculator will support residential irrigation system rebates.
- The commercial program will continue to focus on targeted savings where there is readily available cost-effective technology and a significant customer base, such as dental vacuum pumps. This targeted approach proved very successful with the pre-rinse sprayhead and the medical sterilizer programs in 2004.
- The program will continue to emphasize assistance to both small businesses and the largest commercial customers who made important conservation progress in 2004.

Although not part of or funded by the 1% Program, Seattle Public Utilities continues to implement a Seattle Direct Service Water Conservation Program to accelerate water savings and assist low income residents inside the city limits. In many ways this Program complements the 1% Program, since greater incentives and more community based marketing can be accomplished, resulting in greater savings. During Phase One 11,027 low-income housing units in Seattle were upgraded with efficient plumbing products. Phase Two will begin in 2005 and target approximately 18,000 additional low-income units through 2010. The goal in 2005 is to reach nearly 8,000 homeowner/utility assistance recipient households with details of free or reduced cost conservation assistance. Program partners currently include community based non-profit Senior Services of Seattle King County, Seattle Human Services Department, and other local community based organizations.

Ongoing Performance Monitoring

The 1% Program regional ten-year conservation goal requires significant conservation investments through the year 2010. Carefully tracking and evaluating program performance through efforts such as those included in this report will help meet the 1% goal in a timely and cost-effective manner. Monitoring program performance will ensure that resources are put to their best use and that the programs are managed for highest efficiency. This information will also help identify the need for mid-course corrections and fine-tuning adjustments as the program proceeds toward the goal.

2. Program Design

Regional 1% Program and 10-year Goal

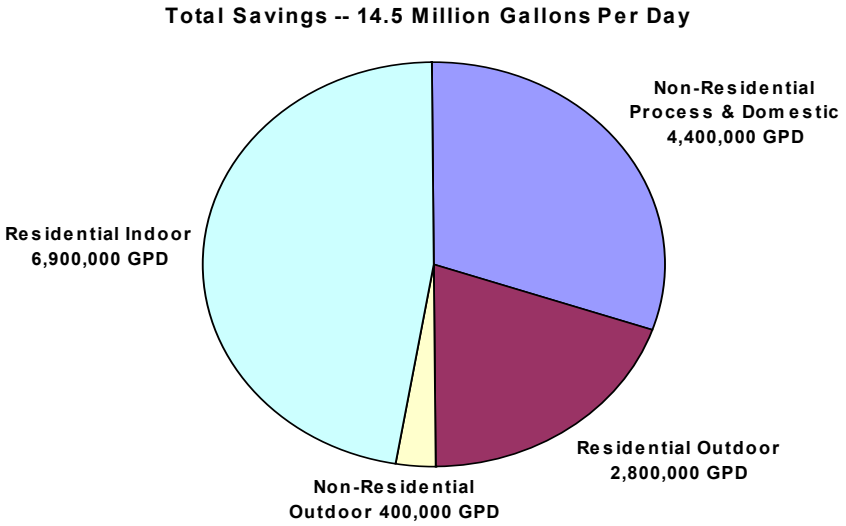
The Saving Water Partnership has an established goal of reducing per capita water use in the regional service area by 1% every year through 2010. When combined with new codes, price impacts and system savings, this goal will result in decreases in total water demand through the year 2010 despite a forecasted 10% growth in regional population over this same time frame. Consequently, water withdrawn from the Tolt and Cedar River supply sources will be no greater in 2010 than they are today, providing significant environmental benefits for fish and other riparian resources. More detailed objectives and strategies for the 10-year program and beyond are presented in the *Ten Year Conservation Program Plan* (Seattle Public Utilities, 2002).

Water system demand reduction comes from several sources: savings from water rates and plumbing codes, conservation programs, and other savings such as the impact of the economy on water use, and utility non-revenue water use. Between 2000 and 2010, savings from rates and plumbing codes are expected to reach 11 MGD annual average savings, and savings from the 1% Program will achieve an additional 14.5 MGD of peak season savings (11.0 MGD annual average). Although Cascade Water Alliance (CWA) utilities are no longer participating in the regional 1% Water Conservation Program, it is assumed that CWA will undertake demand management activities of their own to produce their share of the total Seattle water system savings needed to achieve the 2010 1% target. This report focuses on the 1% Program component of the total conservation picture. Unless otherwise stated, all references to conservation in this report are to those arising from 1% Program implementation.

In 1998, SPU completed a detailed econometric analysis of water conservation potential, the *Conservation Potential Assessment* (CPA, Seattle Public Utilities, 1998; updated in 2004). The CPA provides a rigorous analysis of the cost, volume, and reliability of conservation opportunities available within Seattle's wholesale and direct service areas. The CPA ensures that the 1% Program focuses on the most cost-effective conservation opportunities.

Chart 2 on the next page shows how the savings targets are to be achieved by various customer sectors.

Chart 2: 2010 Peak Season[1] Savings Targets by Sector[2]



[1] See Table 4 on page 13 for annual average saving targets by sector.
[2] Overall messaging and schools elements are considered supports for other elements and do not have savings targets tied directly to them.

Conservation savings will result from improvements in water use efficiency in residential, commercial, industrial, institutional and landscape customer sectors. The 1% Program will implement conservation programs to improve customer water use efficiency through strategies that integrate information, education, incentives, codes and regulations.

10-Year Measures and Strategies

Programs promoting and encouraging the use of efficient water-using equipment, behavior, and technology are the backbone of the 1% Program implementation strategy. Extensive public information and education outreach supports specific targeted program elements.

Since the early 1990's, the SWP has implemented aggressive conservation programs. The effect of these programs during the 1990's is quantified in Chapter 4. Many of these programs continue to be implemented and have been expanded, including: Water Smart Technology commercial/industrial/institutional incentives, Water Efficient Irrigation Program incentives for commercial customers, WashWise water-efficient washing machine rebates for residential customers, and Natural Lawn & Garden techniques for residential landscapes. In addition, new targeted hardware and behavior programs are being implemented for residential landscape and residential indoor uses. These programs are discussed in more detail in Chapter 3.

The initial years of the program have emphasized primarily getting savings from the expansion of ongoing programs, and ramping-up new programs. In 2004, program ramp-up lead to full scale implementation of irrigation system efficiency upgrade incentives for residential landscapes. Major savings over the life of the program will come from residential domestic use

programs, more efficient residential landscaping, and commercial/ industrial cooling and process improvements. Table 4 below shows where specific savings will come from and how the programs will achieve them. For further information on the long-term conservation program plans, see the *Ten Year Water Conservation Program Plan* (Seattle Public Utilities, 2002).

Savings in Table 4 are shown in peak season and annual average. Each customer sector has a unique pattern of annual water usage. Water use in the residential and commercial landscape sectors is heavily peak-season oriented, as landscapes are watered mainly during the hot summer months. Some commercial process water uses increase during the summer months, while others may partially increase and others stay constant year-round. Examples of water uses that increase during the peak season include hotel rooms, other tourism-related businesses, canning and bottling, and cooling. Examples of water uses that remain constant year-round include office building restrooms, laboratories, and commercial and industrial process water. While some residential indoor water uses such as showering and laundry tend to increase during the summer months, the increase is not significant enough to differentiate peak season usage from year-round use.

Table 4: 10-year Conservation Program Savings, Measures and Strategies

Sector	Types of Measures	Types of Strategies
Residential Indoor **Peak Savings: 6.90 MGD** by 2010 Ann Avg Savings: 6.90 MGD by 2010 =12% of annual average residential indoor water use	▪ Replace toilets, faucets, showers (single family & multifamily) ▪ Fix leaks ▪ Change behaviors (flushes, faucet use, showers, full loads)	▪ Incentives and promotion to accelerate code replacement ▪ Behavior messaging
Residential Landscape **Peak Savings: 2.80 MGD** by 2010 Ann Avg Savings: 0.93 MGD by 2010 =16% of annual average residential landscape water use	▪ Reduce lawn watering ▪ Improve Irrigation performance ▪ Change lawn & garden practices	▪ Direct & indirect media outreach ▪ Technical materials ▪ Irrigation efficiency incentives ▪ Landscape industry partnerships
Commercial/Process/Domestic **Peak Savings: 4.40 MGD** by 2010 Ann Avg Savings: 3.04 MGD by 2010 =10% of annual average commercial process and domestic water use	▪ Upgrade toilets and equipment for cooling, process other uses ▪ Improve cooling performance	▪ Technical assistance ▪ Financial incentives
Commercial Landscape **Peak Savings: 0.40 MGD** by 2010 Ann Avg Savings: 0.13 MGD by 2010 =19% of annual average commercial landscape water use	▪ Upgrade equipment (irrigation controls) ▪ Improve scheduling & maintenance	▪ Assessments and technical assistance ▪ Financial incentives

Supporting Elements

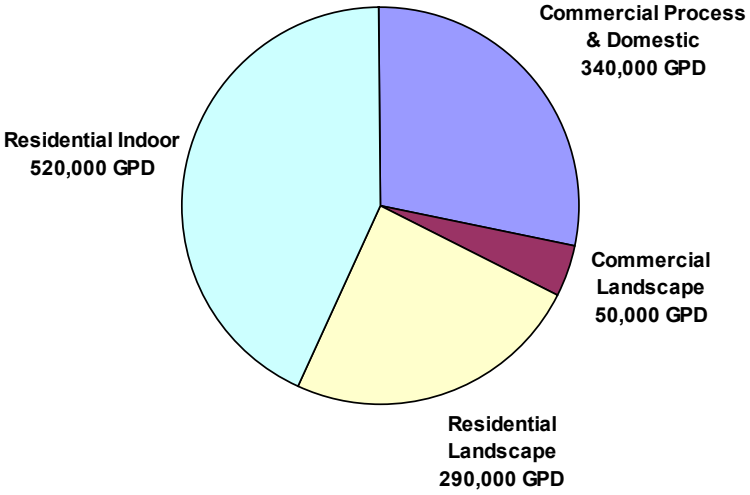
Sector	Types of Measures	Types of Strategies
Youth Education Supports water savings in other sectors	▪ Conservation awareness and personal responsibility	▪ Educator training & resources ▪ Classroom and take-home materials ▪ Watershed tours ▪ Interactive web site
Overall Messaging Supports water savings in other sectors	▪ Conservation awareness, personal responsibility, and residential and commercial measures	▪ Targeted marketing

2004 Program and Goals

An overall peak season savings target of 1.2 million gallons per day (MGD) was set for 2004, based on a total program budget of $3.6 million. For all sectors, new conservation efforts fell into two categories: 1) hardware incentives – primarily financial incentives to replace fixtures or equipment; 2) behavioral incentives and outreach – assistance to change behaviors or upgrade equipment, usually without financial incentives. This year established incentive programs built new savings based on past success, new residential landscape advertising was introduced, assistance and outreach services were expanded and ground was broken on new, future savings programs.

Chart 3 shows the 2004 savings targets planned for various customer sectors.

Chart 3: 2004 Peak Season Savings Targets by Sector



2004 Measures and Strategies

2004 presented special challenges and associated solutions in all of the major customer sectors:

Residential indoor water use. Rebates for clothes washers were lowered in recognition of increasing market share of water efficient machines. To ensure that the market share of these machines continues to increase, marketing efforts were expanded to compensate for the lower rebate.

Residential outdoor water use. Rebates for residential irrigation system efficiency improvements were offered for the second year. An early irrigation season made customer recruitment a challenge for this program. Partnerships continued with retailers, garden writers and the landscape industry. Overcoming customer barriers to water-saving practices, and quantifying savings from these behavioral practices, continue to be a challenge in this sector.

Commercial process, domestic, and landscape water use. Recruiting sufficient customer participation to meet the ambitious savings target for this sector is an ongoing challenge. Two targeted programs - a pre-rinse sprayhead retrofit program focused on restaurants, and a targeted program with a bonus incentive to stimulate retrofit of medical sterilizers, achieved excellent results.

Table 5 shows in detail the different conservation measures and strategies implemented during 2004 within the different customer sectors and supportive elements in youth education and overall messaging.

Table 5: 2004 Conservation Measures and Strategies

Types of Measures	Types of Strategies
RESIDENTIAL INDOOR (2004 Target = 520,000GPD Peak Season Savings)	
▪ Replace washing machines ▪ Replace toilets & faucets (single family & multifamily) ▪ Fix leaks ▪ Change behaviors (flushes, faucet use, shower time, full loads)	▪ WashWise rebates ▪ Double Your Savings rebates ▪ Multifamily toilet rebates ▪ Target building owner and operator associations ▪ Behavior messaging ▪ Collaboration with energy utilities ▪ Promotion through media, mailing ▪ Promotion of results of Maximum Performance Testing of Popular Toilet Models conducted by Veritec Consulting (Veritec, 2004)
RESIDENTIAL LANDSCAPE (2004 Target = 290,000 GPD Peak Season Savings)	
▪ Improve watering efficiency ➢ Irrigation system performance ➢ Landscape watering behaviors ➢ Practices that affect watering (e.g. mulch and soil prep)	▪ Irrigation system efficiency rebates ▪ Aesthetic-oriented media campaign ▪ Regional sales event ▪ Retailer partnerships (nurseries & home & garden centers) ▪ Technical materials ▪ Target high peak users
COMMERCIAL PROCESS/DOMESTIC (2004 Target = 340,000 GPD Peak Season Savings)	
▪ Upgrade toilets and other domestic water use fixtures ▪ Upgrade efficiency of equipment for cooling, process other industrial uses ▪ Improve cooling performance ▪ Upgrade efficiency of specific water consuming medical and lab equipment ▪ Replace pre-rinse spray heads	▪ Target small businesses ▪ Target restaurants and other users of inefficient pre-rinse spray heads ▪ Recognize outstanding projects through BEST awards program ▪ Outreach to chambers of commerce and other business groups through Resource Venture ▪ Technical assistance, assessments, workshops ▪ Financial incentives (custom projects & standard rebates) ▪ Possible bonus incentive to increase participation ▪ Targeted promotion through vendors, trade groups, agencies ▪ Recruit large customers ▪ Perform end-use metering wherever possible to build cost-effective conservation recommendations
COMMERCIAL LANDSCAPE (2004 Target = 50,000 GPD Peak Season Savings)	
▪ Upgrade irrigation equipment (controls, rain sensors, drip) ▪ Improve scheduling & maintenance	▪ Assessments, workshops and technical assistance ▪ Financial incentives (custom projects and set rebates) ▪ Targeted recruiting and promotion ▪ Begin transforming market by establishing and building vendor and contractor relationships

Supporting Elements

Types of Measures	Types of Strategies
YOUTH EDUCATION (Supports savings in other sectors)	
▪ Conservation awareness and residential measures	▪ Educator training and resources ▪ Classroom and take-home materials ▪ Educational TV PSA for kids ▪ Interactive activities
OVERALL MESSAGING (Supports savings in other sectors)	
▪ Conservation awareness supporting recruitment of residential and commercial customers	▪ Targeted marketing ▪ Collaboration with Puget Sound regional water utilities ▪ Festivals

3. Performance by Sector

The commercial customer sector exceeded their expected hardware-related savings in 2004, but other sectors fell below both hardware and behavior-related savings targets because of continued low behavior-related savings as described in Chapter 1.

Highlights:

- Commercial sector water savings were again very strong in 2004. The Water Smart Technology program targeted to commercial process and domestic water conservation exceeded its expected savings in 2004. The Water Efficient Irrigation Program targeted to commercial irrigation did not meet its savings goal.
- Residential indoor sector water conservation savings were also strong again in 2004. WashWise rebates exceeded their goal, but Multifamily Toilet rebates and behavior savings did not meet performance targets, so that the sector achieved significant savings but did not meet sector savings targets. Program costs are expected to decrease in future years as the hardware rebate programs evolve and as confidence in the new toilets and washers increases among customers.
- The residential landscape sector continued a rebate program and rolled out a behavior change campaign targeted to high peak water users, both key components of achieving the long-term goal. Barriers to changing the summer watering practices of these customers are significant and the second year of this program improved over the first year's performance, but did not produce significant savings. Despite a highly visible summer message that addressed overwatering, behavioral savings could not be tangibly demonstrated. An effort is underway to enable the program to better quantify behavioral savings.

Residential Indoor Use

Program Description

The residential indoor sector focuses on the indoor water use of single and multifamily customers. Water conservation efforts result from both fixture upgrades and behavioral changes. The program provides customers with direct financial incentives (rebates), technical assistance, and education. Program information is provided to customers through targeted and regional advertising, point-of-purchase materials at retailers, and direct contact with customers.

The Multifamily Toilet Rebate and other rebates were advertised regularly in the top-read publications for property owners and managers

2004 Goals and Strategy

For 2004, residential indoor conservation services were tasked with achieving 520,000 gallons per day (GPD) of new peak season savings. These savings were to be achieved through fixture replacement and behavioral changes. Fixture upgrades focused on toilets, clothes washers, showerheads and bathroom faucet aerators. While some residential indoor water uses such as showering and laundry tend to increase during the summer months, the increase is not significant enough to warrant using a differential between peak season and year-round savings when counting savings.

Program strategies concentrated on boosting ongoing rebate programs, testing a pilot conservation program, and educating customers about long-term behavior changes. Specific elements included:

- **Washing machine rebates** – The program offered rebates of $50, $75, or $100 to customers for the purchase of qualified efficient clothes washers. Such an approach was intended to educate consumers that washers are not just efficient/inefficient, but offer a range of efficiency levels.

- **Toilet rebates** – The Multifamily Toilet Rebate Program grew from its solid foundation set over the two previous years. A key goal of the program is to work with property owners and managers to replace toilets that would not have otherwise been replaced.

- **Showerheads and bathroom faucet aerators** – Customers who participated in the Multifamily Toilet Rebate Program were eligible to receive these products included in their rebate. These items provided additional water savings in living units as part of the toilet installation "package." The showerheads and aerators have been well received by residents.

Apartment buildings can replace their inefficient showerheads as part of the Multifamily Toilet Rebate Program

- **Outreach** – The WashWise program put major emphasis on advertising in 2004 to keep program participation high in spite of reduced rebate levels. Bus advertising and regional newspaper ads promoted the benefits of resource-efficient machines. Efforts to promote the Multifamily Toilet Rebate continued through articles, case studies, and ads in trade journals. Presentations were made at events sponsored by apartment and condominium owner associations.

2004 PERFORMANCE

Residential indoor conservation produced an estimated 271,500 GPD in new long-term peak season savings. The hardware elements of the program continued to capture savings through thousands of program participants.

Table 6: 2004 Residential Indoor Peak Season Water Savings

Type	Major focus	Peak Savings (GPD)
Outreach & education	Toilets, leaks, behaviors	0
Rebates & promotion	Washing machines, toilets, faucet aerators	271,500
	TOTAL	271,500

Resource efficient clothes washers rebated and installed in the SWP service territory remained a strong source of savings in 2004. The SWP continued to partner with Seattle City Light for customer rebates in Seattle City Light's service area. Clothes washers rebated through the program totaled 6,397 for the year. The water savings attributed to the installation of these machines is an estimated 106,830 GPD of peak season savings. Thirty-nine percent of the rebates were from wholesale service areas, which indicates higher per capita rebate participation for water districts outside of SPU's service territory. An additional 7,000 GPD of peak season savings, the equivalent of 500 efficient washing machine installations, has been attributed to this program. Significant increases in the market share of efficient machines since the WashWise program began indicate that consumers are being influenced to purchase efficient machines, even if they don't apply for a rebate.

WashWise rebates were promoted on Metro buses throughout the regional service area

The program continued to offer tiered rebates, providing greater incentives to customers who purchased higher-efficiency machines. This approach appeared effective, with the greatest number of machines purchased in the highest tier of efficiency. Manufacturers have also increased their offerings of machines in the highest tier of efficiency. According to many local retailers, sales of all rebate-eligible machines now make up around 50% of their total washing machine sales.

Table 7: 2004 Residential Fixture Rebates

Rebated Fixtures	Fixture Targets	Fixture Totals	Peak Season Savings (GPD)
Multifamily Toilets*	7,100	4,141	146,400
Washing Machines	3,600	6,397	113,800
Toilet Flapper Pilot (2003)	600	1,200	9,000
Toilet Recycling Support	300	100	2,300
		TOTAL	271,500

*Savings includes installation of showerheads, aerators and leaks repaired during toilet installation.

The multifamily toilet replacement program helped multifamily building owners and property management firms replace toilets in 143 buildings. Since the program's inception in late 2001, the program has served over 640 participating buildings and rebated over 15,000 toilets.

A total of 4,141 toilets were replaced through the program in 2004, totaling 144,900 GPD of peak season savings. An additional savings of 1,500 GPD of peak season savings, equal to 41 toilets or one percent of program accomplishments was credited to this program to reflect the program's educational effect on property managers who are replacing their fixtures without applying for a rebate. Participation levels below the target of 7,100 fixtures was disappointing but not surprising, given the assumption that many "early-adopters" had already participated in the program. The program continued to have strong participation in wholesale service areas, primarily a reflection of the King County Housing Authority completing the replacement of all old toilets in their housing portfolio. In addition, more than 114 tons of toilets were recycled through the program.

The toilet flapper replacement pilot program that took place in Northshore Utility District in 2003 was evaluated and found to have reduced participants' water consumption by 4.2%, or eight gallons per household per day, on average. The evaluation found that higher savings were achieved from customers with homes more than 10 years old. The level of savings was not sufficient to warrant implementation of a full-scale flapper program in 2005, but a program may be developed that would offer replacement flappers to regional residents with high winter water consumption and who live in older homes.

A common type of toilet flapper

Toilet recycling support for single family residents took place in the form of offering a subsidy of $5 per toilet to participating cities that coordinate city-sponsored recycling events annually. The 1% Program offered the incentive to enable cities to collect toilets for recycling at no cost to the customer. 274 toilets were collected through seven city-sponsored events. In addition, toilets were accepted for recycling year-round at no charge at Seattle's South Recycling and Disposal Station.

Program messages and materials included articles, fact sheets and advertising about conservation behaviors and incentives. Methods included print and bus advertising, press releases, public festivals and events, the savingwater.org web-site, and phone hotline information requests.

LOOKING AHEAD
The residential indoor program will continue to emphasize the WashWise and Multifamily Toilet programs in 2005. Now that the WashWise program has offered tiered rebates for two years, a trend is emerging that shows an increase in the higher efficiency machines. Customers are purchasing higher efficiency machines, and manufacturers are offering more products that are pushing the upper limits of efficiency. The rebate structure in 2005 provides a significantly higher incentive to customers who purchase the most efficient "Three Star" machines. This continues the program's movement toward an exit strategy that provides the greatest incentive to the most efficient machines, and eventually to a program that will be based on customer education rather than incentives. A promotion will be considered for late spring to celebrate the 50,000th WashWise rebate.

As of the end of 2004, the Multifamily Toilet Replacement Program (MTRP) was revamped to increase program participation. The program now offers an $80 per toilet rebate, or a free toilet option. The rebate was increased to stimulate greater participation before use of ratio utility billing systems (RUBS) – various systems for allocating water utility costs directly to tenants – becomes widespread. Once these billing systems are implemented, property owners are less motivated to conserve water. The rebate was also increased to provide more conservation assistance to non-subsidized low-income rental housing units, as mandated in Seattle by city ordinance. For this second reason, a percentage of the MTRP costs in SPU's service territory are being funded by Seattle's low-income program and not funded by wholesale partners. A market penetration study will be conducted in 2005 to determine the remaining potential for toilet replacement in this sector.

Planning is underway to offer a pilot showerhead/bath aerator program to Highline Water District residential water customers. If cost-effective water savings are calculated, such an effort could be expanded throughout the SWP service territory.

An educational effort will launch early in 2005, called FlushStar™. This SWP-driven effort will provide a list of toilets that are recommended to residents based on the results of independent toilet testing. Since mid-2004, all toilets rebated through the Multifamily Toilet Replacement Program have been required to be FlushStar™ qualified products. The FlushStar™ program in 2005 may be supplemented with a time-limited single-family toilet rebate program.

An additional educational effort is planned to capture savings from people making changes in everyday behaviors. An advertising and outreach campaign is scheduled to take place in fall of 2005 to increase the number of households washing full loads of clothes.

Residential Landscape Use

PROGRAM DESCRIPTION
This customer sector targets water used for single family landscapes. The long-term goal, over ten or more years, is to build a new customer ethic with respect to landscapes, replacing traditional and resource-intensive practices with those that are more resource-efficient and more closely follow a natural model. The primary target audience is high peak water users: customers who use significant quantities of water in the landscape. The important secondary audience is users who may not use as much water but who actively garden. The Natural Lawn & Garden (NLG*)* is the unifying concept that conveys key messages about healthy landscapes that require fewer resources, such as water and chemicals. It is an integrated approach,

addressing water supply, solid waste reduction and surface water quality and quantity issues and is supported with funding from Seattle and King County solid waste and drainage utility funding. This holistic approach has created efficiencies by leveraging resources from other utilities and agencies and has been well received by landscape professionals and customers. Program efforts focus on outreach and education, program incentives, ecological landscape management, and evaluation.

The key "what" message of this program is summarized in five steps to establishing and maintaining a healthy and beautiful natural lawn and garden.

1. Build healthy soil
2. Plant right for your site
3. Practice smart watering
4. Think twice before using pesticides
5. Practice natural lawn care.

Ways to implement the five steps listed above are detailed in a series of publications called the natural lawn and garden guides:

- Growing Healthy Soil
- Choosing the Right Plants
- Smart Watering
- Natural Pest, Weed & Disease Control
- Composting at Home
- Natural Lawn Care
- Natural Yard Care (summary)
- The Plant List (draft completed in fall, 2004)

2004 GOALS AND STRATEGY

Residential landscape conservation was targeted to reduce long-term water use by 290,000 gallons per day (GPD) in 2004. The strategy focused on four areas:

- **Awareness building** – Raising awareness is the first step toward achieving changes toward new, efficient behaviors. A highly visible advertising campaign about the costs of overwatering was implemented to build interest among the general public in how to water landscapes efficiently.

- **Education** – The program offered technical assistance, materials and training to assist customers in changing their behaviors. An advertising campaign with the tag line "Plant Right for Your Site," and a new brochure called *The Plant List*, encouraged customers to choose plants suited to the site where they would be planted. This idea of "right plant, right place" was further supported with a series of classes. Alliances with local garden columnists resulted in additional publication of the "plant right for your site" message in newspapers, and in securing highly respected garden writers as hosts and teachers of the classes. The Natural Lawn and Garden Hotline answered customer questions about all aspects of resource-efficient gardening, Although not funded by the 1% Program, 17 classes focused on landscape design and maintenance were offered to professionals such as landscape architects, designers, builders, turf and landscape installation and maintenance contractors.

- **Behavior change using incentives** – Two efforts made use of financial incentives to encourage customers to practice resource-efficient behaviors in their landscapes. The Water Efficient Irrigation Rebate (WEIR) provided an incentive to encourage people to upgrade

their in-ground irrigation systems. Northwest Natural Yard Days was a highly visible promotion of resource-efficient products sold at discount prices in many nurseries and box stores in the spring and fall.

- **Research and evaluation** – Research and evaluation ensure that program resources are put to their best use. In 2004, research on woody mulch products, a survey on mulching practices, and a survey on use of the natural lawn and garden guides were conducted to further refine recommendations to customers.

2004 Performance
Residential landscape savings totaled 156,500 gallons per day of peak season savings, achieving 54% of the target of 290,000 gpd of peak season savings. An early irrigation season, a delay in marketing of the rebate program, and difficulty in attributing savings to behavioral changes have in part contributed to savings falling below target.

Table 8: 2004 Residential Landscape Peak Season Savings

Type	Major focus	Peak Savings (GPD)
Behavioral incentives & outreach	Radio and print ads, nursery partnerships, retailer partnerships, compost, water timers, soaker hoses and educational materials	150,000
Hardware incentives & promotion	Automatic irrigation system hardware retrofits	6,500
	TOTAL	156,500

"Overwatering…Soaks You, Drowns Plants, Drains Resources" campaign
Developed as a comprehensive public awareness approach to behavioral and equipment changes, the "Overwatering" campaign utilized radio, internet banner, bus, and print ads throughout the summer. With three different messages, customers learned about the negative impacts of overwatering and the resources available to use water more efficiently. The messages focused on the financial, plant health, and environmental issues of overwatering, and included graphic images depicting each of the scenarios. In addition, the campaign directed customers to savingwater.org and 684-SAVE for information on irrigation sprinkler rebates and watering tips.

This ad campaign encouraged people to think about how they water their landscapes, and why they might want to change the way they do it

A radio ad aired during peak listening periods on two stations, KOMO AM 1000 and 570 KVI AM. The ad featured two men light-heartedly discussing the financial and environmental impacts of their neighbor's overwatering problem. The *Seattle Times, Seattle PI, King County Journal*, and community papers, bus, and radio and newspaper websites rotated one of the three messages weekly.

"Plant Right for Your Site" Campaign
The goal of this campaign was to encourage customers to choose the "right plant for the right place." Plant selection is a highly misunderstood concept by the gardening public. From surveys, we have found that most gardeners choose plants for aesthetic

Choosing the right plant gives you less yard work and more time to enjoy your yard

reasons without regard to whether their plants will thrive in their existing sun, soil and water conditions. This can result in excessive use of water, fertilizers and pesticides. However, gardeners are strongly influenced by nurseries and local garden writers. Therefore, in Spring 2004, SWP partnered with nine area nurseries and five of the Puget Sound's most widely known garden columnists to teach and host classes. The columnists taught classes at the nurseries from March 27th through May 1st (peak plant sale period). In total, 207 people attended the classes. Of these attendees, 162 completed class evaluations. The evaluations revealed that 75% of those responding were going to try matching the right plants for their gardens. In addition, 10 nurseries helped to promote the classes and proper plant selection through cooperative SWP-nursery advertising in *Pacific NW Magazine*, *Seattle Home + Garden*, *NW Garden News* and KIRO radio during Ciscoe Morris's gardening show.

Proper plant selection was presented in a fresh light through a full-page ad in an October issue of Pacific Northwest Magazine, entitled "Pull on your galoshes and plant for dry summers ahead." The goals of the ad were to educate gardeners on why fall is the best time to plant and to use the following resources with our dry summers in mind: request the new *Plant List* and other Natural Lawn & Garden guides available through the Natural Lawn & Garden Hotline; visit savingwater.org website and attend the class, "Under the Seattle Sun…Drought Resistant Gardening Inspired by Tuscany." Following the ad, the Hotline received 200 requests for *The Plant List* and 97 people attended the class taught by gardening columnist Marianne Binetti. 89% of the attendees returned evaluations, with 91% saying they would try plants suggested during the class.

Development of *The Plant List*
The Plant List was developed as a key tool to support customers in selecting the right plant for the right place in their landscapes. The newest addition to the family of Natural Lawn & Garden Guides was developed during the second half of 2004, with a draft completed in time for an October waterwise gardening class. *The Plant List* was developed with the valuable assistance of the Great Plant Picks horticultural education program. The list consists of almost 400 plants, organized into four categories: Wet Winter/Dry Summer Plants, Moisture-Loving Plants, Favorite Pacific Northwest Native Plants, and Drought-Tolerant Plants. *The Plant List* will be finalized as a 14 page, full color brochure in early 2005.

"The Plant List" helps people choose the right plant for the right place

Alliances with local garden columnists were initiated in 2003 and showed numerous results in 2004. Columnists understood our goals and programs and enthusiastically partnered with us to teach the classes described earlier. In addition, five of the *Seattle Times* and *Seattle P.I.* journalists wrote articles about watering less in the garden. Two of these titles were "Curb your watering habit for healthy grass" and "How to stop wasting water with irrigation systems."

Natural Lawn & Garden Hotline
The Natural Lawn & Garden Hotline had nearly 7,500 public contacts in 2004, answering over 13,000 questions from the gardening public. Approximately 30% of the calls received came from King County residents outside of Seattle plus another 10% from gardeners living outside

Table 9: 2004 Landscape Customer Outreach

Contacts	Targets	Actual
Naturals guides	60,000	44,720
Public class attendees	300	304
Attendees at training for professionals	400	365
Natural lawn & garden hotline questions answered	12,000	13,000

King County. The Hotline number was seen more than ever - in addition to the SWP using it, it was also used by suburban cities, various media outlets and even gardening businesses. The Hotline was promoted through business cards and magnets, print ads in landscape industry publications and radio ads on the Ciscoe Morris show on KIRO radio. The Hotline was also a point of contact for Northwest Natural Yard Days, irrigation contractors and evaluation of the "Naturals" brochures.

Natural Landscapes – 2004 Professional Education

While funded by SPU's Solid Waste and Drainage utilities and not by the 1% Program, this professional education and outreach work complements ongoing public education and market transformation campaigns in the landscape area, and includes a strong landscape water conservation focus. In 2004, 17 classes and full day workshops attracted 365 professionals, including: architects/landscape architects/designers/project managers; builders & contractors; engineers & consultants (stormwater, erosion control, civil, etc.); realtors/development sales staff; and turf & landscape installation & maintenance contractors. Classes for these audiences focused on landscape design and maintenance choices, with a particular emphasis on soil preparation, mulching, and appropriate plant selection.

Water Efficient Irrigation Rebate Program

Now in its second year, the objective of the Water Efficient Irrigation Rebate Program (WEIR) is to increase the efficiency of residential automatic irrigation systems through customer rebates. The mostly vendor driven program doubled the number of rebates for irrigation controllers and rain sensor upgrades in 2004 compared to the first year of the program, even with a reduced service area.

Focusing on landscape and irrigation contractors as a vehicle for marketing the program, WEIR sent an irrigation newsletter and provided training opportunities for contractors to learn about the rebates, important irrigation efficiency information, and industry news. The program also offered contractors who attended the training the opportunity to be posted in a section of www.savingwater.org. which lists contractors who can perform efficient irrigation retrofits. This information was also distributed through the Natural Lawn and Garden Hotline when customers called 684-SAVE and were directed to the hotline with questions about the rebate program.

Ciscoe Morris, a popular local gardening expert, served as spokesperson for Natural Yard Days

Half of the customers who received rebates in 2004 were in wholesale service areas. 88% of customers installed rain sensors and 71% upgraded their controllers. Of the 57 customers who upgraded their controllers, eight installed evapotranspiration controllers. 73% of the customers learned about the rebates from their contractor. Others found out from direct-mail, newspaper, and radio. Two irrigation contractors were responsible for 60% of the rebates received from customers. $17,850 was paid in rebates, with an average rebate amount of $220.

Northwest Natural Yard Days
2004 was the seventh year for Northwest Natural Yard Days. The campaign continues to emphasize the five steps to natural yard care outlined in the Natural Yard Care brochure. For the first time, in 2004 the campaign was carried out in two seasons, spring and fall. The fall campaign discounted compost and organic fertilizers. Local radio and TV gardening personality Ciscoe Morris was again the spokesperson for the campaign. Ciscoe appeared in two 30-second TV spots and one 10-second spot, as well as a radio ad, print ads, a pullout supplement to the *Seattle Times/P-I* Pacific Magazine, and in-store banners, shelf talkers and near life size silhouettes. In addition, the program kick-off generated an extended spot on KCPQ-TV and a story in the Seattle Times. The program's direct education focus shifted from store customers to retail staff at 23 stores - 139 staff received training in the spring and 130 were trained in the fall. Though compost sales rose only moderately, sales of soaker hoses and water timers went up substantially.

Table 10: 2004 NW Natural Yard Days Sales Results

Product	Number of items sold
Electric Mowers	1,486
Push Mowers	1,741
Weed Puller	2,678
Soaker Hoses	5,657
Insecticidal Soap	2,545
Water Timers	1,354
Bags of Compost2	94,318
Bags of Organic Fertilizer	6,255
Overall Items Sold	**116,034**

Mulch research
In 2004, SPU contracted with Howard Stenn to conduct research on documented benefits or harm associated with the use of various woody mulches in landscapes. The purpose of the research was to determine whether bark mulch was a good product to add to the Northwest Natural Yard Days retail promotion. In prior years, SPU primarily recommended wood chips from arborist work as a woody mulch product. While this product is adequate, many residents were frustrated with the lack of a predictable schedule for availability and delivery of the material.

The literature review and interviews with landscape professionals found that there is no evidence of growth inhibition in woody landscape plants due to the use of commonly available bark mulch products. Surface crusting (and related water-shedding) and nitrogen immobilization can sometimes be a problem with using certain types of woody mulches. Disease transmission by arborist chips from diseased plants is not a documented phenomenon.

As a result of the research bark mulch was added to the discounted products offered by retailers during the Northwest Natural Yard Days promotion.

Mulch intercept survey
SWP has undertaken many programs to encourage gardeners to mulch. Among other benefits, mulching helps soil retain moisture, meaning that gardeners don't need to water as often. However, SWP has learned from previous surveys that although customers mulch, they may or may not water less. In an effort to gauge whether or not customers make this connection and to what extent they would be motivated to mulch if they knew they could use less water, SWP conducted a customer intercept survey at four large retailers (box stores such as Home Depot and Lowe's) and three nurseries. 520 responses were collected. Most customers (71%) thought that mulching in the fall would help them save water in the summer. And most customers (62%) claim to water mulched beds less than unmulched beds. While this survey had a small sample size and relied on self-reported behavior, the responses showed that customers were making the intended connection between mulching and watering.

Natural lawn & garden guides survey
To help determine whether customers who receive copies of the Naturals guides find them useful, a postage-paid postcard was sent with four questions to a total of 347 customers during the summer of 2004. These were customers who had been sent guides after calling the Natural Lawn & Garden Hotline. In total, 89 postcards were returned, or 26% of the total. Comments were generally favorable. Respondents said that they changed their practices most often in the following areas, based on reading the guides:

- Improving mulching and composting practices
- Reducing water use through scheduling changes
- Improvements to natural lawn care practices
- Reducing pesticide and weed and feed use

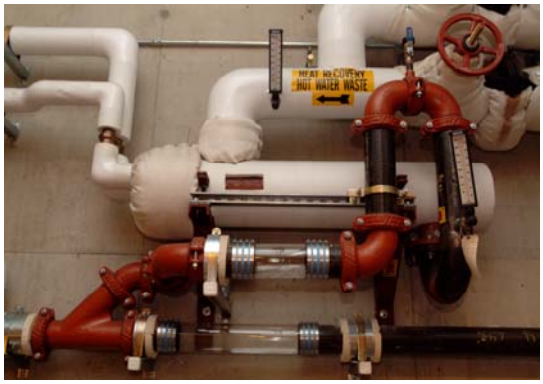
To obtain data from customers over the course of an entire year, the survey will continue through spring of 2005.

LOOKING AHEAD
In 2005, the SWP will research the feasibility of working with housing developers on establishing limited-to no-irrigation landscapes. Successes from 2004 will be reinforced in the coming year. A key objective is to continue to leverage resources through strong partnerships with a variety of actors, including housing developers, nurseries, garden writers and landscape and irrigation professionals. Activities were:

- Forming new community partnerships with garden tours, plant sales, and large garden clubs to distribute educational materials at community events with high gardener attendance.
- Establishing partnerships with libraries and book stores to capture the interest of gardeners who read. The SWP will approach libraries and bookstores with a new bookmark to promote *The Plant List* and explore opportunities to display *The Plant List* in gardening book promotions. Potentially host classes at libraries in an effort to connect with gardeners at a neighborhood level.
- Rewriting the Soaker Hose fact sheet to appeal more to beginner gardeners.
- Assessing the Naturals guides to determine if re-designs and re-writing would add value and appeal to new gardeners.
- Promoting the new evapotranspiration website at iwms.org, which will post daily ET, irrigation scheduling calculators, and a water budget calculator.
- Repeating the 'Overwatering' campaign, including a direct mail to high peak season water users.
- Publishing two newsletters and conduct two landscape and irrigation contractor trainings to promote the rebate program.
- Developing and implementing a plan to enable the landscape program to better quantify savings made from customers changing their water-using behaviors.

Commercial Process and Domestic Use

PROGRAM DESCRIPTION
The Water Smart Technology program provides technical assistance and financial incentives to reduce water use in commercial, industrial and institutional facilities. Conservation opportunities include replacing toilets and urinals, converting ice machines and refrigeration equipment from water cooling to air cooling, other types of pass-through cooling, installing high efficiency commercial



Water reclamation system at Fred Hutchinson Cancer Research Center

clothes washers, upgrading air compressors and other medical equipment, process water recycling and reuse, cooling tower improvements, and other water use efficiency technologies. Program staff and consultants provide efficiency solutions through on-site assessments and metering, technical review, product evaluation, fact sheets, and case studies. Program financial incentives provide standard rebates, custom incentives of up to 50% of the installed costs of any cost-effective conservation measure, and special incentives of up to 100% of installed cost for targeted measures. Most program participants have a simple payback period of less than two years on their investment.

2004 GOALS AND STRATEGY

The Water Smart Technology Program had a water savings target of 340,000 GPD of peak season savings for 2004, including savings produced from customer information and outreach activities.

Program delivery and outreach focused on four strategies:

- Promotion through service and equipment vendors;
- Partnerships with trade groups, electric utilities, agencies and other service providers;
- Targeted recruiting of select business categories, including large customers, hospitality, medical facilities, and schools and institutions; and
- Workshops designed to address selected end uses.

These strategies and priorities are described in the *Commercial Delivery Strategy* (Seattle Public Utilities, 2001).

2004 PERFORMANCE

The Water Smart Technology Program exceeded its savings target by 42% in 2004. Improvements at commercial facilities produced estimated long-term water savings of 483,700 GPD of peak season savings.

Table 11: 2004 Commercial Process and Domestic Peak Season Savings

Type	Major Focus	Peak Savings GPD
Rebates & administration	Toilets, cooling, process, technical assistance	483,700
	TOTAL	483,700

Significant outreach and assistance was provided by the Resource Venture and contributed to these savings. The Resource Venture is a non-profit affiliate of the Greater Seattle Chamber of Commerce that is under contract to the SWP and SPU to provide resource conservation outreach to the business community.

2004 program accomplishments included:

- Completed or making significant progress on major incentive projects at the University of Washington (campus toilet retrofit is now approximately 75% complete and a study evaluating water treatment options for UW's 20+ cooling towers is in progress), Westin Hotel (complete toilet replacement - North Tower), Children's Hospital medical air compressor, Consolidated Laundry installing a water reclaim system, and Highline School District multi-school bathroom retrofits.
- Targeted program focus and special program incentive on medical sterilizers brought in estimated savings of 45,000 GPD of peak season savings. The interest and success encouraged an extension of the special program incentive through March 1, 2005.

- Assisted customers with long-term conservation planning, including the Port of Seattle, University of Washington, and several King County facilities.
- Adopted the FlushStar Toilet list for the Water Smart Technology Program.
- Held third annual Businesses for an Environmentally Sustainable Tomorrow (BEST) awards ceremony, recognizing businesses for their environmentally beneficial accomplishments including water and energy conservation. The awards are sponsored by a partnership of the SWP, the Resource Venture, the Greater Seattle Chamber of Commerce and Seattle City Light. The awards draw attention to businesses' success in resource conservation.

Table 12: 2004 Commercial Incentive Projects

Process and Domestic Measures	Projects	Peak Savings GPD
Bathroom measures	36	135,698
Refrig./ Ice Machines/ Cooling	15	36,439
Medical Equipment	7	58,357
Washing Machines/Laundry Sys	4	51,569
Process Water	9	33,488
Laundrywise	NA	3,843
Sprayheads	NA	152,260
2004 Total	71	471,654
2004 Target	*75*	
Non-incentive Projects	Projects	GPD
Non-incentive projects	6	12,033

- The Resource Venture conducted eight presentations for facilities managers and targeted trade group audiences on water conservation programs and services, and conducted 12 water conservation assistance visits. Articles were published in several newsletters, and water conservation is a main feature on the Resource Venture website.
- Sponsored two hospitality industry workshops providing technical information tailored specifically to water conservation opportunities in that sector.
- Sponsored a vendor/contractor workshop to promote a special Water Smart Technology Program Incentive and to increase participation in the WST Program.
- The Efficient Pre-rinse Sprayhead Program partnership with Puget Sound Energy was highly effective for all of 2004. Over 2,000 heads were installed in SWP territory. This success was rewarded with agreement to install an additional 750 heads above the original goal of 3,000. This program
  involves the direct replacement of inefficient pre-rinse sprayheads in food service settings at no cost to the participating customer. New, highly efficient sprayheads produce significant water and energy (hot water) savings.
- Developed a program partnership with Puget Sound Energy to offer a significant rebate increase for coin-op clothes washers installed in commercial laundromats.
- Completed a direct mail promotion to 800 small business customers that had requested information through a 2003 direct mail campaign.
- SWP staff outreach activities included conducting more than 20 audits and assistance visits at commercial facilities such as Bunge Foods, Trident Seafoods Four Seasons Hotel, Alaska Airlines, Cabrini Medical Tower, King County South Transit Base, Ash Grove Cement, Westfarm Foods, Arctic Ice Cream, and the Washington State Trade and Convention Center. Made promotional and workshop presentations to business organizations such as BOMA (Building Operators and Managers Association), numerous local chambers of commerce, and the Medical Industry Roundtable.
- Extended the Resource Venture contract to the end of 2005. More emphasis was placed on core services and easy to obtain and effective educational materials.

More than 2,000 efficient sprayheads are saving over 150,000 gallons per day in restaurants throughout the service area

LOOKING AHEAD
With the extension of the sprayhead program and continuing to target medical sterilizers, as well as two large projects lined up for early 2005, Nucor Steel and the Shoreline School District, the Water Smart Technology Program is well positioned to achieve target savings in 2005. The program will continue to support a broad spectrum of cost-effective conservation measures through technical assistance and incentives. New targets providing potential opportunities for specific end-use savings are dental vacuum pumps and continuing with coin-op clothes washers that got a late start in 2004. Consideration will also be given to updating the commercial toilet incentive to match the multi-family offer of either a free toilet or $80 rebate for a FlushStar toilet. Outreach recruitment will continue utilizing the Resource Venture for targeted business sectors including hotels and restaurants, medical, and institutional facilities. A special emphasis will be given to sprayhead program participants. A new commercial assistance brochure will be completed by the end of the second quarter, and evaluation of the Sprayhead Program, now due to be completed by the second half of 2005, will occur late in the year.

Commercial Landscape and Irrigation Use

PROGRAM DESCRIPTION
The Water Efficient Irrigation Program (WEIP) provides irrigation conservation services to commercial and multifamily customers in the form of free irrigation audits, water use analysis, and financial incentives to encourage irrigation system capital improvements that save water. It differs from the residential program (Water Efficient Irrigation Rebates, or WEIR), in that it provides a more customized service, since commercial/multifamily irrigated properties tend to be larger and therefore the potential for water savings is greater.

2004 GOALS AND STRATEGY
New commercial landscape efficiencies produced 500 gallons per day (GPD) peak season savings in 2004, 1% of the expected hardware savings of 50,000 GPD in peak season savings. In 2004, changes in program staffing led to a delay in recruiting customers for the program, and impacted the overall success of WEIP. Most outreach efforts focused on recruitment for irrigation audits. Only six customers submitted applications for irrigation incentives and all were for standard rebates.

Efficient irrigation systems deliver water uniformly

2004 strategy paralleled the strategy used in 2003. The program emphasized customer landscape assessments and audits. A professional irrigation auditor reviewed the performance of participating customers' irrigation systems and made recommendations for improving efficiency. The following promotional efforts took place:

- Workshops for landscape and irrigation professionals, property managers and other irrigation customers to educate them about the costs of poorly managed systems, efficiency opportunities, and how to qualify for financial incentives.
- Standard rebates for the installation of rain sensors, conservation controllers and evapotranspiration (ET) controllers.
- Promotion and technical assistance through sector targeting conducted by the Resource Venture.

- Partnerships with landscape and irrigation professionals to help them understand the business opportunities associated with water conservation and to increase awareness of WEIP incentives for customers.

2004 PERFORMANCE

Program accomplishments included:

- Conducted 36 irrigation system audits and provided specific efficiency recommendations to property owners/managers.
- Provided rebates to one medical research facility, one office park, and four multifamily customers, for a total of six sites. Rebated measures included four rain sensors, four conservation controllers and four reprogrammed irrigation schedules.

Table 13: 2004 Commercial Landscape Peak Season Savings

Type	Major focus	Estimated GPD Peak
Outreach and education	Audits, rain sensor promotion	Not determined
Rebates & administration	Irrigation upgrades, rain sensor rebates	500
	TOTAL	500

A comprehensive review of commercial programs and savings can be found in *Impact and Process Evaluation: 2001 Commercial Water Conservation Programs* (Seattle Public Utilities, 2002).

LOOKING AHEAD

The Water Efficient Irrigation Program is undergoing major changes. An assessment of the program revealed the need for a more cost-effective approach to water savings for the commercial and multifamily sectors. The two existing central program initiatives, audits and customized incentives, appeared to be a comprehensive solution to improving the irrigation systems of commercial customers. The audit identifies a system's inadequacies, and the financial incentives provide the encouragement a customer needs to make improvements. But a closer look revealed problems, hidden costs, and conflicts that proved detrimental to the program's success and its ability to create long-term water savings.

Table 14: 2004 Commercial Landscape Assistance

Technical assistance	2004
Audited sites	36
Rebated measures*	
Schedule & weather controls	4
System performance	4
Install rain sensor	4
Rebate projects	
Total Measures	12
Target	*50*
*Projects have multiple measures	

According to an analysis of historic project data, of the 244 audits provided between 1995 and 2004, only 38 led to incentive projects. Follow-up with customers revealed that even the simplest recommendations were not being implemented.

Another concern with providing free irrigation audits performed by SWP consultants was that the service discouraged contractors from performing audits for their customers. Programmatic efforts would be better served by encouraging contractors to provide auditing services directly and to pursue the Irrigation Association Auditor Certification. Restructuring the auditing portion of the program to support all contractors to provide an auditing service will be more in line with SWP efforts to improve professional irrigation skills.

The Market Transformation Approach

Changes to the program support market transformation by encouraging irrigation contractors to utilize all program tools to increase their customers' water efficiency. Changes will increase their knowledge of irrigation technologies and practices that save water, and make it easier for them to provide conservation and SWP rebate services to their customers. SWP staff

anticipates that contractors will be more likely to support conservation if it positively improves their bottom-line. The residential rebate program has successfully established that this type of partnership is viable with contractors.

The Water Efficient Irrigation Program will continue to promote financial incentives and support events that promote the design, installation and maintenance of efficient irrigation systems. In 2005, the program will sponsor two Irrigation Association trainings for landscape and irrigation professionals. Contractors will learn about the program changes through direct mail pieces and the free trainings (required for contractor listing on savingwater.org). The program will also continue to reach customers through Resource Venture outreach.

The new program will offer contractors and commercial properties the following incentives and services:

Technical Support
- Irrigation Scheduling Calculator
- Water Budget and Water Budget Calculator
- Before and After Irrigation Schedules
- Inspection of Valves and Heads
- Assessment Forms
- Assessment Recommendation for Rebates

Standard Rebates
- Rain Sensor
- Conservation Controller
- Evapotranspiration (ET) Controller

Potential New Standard Rebates
- Central Control System
- Flow Sensors
- Pressure Regulating Valves
- Double-Check Valve Heads to prevent the system from leaking after the water is shut off

Resources
- Smart Water Application Technologies (SWAT) Website – Irrigation System Information – www.irrigation.org/SWAT
- Irrigation Water Management Society Website – Daily ET – www.iwms.org
- Demo Sites

General Customer Outreach and Messaging

PROGRAM DESCRIPTION
The purpose of general messaging efforts is to continue building and reinforcing a water conservation ethic among all Saving Water Partnership customers. In 2004 the messaging efforts combined general messages with program specific outreach. The approach worked well by allowing the SWP to better leverage promotional dollars, reaching a large number of people at a reasonable cost.

2004 GOALS AND STRATEGIES

Outreach efforts focused on developing messages that both encouraged water conservation and directed customers to specific programs. It was determined that focusing on individual programs instead of general messaging was the best way to achieve actual water savings with customers. Advertising such as the "Overwatering Soaks You" campaign included a general message with a program specific promotion. The ad campaign promoted rebates for in-ground lawn sprinkler systems, but also carried a general message that overwatering was bad – not good – for the lawn.

Banner ads like this one appeared on selected radio station web sites and linked directly to information about irrigation system rebates on the 1% Program web site, www.savingwater.org

Radio and print advertising played a key role in 2004 outreach efforts. Radio served as the linchpin for driving messages to the greatest number of customers while being reinforced by print advertisements in *The Seattle Times*, *Seattle PI* and targeted community papers reaching SWP wholesale water customers.

Transit ads, which proved to be an extremely successful vehicle for the WashWise campaign, continued to also serve an important role in customer outreach.

Anchoring all the advertising was a completely remodeled Savingwater.org web site. The site has seen a three-fold jump in visitors since the remodel, which was accomplished after extensive research and usability. Savingwater.org serves as the main contact point in all SWP advertising.

2004 PERFORMANCE

A newly remodeled **Savingwater.org** web site allowed the SWP to better track advertising response rates and helped the programs access overall market outreach success. During the "Overwatering Soaks You" campaign, for example, staff were able to directly track visitors from banner ads and links on radio station home pages. During these periods, upwards of 70 percent of visitors to savingwater.org would arrive from advertised links; a major success by any measure.

Broadcast radio advertising served as a major venue for outreach in 2004. The SWP was able to negotiate an excellent ad package with Fisher Broadcasting (KOMO AM, KING FM, KPLZ FM and KVI AM radio stations) that allowed the program to reach the greatest number of area customers for the lowest ad dollar. The ad package also included Mariner Baseball coverage on KOMO AM radio. Listenership for Mariner broadcasts is nearly 50 percent of the SWP customer base, and even with a poor year for the Mariners, listenership did not waver.

The WashWise program developed a **co-op ad campaign**. Fisher developed a washer give-away contest and recruited area appliance dealers to donate the washers in exchange for name recognition at the end of the ads. All washers had to meet the WashWise approved ratings requirements.

Print advertising focused on *The Seattle Times* and *Seattle PI*, as well as community papers that could best reach the targeted audience. Both the "Overwatering Soaks You" and Wash Wise campaigns made use of the outstanding reach of *The Seattle Times* and *PI*. Even in

specific wholesale water districts, more people subscribed to and read the *Times* and *PI*, than read the community papers.

In addition to newspaper advertising, landscape messages were advertised in Sunset Magazine. Since the addition of the Inside Seattle section, the program was able to target 20,000 avid gardeners with outdoor watering messages during the spring, summer and fall.

Transit ads on the sides of King County Metro buses served both the WashWise program and "Overwatering Soaks You" campaigns very well in 2004. The SWP was able to negotiate a new long-term contract with Titan, the company that manages Metro Bus advertising, that will allow the program to take advantage of excellent rates and customer reach in 2005.

LOOKING AHEAD IN 2005

The Saving Water Partnership will continue to promote an overall conservation ethic, specific behavior changes and rebate programs. The SWP's advertising reach and success continues to improve with each passing year. The newly negotiated contracts with Fisher Broadcasting and Titan, plus ongoing contracts with *The Seattle Times* and *PI* give the SWP the best ad rates and customer reach the water conservation program has ever had. The new year will bring with it several milestones and events that merit promotion. The first major milestone will be the celebration of the 50,000th rebate for the WashWise program. It is estimated that that rebate will occur in late spring. Landscape messages will continue to be advertised, and a residential indoor campaign encouraging customers to wash full loads of clothes will be developed.

Youth Education

Close to 1,000 people visited the 1% Program booth at Issaquah Salmon Days

PROGRAM DESCRIPTION

Raising the awareness level of school-based audiences about the importance of valuing and conserving water is a goal of the SWP. Resources and program materials for students, teachers and other associated educational groups are developed through partnerships with respective school districts. Materials and services are developed to directly meet the needs of schools and youth organizations.

2004 GOALS AND STRATEGY

Activities developed for youth education support measurable savings achieved by the residential indoor and landscape conservation programs. In 2004, youth education strategies included:

- Making on-line resources for kids and educators easier to access
- Developing advertisements to encourage use of the on-line resources
- Refining services and products that have been successful in the past
- Revising the Water Matters teacher training workshop and evaluating whether to combine this workshop with existing teacher training offered by Seattle Public Utilities staff at the Cedar River Watershed
- Continuing to provide field trips to the Cedar River Watershed upon request.

2004 PERFORMANCE

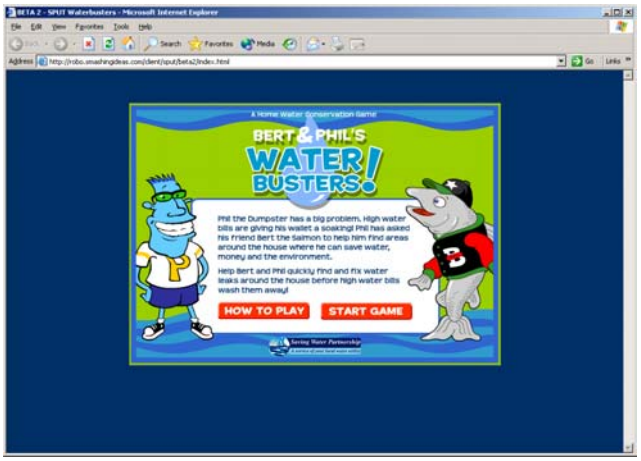
Accomplishments in the area of youth education included development of a revised Home Water Conservation Kit, Waterbusters promotional ad, revised web page, distribution of existing materials to school groups, and water event sponsorship and participation.

Table 15: 2004 Youth Education Resources

Activity	Target	Totals
Conservation kits	2,000	2,000
Posters distributed	100	150
Water timers distributed	300	500
Activity books distributed	300	300

A revised **Regional Home Water Saver Kit** was produced and distributed. The new version includes a revised description of the rationale for water conservation and list of current SWP members. Kits were distributed as part of school programs and event giveaways.

A **Waterbusters ad** was created featuring Bert the Salmon and his sidekick, Phil Dumpster, to promote the on-line interactive conservation game. The ad depicts Phil playing the game on a laptop computer while floating on an inner tube in a living room filled with water. As he continues to solve the challenges, the water level recedes. Viewers are encouraged to go to the Savingwater.org website and play the game. The web site received more than 10,000 visits, most of them within one hour of the time the ads aired. The ads aired during youth-oriented programming on KCPQ 13 and WB22 from June to September.

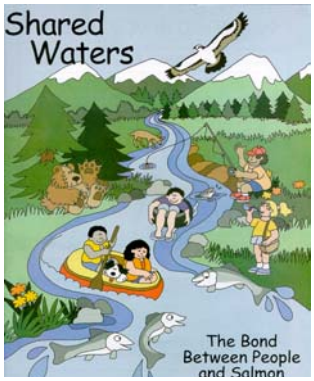


Phil Dumpster gets help reducing his water use from Bert the Salmon

The **youth education web page** was revised as part of the overall Savingwater.org website remodel. New information and links were included as well as revised text so that student and educator groups could more easily navigate the site.

Resources were distributed to educators and student groups. Included were copies of the Regional Water System poster, Bert the Salmon bookmarks promoting the Waterbusters game, Shared Waters student activity books, Five Minute Shower timers and the above-mentioned Home Water Conservation Kits.

The Saving Water Partnership was involved with the **H2O 2004 Festival, The Sammamish Watershed Festival** and, for the second year, **Issaquah Salmon Days**. Home Water Conservation kits, Regional Water System posters, Bert the Salmon bookmarks and *Shared Waters* activity books were distributed to children attending the events.



Shared Waters is a student activity book that explains the importance of protecting water resources

LOOKING AHEAD

- It has been more than 20 years since the first regional youth education programs were offered. An evaluation of the effectiveness of these efforts is planned to provide future program guidance.
- The popular Waterbusters Game will undergo a revision to include more challenges and features.

- The Waterbusters promotional ad will again be aired during summer and early fall months.
- The revised Shared Waters student activity books will be produced and available for distribution.
- A revised Water System poster will be produced to reflect the departure of CWA utilities from the 1% Program and distributed along with other available resources.
- Sponsorship and participation in selected water-related community events will again take place.

Evaluation and Monitoring

PROGRAM DESCRIPTION
Each conservation program plan contains a feedback loop for monitoring progress and evaluating costs and savings. Ongoing program evaluation is essential for designing and managing effective programs, monitoring results, and achieving conservation goals in a timely and cost-effective manner. Monitoring, program service delivery evaluation, and program impact evaluation all ensure that resources are put to their best use, that programs are managed for optimum results, and that effective adjustments are made as program implementation proceeds.

Program evaluation includes accurate tracking of program statistics, resources and activities. Service delivery evaluation reviews participant satisfaction with the process of participating in a program, non-participant awareness of the program and barriers to participating, and opportunities for program improvement. Impact evaluation examines program results, accuracy of initial program estimates, and satisfaction with the new products installed and/or new behavior changes undertaken.

The *Conservation Potential Assessment* (CPA, Seattle Public Utilities, 1998) is an overarching conservation tool that guides effective program implementation by identifying potential conservation opportunities and estimating costs. As programs are implemented, the cost and savings assumptions of the CPA are tested, refined, and either validated or modified. A major update of the CPA will be finalized in 2005.

2004 GOALS AND STRATEGY
Evaluation efforts in 2004 focussed on five major areas to support comprehensive review and improvement of conservation services:

- **Complete the 2003 Annual Report** of 1% Program savings and accomplishments.
- **Improve tracking and reporting** to facilitate regular monitoring and coordination of conservation efforts. Maintain and utilize a database of retail and wholesale customer data on a voluntary basis (Wholesale Customer Billing and Research Database). Enhance database tools for both wholesale and direct service customers.
- **Implement residential customer surveys and product research to evaluate the largest water saving opportunities**: indoor water use (end use metering and indoor behaviors) and mulch research. Responses are key to the design of cost-effective measures to reach these targeted customers. An end-use metering study of random homes took place in 2003, followed by surveys of water use behaviors, appliances, and fixtures. The analysis of this monitoring data was completed in 2004. It represents the first major quantification of the market share of the largest water uses in most homes. Learning how efficient these are,

and the rate of change to efficiency is critical to the design of retrofit programs. Mulch research helped document benefits and effectiveness of woody mulches in landscapes.

- **Upgrade the Conservation Potential Assessment model** to allow more dynamic modeling by program managers of program costs, alternatives, and savings potential.
- **Identify customer barriers to conservation** so that greater participation can be obtained**.** During 2004, a regional survey and two focus groups were conducted to identify barriers to adopting residential indoor behaviors such as washing full loads of clothes, taking shorter showers and fixing leaks. Better information will lead to ways to overcome these barriers and thus achieve greater overall adoption of measures. In addition, a postcard survey of recipients of the *Naturals* guides provided information on which landscape-related water-saving behaviors were being adopted most often by customers.

2004 ACCOMPLISHMENTS

SWP staff and consultants designed and implemented new evaluation tools in 2004 to improve program performance and reporting, including:

- Issued the 2003 Annual Report for the 1% Program, containing an improved analysis of system water consumption.
- Made upgrades to the Conservation Potential Assessment model to make it more user friendly and expand interactive capabilities, and completed a report on the updates.
- Conducted a detailed barrier analysis of residential indoor measures.
- Developed a new database to track savings of Multifamily Toilet Rebate participants over time.

Residential indoor behaviors: A regional survey and two focus groups of homeowners and renters were held to establish a baseline and to identify barriers to adopting residential indoor behaviors such as washing full loads of clothes, taking shorter showers and fixing leaks. The research will inform coming behavior message campaigns and will serve as a baseline to measure the success of the campaigns. Some interesting findings from the research include:

- Customers think they are washing full loads, but are actually filling the machine 25-30% under capacity.
- Less than half of survey respondents said they checked their toilets for leaks in the past two years.
- There is potential for customers to save water, but in general it will be challenging to interest people in changing their behaviors.

Flapper replacement: Also in 2004, the toilet flapper replacement pilot program that took place in Northshore Utility District in 2003 was evaluated. This pilot was a field test of savings and customer participation in a not-too-glamorous toilet maintenance activity that is a common source of water leakage. The pilot was found to reduce participants' consumption by 4% on average. The evaluation found that higher savings were achieved from customers with homes more than 10 years old. The level of savings was not sufficient to warrant implementation of a full-scale flapper program in 2005, but a program may be developed that would offer replacement flappers to regional residents with high winter water consumption and who live in older homes.

New multifamily database: Developed a database to track "rolling savings" of mutifamily toilet replacement participants. This database includes monthly and annual water use for participating buildings in SPU's service territory. The database will be expanded in the future to include wholesale customer consumption data. The data will enable the SWP to refine estimates of program savings.

Residential landscape behaviors: A postcard survey was mailed to customers who had received the *Naturals* guides. Respondents reported that they found the guides very helpful, and that they had changed a variety of practices. The practices most mentioned were watering/water use practices, mulching and pesticide usage. Integration of these findings continues, but has already played a major role in determining the focus of the program on 'plant right for your site,' including *The Plant List* and seminars dedicated to the topic of 'right plant, right place.'

Natural Yard Care Neighborhoods: This program is based on a 'social diffusion' model and attempts to help people change to new, resource efficient landscaping practices by offering a series of workshops and incentives and assistance to a particular neighborhood. In 2002 and 2003 the 1% Program contributed funding to this program. In 2004 Seattle's program was funded entirely by King County's Local Hazardous Waste Management Program, without 1% funds. A participant survey was fielded in late 2003 and the results received in 2004. Highlights of the findings include:

- Significant increases in how knowledgeable people became about some of the topics covered in the workshops.
- For every practice taught in the workshops, at least some participants had begun new conservation behaviors.
- There was a strong correlation between the number of workshops attended and the number of people participants talked to about the practices.

Mulch research: This product research documented benefits and found no harm associated with the use of various woody mulches in landscapes. The research enabled SPU to add bark mulch to the list of products sold at discounted prices through the Northwest Natural Yard Days promotion. The additional recommended mulch product addressed customer frustrations with obtaining the one type of mulch SPU recommended in the past, arborist wood chips.

Mulch intercept survey: Previous surveys had shown that customers who were mulching were not necessarily watering less. Through this survey staff learned whether customers were making the connection between two behaviors: mulching and watering less. The survey found that most customers (71%) thought that mulching in the fall would help them save water in the summer. And most customers (62%) claim to water mulched beds less than unmulched beds.

LOOKING AHEAD

In 2005 methods will be developed to attempt to better quantify behavioral savings achieved through 1% Program efforts. In addition to the 2004 Annual Report, a variety of service delivery and program impact evaluations will be conducted in the residential and commercial sectors of the 1% Program, including:

- A water savings potential matrix will be developed for hardware and behavioral measures that save water in the landscape. This information will be used to gain a more comprehensive understanding of water savings from various actions.
- Residential irrigation hardware will be further evaluated to determine persistence of savings.
- Behavioral efforts such as distribution of the Natural Lawn and Garden guides, nursery partnerships, and compost discounts will be assessed from a perspective of multiple years of implementation.

- The Multifamily Toilet Rebate Program will conduct a market saturation study to assess savings potential for the program and will assess customer satisfaction and evaluate savings.
- A plan will be developed to better determine behavioral savings from the residential indoor sector.
- Research into overcoming barriers that prevent customers from participating in SWP programs will continue.
- Retailer feedback will also be solicited, in order to continue smooth delivery of collaborative programs, and in order to refine estimates of market share of efficient products.
- The Conservation Potential Assessment will continue to be updated in 2005 and in the ensuing years. It will provide estimates for savings potential and costs based on new research, technology improvements, survey and program data.

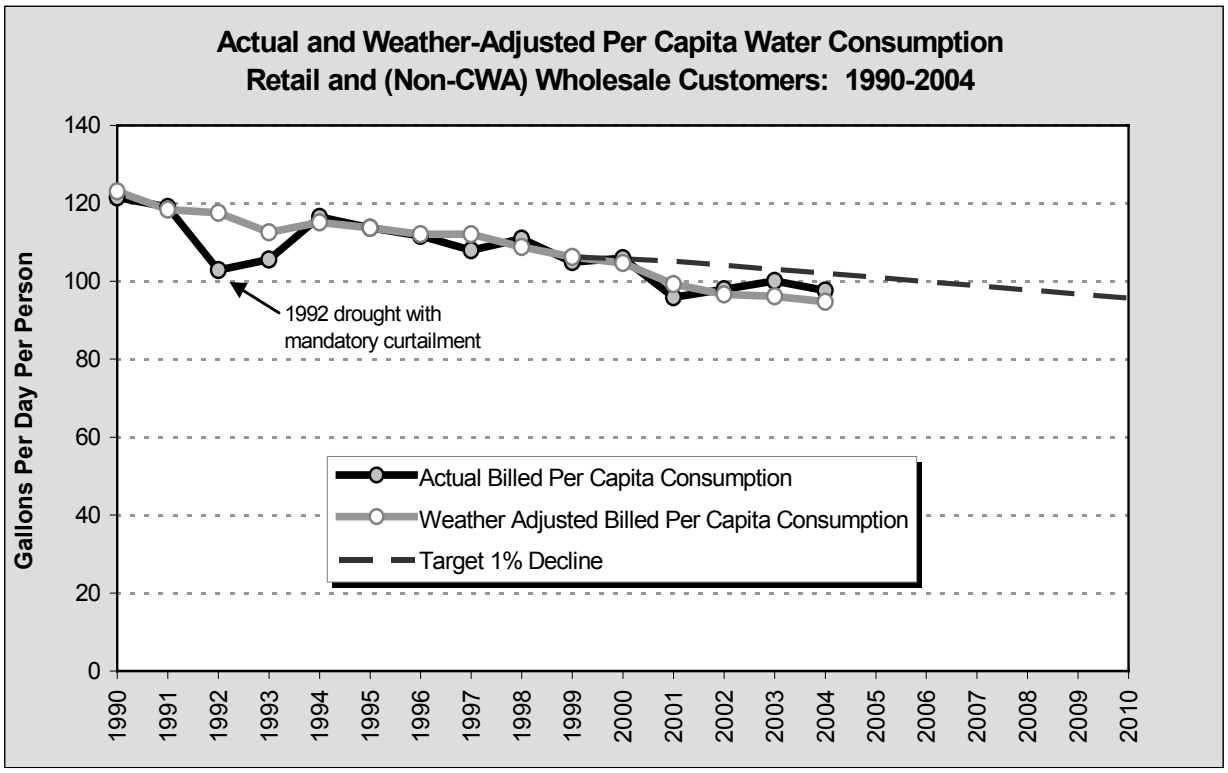
4. Consumption Analysis

Historical Data

Per capita water consumption has declined steadily since 1990, due to a number of factors including changes in the structure and level of water rates, the Washington State plumbing code, and a history of water conservation programs culminating in the current 1% Program. Another source of water savings over the past 14 years has been more efficient system operations, (reservoir overflowing and cleaning, main flushing, etc.). While the system efficiency improvements reduced *non-revenue* water by more than half, they do not affect billed water use by customers, which is the focus of this analysis.

The consistent downward trend in billed per capita water consumption is easily seen in Chart 4 and Table 15 below, especially after adjusting for summer weather. Much of the up and down variation in consumption from year to year is caused by different weather conditions in the summer months. The normal increase in water use during the peak season is reduced in cool wet summers and amplified by hot dry summer weather. Adjusting for summer weather is important in revealing the underlying trends in consumption. For example, the increase in actual consumption from 2002 to 2003 was due entirely to an extremely hot dry summer in 2003. It is estimated that 2003 per capita consumption would have actually dropped slightly from the prior year given normal summer weather.

Chart 4: Annual Average Billed Per Capita Water Use — Combined 1% Program Participating Utilities



The tables and charts in this section show average annual customer consumption for participating 1% Program utilities. The amount of water sold to wholesale customers and the number of people served have been changed from previous 1% Program annual reports to reflect the departure of Cascade Water Alliance utilities from the 1% Program. Also, the numbers do not include non-revenue water. In the 2001 and 2002 annual reports, the consumption analysis used regional average water demand numbers that included non-revenue water. The total demand trends were representative of customer water use. However, since the 1% Water Conservation Program focuses on reducing customer demands, and excludes non-revenue water reductions, reporting on total water system demand does not correctly capture the effects of the 1% Program. Therefore, the 2003 and 2004 reports have used actual billed consumption (billed water sales), rather than total regional water demand, in the consumption analysis. Although it doesn't make a significant difference in trends or conclusions, doing so produces actual savings numbers that are a little lower. Readers should note this minor difference if they compare the 2001 and 2002 annual reports with this report.

Table 16: Water Consumption Trends - SWP Utilities (Annual Average)

Year	Water Sold Retail in MGD	Water Sold Wholesale* in MGD	Total Water Sold in MGD*	Population Served* (thousands)	Gallons per Person per Day (GPD)	Weather Adjusted GPD
1998	71	42	113	1,019	111	109
1999	68	40	108	1,029	105	106
2000	69	40	109	1,031	106	105
2001	62	37	99	1,033	96	99
2002	63	38	101	1,034	98	97
2003	62	41	103	1,036	100	96
2004	61	39	100**	1,028**	98	95

* Excludes Cascade Water Alliance utilities
** Decline in population from 2003 to 2004 reflects the transfer of much of Coal Creek to Bellevue.

Total water sold to all customers (of participating utilities) over the past seven years has declined at an average rate of about 1.8% per year. Meanwhile, population increased by about 0.3% per year resulting in an annual decrease in consumption per capita of 2.1%. Normalizing the consumption figures for summer weather bumps the annual decline in per capita consumption down slightly to 2.3%, far exceeding the 1% per year annual goal for the 1% Program. However, less than half of the reduction in water use can be credited to the 1% Program. The bulk of the per capita reduction is estimated to have come from the impact of increased water rates and the water efficiency plumbing code. In addition, the recent economic slowdown is estimated to have contributed significantly to the decline since 2000.

Table 16 shows a breakdown of where the peak season savings came from in 2004. Savings attributed to the 1% Program are shown in the first three columns shaded in gray. Hardware savings are based on installation of water saving equipment with known and measured savings, and thus these numbers are fairly accurate. The behavior based residual savings are difficult to measure, and they are derived from the difference after accounting for all other savings. Allocation of behavior savings between the different customer sectors is based on program evaluation work that has been conducted over the past four years. The remaining columns show savings from sources other than the 1% Program, and as previously noted, these savings continue to be larger than the combined 1% numbers.

In 2004, total savings were overshadowed by an increase in non-revenue water use (or negative savings) of 4.6 MGD annual average use. The increase in non-revenue water use was

due to increased reservoir overflowing for water quality reasons. Of the total estimated -2.67 MGD annual average savings, 0.7 MGD of annual average savings came from the 1% Program, 1.2 MGD of the total savings came from rates and codes and 0.03 MGD came from retrofit work with low income homeowners and housing providers in Seattle. Note that the low-income program applies only to the City of Seattle. It represents a small amount of additional savings that is neither credited to nor funded by the regional 1% Program.

Table 17: New Water Savings Achieved in 2004 (in MGD)

	New Long-Term Customer Savings						Other Savings		Total
	1% Conservation Program		1% Program Total	Rates	Code	Seattle Low Income	Economy	System	
	Hardware	Behavior							
Residential Indoor	**0.27**[1]		**0.27**	0.1	0.5	0.03			
Residential Landscape	**0.01**	**0.15**	**0.16**	0.1					
Commercial Non-Landscape	**0.48**		**0.48**	0.1	0.3				
Commercial Landscape	**<0.1**	**<0.1**	**<0.1**	0.1					
Other Savings								-4.6[3]	**-4.6**
2004 Total 1% Program Peak Season Savings	**0.76**	**0.15**	**0.91**						**0.91**
2004 Total Annual Ave Savings[2]	**0.65**	**0.05**	**0.70**	**0.4**	**0.8**	**0.03**	**0.0**	**-4.6**	**-2.67**

[1] 1% Program sector savings are reported as peak season savings.
[2] See text in Chapter 1, page 2, and Chapter 2, page 13 for conversion of peak season savings into annual average numbers.
[3] Much of the higher than usual non-revenue water use was believed to be due to reservoir overflowing for water quality purposes.

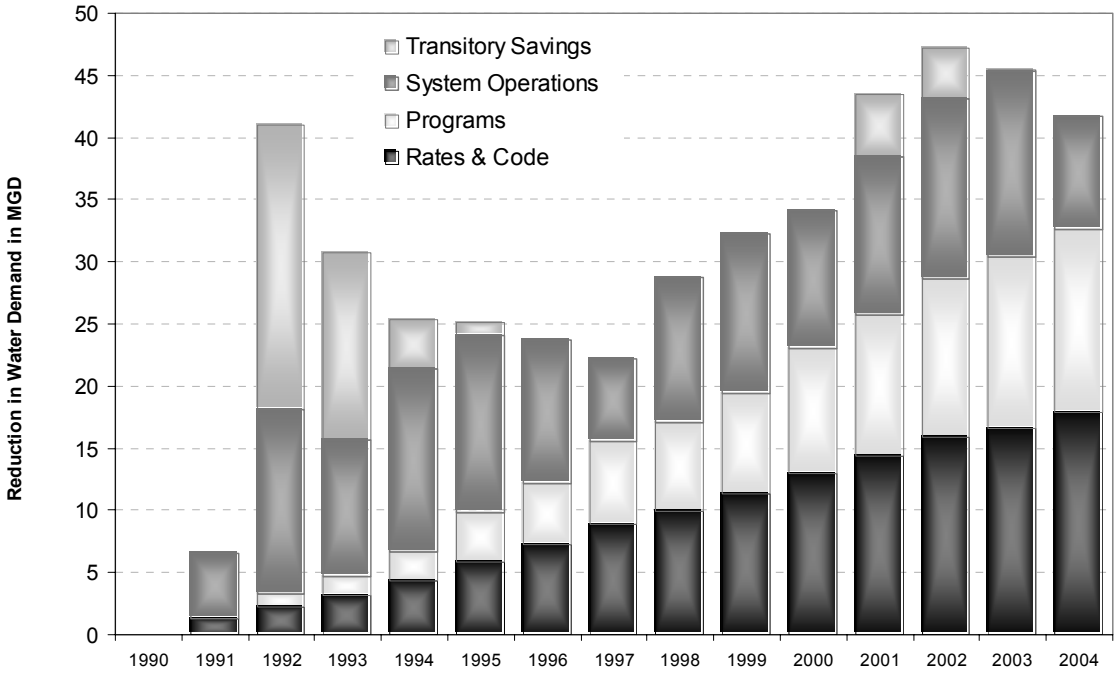
Cumulative Savings

Chart 5 depicts cumulative water savings since 1990. The chart is best used as a picture of historical progress, rather than as an absolute count of cumulative savings. The 1% Program savings shown are peak season savings, while the other three categories are all shown as annual average savings. These savings are planned to keep system demand essentially flat by offsetting increased demand due to population growth. Note the transitory savings (the top bar) seen in 1992-1995, and again in 2001 and 2002, disappear over time, since these savings are a result of sacrifice in response to a drought curtailment message, and are not derived from long-term water efficiency measures. Once customers believe that a drought is over, most of them return to their previous water using behaviors.

System savings (the third bar) are reductions in non-revenue water use. System savings come from a variety of sources such as reducing leaks and lining reservoirs, improved meter accuracy, and modifications to how water mains and reservoirs are flushed to maintain the highest water quality. System savings since 1990 have fluctuated from year to year, but average about 12 MGD annual average.

Long-term customer savings including rate and code effects, (the bottom and second bars) have grown steadily. Refinements in the method of calculating code savings resulted in a decrease in these cumulative savings compared to the figure reported in the 2003 Annual Report. Customer savings are derived from specific conservation measures and actions, and also include rate and code savings.

Chart 5: Cumulative Water Savings[1] Since 1990



[1]This chart provides historical progress rather than an absolute count of cumulative savings. 1% Program savings are shown as cumulative peak season savings, while rates, codes, system operations, and transitory savings are shown as annual average savings.

The savings breakout in Chart 5 was estimated as follows:

1. Rates – price elasticity parameters from SPU's econometric model forecast
2. Code – natural replacement of plumbing fixtures as forecast in SPU's Conservation Potential Assessment model. In 2004, refinements in the method of calculating code savings led to a new estimate of savings that is approximately 8MGD lower than the amount reported in prior years
3. 1% Program – see individual program estimates from Chapter 3 of this report
4. System – analysis of water operating system use
5. Transitory Savings – analysis of post-drought experience.

5. Rebate Program Activity by Water Provider

Tables 18 through 24 summarize rebate program activity in the SWP service area by water provider. Selected commercial/industrial projects are described in greater detail at the end of this chapter.

Table 18: WashWise High Efficiency Clothes Washer Rebates in 2004

Utility	Clothes Washer Rebates	% of Rebates in 2004	Total Rebates: Program to Date
Cedar River	175	2.7%	841
City of Bothell	91	1.4%	558
City of Duvall	47	0.7%	282
City of Mercer Island	169	2.6%	1,060
Coal Creek Utility District	92	1.4%	788
Highline	186	2.9%	1,203
Northshore	348	5.4%	2,216
Olympic View	17	0.3%	244
SPU	4,092	64.0%	26,482
Shoreline	170	2.7%	1,134
Soos Creek	297	4.6%	1,738
Water District #20	93	1.5%	467
Water District #45	8	0.1%	47
Water District #49	48	0.8%	306
Water District #90	48	2.3%	649
Water District #119	24	0.4%	142
Water District #125	34	0.5%	197
Woodinville	358	5.6%	2,025
Total	**6,397**	**100.0%**	**40,379**

Table 19: Multifamily Toilet Rebates in 2004

Utility	Toilets Rebated in 2004	% of Toilets Rebated in 2004	Total Toilets Rebated: Program to Date	Total Projects to Date
Cedar River			56	2
City of Bothell	129	3.1%	209	8
City of Mercer Island			9	1
Highline	326	7.9%	695	20
Northshore	107	2.6%	672	23
Olympic View	6	0.1%	74	3
Shoreline	490	11.8%	620	15
Soos Creek	165	4.0%	189	5
SPU	2,538	61.3%	9,696	515
Water District #20	212	5.1%	212	4
Water District #45			59	3
Water District #49	162	3.9%	262	9
Water District #125			208	4
Woodinville	6	0.1%	115	4
Total	**4,141**	**100%**	**13,076**	**616**

Table 20: Water Efficient Irrigation Residential Rebates in 2004

Water Utility	Estimated Peak Savings (GPD)	Rebate Measures	Rain Sensor	Tune-Up Signed
City of Mercer Island	25		Rain Sensor	Yes
City of Mercer Island	100	Cons. Controller	Rain Sensor	Yes
City of Mercer Island Total	**125**			
Olympic View Water & Sewer District	25		Rain Sensor	Yes
Olympic View Water & Sewer District	75	Cons. Controller		Yes
Olympic View Water & Sewer District	100	Cons. Controller	Rain Sensor	Yes
Olympic View Water & Sewer Dist. Total	**200**			
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	25		Rain Sensor	Yes
Seattle Public Utilities	75	Cons. Controller		Yes
Seattle Public Utilities	75	Cons. Controller		Yes
Seattle Public Utilities	75	Cons. Controller		Yes
Seattle Public Utilities	75	Cons. Controller		Yes
Seattle Public Utilities	75	Cons. Controller		Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	100	Cons. Controller	Rain Sensor	Yes
Seattle Public Utilities	200	ET Controller	Rain Sensor	Yes
Seattle Public Utilities	200	ET Controller	Rain Sensor	Yes
Seattle Public Utilities	200	ET Controller	Rain Sensor	Yes
Seattle Public Utilities	200	ET Controller	Rain Sensor	Yes
Seattle Public Utilities	200	ET Controller	Rain Sensor	Yes
Seattle Public Utilities Total	**3,400**			

Water Utility	Estimated Peak Savings (GPD)	Rebate Measures	Rain Sensor	Tune-Up Signed
Shoreline Water District	200	ET Controller	Rain Sensor	Yes
Shoreline Water District Total	**200**			
Water District No. 20	200	ET Controller	Rain Sensor	Yes
Water District No. 20 Total	**200**			
Water District No. 90	100	Cons. Controller	Rain Sensor	Yes
Water District No. 90	100	Cons. Controller	Rain Sensor	Yes
Water District No. 90	100	Cons. Controller	Rain Sensor	Yes
Water District No. 90 Total	**300**			
Woodinville Water District	25		Rain Sensor	Yes
Woodinville Water District	25		Rain Sensor	Yes
Woodinville Water District	25		Rain Sensor	Yes
Woodinville Water District	25		Rain Sensor	Yes
Woodinville Water District	25		Rain Sensor	Yes
Woodinville Water District	75	Cons. Controller		Yes
Woodinville Water District	75	Cons. Controller		Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	100	Cons. Controller	Rain Sensor	Yes
Woodinville Water District	200	ET Controller	Rain Sensor	Yes
Woodinville Water District Total	**2,075**			

Table 21: NW Natural Yard Days Sales Data 2004

Sales Items	Store Sales 2001	2002 Event & Store Sales	2003 Event & Store Sales[1]	2004 In-Store Sales Only[2]	Percent Increase 2003-2004
Electric Mowers	447	1,966	1,812	1,486	-18
Push Mowers[3]	246	811	325	1,741	536
Weed Puller	1,027	2,189	2,296	2,678	17
Soaker Hoses	632	2,073	1,787	5,657	317
Insecticidal Soap	163	799	2,264	2,545	12
Water Timers	343	1,077	695	1,354	95
Bags of Compost[2]	14,496	41,039	81,651	94,318	15
Bags of Organic Fertilizer[2]	2,019	3,849	4,241	6,255	47
Overall Items Sold	**19,373**	**53,903**	**97,999**	**116,034**	**18**

Notes:

1 In 2003 and 2004 Northwest Natural Yard Days (NNYD) was a collaboration of the Saving Water Partnership, Seattle Public Utilities, King County Solid Waste, King County Hazardous Waste, the City of Tacoma, Puget Sound Clean Air Agency, Washington State Department of Ecology, Thurston County, and a number of suburban cities. In order to work more effectively with the "box stores", the promotion in those stores was extended to their Western Washington marketing areas, from Bellingham to Olympia. The sales figures listed in the 2003 1% Program Annual Report are from the larger, Western Washington area. The 2003 and 2004 sales figures reported above are from the Seattle/King County/Tacoma area.

2 In 2003 natural yard care products were promoted in the month of April. In 2004 the promotion ran through April and May. In addition, a promotion of compost and organic fertilizer took place in September 2004. 2004 sales, above, aggregate those three months.

3 Home Depot and Lowe's did not discount push mowers in 2003. Lowe's did sell 302 push mowers in 2003 (not included in the 325 listed above).

Table 22: Water Efficient Irrigation Commercial Audits in 2004

Utility	Name of Business/Company	Facility Name
Cedar River Water & Sewer District	City of Maple Valley Parks	Take-a-Break Park
Cedar River Water & Sewer District	Lake Wilderness Arboretum	Lake Wilderness Arboretum
Cedar River Water & Sewer District	Tahoma School District	Tahoma Junior High School
Cedar River Water & Sewer District	Senior Care Services	Fountain Court Assisted Living
Cedar River Water & Sewer District	Trammell Crow Residential	Pebble Cove Apartments
Cedar River Water & Sewer District	Fairway Village Condominium Association	Fairway Village Condominiums
City of Bothell	Seattle Times	Seattle Times, Bothell
City of Bothell	CWD Management Group	Riverfront Landing B & C
City of Bothell	Archstone Communities	Canyon Creek
City of Bothell	Allied Group	Heritage Park Apartments
Highline Water District	City of SeaTac	Valley Ridge Park
Highline Water District	City of Des Moines Parks	S J Underwood Park
Highline Water District	Allied Group	Windsor Heights Apartments
Highline Water District	Highline Water District Offices	Highline Water District Offices
Northshore Utility District	Saratoga Capital	Willow Glen Apartments
Seattle Public Utilities	Nitze-Stagen & Co, Inc	Lander Station
Seattle Public Utilities	Nitze-Stagen & Co, Inc	Starbucks Center
Seattle Public Utilities	Nitze-Stagen & Co, Inc	Frye Commerce Center
Seattle Public Utilities	Royal Richmond Condominium Assoication	Royal Richmond Condominiums
Seattle Public Utilities	City of Seattle Parks and Recreation	Judkins Park/Playfield (CE)
Seattle Public Utilities	Providence Mount Saint Vincent	Providence Mount Saint Vincent
Seattle Public Utilities	Northwest Hospital	Northwest Hospital
Seattle Public Utilities	Seattle Tennis Club	Seattle Tennis Club
Seattle Public Utilities	Capitol Hill Housing Improvement Program	Burke Gilman Gardens
Seattle Public Utilities	Indigo Real Estate	Shorewood Heights Apartments
Seattle Public Utilities	Seattle Conservation Corps	Terminal 18 Landscaping
Seattle Public Utilities	Lorig Management Services	Nordheim Court
Seattle Public Utilities	Lorig Management Services	Radford Court
Seattle Public Utilities	S-J Management LLC	Club at Bitterlake Apartments
Seattle Public Utilities	S-J Management LLC	Westhaven Apartments
Seattle Public Utilities	Historic Seattle	Good Shepherd Center
Soos Creek Water & Sewer District	Prometheus Properties	Mission Ridge Apartments
Water District No. 125	Allied Group	Empire Terrace Apartments
Water District No. 20	Kennedy High School	Kennedy High School
Woodinville Water District	SUHRCO Residential Properties	Redwood Village
Woodinville Water District	Fairfield Properties	Cascade Pines

Table 23: Water Efficient Irrigation Commercial Incentives in 2004

Utility	Business/Company	Facility Name	Estimated Peak Savings (GPD)	Install Rain Sensor	Irrigation Scheduling	Irrigation System Performance
City of Mercer Island	J.A.R. Investments	Lighthouse Properties	100	Yes	Yes	
Seattle Public Utilities	CondoManagements, Inc	Bay Villa HOA	25	Yes		
Seattle Public Utilities	Council House	Council House	75		Yes	Yes
Seattle Public Utilities	Maf-Jo Investments	Maf-Jo	100	Yes	Yes	Yes
Seattle Public Utilities	Arboretum Owner's Association	Arboretum Place Condos	100	Yes		Yes
Soos Creek Water & Sewer District	Euro Institute	Euro Institute	75		Yes	Yes

Table 24: Water Smart Technology Incentives in 2004

Utility	Business/Company	Facility Name	Final Peak Savings (GPD)	Measure Group Type
City of Bothell	Power Cleaners, Inc	Laundry Basket, The	144	Laundry Systems
City of Bothell	Ivar's Inc.	Ivar's Seafood Bar Bothell	510	Cooling/Refrigeration/Ice
Highline Water District	Highline School District 401	Chinook Middle School	1289	Bathroom
Highline Water District	Highline School District 401	Southern Heights	1115	Bathroom
Highline Water District	Highline School District 401	Olympic Elementary School	1263	Bathroom
Highline Water District	Highline School District 401	McMicken Heights Elementary	1219	Bathroom
Highline Water District	Highline School District 401	Manhattan Learning Center	1332	Bathroom
Highline Water District	Bright & Bold LLC	Orchard Plaza Maytag Inc.	1584	Washers
Water District No. 90	CKR Renton Retail Project	Hop In Grocery	5065	Custom Projects
Northshore Utility District	Frosty's Restaurant	Frosty's Restaurant	300	Cooling/Refrigeration/Ice
Seattle Public Utilities	Roosevelt Hotel	Roosevelt Hotel	1510	Bathroom
Seattle Public Utilities	Children's Hosp & Med Center	Children's Hosp & Med Center	11520	Custom Projects
Seattle Public Utilities	Children's Hosp & Med Center	Children's Hosp & Med Center	10000	Custom Projects
Seattle Public Utilities	Beso del Sol	Beso del Sol	800	Cooling/Refrigeration/Ice
Seattle Public Utilities	Virginia Mason Medical Center	Virginia Mason Medical Center	19400	Custom Projects
Seattle Public Utilities	University of Washington	UW - Multi-facility	31880	Bathroom
Seattle Public Utilities	University of Washington	UW - Multi-facility	12125	Custom Projects
Seattle Public Utilities	University of Washington	Haggett Hall Dormitory	7897	Cooling/Refrigeration/Ice
Seattle Public Utilities	University of Washington	Haggett Hall Dormitory	2660	Bathroom
Seattle Public Utilities	University of Washington	UW Medical Center	2437	Custom Projects
Seattle Public Utilities	University of Washington	Johnson Hall	8500	Cooling/Refrigeration/Ice
Seattle Public Utilities	UW Consolidated Laundry	UW Consolidated Laundry	45041	Laundry Systems
Seattle Public Utilities	Starwood Hotels & Resorts	Westin Hotel	6041	Bathroom
Seattle Public Utilities	Kidd Valley Restaurant	Kidd Valley Restaurant	300	Cooling/Refrigeration/Ice
Seattle Public Utilities	Seattle University	SU - Multi-facility	1071	Bathroom
Seattle Public Utilities	Seattle University	SU - Multi-facility	2575	Bathroom
Seattle Public Utilities	Highline School District 401	Cascade Middle School	1088	Bathroom

Utility	Business/Company	Facility Name	Final Peak Savings (GPD)	Measure Group Type
Seattle Public Utilities	Highline School District 401	Evergreen High School	3885	Bathroom
Seattle Public Utilities	Lorig Management Services	Hawthorne Hills Professional Center	245	Bathroom
Seattle Public Utilities	Market Place Offices	Market Place Offices	2000	Bathroom
Seattle Public Utilities	Port of Seattle	Seattle-Tacoma International Airport	70970	Bathroom
Seattle Public Utilities	Seattle Children's Home	Seattle Children's Home	2553	Cooling/Refrigeration/Ice
Seattle Public Utilities	Nitze-Stagen & Co, Inc	Starbucks Center	2160	Cooling/Refrigeration/Ice
Seattle Public Utilities	MacDonald Meat Company, LLC	MacDonald Meat Company	550	Custom Projects
Seattle Public Utilities	Al - Dearl Investment	Varons Building	70	Bathroom
Seattle Public Utilities	John Bennett	Ace Building	40	Bathroom
Seattle Public Utilities	John Bennett	Yi Building	60	Bathroom
Seattle Public Utilities	John Bennett	O'Neil Building	50	Bathroom
Seattle Public Utilities	John Bennett	Ritz Building	75	Bathroom
Seattle Public Utilities	John Bennett	Boysen Building	40	Bathroom
Seattle Public Utilities	John Bennett	Seaway Building	80	Bathroom
Seattle Public Utilities	John Bennett	Jukebox City Building	80	Bathroom
Seattle Public Utilities	North Seattle Dental	North Seattle Dental	40	Bathroom
Seattle Public Utilities	Park 90/5	Park 90-5 Police Support Facility	3387	Custom Projects
Seattle Public Utilities	Equity Office Properties	1100 2nd Ave Bldg.	814	Cooling/Refrigeration/Ice
Seattle Public Utilities	Prudential Signature Properties	Chardon Building	50	Bathroom
Seattle Public Utilities	Aurora Veterinary Hospital	Aurora Veterinary Hospital	113	Bathroom
Seattle Public Utilities	Chinatown Market Corp.	Chinatown Market	7500	Cooling/Refrigeration/Ice
Seattle Public Utilities	Ballard Baptist Church	Ballard Baptist Church	120	Bathroom
Seattle Public Utilities	Women's University Club	Women's University Club	1000	Custom Projects

Utility	Business/Company	Facility Name	Final Peak Savings (GPD)	Measure Group Type
Seattle Public Utilities	Kress Building	Kress Building	100	Bathroom
Seattle Public Utilities	Providence Mount Saint Vincent	Providence Mount Saint Vincent	4800	Laundry Systems
Seattle Public Utilities	Port of Seattle	Port of Seattle Maintenance Shop	1755	Cooling/Refrigeration/Ice
Seattle Public Utilities	O.S.F. International, Inc.	Old Spaghetti Factory	2000	Cooling/Refrigeration/Ice
Seattle Public Utilities	Tropic Isle, Inc.	The Islander Restaruant & Tiki Lounge	1500	Custom Projects
Seattle Public Utilities	Washington Biomedical Research Properties I	UW Medicine Lake Union @ 815 Mercer	360	Bathroom
Seattle Public Utilities	CC Slaughters North Ltd	CC Attles	750	Cooling/Refrigeration/Ice
Seattle Public Utilities	Julia's in Wallingford, Inc	Julia's in Wallingford	400	Cooling/Refrigeration/Ice
Seattle Public Utilities	Pig Iron Barbeque	Pig Iron Barbeque	200	Cooling/Refrigeration/Ice
Seattle Public Utilities	Seattle Surgery Center	Seattle Surgery Center	5000	Custom Projects
Seattle Public Utilities	Chinese Evangelical Church	Chinese Evangelical Church	200	Bathroom
Seattle Public Utilities	The Polyclinic	The Polyclinic	2500	Custom Projects
Seattle Public Utilities	Soules Properties	4301 Building	40	Bathroom
Seattle Public Utilities	Soules Properties	3212 Building	180	Bathroom
Soos Creek Water & Sewer District	Le Cruz Construction Company Inc.	H. P. Car Wash	2360	Custom Projects
Water District No. 125	King County - Metro Facilities	South Base Complex	5026	Custom Projects
Water District No. 20	Highline School District 401	Beverly Park @ Glendale Elementary	1663	Bathroom
Water District No. 20	Highline School District 401	Salmon Creek Elementary	863	Bathroom
Water District No. 49	Highline Community Hospital	Highline Community Hospital	7500	Custom Projects
Water District No. 49	Highline School District 401	Sylvestor Middle School	1331	Bathroom
Water District No. 49	Burien 76	Burien 76	2475	Custom Projects

Select Commercial Project Descriptions

Steam Sterilizer Water Conservation Kits - Six Locations

This project involved installation of water conserving trap cooling kits on older steam sterilizers in area hospitals and laboratories. These older sterilizers typically have a one to two gallons per minute (gpm) continuous flow of cold water going down the drain whenever the sterilizer is operational (often 24/7 in the case of hospitals) to ensure the temperature in the drain line remains below 140F. Installation of a kit incorporating a temperature sensor in the drain line can save approximately 90% of the water previously used. During 2004 the Water Smart Technology Program provided incentives for installation of 33 kits at six facilities including at two Highline Hospital locations (Water District 20 & Water District 49), Children's Hospital (Seattle), Virginia Mason Hospital (Seattle), Seattle Surgery Center (Seattle), and Polyclinic (Seattle). Total savings from these installations is estimated at approximately 45,000 GPD of peak season savings, or 22,000 CCF annually.

University of Washington Laundry – Water Recycling System

The University of Washington Consolidated Laundry (UWCL) performs complete laundry service for the UW Medical Center, other campus operations, and outside contracts. The quantity of goods processed is approximately 10 to 12 million pounds per year. Laundry operations by their nature consume significant quantities of water, electric, and natural gas resources. UWCL currently operates with two high-efficiency tunnel washers along with multiple washer extractors. Water use efficiency was about 2.5 gallons of water used per pound of laundered goods. The proposed water filtration/recycling system allowed UWCL to, cost effectively, reach close to the highest level of efficiency attainable with existing filtration technology. Successful implementation of this technology will become a case study for other large laundry facilities, demonstrating state of the art water efficiency.

Hop-in Grocery Car Wash – Water District 90 – Water Reclaim System

This project involved the installation of a car wash water reclaim system. This new construction project included a convenience store, gas station, retail center, and car wash. Savings were calculated when the new car wash facility was brought on line, by closely monitoring the numbers to verify car wash performance with both reclaim and no reclaim and number of daily washes.

HP Car Wash – Soos Creek Water & Sewer District – Water Reclaim System

The existing car wash facility consists of a touch-free station and four self-serve stations. A data-logger was installed to track water consumption in the car wash. This water reclaim project was undertaken as a pilot and research project. There were two main reasons for proceeding with this project:

- This is largely a self-serve facility. This was the first self-serve facility to install a reclaim system in the Saving Water Partnership service area and represents, if successful, the opportunity for water savings previously considered unobtainable.
- This is a relatively new technology to the United States and has the potential for significant market penetration due to its design utilizing aerobic bacteria in the water purification process, without the typical filtration and ozonation. No other systems of this type will be authorized until a thorough study of this system is completed.

Westin Hotel – Seattle – Toilet Replacement

The Westin Hotel will be retrofitting all their guestroom toilets in two phases, which will coincide with the hotel design of two distinctive circular towers. The South Tower was retrofitted in 2004, and the North Tower will follow in 2005. The Westin Hotel has undergone extensive analysis as part of the 2001 Hotel Demonstration Project and the toilet flush volume was thoroughly documented at 3.5 and 5 gallons per flush in the North and South Towers respectively. Significant toilet leaking was also discovered by submetering plumbing risers throughout the building. While this may not be a current issue, water savings as estimated in the hotel report for just the replacement toilets were up to 12,500 gallons per day (gpd) of peak season savings.

Seattle Police Department – Water Reuse

This was a City of Seattle project subject to and constructed under the City Leadership in Energy and Environmental Design (LEED) Policy for sustainability. The project involved a complete renovation of a building formerly occupied by Starbucks, into a facility that houses many City of Seattle Police functions; including photo lab, evidence holding, motorcycle patrols, and parking enforcement. The facility also offers police training room facilities, locker rooms, exercise equipment, and office space for high-ranking members.

The water conservation project made use of an opportunity to incorporate on-site drainage and stormwater management with domestic and landscape end uses not requiring potable water. This site has high groundwater levels that necessitate pumping water to the combined sewer system. The flow of water pumped varies from six to 60 gpm, but is continuous under all conditions and seasons. The project utilized this available water for on-site toilet flushing, vehicle washing, and landscape irrigation. Use of potable water supplied by the city was reduced significantly as estimated by the project mechanical design engineer.

Children's Hospital – Air Compressor

This project involved replacement of a water-cooled air compressor that provides medical air, is part of the fire suppression system, and air for pneumatic controls. The new system was all air-cooled and segregated systems. SPU performed one week of metering, which essentially validated water use by the air compressor system as reported in the water audit report. This project saved over 11,000 gpd of peak season savings. In addition, substantial energy savings also resulted, as the selected equipment was much more efficient than the equipment that was replaced.

King County-Metro Bus Maintenance Facility – WD #125 – Air Compressors

This project involved the replacement of two water-cooled air compressors with two air-cooled air compressors. The subject site is a KC-Metro bus maintenance facility and is located in the Water District #125 service area. Sub metering by motor loggers and point of discharge water meters was completed on both compressors. Over 5,000 gpd of peak season savings resulted from this project.

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Saving Water Partnership
www.savingwater.org
(206) 684-SAVE

Cedar River Water & Sewer District
City of Bothell
City of Duvall
City of Mercer Island
Coal Creek Utility District
Highline Water District
Northshore Utility District
Olympic View Water & Sewer District
Seattle Public Utilities
Shoreline Water District
Soos Creek Water & Sewer District
Water District No. 20
Water District No. 45
Water District No. 49
Water District No. 90
Water District No. 119
Water District No. 125
Woodinville Water District

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SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

I. WATER RESOURCES

APPENDIX C
WATER RIGHTS EVALUATION

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Seattle Public Utilities
Water Rights Evaluation
June 2006

1. Introduction

Seattle currently utilizes surface water from the Cedar River and the South Fork Tolt River, and ground water from the Seattle Well Fields. The City holds various water rights for use of water from these sources. Also, the City has water rights applications on file with Ecology for potential future sources of supply. These sources include the North Fork Tolt River, the Snoqualmie Aquifer, and additional yield from the Seattle Well Fields. This appendix provides a description of these water rights and applications, and with Tables 1 through 3, provides the evaluation of water right adequacy outlined in the DOH planning guidelines.

2. Changes from 2001 WSP

Several significant events related to water rights have occurred since the 2001 Water System Plan:

- Through this Water System Plan, SPU is seeking to replace its place of use for the Cedar River and Lake Youngs claims to be the service area described in this plan as allowed by the 2003 Municipal Water Law.
- Ecology granted a certificate for the South Fork Tolt Reservoir on January 17, 2003, which establishes Seattle's right to store water at the reservoir.
- Seattle applied for a reservoir permit in June 2005 for the Aquifer Storage and Recovery (ASR) project at its two well fields and permits for use of the wells to replace its temporary permits.
- Ecology granted a 27-year extension to the City's diversion permit for the South Fork Tolt River on November 30, 2005.

3. Cedar River Supply System

The City relies on a combination of documented water right claims and permits for the Cedar River water supply system which allow for:

- Storage of water behind Masonry Dam
- Diversion of water from Chester Morse Lake and the Cedar River at the Landsburg Diversion Dam for municipal and industrial (M&I) use;
- Storage of water in Lake Youngs for M&I use;
- Pumping from the dead storage of Chester Morse Lake for M&I use;
- Diversion of water at Landsburg for use as recharge water for the Seattle Well Fields ASR Project; and
- Diversion of water from the Masonry Pool for the Sallal Pipeline.

Claim No. 068624 – Cedar River Storage and Diversion. In 1974, the City documented its pre-existing water claim for storage of up to 160,000 acre-feet, and diversion of up to 465 cfs (300 MGD) of Cedar River water. The claim has not been subjected to an adjudication process. Storage is accomplished by impounding water behind the Masonry Dam, located at river mile 35.6 in the municipal watershed approximately 30 miles east of Seattle. Water is released from storage either through valves and gates located on the dam, or through penstocks leading to the Cedar Falls Hydroelectric Plant. Flows used for power generation are returned to the river approximately 2 miles downstream of Masonry Dam. The City holds a water right certificate to use this water for power generation by Seattle City Light. Diversion of water for M&I purposes currently occurs at the Landsburg Diversion Dam, at river mile 21.9, and at the Masonry Dam for the Sallal Pipeline.

Through its Cedar River Watershed HCP, the City guaranteed instream flows in the river below Landsburg. As an additional part of the HCP commitments, the City dedicated one-third of this claim to instream flows for the 50-year duration of the HCP. This commits the City to keeping diversions below 200 MGD on an average annual basis (historic highest annual average diversion was about 144 MGD, while current use is around 100 MGD).

Subsequent to adoption of the HCP, the City has agreed to further limits on its annual diversions, in a comprehensive settlement agreement with the Muckleshoot Indian Tribe regarding the Cedar River Municipal Watershed. The City has agreed to dedicate that portion of its water right above 124 MGD to instream flows and to limit its annual diversions from the Cedar River, in perpetuity, to no more than 124 MGD in any single calendar year. Further, beginning in 2051, the City's annual diversions shall not exceed 114 MGD calculated on a 10-year rolling average.

The City has agreed to temporary limits on its annual diversions as follows:

> From the time the settlement agreement is approved by the federal court through December 31, 2020, the City's annual average diversions shall not exceed 105 MGD in any calendar year.
>
> From January 1, 2021 through December 31, 2030, the City's annual average diversions shall not exceed 110 MGD in any calendar year.
>
> From January 1, 2031 through December 31, 2050, the City's annual average diversions shall not exceed 110 MGD, calculated on a 10-year rolling average (and cannot exceed 124 MGD in any calendar year).

Claim No. 068623 – Lake Youngs Storage. Water diverted from the Cedar River at Landsburg enters a 10-mile long conveyance and is discharged into Lake Youngs for subsequent treatment and delivery to the transmission system. In 1974, the City documented its pre-existing water claim for storage of up to 33,770 acre-feet of Cedar River water in Lake Youngs. The claim has not been subjected to an adjudication process. The place of use for this claim is the same as for the Cedar River Claim No. 068624, described above.

Permit No. S1-25929 – Chester Morse Lake Pumping Plants. A substantial quantity of water in Chester Morse Lake is in "dead storage", water stored below the historic

natural lake outlet and reserved for use during drought emergencies. The City has two barge-mounted pumping plants on the lake to access dead storage during drought emergencies. Because natural infilling of the outlet channel has reduced the gravity flow capacity of the channel, the plants can also be used to augment gravity flow during normal supply conditions before dead storage is tapped. Each plant has the capacity to pump up to 120 MGD of high quality water from Chester Morse Lake into Masonry Pool, where it is released for downstream uses (instream flows and M&I supply). Although the City believes the Cedar Claim covers use of the plants, Ecology required a separate permit, and issued a 15-year water right permit in 1992 with a Qi of 252 MGD. The permit is conditioned on the instream flows measured at Renton established in 1979 and codified in WAC 173-508. These differ from the instream flow requirements later adopted in the HCP, which would cause operational difficulties if both criteria needed to be met. The City is discussing ways to resolve this and other issues regarding use of the pumping plants with Ecology and other stakeholders. As a term permit, the current permit will not progress to certificate, but time extensions are allowed.

Permit No. S1-25330P – Aquifer Recharge Water. Development work on the well fields included an ASR demonstration project. Although the City believes the Cedar Claim covers using Cedar water for recharge, Ecology required a separate diversion permit for the demonstration project and any later recharge. A temporary permit was granted in August 1988 to divert up to 10 cubic feet per second of water from the Cedar River at Landsburg until completion of the demonstration project, at the time estimated to be in 1995. Ecology has since granted several short-term extensions, with the expiration date currently being February 22, 2007. The right is junior to minimum instream flow requirements set by the State in 1979, and diversion may take place only during the months of October through May.

After Ecology adopted a rule on ASR's in 2003, Seattle submitted an application for its project in June 2005 (discussed below), and included the observation that:

> *"With the ASR rule identifying a water claim as a legitimate source of recharge, and Ecology's ability to incorporate conditions like instream flows into the ASR reservoir permit itself, the 10 CFS permit will become superfluous. After Ecology issues the ASR reservoir permit, it should no longer require the 10 CFS permit for operation of the ASR project."*

4. South Fork Tolt River Supply System

The City has two separate water rights that pertain to the South Fork Tolt River water supply system which allow for:

- Storage of water in the South Fork Tolt Reservoir for M&I and hydropower use.
- Diversion of water at the South Fork Tolt Dam for M&I and hydropower use.

These water rights are described as follows:

Permit No. R-206 – South Fork Tolt Reservoir Storage. The City was originally issued a water right permit in 1957 to store up to 57,830 acre-feet of water in the South Fork Tolt Reservoir. Ecology issued a Certificate for the Reservoir on January 17, 2003.

Permit No. 10602 – South Fork Tolt Diversion. The City was originally issued a water right permit in 1957 to divert up to 181 MGD (Qi) and 168,000 acre feet annually at the South Fork Tolt Dam. A superseding permit was issued in 1997 adding hydropower as a permitted use, in addition to M&I. Addition of the hydropower facility to the South Fork Tolt system led to licensing under the FERC. The superseding water right permit is conditioned on the conditions of the FERC Project No. 2959 Settlement Agreement, including instream flows. In November 2000, the City documented the full use of the Qi allowed by the permit. On November 2, 2005, The City requested a 50-year extension to this permit, and Ecology granted a 27-year extension to November 30, 2032.

5. Seattle's Well Fields

The water rights for Seattle's Well Fields have remained in a preliminary status, even though development of the fields began in the early 1980's and production from the wells began in 1988. Currently, the water rights consist of a temporary permit for 4000 gpm at each well field. Because ASR was an integral part of the development, Ecology preferred to delay making final water rights decisions regarding the wells until promulgation of a rule on ASR, which did not happen until 2003. With its ASR application in June 2005, the City requested specific actions on well field rights, including:

- An ASR Reservoir permit for 1500 acre-feet.
- Riverton Well Field – a permit for Q_i of 6300 gpm based on temporary permit G1-24621 and application G1-24824.
- Boulevard Park Well Field – a permit for Q_i of 2900 gpm based on temporary permit G1-24619 and application G1-24825.
- Removal of the requirement for a separate permit to divert water from the Cedar for recharge, as discussed above under Cedar rights.

Temporary Permit Nos. G1-24619 and G1-24621– Boulevard Park and Riverton Well Fields. In an aquifer located immediately north of SeaTac Airport, the City currently operates three water supply wells with a combined capacity of approximately 10 MGD. Two wells are located near the City's Riverton Heights Reservoir in what is referred to as the Riverton Well Field, and draw water from a depth of about 330 feet. The Boulevard Park Well Field, currently with a single well, is located approximately one mile north of Riverton, and draws water from a depth of about 250 feet. Seattle submitted permit applications for the two fields in 1985, and Ecology issued temporary permits for pumping 4000 gpm at each well field in 1987.

Application Nos. G1-24824 and G1-24825 – Outstanding Well Field Applications. In anticipation of being able to develop more than 4000 gpm production capacity at each of the well fields, the City submitted applications for 4000 gpm of additional water rights at each well field in 1986.

Application No. R1-28168 – Seattle Well Fields ASR Project. Development of the well fields included a successful ASR demonstration project. Until Ecology promulgated an ASR permit rule in 2003, there was no mechanism for obtaining a reservoir permit for the project. As noted above, the City submitted an application for a 1500 acre-foot reservoir permit in June 2005.

6. Potential Future Water Supply Sources

Application No. S-4254 – North Fork Tolt River Diversion. The North Fork Tolt Diversion is a future water supply source option for Seattle and the region that has been identified in the past as a water supply option. Seattle filed a water rights application in 1936 for an instantaneous flow of 181 MGD, and an annual maximum volume of 203,000 acre feet. Seattle has requested processing of the application be held in abeyance for the time being, and Ecology has not processed this application to date.

Application No. G1-24620 – Possible Non-Potable Well at Glacier. In addition to the three water supply wells the City operates at its well fields, a production well at the nearby Glacier site was completed in 1986. It draws water from the deep aquifer at a depth of about 550 feet. Tests of the well indicated that the sustainable production rate over the planned use period would be about 700 to 900 gallons per minute. Water quality concerns, specifically the presence of hydrogen sulfide, led the City to abandon plans to develop this well as a potable supply.

Application Nos. G1-27384 and S1-27877 – Snoqualmie Aquifer Project. Study of the Snoqualmie Aquifer Project has been in progress since 1992 under the sponsorship of the East King County Regional Water Association (EKCRWA). Seattle is a partner in the project, and is a co-applicant with EKCRWA in the water rights process. As originally conceptualized, the project was to be developed as a conventional ground water supply. However, in late 1997, an alternative was proposed involving the conjunctive use of surface water and ground water.

A joint water right application (G1-27384) was filed with Ecology by EKCRWA and Seattle on January 19, 1994, to withdraw 60 MGD from the Upper Snoqualmie basin. This is equivalent to 92 cubic feet per second (cfs), or 67,200 acre-feet per year (AF/y).

The change in concept necessitated that an application be filed with Ecology for a surface water right. The surface right application (S1-22877) was submitted by EKCRWA and was assigned a priority date of January 29, 1998. The applicants are requesting a withdrawal of not more than 100 cfs for a regional water supply. The maximum quantity to be used annually is 72,000 acre-feet (AF/y).

Water Rights Evaluation
Table 1 - Existing Water Rights Status

Permit Certificate or Claim #	Name of Rightholder or Claimant	Priority Date	Source Name/ Number	Primary or Supplemental	Existing Water Rights		Existing Consumption		Current Water Right Status Excess (positive)/Deficiency (negative)	
					Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Certificates										
1. R-206	City of Seattle Water Department	7/14/1936	South Fork Tolt Reservoir	Primary	N/A	Storage 57,830 acre feet	N/A	Storage 57,830 acre feet	N/A	Storage 0 acre feet
Permits										
1. S1-25929	City of Seattle Water Department	8/17/1990	Cedar River: Temporary Pumping Plant	Supplemental (Term Permit)	390 cfs (252 mgd)	N/A Note 1				
2. S1-25330P	City of Seattle Water Department	8/22/1988	Cedar River: Aquifer Storage and Recovery (ASR)	Primary	10 cfs (6.5 MGD) (Oct thru May)	4,800 acre feet (1,564 mg)	3.5 cfs (2.3 MGD) Note 3	1,170 acre feet Note 2	6.5 cfs (4.2 MGD)	3,630 acre feet
3. 10602	City of Seattle Water Department	7/14/1936	South Fork Tolt Diversion	Primary	280 cfs (181 MGD)	168,000 acre feet (150 MGD)	263 cfs (170 MGD) Note 5	58,251 acre feet (52 MGD) Note 4	17 cfs (11 MGD)	109,749 acre feet
Temporary Permits										
1. G1-24619	City of Seattle Water Department	3/7/1985	Boulevard Park Well Field	Primary	4000 gpm (5.8 MGD)	To be determined Note 6	2,900 gpm (4.18 MGD) Note 7	764 acre feet Note 8	1,110 gpm (1.6 MGD)	To be determined
2. G1-24621	City of Seattle Water Department	3/7/1985	Riverton Well Field	Primary	4000 gpm (5.8 MGD)	To be determined Note 9	6,300 gpm (9.07 MGD) Note 10	2,422 acre feet Note 11	-2,292 gpm (-3.3 MGD) Note 12	To be determined
Claims										
1. 068624	City of Seattle Water Department	1888	Cedar River and Chester Morse Lake	Primary	Note 17	336,650 acre feet (300 MGD) Note 13	350 cfs (226 MGD) Note 14	161,312 acre feet (144 MGD) Note 15	115 cfs (74 MGD)	175,338 acre feet (156 MGD) Note 13
2. 068623	City of Seattle Water Department	1926	Lake Youngs	Primary	N/A	Storage 33,770 acre feet	N/A	Storage 33,770 acre feet	N/A	Storage 0 acre feet
Interties - Note 18										
TOTAL - Note 16	*********	*****	*******	**********	Note 17	504,650 acre feet (450 MGD)	638 cfs (412 MGD) Note 16	222,749 acre feet (199 MGD) Note 16	Note 17	281,901 acre feet (251 MGD)

Notes:

1. Not included in water rights calculations; pumping plants operated only for testing or under conditions of extreme drought.
2. Maximum volume recharged to date: January 1993 to May 1993 during demonstration project; recharge period is October through May.
3. Per Integrated Water Resource Management System (IWRMS) average rate over 24 hours recorded 1/3/95.
4. Tolt Pipeline 24-hour volumes from IWRMS (1985-1999); highest occurred in 1994.
5. Flow diverted from South Fork Tolt River and measured by Seattle City Light at powerhouse on 6/3/1996.
6. With June 2005 ASR application, City requested Qi of 2900 and Qa of 1200 acre-feet at Boulevard Well Field, based on this permit and application G1-24825
7. Per Seattle Well Field, O&M Manual; Maximum range of normal operations.
8. Maximum well field use occurred between June and December 1992.
9. With June 2005 ASR application, City requested Qi of 6300 and Qa of 3200 acre-feet at Riverton Well Field, based on this permit and application G1-24824
10. Per Seattle Well Field, O&M Manual; Maximum range of normal operations.
11. Maximum well field use occurred between June and December 1992.
12. The installed pumping capacity exceeds the Qi specified in the existing temporary permit.
13. Agreement with Muckleshoot Indian Tribe (MIT) (June 2006) limits average annual diversion from Cedar to 105 MGD until 2020, 110 MGD from 2021 to 2030, and 124 MGD beginning in 2031.
14. Per IWRMS data 226 mgd was recorded 6/23/96 (7:00 am reading).
15. Landsburg diversion calendar year 1990: 144 mgd, 52,560 mg, 161,312 ac-ft.
16. Peak instantaneous and peak annual demand occurred at different times on individual sources, so sums do not represent system wide peaks. Emergency source, ASR recharge water diversion, and storage not included.
17. Cedar Claim and MIT agreement do not specify a Qi.
18. SPU does not use interties as a normal supply source

Wate Rights Evaluation
Table 2 - Pending Water Rights Status

Water Right Application	Name on Permit	Date Submitted	Source Name	Primary or Supplemental	Pending Water Rights	
					Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested
1. S-4254	City of Seattle Water Department	Filing date 07/14/36 being held in abeyance	North Fork Tolt River	Primary	280 cfs (181 MGD)	203,000 acre-feet
2. Gl-24620	East King County Regional Water Association and City of Seattle Water Department	1/19/1994	Snoqualmie Aquifer	Primary	41,600 gpm (60 MGD)	To be determined
3. S1-27877	East King County Regional Water Association and City of Seattle Public Utilities	1/29/1998	Snoqualmie River	Primary	100 cfs (65 MGD)	To be determined
4. G1-24620	City of Seattle Water Department	3/7/1985	Glacier Well	Irrigation or other non-potable use only	To be determined	To be determined
5. G1-24824 (Note 1)	City of Seattle Water Department	4/14/1986	Riverton Well Field: (Note 3)	Primary	4000 gpm (5.8 MGD)	To be determined
6. G1-24825 (Note 2)	City of Seattle Water Department	4/14/1986	Boulevard Park Well Field (Note 3)	Primary	4000 gpm (5.8 MGD)	To be determined
7. R1-28168	City of Seattle	6/29/2005	Seattle Well Fields ASR (Note 3)	Primary	N/A	1500 acre-feet

Notes:

1. With June 2005 ASR application, City requested Qi of 6300 and Qa of 3200 acre-feet at Riverton Well Field, based on this application and temporary permit G1-24621
2. With June 2005 ASR application, City requested Qi of 2900 and Qa of 1200 acre-feet at Boulevard Well Field, based on this application and temporary permit G1-24619
3. Since the last WSP update, the Highline Well Field has been renamed Seattle Well Fields (Riverton Well Field and Boulevard Park Well Field)

June 2006

Water Rights Evaluation
Table 3 - Projected Water Rights Status

Permit Certificate or Claim #	Name of Rightholder or Claimant	Priority Date	Source Name/ Number	Primary or Supplemental	Existing Water Rights		Forecast Water Demand for 2030		Forecast 2030 Water Right Status Excess (+) / Deficiency (-)	
					Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Certificates										
1. R-206	City of Seattle Water Department	7/14/1936	South Fork Tolt Reservoir	Primary	N/A	Storage 57,830 acre feet				
Permits										
1. S1-25929	City of Seattle Water Department	8/17/1990	Cedar River: Temporary Pumping Plant	Supplemental (Term Permit)	390 cfs (252 mgd)	N/A Note 1				
2. S1-25330P	City of Seattle Water Department	8/22/1988	Cedar River: Aquifer Storage and Recovery (ASR)	Primary	10 cfs (6.5 MGD) (Oct to May)	4,800 acre feet (1,564 mg)				
3. 10602	City of Seattle Water Department	7/14/1936	South Fork Tolt Diversion	Primary	280 cfs (181 MGD)	168,000 acre feet (150 MGD)				
Temporary Permits										
1. G1-24619	City of Seattle Water Department	3/7/1985	Boulevard Park Well Field	Primary	To be Determined - Note 2					
2. G1-24621	City of Seattle Water Department	3/7/1985	Riverton Well Field	Primary	To be Determined - Note 3					
Claims										
1. 068624	City of Seattle Water Department	1888	Cedar River and Chester Morse Lake	Primary	Note 5	336,650 acre feet (300 MGD) Note 4				
2. 068623	City of Seattle Water Department	1926	Lake Youngs	Primary	N/A	Storage 33,770 acre feet				
Interties - Note 7										
TOTAL - Note 8	*********	*****	*******	**********	Note 5	504,650 acre feet (450 MGD)	668 cfs - Note 6 (431 MGD)	144,800 acre feet (129 MGD)	Note 5	359,850 acre feet (321 MGD)

Notes:

1. Not included in water rights calculations; pumping plants operated only for testing or under conditions of extreme drought.
2. With June 2005 ASR application, City requested Qi of 2900 and Qa of 1200 acre-feet at Boulevard Well Field, based on this permit and application G1-24825
3, With June 2005 ASR application, City requested Qi of 6300 and Qa of 3200 acre-feet at Riverton Well Field, based on this permit and application G1-24824
4. Agreement with Muckleshoot Indian Tribe (June 2006) limits average annual diversion from Cedar to 105 MGD until 2020, 110 MGD from 2021 to 2030, and 124 MGD beginning in 2031.
5. Cedar Claim and MIT agreement do not specify a Qi.
6. Flow rate listed is maximum capacity of raw water pipelines.
7. SPU does not use, and does not project to use, interties for normal supply.
8. Emergency source, ASR recharge water diversion, and storage not included. Forecast demand not divided by source.

SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

I. WATER RESOURCES

APPENDIX D

WATER SHORTAGE CONTINGENCY PLAN

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SEATTLE PUBLIC UTILITIES

WATER SHORTAGE CONTINGENCY PLAN

July 2006

SUPPLEMENT TO THE SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

SEATTLE PUBLIC UTILITIES
WATER SHORTAGE CONTINGENCY PLAN
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SEATTLE PUBLIC UTILITIES
WATER SHORTAGE CONTINGENCY PLAN

SECTION I

INTRODUCTION

This plan provides guidelines for Seattle Public Utilities (SPU) to manage water supply and demand in the event of a supply problem. Such problems could include imminent supply disruptions resulting from a major pipeline failure as well as forecasted water supply shortages due to droughts. "Water shortage" as is discussed in this document means that SPU will not have the normal amount of water to provide to its customers. It is extremely improbable that SPU would ever run out of water. The stages noted in the plan will be implemented depending on the magnitude of the water shortage. This document supplements the *2007 Water System Plan*, and updates the April 2001 Water Shortage Contingency Plan (WSCP).

OBJECTIVE OF WSCP

The objective of the WSCP is to establish actions and procedures for managing water supply and demand during water shortages. The plan enables SPU to maintain essential public health and safety and minimize adverse impacts on economic activity, environmental resources and the region's lifestyle.

INTEGRATION INTO OTHER EMERGENCY PLANNING

A discussion of how SPU will respond to non-drought water emergencies, such as a major transmission pipeline break, is provided in Section 4 of this plan.

RELATIONSHIP TO WHOLESALE CUSTOMERS' WSCPS

There are approximately 1.45 million people living in the areas served by SPU and our wholesale water customers. SPU provides water to utilities in much of King County and a small part of Snohomish County. SPU has contracts with 21 wholesale customers, including the Cascade Water Alliance, which wholesales water to eight utilities in the region. Water supply disruptions affect Seattle, Seattle's wholesale customers, and their respective retail customers.

SPU's wholesale contracts include a provision that wholesale customers will assist and support emergency curtailment measures required to manage demand during an emergency or shortage. This plan has been developed by SPU, in consultation with its wholesale customers and other participants, based on the premise that an effective demand management strategy must be regionally consistent. This is based on several considerations:

- Public support and cooperation is likely to be higher if actions are equitable, i.e., all water users are experiencing the same service level and degree of hardship.

- A unified message and approach is easier to understand and distribute through the media, which is key in communicating information to the public.

- Consistency makes it easier for Seattle to forecast demand reductions, which is essential to effectively manage the system during a water shortage.

SECTION 2

OVERVIEW OF DROUGHT MANAGEMENT STRATEGY

This Water Shortage Contingency Plan focuses on weather-related water shortages – generally referred to as "droughts." Droughts are naturally occurring unpredictable weather events of varying frequency, duration and severity. In the region served by the Seattle Regional Water System, available data indicate a very low probability of a multi-year drought, but the region has experienced short-term droughts.

This region is generally faced with a relatively dry summer period. In the Seattle area, only about 5 of our 37 inches of annual precipitation fall during the summer months (based on National Weather Service data for 30-year average at SeaTac Airport). The Seattle Regional Water System operates with an annual refill and drawdown cycle of its water supply storage reservoirs. Highly unusual weather events affect this cycle and can cause water shortages.

TYPES OF DROUGHTS BY SEASON

The types of droughts that affect the Seattle Regional Water System range from poor snowpack accumulation in the winter to delayed onset of rains in the fall. Since the nature of these droughts varies, Seattle's response will also vary. The types of droughts the system has experienced can be categorized by season as follows:

Winter/Spring Drought

Low snowpack is the primary issue with winter/spring droughts. While a below normal snowpack may not lead to poor water supply conditions if ample spring rains occur, caution is used in managing the water supply in these situations because rainfall is inherently difficult to forecast. Below normal snowpack can occur during a winter when mountain temperatures are warm, when precipitation is below average, when intense rainfall events melt off low to mid-elevation snow cover, or through a combination of these factors. Tracking El Niño events, which are typified in the Pacific Northwest by warmer and drier than average winter conditions, can alert water managers to the increased potential of a winter/spring drought. Seattle's use of the dynamic rule curve – varying reservoir storage targets based on real-time snowpack measurements and soil moisture estimates – in these types of droughts helps to ensure that our reservoirs are as close to full as possible at the start of the summer drawdown cycle.

When winter/spring drought conditions result in low water supply availability, water use restrictions may need to be imposed because the potential for water use reductions by customers is greater in the spring and summer, there is much uncertainty about impending summer weather which is so influential on demand, and weather forecasts of when the fall rains will begin are not reliable. These conditions generate uncertainty about whether water stored in the spring will be sufficient to meet demands until supplies are replenished in the fall. This can make the imposition of water use restrictions in the

spring and summer necessary, despite the fact that in some years no water shortfall may ever really develop.

Summer/Fall Drought

In years in which reservoirs refill as normal in early summer, droughts can still develop over the summer and extend into the fall if summer demands are high and inflows to the reservoirs drop below normal levels for an extended period of time. These types of droughts require careful monitoring of summer demands and water supply. Unfortunately, it is not possible to accurately predict in advance the timing and amount of the fall rains. When these types of droughts become apparent, and are significant, Seattle will ask for curtailments and prepare to use emergency storage at Chester Morse Lake should it be needed later in the year (see below for details on the pumping plants at Chester Morse Lake).

Fall/Early Winter Drought

Fall is the time when demands for fish habitat needs are especially high and the ability for people to cut back on water is limited since little water is being used for landscape irrigation. These factors can make fall droughts particularly challenging. Droughts can occur in the fall, and extend into the early winter. When the normal rainy season develops later than normal, storage reservoirs can be depleted to minimum levels. For this reason, the emergency pumping plants at Chester Morse Lake are maintained and may be used if needed to allow use of "dead storage" below the lake's natural outlet. Other emergency supplies that may be activated in these types of droughts are discussed later in this WSCP.

Attachment A provides examples of past drought events that resulted in Seattle activating its Water Shortage Contingency Plan.

MANAGING INSTREAM FLOWS DURING WATER SHORTAGES

The management of stream flows downstream of Seattle's water storage and diversion facilities is a critical consideration in managing water resources during water shortages. In addition to meeting the needs of SPU's retail and wholesale customers, the Cedar and South Fork Tolt rivers are managed to protect instream resources. Seattle has ongoing formal and informal agreements with state, federal and local resource agencies, Indian Tribes and the U.S. Army Corps of Engineers that help guide how it manages streamflows. Streamflow management in the South Fork Tolt is governed by the South Fork Tolt River Settlement Agreement. Cedar River flows are governed by the Cedar River Instream Flow Agreement, a component of the Cedar River Watershed Habitat Conservation Plan (HCP). These agreements provide guaranteed flow regimes as well as adaptive features to ensure that water is released from Seattle's mountain storage reservoirs in a manner that provides beneficial conditions for salmon and other species downstream of the Seattle's reservoirs. During substantial portions of the year, total runoff into the Cedar River and South Fork Tolt basins can exceed the amount required to meet municipal demands and the guaranteed flow regime. This additional water is managed adaptively and in collaboration with the Cedar River Instream Flow

Commission and Tolt Fisheries Advisory Committee in an effort to further enhance conditions for instream resources. The protective provisions of the governing agreements are particularly important during droughts and associated periods of low stream flow.

The Cedar River also provides approximately half of the inflow to Lake Washington on an annual average basis. The U.S. Army Corps of Engineers manages Lake Washington lake levels as part of its Lake Washington Ship Canal Project (Hiram Chittenden Locks in Ballard) which connects Lake Washington to the saltwater of Puget Sound. Their management objectives include providing water flows at the Locks for navigation, fish passage, and control of the salt water intrusion caused by operation of the Locks.

DROUGHT MANAGEMENT STRATEGY

Seattle's strategy for dealing with the hydrologic uncertainty associated with drought management involves several components:

- Monitoring current conditions,
- Forecasting,
- Communication,
- Operational Adjustments,
- Curtailment Actions, and
- Alternative Water Supplies.

During years in which precipitation is significantly below normal, Seattle expands and utilizes these management strategies as explained below.

Monitoring Current Conditions

To deal with hydrologic uncertainty in real-time and in longer term planning horizons, Seattle's water resource management team uses a number of available informational and data gathering sources. Seattle contracts with the U.S. Geological Survey (USGS) to provide continuous streamflow monitoring and data collection services. Strategic placement of USGS stream gauging stations provides real-time information for understanding the hydrologic state of the water supply and river systems. Seattle also contracts with the Natural Resources Conservation Service (NRCS) to provide real-time snow monitoring and weather data collection services.

Forecasting

Through the National Oceanic and Atmospheric Administration (NOAA), Seattle regularly monitors daily weather forecasts (National Weather Service Seattle Forecasting Office), mid-range weather forecasts (National Centers for Environmental Prediction), 30- and 90-day and multi-season climate outlooks (Climate Prediction Center), and daily hydrometeorological forecasts (Northwest River Forecast Center in Portland, Oregon). The internet provides access to vast amounts of additional useful information to assist SPU in forecasting. For example, NOAA's web information on El Niño/La Niña provides a wealth of timely information on current and forecasted El Niño and La Niña conditions with enough lead time for water resource managers to prepare for such events.

Seattle uses a number of analytical tools for forecasting hydrologic conditions as they relate to water supply and fisheries including:

- Streamflow forecasts prepared by the USGS and NRCS.
- Weather, climate and river forecasts from NOAA.
- In-house reservoir management and streamflow forecasts using a computer model known as the Seattle Forecast Model, or SEAFM. This model is regularly updated with hourly meteorological and hydrological data, and simulates the current state of the watershed (including snowpack, soil moisture, aquifer storage, and streamflows) and water supply system. The model is used to analyze and assess various future reservoir operating scenarios, both in real time and in near- and long-term operational planning, based on probabilistic analysis of over 70 years of historic weather; and
- Seattle's Conjunctive Use Evaluation (CUE) model, which is a weekly time step simulation model used for calculating and evaluating the firm yield and reliability of Seattle's water supply system and potential future water supply projects. While not a forecast tool, per se, the model provides valuable insight into the hydrologic record.

Communication

SPU's Water Resources Management staff work closely with members of other city, local, state, federal and tribal resource agencies, including Seattle City Light, City of Renton, King County, Washington State Department of Ecology, Washington State Department of Fish and Wildlife, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Services, Muckleshoot Indian Tribe and Tulalip Tribes.

The interagency Cedar River Instream Flow Commission established by the Cedar River Watershed HCP, convenes in regularly scheduled meetings once per month throughout the year to oversee Seattle's instream flow management on the Cedar River. Additional meetings, in person or by conference call, are scheduled on an as needed basis, especially during periods of water shortages. The interagency Tolt Fisheries Advisory Committee, established by the South Fork Tolt River Settlement Agreement convenes on an as needed basis throughout the year and is the primary forum for interagency technical communications related to that river during water shortages.

In addition to the communications noted above, throughout this plan are references to communication to customers, stakeholders and the media. What is in this plan regarding communications is guidance. It may be appropriate to do more or less communication depending on the particular circumstances of the water shortage.

Operational Adjustments

Specific operational actions that will be made to reduce all non-essential water use are provided in Section 3 for each WSCP stage. Below is a discussion of how Seattle's water supply reservoirs are managed for people and fish during droughts.

Management of Water Supply for People and Fish
Operational flexibility is key, with operating plans changing as conditions and forecasts change. SPU has developed "dynamic rule curves" to operate its mountain reservoirs in the winter season. These rules set target reservoir levels that vary with watershed snowpack and soil moisture conditions. At times when there is little snowpack and low soil moisture, the reservoir target will be set higher than normal flood control levels, and vice versa. Dynamic reservoir rule curves are used to adjust operations to actual watershed conditions and to help manage risk and uncertainty. Also, periodic salmon and steelhead redd surveys are undertaken during seasonal fish spawning events that enable informed management decisions to be made that seek to ensure adequate flow levels are provided during critical fish incubation and emergence periods.

Curtailment Actions

Customers will be asked to take actions to curtail their use of water during a shortage. Those actions will depend on the stage of the WSCP being implemented at the time. Examples of potential water saving actions are noted in Section 3.

Criteria for Curtailment During a Water Shortage
There are several criteria for deciding which curtailment measures are appropriate to reduce demand during a water shortage:

- Timing: Can the measures or actions produce results in the necessary timeframe?

- Magnitude of savings: Will the measures or actions result in enough savings to make a meaningful difference; i.e., reduce demand to the level the impaired water system can handle?

- Season: Are the actions or measures relevant to the time of year; i.e., banning lawn watering during the summer irrigation season vs. during non-irrigation season?

- Costs: How severe are the cost implications of the measure to the customer, including local business and industry, relative to the need for action? Note: While there could be costs to certain customers, which would be considered, particular actions still may be necessary for public health and safety reasons.

Exit Strategy for WSCP Stages
As soon as actual and forecasted supply conditions substantially improve, SPU will either inform the public of the return to normal use of water, or inform them that the utility is moving from one stage to a lesser stage of this plan. This latter process would occur until there was a return to normal operations. Stages could be skipped in this process as conditions and forecasts warrant.

Alternative Water Supplies

Depending on the nature and timing of a water shortage, alternative or emergency water supplies may be useful to supplement existing supplies. SPU has several options available:

- Chester Morse Lake "Dead Storage" – Seattle's primary storage reservoir has a natural, gravity fed outlet. When inflows to the reservoir are low, its water surface elevation can fall below the natural outlet, but still contain a substantial amount of high-quality water in what is called "dead storage." In 1987, Seattle installed the first of two emergency pump stations to pump the water over the natural outlet and into the river, thereby augmenting both instream flows and water availability for customer use. The second Morse Lake Pumping Plant was installed in 1992. These pumping plants allow use of dead storage during drought emergencies.

- Interties - Since water supply problems will not affect all water suppliers in the region to the same extent, it is sometimes feasible for SPU and its wholesale customers to obtain water from other providers through interties.

- Reclaimed water - Reclaimed water is highly-treated effluent that may be used instead of potable water for irrigation, street washing, construction purposes, etc., in order to reduce demand for potable water and lessen the impact of shortages on the community. Currently there are some significant constraints on the use of reclaimed water during a shortage, e.g., lack of availability, cost and safety of trucking or piping water over long distances. It is important to note, however, that if reclaimed water becomes more widely available in the region and becomes less expensive it may become prudent for SPU to draw on it as a limited back-up supply during water shortages, for non-potable uses only. If reclaimed water is used it would be in adherence with applicable state regulations governing reclaimed water use.

A key assumption of this plan is that abundance, shortage and risk must be shared among all beneficiaries of the water resource. For example, critical minimum instream flow levels at locations specified in the Tolt and Cedar agreements referenced above are resorted to only after human water consumption is curtailed. All of the tools, information sources and communications outlined above, are needed for coordinating and making decisions related to real-time operations.

WATER SHORTAGE CONTINGENCY PLAN PRINCIPLES

SPU has learned a great deal over the years about how best to operate the utility during drought events, while minimizing impacts to customers and instream resources. This knowledge is reflected in this Water Shortage Contingency Plan, and articulated in the following principles:

- Given clear, timely and specific information on supply conditions and the necessary actions to forestall worsening conditions, customers prefer the opportunity to meet targeted demand reduction levels through **voluntary** compliance measures. The decision to move to mandatory restrictions is more acceptable if the voluntary approach has been tried first but has not resulted in enough demand reduction to ensure public health, safety and adequate streamflows through the projected duration of the shortage.

- Each drought or other shortage situation has enough unique characteristics that a plan cannot specifically define all the scenarios and specific supply and demand management actions. The usefulness of a Water Shortage Contingency Plan lies in planning the range of supply and demand management actions in advance of the situation, and in defining the communication mechanisms by which decisions will be made during the event.

- Given the highly-effective long-term regional conservation program operated by SPU, it is important to distinguish between the short-term **curtailment** measures necessitated by a water supply problem, and the **conservation** measures SPU regularly promotes to its customers. Conservation focuses on long-term efficiencies which do not adversely affect customers' accustomed use of water, whereas curtailment measures involve short-term water use reductions that can create hardships.

- It is essential to closely monitor water quality during droughts and particularly during a warm weather drought. This applies to water quality in rivers as well as to the drinking water provided to customers. Water quality issues must be considered for drinking water and instream uses when supply management decisions are made. The Seattle water distribution system is designed to carry a large capacity of water during summer peak months. If demand is significantly lowered, water will not move through the system at the "design" rate. The slower moving water, coupled with higher summer temperatures will increase the likelihood that drinking water quality problems may arise.

SECTION 3

PHASED CURTAILMENT PLAN

OVERVIEW OF PLAN STAGES

This plan provides four stages of response based on increasing severity, as progressively more serious conditions warrant. This type of response would be appropriate for a drought or other long-range disruption. It is the role of the Mayor of Seattle to officially activate the WSCP, when necessary. The four response stages include a variety of communications, internal operations, and supply and demand management strategies as appropriate, and are characterized as follows:

- **Advisory Stage** - The public is informed as early as meaningful data are available that a water shortage may occur.

- **Voluntary Stage** - If supply conditions worsen, the plan moves to the Voluntary Stage which relies on voluntary cooperation and support of customers to meet target consumption goals. During this stage, specific voluntary actions are suggested for both residential and commercial customers.

- **Mandatory Stage** - If the Voluntary Stage does not result in the reduction needed, or supply conditions worsen, the Mandatory Stage would be implemented. This stage prohibits or limits certain actions, and may be accompanied by an enforcement plan which could include fines for repeated violation.

- **Emergency Curtailment** - This stage addresses the most severe need for demand reduction and includes a combination of mandatory measures and rate surcharges. This would be used as the last stage of a progressive situation, such as a drought of increasing severity, or to address an immediate crisis, such as a facility failure.

PREPARATION FOR IMPLEMENTING WSCP STAGES

Recommendations about implementing the WSCP are made to the SPU Director by the SPU Water Shortage Response Team formed at the direction of the Director. Suggested team membership is provided in Attachment B. The actual composition of the team may change at any time as requested by the Director. This team, involving key departmental staff, would meet as often as appropriate to consider many or all of the following factors in making its recommendations about entering into any stage of this WSCP and modifying its recommendations as conditions change:

- total supply availability, including groundwater, interties, and modified instream flow releases
- the rate of decline in total reservoir storage compared with typical rates
- short- and long-term weather and hydrologic forecasts

- computer modeling of streamflow and reservoir storage, for different weather and demand assumptions (see Attachment C for possible demand management scenarios)
- the trends and forecasts of the system's daily water demands
- recommendations from the Water Shortage Advisory Group (if it has already been formed, if not yet formed, move forward in creating this group, see Attachment B for suggested role of this group and membership)
- recommendations from the Cedar River Instream Flow Commission and the Tolt Fisheries Advisory Committee
- the estimated margin of safety provided by the demand reduction, compared with the level of risk assumed if no action is taken
- potential water quality issues
- increased operating costs of potential actions and the value of lost water sales revenue, compared with the increased margin of reliability (see Attachment D for estimated costs and revenue losses for different stages of the WSCP)
- consultation with elected officials, wholesale customer representatives, state resource agencies, the Army Corps of Engineers and Tribes
- the length of time between stage changes (abrupt starts and stops are to be avoided, at least two weeks between stages is best to allow time to prepare)
- current events
- customer response, and
- water use consumption goals to be achieved, which may be revised as needed.

An SPU staff member is to be identified by the SPU Director to lead the water shortage response effort before it is activated.

The SPU Director will communicate the nature and scope of WSCP stage measures and strategies to the Mayor and Seattle City Council prior to implementing the WSCP and receive their input. The Director will communicate regularly throughout the shortage with the Mayor and City Council.

Preparation Between Plan Stages

When SPU is considering moving from one stage of the plan to another the department evaluates the need for doing so using much of the same information as noted above. Prior to moving to different stages of the plan, SPU will plan to consult with key stakeholders. There are also a number of preparatory measures that need to occur prior to moving from one stage to another, including, but not limited to: modifying any communication materials including customer water saving measures for the given stage, and "Questions and Answers" for customer groups, the determination of any staffing reassignments needed, and estimated costs and plans for covering those costs.

ADVISORY STAGE

Objectives

- Prepare the Department, City, relevant agencies and water users for potential water shortage thereby allowing all parties adequate planning and coordination time.

- Undertake supply management actions that forestall or minimize the need for more stringent demand or supply management actions.

Triggers

As presented earlier, there are a variety of weather and other conditions that may cause concern about water availability and a potential water shortage. SPU will enter the "Advisory Stage" if supply conditions and supply forecasts raise significant concerns about the utility's ability to meet supply needs later in the year.

Public Message

"Potential exists for lower than normal supply; conditions **may** return to normal, or later on, we may need to reduce consumption. Continue to use water wisely to help ensure sufficient supply for people and fish. We'll keep you informed."

Communication Actions

- Step-up and/or alter message of ongoing media education effort about the water system, particularly relationship of weather patterns to supply and demand; provide up-to-date data and implications for water use, if known.

- Initiate report to wholesale customers and request that they trigger their WSCPs.

- Provide periodic updated information on supply and demand data to SPU's wholesale customers via SPU's web page, or other means.

- Meet with landscape industry representatives to inform them of current and projected conditions; develop partnership programs and informational materials on the shortage, consumption goals, etc. for distribution by industry and utilities. Use landscape industry newsletter to communicate with industry members. As appropriate, communicate essential information via email by using Resource Conservation's professional landscape industry database.

- Communicate with other special interests, e.g., large water users including parks, and major water using industries and provide periodic updated information to a variety of key customers (see Attachment E for a list of key contacts and Attachment F for potential Advisory Stage tips for saving water).

- Step-up communication and encourage cooperation of City departments and other public agencies, including: state and federal resource agencies, tribes, and other

regional water suppliers, including the Cities of Everett and Tacoma, about water supply conditions and projections.

- Prepare and distribute public information materials explaining the Water Shortage Contingency Plan stages and communicate water use efficiency tips to customers (see Attachment F).

Operating Actions

- Increase data collection actions (i.e., streamflows, snowpack conditions, etc.) and monitoring weather forecasts.

- Increase SPU's computer modeling runs of projected supply, storage, demand and revenue scenarios.

- Identify and implement supply side management techniques to optimize existing sources.

- Assess current water main flushing and reservoir cleaning activities to determine whether they should be accelerated to be completed prior to the peak season or reduced to conserve supply; communicate strategy to wholesale customers.

- Assess water quality in reservoirs and distribution system to identify areas that may experience severe degradation with reduced consumption.

- Initiate planning and preparation for Voluntary Stage actions, including an assessment of potential staffing impacts, training needs, and communications strategies.

VOLUNTARY STAGE

Objectives

- Take necessary supply management actions to further stretch available supply.
- Maintain or reduce demand to meet target consumption levels by customer voluntary actions.
- Forestall or minimize need later for more stringent demand or supply management actions.
- Minimize the disruption to customers' lives and businesses while meeting target consumption goals.
- Maintain the highest drinking water quality standards throughout the shortage.

Triggers

The "Voluntary Stage" will be implemented when one or both of the following factors applies: 1) supply conditions have not improved, or have worsened, 2) demand levels need to be reduced given supply conditions.

Public Message

"Demand needs to be reduced by _____%. Customers are responsible for determining how they will meet that goal. We are relying on support and cooperation of all water users to stretch the available water supply. If everyone cooperates, we may avoid imposing more stringent restrictions. In addition to meeting essential water needs of customers, meeting the needs of fish habitat and other environmental concerns is a priority."

Communication Actions

- Communicate regularly with wholesale customers, groups that may be especially impacted by the water shortage, tribes, and resource agencies.
- Continue to communicate with other City departments and other public agencies to inform them of conditions, and encourage their cooperation.
- Identify and communicate actions taken by City departments to meet the voluntary curtailment goal.
- Consult with the Water Shortage Advisory Group, throughout the shortage, to help develop public information messages and materials and to obtain feedback on utility shortage actions.
- Develop and initiate a strategic public information, media and advertising campaign appropriate to the severity of the problem and the goal for demand reductions. This

could include publishing consumption information in daily newspapers to communicate the goal and ways to reduce consumption.

- Establish routine timing for press releases (e.g., every Monday morning) that provide current status and outlook; present information in standardized format that becomes familiar to media and public.

- Provide recommendations for customer actions to reduce consumption. See Attachment G for a list of recommended actions for this stage. Encourage customers to visit the *savingwater.org* website for more details on reducing water use.

- Include drinking water quality information in public information so that if flushing is necessary, the public understands that it is essential for drinking water quality maintenance.

- Publicize the water supply conditions web page, which is updated regularly. Ensure the information provided covers the needs of all key interests: the public, news media and key customers.

- Continue and intensify coordination and communication with state and federal resource agencies and tribes about supply conditions, demand management actions and streamflow levels.

- Establish and promote "hotlines" or websites for customers to obtain additional water conservation information.

- Contact largest customers to request percentage reduction.

- Establish regular communication mechanism to keep Department employees up to date on goals, conditions, and actions, especially utility account representatives that are tracking costs associated with the water shortage.

- Respond to customer correspondence regarding the shortage as quickly as possible and acknowledge receipt of correspondence if information is not readily available.

Operating Actions

- Continue actions listed in the Advisory Stage.

- Increase drinking water quality monitoring.

- Communicate flushing restrictions based on contract type to wholesale customers; eliminate demand metering charges, if demand metering is in effect.

- Assess revenue implications and potential remedies, including reprioritizing current revenue, reprioritizing expenses, and potential withdrawals from the revenue stabilization fund.

Supply and Demand Management Actions

Based on the consumption goal, some or all of the following actions will be taken. **Those actions that are asterisked (*)** will be considered initially for implementation if demand reductions more than 10 percent are necessary, or later if voluntary measures are not delivering targeted savings.

Supply Actions

- Eliminate all operating system water uses determined to be non-essential to maintain drinking water quality such as pipeline flushing, reservoir overflows. Complete cleaning of any in-town reservoirs only as needed.

- Request that wholesale customers who have alternative sources use them.*****

- Request the Corps of Engineers to reduce flow requirements and modify use of the Chittenden (Ballard) Locks.*****

- Investigate using any existing interties to increase supply availability.*****

- Begin to ready the pumping plants on Chester Morse Lake.*****

- In coordination with state and federal resource agencies and tribes, review stream flow levels.

Demand Actions

- Restrict hydrant permits to essential purposes.*****

- Request that Fire Department limit training exercises that use water.

- Request that City and County agencies eliminate washing of fleet vehicles unless water recycling car washes are used.

- Attachment G provides many possible actions customers can take to reduce water use. The actual actions requested at the time will depend on the specific demand reduction goal and the possible savings that can be achieved at that time.

- Evaluate ability to accelerate or enhance or expand long-term conservation programs; implement as appropriate.

MANDATORY STAGE

Objectives

- Achieve targeted consumption reduction goals by restricting defined water uses.

- Ensure that adequate water supply will be available for the duration of the situation to protect public health and safety and to balance the need for stream flows for instream resources, including fish habitat.

- Minimize the disruption to customers' lives and businesses while meeting target consumption goals.

- Maintain the highest drinking water quality standards throughout the shortage.

- Promote equity among customers by establishing clear restrictions that affect all customers.

Triggers

The “Mandatory Stage” will be implemented if supply conditions have not improved, or the level of demand needs to be further reduced.

Public Message

"It is necessary to impose mandatory restrictions to reduce demand because the voluntary approach has not resulted in the necessary savings [*or* conditions have continued to get worse and even more savings are needed]. We are continuing to rely on the support and cooperation of the public to comply with these restrictions, but need the certainty and predictability of restricting certain water uses in order to ensure that throughout the duration of this shortage an adequate supply of water is maintained for public health and safety."

Communication Actions

- Inform the public about the nature and scope of the mandatory restrictions through a press conference, potentially paid advertising and other means. The enforcement mechanisms, rate surcharges (if the City determines that a surcharge should be implemented at this stage), target consumption goals, projections for how long restrictions will be in place and the reasons for imposing restrictions will also be identified, as will the possible consequences if goals are not met.

- Identify clearly any exemptions from restrictions.

- In communicating mandatory restrictions to the public, distinguish clearly between lawn/turf watering and watering gardens since lawns and turf can go dormant in the summer. The type and amount of watering allowed will be clearly defined.

- Urge customers who irrigate with private wells, reclaimed or recycled water to install signs to let the public know the type of water being used.

- Continue and enhance communication actions from the Advisory and Voluntary stages.

- Prepare plans to move into the fourth stage - Emergency Curtailment - and begin preparatory measures, as appropriate.

Operating Actions

- Continue appropriate actions from previous stages.

- Increase drinking water quality monitoring as necessary to ensure the water supply and demand management strategies will not result in unacceptable drinking water quality.

- Make reclaimed water available to tanker trucks for street cleaning, construction projects, landscape irrigation, dust control, etc., if practical.

Supply and Demand Management Actions

Supply Actions

- Commence emergency pumping of Chester Morse Lake when water levels are several feet above the rim of the natural lake and gravity flow is no longer sufficient, if needed.

- Continue intensive supply side management measures, including possible changes in instream flow releases in consultation and cooperation with the Corps of Engineers, Tribes, and state and federal resource agencies.

- If not already implemented, activate interties and any other alternative sources of supply, as feasible.

Demand Actions

- Finalize and implement procedures for exemptions from restrictions.

- Consider implementing rate surcharges to accelerate customer compliance with the restrictions, as authorized by the Director. These could potentially be implemented as outlined under the Emergency Stage of this plan.

- Adopt Council legislation on mandatory restrictions and on rate surcharges, if surcharges are to be implemented.

- Intensify communication of actions that customers should be taking that are identified in Attachment G, and modify if needed.

- If supply conditions continue to deteriorate and irrigation is still occurring, before moving to the Emergency Curtailment Stage, lawn watering will be restricted. Newly installed lawns may be watered according to certain guidelines, if procedures described in the section below are followed.

- Possible water restrictions are noted below. The nature of the restrictions used will depend on the severity and timing of the situation:

  - Prohibit all watering during the warmest hours of the day, for example between 10:00 a.m. and 7:00 p.m.

  - Limit all watering to a specific number of days per week or per month. This choice will depend on target consumption goals, the time of year and the extent to which watering is occurring, and how much demands have already decreased. For example, if demand has already been reduced by 15% through other measures, during July and August limiting turf watering to **two** days a week on a region-wide basis could further reduce average daily demand by as much as 15 million gallons. Limiting lawn or turf watering to **one** day a week could yield an additional average daily reduction of up to 15 to 20 million gallons.

  - Ban lawn watering (see exemptions section below), with other watering prohibited during the warmest hours of the day, for example, between 10:00 a.m. and 7:00 p.m. Note: This should be considered only when the less stringent measures noted above have been tried and found inadequate; it would be best to consult with utility and landscape partners before taking this action.

- Other possible restrictions are noted below. Again, the nature of the restrictions used will depend on the severity and timing of the situation:

  - Prohibit use of any ornamental fountain using drinking water for operation or make-up water.

  - Prohibit car washing except at commercial car wash facilities that recycle water.

  - Rescind hydrant permits.

  - Prohibit washing of sidewalks, streets, decks or driveways except as necessary for public health and safety.

  - Limit pressure-washing of buildings to situations that require it as part of scheduled building rehabilitation project (e.g., painting).

  - Prohibit water waste including untended hoses without shut-off nozzles, obvious leaks and water running to waste such as gutter flooding and sprinklers/irrigation whose spray pattern unnecessarily and significantly hits paved areas.

Possible Exemptions from Water Use Restrictions

Categories of possible exemptions include: new lawns, new landscapes, sport fields and golf courses, ball fields and play fields, use of water for dust control at construction areas and other areas to comply with air quality requirements. The exemptions noted in Attachment H are possibilities for SPU to consider in creating actual exemptions at the time of the event.

EMERGENCY CURTAILMENT STAGE

At this stage, SPU recognizes that a critical water situation exists and that, without additional significant curtailment actions, a shortage of water for public health and safety is imminent. This type of situation has never occurred in the Seattle water system's history.

This stage is characterized by two basic approaches. First, increasingly stringent water use restrictions are established. Secondly, significant rate surcharges are used to increase customer compliance. A surcharge is a key component to the success of this stage**.**

Objectives

Strive to meet the water use goals established for this stage, recognizing that customers' lives and businesses may be significantly impacted in order to achieve necessary water savings.

Triggers

The water savings needed to ensure sufficient water is available for public health and safety throughout the water shortage are not being achieved, or conditions have worsened, therefore, more stringent measures are needed.

Public Message

"We are in an emergency water supply situation and need the immediate assistance of the public to achieve necessary water savings. We are imposing additional water restrictions and a rate surcharge to achieve the savings because the mandatory approach has not resulted in sufficient savings [*or* conditions have continued to get worse], and we need to ensure water will be available for public health and safety throughout this shortage."

Communication Actions

- Continue and intensify all previous, applicable actions.
- Define the problem to the public as an emergency and institute formal procedures to declare a city emergency.
- Inform customers of the rate surcharge and how it will affect them. Provide information on an appeal process.
- Coordinate with police and fire departments requesting their assistance in enforcing prohibition of water waste, if authorized by the Director.
- Inform customers that taste and odor water quality problems may occur with system-wide reduced water consumption.
- Inform customers about possible pressure reductions and problems that may occur, if any, due to the emergency water supply situation.

- Define and communicate exemptions for medical facilities and other public health situations.

Operating Actions

- Continue actions listed in prior stages.

- Curtail fire line testing unless it can be shown to be essential to protect the immediate public health and safety.

- Further enhance drinking water quality monitoring actions.

Supply and Demand Management Actions

Supply Actions

- Continue actions listed in prior stages.

- Work with Army Corps of Engineers to substantially limit use of the Hiram Chittenden Locks.

Demand Actions

- Implement rate surcharges to accelerate customer compliance with the restrictions, as authorized by the Director. These could potentially be implemented as follows:

  Commercial Customers - Commercial, multifamily and industrial users would be asked to reduce water use by a set percentage of their consumption during the same period in the previous year. Emergency rate surcharges would be established to provide an additional incentive to reduce water use. It is SPU's intention to establish a two-tiered structure. This "variable block approach" would allow for two different surcharge rates: one on the first block and a higher rate on the second block. These "blocks" would be based on the individual customer's consumption during the same period in the previous year. For example, if we were to target desired consumption to be 85% of the previous year's consumption in that period, any consumption between 0% and 85% would be billed at one rate and any consumption over 85% would be billed at the second, much higher rate. In this way, the targeted reduction amount and resulting surcharges would be customized around each customer's water use patterns, while still resulting in a steep surcharge for consumption in excess of the target amount for each block.

  A billing system modification would be needed to allow SPU to accomplish this. If this has not been done by the time it may be needed, a simple across-the-board rate surcharge would be applied.

  Residential Customers - A three-tiered, increasingly steep rate structure would be implemented for residential customers (includes single-family dwellings and

duplexes). While there are differences in household size, there is more similarity in residential domestic water use than there is in commercial water use.

Exemption from Rate Surcharge for Special Medical Needs - The utility will exempt customers with special medical needs such as home dialysis from a rate surcharge, provided individual customers notify the utility of such a need.

- Prohibit all lawn and sport field watering, with no exemptions.
- Require that all fire fighting agencies discontinue the use of water in training exercises until emergency is over.
- Rescind all hydrant permits.
- Require local parks departments to close down pools.

SECTION 4

NON-DROUGHT WATER EMERGENCY CURTAILMENT PLAN

INTRODUCTION

Although many of the demand reduction measures employed would be similar to those used during a progressive, weather-related shortage, non-drought water emergencies are unique because of a lack of preparation time and the urgency of immediate, potentially large-scale demand reductions. Each emergency scenario is different, but many could require major curtailment actions by customers. Also, unlike droughts, some emergencies may be very localized, requiring demand reduction for only a limited geographic area within the SPU service area.

In order to provide a frame of reference for future emergency situations, a short discussion of potential major water emergencies is provided here. This WSCP complements SPU's Emergency Response Plan. That plan is a supplement to the City of Seattle Disaster Readiness and Response Plan (City Disaster Plan) and would be implemented in immediate emergencies such as in the examples provided below. SPU's emergency plan defines decision-making authority in emergencies and creates specific emergency action plans for a number of systems, security, and management procedures, including information. Furthermore, if needed, SPU has emergency water provisioning equipment and plans for implementation as described in the "Emergency Drinking Water Distribution Plan." This plan would be implemented to provide water if customers in an area, or areas, were unable to receive water through normal means.

TYPES OF POTENTIAL NON-DROUGHT WATER EMERGENCIES

Major Transmission Pipeline Break

One potential water supply emergency is a major transmission line break from either the Tolt or the Cedar River supplies. The potential impact on customers would depend on the location of the break, the extent of damage, the amount of time needed for repair, the season it occurred, and how easily SPU could re-route water supply to customers in the affected area. Due to the redundancy in SPU's system, the two major pipeline failures that occurred since 1987 had fairly minor impacts on customers.

Temporary Treatment Plant Shut Down

Another type of supply emergency is a temporary shut down of either the Cedar or the Tolt water treatment plants. As with a transmission pipeline break, the potential impact on customers would depend on the time needed to return the plant to service and the time of year. An example of this was in 2003 when the Tolt Treatment Facility was shut down for about a week when a raw water inlet valve malfunctioned causing flooding of the plant. Because this event occurred during the winter when demands were low, all retail and most wholesale customers were provided water from the Cedar system without disruption; a few wholesale customers were supplied from water stored at the plant's clearwell.

Major River Flooding Leading to High Turbidity

If substantial flooding occurred on the Cedar River or South Fork Tolt River it could lead to high turbidity causing SPU to temporarily stop using that supply. For the Cedar, if major flooding occurred at the same time that Lake Youngs was at or below normal minimum operating levels, high turbidity could lead to a temporary shut down of that supply. In 1990 such an event occurred on the Cedar, when flooding exceeded the 100-year event. It should be noted that with the addition of filtration on the Tolt supply and the change in intake location on the Cedar supply, SPU's supply sources are much less vulnerable to impacts of turbidity than in the past.

SUPPLY AND DEMAND MANAGEMENT DURING NON-DROUGHT WATER EMERGENCIES

No single strategy can be created which will meet the needs of the department for all non-drought water emergency scenarios. Strategies for dealing with emergencies have been developed based on lessons learned from previous water utility events, and other utility experiences. The criteria listed in Section 1 of this WSCP create a framework for decision-making. The types of non-drought emergencies listed in this section initially require quick and immediate response. Once an assessment is made as to how long it will take to restore the system, the immediate response strategy may change if it appears that the repair process will be lengthy.

The strategy for most emergencies can be narrowed to measures having the most immediate impact on achieving water supply and consumption targets. All needed and available back up supplies would be activated during an emergency: interties, well-fields, off-loading wholesale customers who have other sources, etc.

Attachment A

Examples of Past Regional Drought Experiences

The droughts that the Seattle regional water system has experienced in recent history were very different types of droughts. While SPU has changed how it operates the system based on the lessons learned from the past, it is useful to be aware of these past drought events and the actions taken to successfully manage both supply and demand.

Summer/Fall Drought

In 1987, storage reservoirs were at normal levels on June 1, but the summer weather was unusually warm and dry. Higher than normal outdoor water use accelerated the drawdown of the storage reservoirs. To reduce demand, in early August lawn watering was restricted to no more than once every three days and customers were urged to voluntarily curtail other water uses. These actions reduced demand by approximately 10 percent. In early fall, an emergency pumping station was installed at the Chester Morse Lake reservoir to pump "dead storage" in case the reservoir level fell below the lake's natural outlet.

Throughout the fall, precipitation continued below normal; the water supply system was managed and adjusted to obtain the maximum supply available (e.g., relying on Lake Youngs more than normal). In November 1987 and January 1988, the Chester Morse reservoir was low enough to require pumping and it was not until February 1988 that rainfall began refilling the storage reservoirs.

Winter/Spring Drought

In 1992, the system experienced a very different type of drought. Because the winter was unusually warm, snowpack and flows into the storage reservoirs were at record low levels. In late February, it was evident that there was insufficient snowpack to fill the storage reservoirs and that the likelihood of recovery by June 1 due to rainfall was low. A number of measures were taken to maximize available supply (e.g., reducing system flushing, adjusting stream flow levels, etc.) and to reduce demand. In May, a number of mandatory curtailment actions were implemented in the Seattle service area, including a ban on lawn watering. This resulted in an average consumption reduction of 25 to 30 percent below normal throughout the summer. Tribes, state resource agencies and the Army Corps of Engineers played a significant role in cooperating to maximize available water supply. In addition, other measures were taken to increase available supply including initiating an intertie with Renton and accelerating the construction of a second pump plant for use of dead storage at Chester Morse Lake. The mandatory restrictions were rescinded in September as supply levels returned to normal with the onset of fall rains.

In 2005, SPU watersheds experienced the lowest snowpack in 60 years, one of the driest winters on record and warmer than normal winter temperatures. Water managers responded by activating the Advisory Stage of the WSCP, reducing system water use and maximizing the amount of water held in storage using the dynamic rule curve. As a result of this active management and nearly average rainfall in the spring, SPU was able to return to normal operations by summer that year.

Attachment B

Water Shortage Response Team and Water Shortage Advisory Group Memberships and Roles

Water Shortage Response Team

Purpose: SPU's internal team whose role is to evaluate conditions, advise the Director on supply and demand actions, and make assignments to SPU staff as needed to respond to the shortage.

Membership: The Team is appointed by the Director and may include the following members to fill the roles indicated; however, the actual composition may change at any time as requested by the Director:

- SPU Director – Overall direction on the response.
- Branch Directors – Input to Director for response.
- Lead for Shortage Response – Issue coordination, information gathering and dissemination, key support staff assignments, role clarification, and communication with broad array of interested parties.
- Drinking Water Division Director – Overall guidance on supply management, drinking water quality and operations, status of non-revenue water, issues related to potential alternative supplies, and opportunities for use of non-potable water.
- Cedar and Tolt Watershed Services Division Director – Provide guidance regarding watershed activities that may impact water supply.
- Water Resources Business Area Manager – Provide water supply condition reports, forecasts, demand pattern reports, operational needs, and modeling identification and oversight.
- Water Resources Management Staff Representative – Provide guidance regarding instream flows/fisheries, river analyses, river biological assessments, and coordinate with Cedar River Instream Flow Commission and Tolt Fisheries Advisory Committee.
- Resource Conservation Manager –Water use reduction measures management and messaging, cost estimates to achieve savings, and communication with landscapers, nurseries and large water users (commercial and residential).
- Communications Director and Staff Representative(s) – Messaging, customer relations, media relations, press releases, key contact for interagency Public Information Officers (PIOs), agency communication, and coordination with wholesale customers, cities of Everett and Tacoma and Central Puget Sound Water Suppliers' Forum.
- Finance Staff Representative – Cost estimates for supply alternatives, increased messaging needs and additional water use reduction measures, expected lost revenue estimates, budgets and charge number set-up for shortage-related activities, and process necessary to access revenue stabilization fund, if needed.

Note: If the Morse Lake Pumping Plants need to be readied for potential use, an additional staff member may participate in the Response Team to report on issues related to the plants.

Water Shortage Advisory Group

Purpose: To advise the SPU Water Shortage Response Team in defining messages and providing feedback on utility water shortage response actions and programs.

Membership: Group membership will be based on the type of water shortage and how widespread it is. The Director, or his/her designee, will send out invitations to potential members and agencies. The following is a list of potential members to be considered when forming the Group membership:

- Wholesale customer representative(s)
- State and federal resource agencies, such as the Army Corps of Engineers, Washington State Department of Ecology, etc.
- Landscape and/or nursery representative(s)
- Other potentially impacted industries and businesses (e.g., restaurants, hotels, car washes, etc.)
- Environmental representative
- Tribal representatives
- Water System Advisor committee representative
- Other City departments, such as Parks or Seattle City Light
- Other regional water suppliers, such as Tacoma Water or Everett Public Utilities
- SPU staff as appropriate.

Attachment C
Possible Demand Management Scenarios

Note: Information developed during spring 2005.

Scenarios	% Savings	Savings (in mgd)				Residential Indoor	Residential Outdoor	General Commercial	Commercial Outdoor
		Apr-May	Jun-July	Aug.	Sept-Oct				
Pre and Stage 1 Advisory	<1%	1	2	4	2	full clothes and dish washing machine loads, check and repair leaks	sweep driveways & sidewalks, water wisely, drought proof new plantings, top dress, aerate and grasscycle lawns, mulch all planting beds, use commercial car wash that recycles water	check and repair leaks, encourage employee suggestions, sweep driveways and sidewalks, voluntary City facility reductions	check systems and repair real time ET controllers, central controls for multi-control systems, rain shut-offs, soaker hose or drip alternatives, top dress, aerate, and grasscyle lawns, drought proof new plantings, mulch all planting beds
Stage 2 Voluntary Curtail-ment	5-10%	5	10	15	10	push above measures harder, 1 or more less minutes per shower, reduce toilet flushing, install efficient fixtures & appliances	push above measures harder, water only between 7 p.m and 10 a.m., allow lawn to go dormant, avoid draining hot tubs & pools, defer car washing, reduce landscape watering, water planting beds infrequently, new landscapes exempt	push above measures harder, mandatory City facility reductions, defer washing vehicles, inspect cooling towers, water at restaurants by request only, hotel linen change by request only, install efficient fixtures, cost-effectively invest in efficient technologies, use reclaimed water, if practical	push above measures harder, curtail fountain use, no make up water, suggest watering restrictions including time of day (new lawns exempt, sports fields partially exempt)

Scenarios (cont.)	% Savings	Savings (in mgd)				Residential Indoor	Residential Outdoor	General Commercial	Commercial Outdoor
		Apr-May	Jun-July	Aug.	Sept-Oct				
Stage 3 Mandatory Curtail-ment	10-20%	10	20	30	15	push above measures harder	push above measures harder, prohibit vehicle washing, prohibit sidewalk, driveway washing, watering restrictions including time and number of days, new landscapes still exempt, no pool or hot tub drain & filling, curtail power washing, no fountain make-up water	push above measures harder, prohibit vehicle washing, defer major uses if possible, use reclaimed water if practical	push above measures harder, prohibit sidewalk, driveway washing, ET limitations for auto irrigation use, prohibit fountain use, watering restrictions including time and number of days, sports fields may be partially exempt, new lawns may be partially exempt
Stage 4 Emergency Curtail-ment	>20%	20	30	40	20	push above measures harder	push above measures harder, lawn watering ban, new landscape watering restrictions/ban	push above measures harder, must use reclaimed water if practical	push above measures harder, lawn watering ban, no potable water for irrigation, new landscape watering restrictions/ban

Attachment D

Estimated Cumulative Costs and Revenue Losses for WSCP Stages (based on 2005 dollars)

Revenue & Cost Impacts	**Stage 1 Advisory**	**Stage 2 Voluntary**	**Stage 3 Mandatory**	**Stage 4 Emergency**
Revenue Loss	**$ 1,000,000**	**$ 5,000,000**	**$ 9,000,000**	**$ 13,000,000**
Cost	**$ 55,000**	**$ 1,485,500**	**$ 2,935,500**	**$ 3,285,500**
Demand Management				
customer outreach		250,000	650,000	650,000
customer incentives			950,000	950,000
enforcement			100,000	300,000
Cedar Pumping				
preparation		500,000	500,000	500,000
mobilization	30,000	354,500	354,500	354,500
pumping costs		81,000	81,000	81,000
Seattle wells	25,000	300,000	300,000	450,000
Total: Revenue loss & costs	**1,055,000**	**6,485,500**	**11,935,500**	**16,285,500**
Financial Tools Used to Mitigate Impacts (descriptions below table)				
Reprioritize Current Revenue	X	X	X	X
Reprioritize Expenses		X	X	X
Withdrawal from Revenue Stabilization Fund			X	X
Rate Surcharge			X*	X

Notes:

1) Estimates were created in spring of 2005 for 2005 event. Actual future costs would vary depending on the season, and specific actions taken in a given event. In 2005 SPU entered into Advisory Stage only.
2) Above are costs incurred for each stage. The costs for Stages 2 - 4 include the costs incurred in the previous stage(s). Estimated lost revenue follows the same approach.
3) Stage 4 revenue loss estimates here do not include funds that will be brought in by surcharges. Estimates for those surcharges have not been developed.

* The City may implement a rate surcharge in the Mandatory Stage.

Reprioritizing Current Revenue – This consists of reducing revenue contributions to the capital program and lowering the year end operating cash target. These are the most flexible resources to offset revenue and expenditure problems.

Reprioritize Expenses – Reducing planned operations and maintenance expenditures reduces demand on revenues or frees up money to meet unexpected needs.

Withdrawals from Revenue Stabilization Subfund – The City of Seattle has established a Revenue Stabilization Subfund for the water fund. The target balance is $9 million, which can serve as a source of revenue during moderate droughts. Withdrawals from the Subfund require Council approval.

Rate Surcharge – In emergency situations, rate surcharges send a strong signal to customers to reduce water use and also help to make-up revenues lost due to decreased demand.

Attachment E

CONTACT LIST FOR WATER SHORTAGE CONTINGENCY PLAN

A working list of contacts for easy reference in case of a drought or emergency should be developed and regularly updated by the Resource Conservation Section in consultation with others in the Department. In addition to the communication elements contained in the WSCP, the following will be contacted directly in the event of a drought or emergency to inform them and ask for their support and cooperation in reducing demand.

Customers
List of wholesale water customers
List of large irrigators, including those using alternate sources
List of large commercial and industrial customers

City of Seattle Contacts
Department Directors
Contacts for:

- Seattle Department of Parks and Recreation
- Seattle Transportation Department
- Seattle Center
- Fire Department
- Department of Executive Administration
- Fleets and Facilities

List of City owned, non-re-circulating and re-circulating fountains

Other public agencies with high visibility water use
State Department of Transportation
University of Washington
Army Corps of Engineers
King County Department of Natural Resources & Parks
Seattle Public Schools

Landscape Interests
King County Cooperative Extension
Washington State Nursery and Landscape Association
Irrigation Association
Washington Association of Landscape Professionals
American Society of Landscape Architects
Center for Urban Horticulture
Pacific Northwest Golf Course Superintendents' Association
Washington Irrigation Contractors Association
*Note: Resource Conservation maintains a database of over 400 landscape-related businesses and other contacts.

Business Groups
Seattle/King County Chamber of Commerce
Building Owners and Managers Association

Attachment F

POSSIBLE ADVISORY STAGE WATER CONSERVATION TIPS FOR CUSTOMERS

Conserve Inside

For most households, the vast majority of water is used indoors. Taking conservation actions and installing efficient fixtures help reduce your water use year-round. There are also ways to conserve water in outdoor uses and at work. Below are suggested actions:

- Fix leaking faucets and toilets.
- Wash only full loads in the dishwasher and clothes washer.
- Minimize faucet use when brushing your teeth, shaving and washing dishes.
- Don't pre-rinse dishes unless you need to. Most new dishwashers don't require pre-rinsing.
- Save luke warm water for watering plants, etc. while you wait for hot water in kitchens and showers.
- If you are buying a new toilet, look for a FlushStar model. Call us or visit us online if you have questions.
- If you are buying a new washing machine, WashWise rebates are available for qualified machines.

Conserve Outside

Make the most of the water you will use in the spring and summer:

- Aerate lawns in the spring to better absorb water.
- Mulch planting beds to decrease evaporation.
- Select the right plants for the right place – contact SPU or see our website for information.
- Tune-up and improve your irrigation system – rebates may be available.
- Wash your cars at locations that recycle their water.

Note: For more information on home water conservation tips for inside and out, visit www.savingwater.org or call 684-7283 (684-SAVE)

Conserve at Work

Businesses and institutions can reduce water use and lower utility costs by adopting conservation practices and replacing inefficient equipment or operations.

- Check for leaks.
- Use a broom, instead of a hose, to routinely clean driveways and sidewalks
- Turn off water-using equipment when not in use, including dishwashers, garbage disposals, and food troughs.
- Upgrade equipment efficiency – rebates may be available.
- Increase employee awareness of water conservation.
- Call (206) 343-8505 for technical assistance for work-related water-wise tips.

Attachment G

POSSIBLE VOLUNTARY STAGE CUSTOMER WATER SAVING ACTIONS

The following voluntary actions are being requested of all customers:

SET A GOAL: Such as use 10% less water
Most customers can easily save 10% by choosing several items from the menu of water saving actions below. If you routinely do outdoor watering, select those actions first. Set a goal to reduce your water use by 10% from the amount you used during the same billing period last year. Most utility bills contain your water consumption for each billing period. Much of the 10% can probably be achieved through conservation actions that are wise to do all the time. If that is not sufficient, then the special curtailment actions listed here can be implemented during the duration of the supply problem.

REDUCE OUTDOOR WATER USE

Conservation Actions:

- Avoid **watering** between 10 AM and 7 PM to reduce evaporation.
- **Stop obvious water waste** such as gutter flooding, sidewalk and street watering, and fix leaks.
- **Never leave a hose running,** always use a shut-off nozzle.
- **Use a broom** rather than a hose or pressure washer to clean sidewalks and driveways.

Curtailment Actions:

- **Reduce lawn watering** (twice a week or less if possible).
- **Let your lawn go dormant**. Customers who choose to not water their lawns should water deeply once each rainless month to keep grass roots alive. To avoid runoff when you water, if the water puddles, cycle your sprinkler on and off until water is absorbed.
- **Refrain from filling** empty pools and hot tubs.
- **Turn off water features** and fountains.
- **Wash vehicles only at car washes that recycle their water.**

REDUCE INDOOR WATER USE

Conservation Actions:

- **Install a water efficient FlushStar toilet.** These toilets have proven to perform well and give long-term water savings. Replacing a frequently used old toilet with a new efficient toilet can save most households up to $70 a year in utility bills *(based on data from 2005).* Check www.savingwater.org for FlushStar toilet models.
- **Install a high-efficiency clothes washer**. New washers are typically one-third more water efficient than old washers. Rebates are available from Seattle Public Utilities by calling (206) 684-SAVE.
- **Wash only full loads in the clothes washer and dishwasher,** or choose an appropriate load-size setting for the number of items in the washer.
- **Turn off the tap** while brushing your teeth, hand-washing dishes or shaving.
- **Fix leaky faucets and toilets**. Put several drops of food coloring in your toilet tank. After 20 minutes, if you have color in the bowl, you have a slow leak that over time can amount to a lot of water.

- **Install an efficient showerhead.** New showerheads work well and use much less water than old high-flow models.
- **Install an efficient faucet aerator.** Replace your older bathroom faucet nozzle (aerator) with one that uses one gallon per minute or less.

Curtailment Actions:
- **Spend one minute less in the shower.** Try to limit showers to five minutes or less.
- **Flush your toilet less often.** Toilet flushing is the largest water use inside the home. As the saying goes, "If it's yellow, let it mellow."

REDUCE WATER USE AT WORK

There are a wide variety of opportunities for businesses and agencies to reduce their water use and operating expenses.

Conservation Actions:
- **Check cooling towers.** Cooling towers - and the ways that they regulate water use – represent real opportunities for improving water efficiency.
- **Check for and fix leaks.** Toilet and urinal leaks are very common. Investigate obvious or suspected leaks.
- **Use a broom,** instead of a hose or pressure washer, to routinely clean driveways and sidewalks.
- **Turn off water-using equipment** when not in use, including open hoses, dishwashers, garbage disposals, and food troughs.
- **Check air conditioners, refrigerators, and ice machines.** If your company's air conditioners or refrigerators use water-cooled condensers, investigate air-cooled equipment for possible efficiencies. Rebates are available. Visit **www.savingwater.org.**
- **Install water-efficient toilets, urinals and faucets** in public and employee restrooms. Replacing old toilets, urinals, and faucet aerators with efficient ones can produce substantial savings. Rebates are available. Visit **www.savingwater.org.**
- **Reuse process water.** Water used in industrial and manufacturing processes should be reused as often as possible. Rebates are available. Visit **www.savingwater.org.**
- Hospitality businesses can offer guests the option of clean linens each day.
- **Increase employee awareness of water conservation** through management memos or newsletter messages. Install signs that encourage water conservation in restrooms or work areas where water is used. For additional work-related conservation tips, call (206) 343-8505**.**

Curtailment Actions:
- **Reduce outdoor watering** (twice a week or less if possible). Rebates are available for smart irrigation technologies. Visit **www.savingwater.org.**
- **Minimize vehicle washing**, defer or use a water recycling car wash.
- **Turn off** decorative water fountains.
- **Serve water only on request** at restaurants. Avoid thawing with running water.

For home water conservation tips, visit www.savingwater.org
or call (206) 684-7283 (684-SAVE)

Attachment H

POSSIBLE EXEMPTIONS FROM WATER USE RESTRICTIONS

New Lawns and Landscapes

If a lawn and/or landscape is installed prior to the date the watering restrictions were announced, and in the same calendar year, it may be watered for a limited duration on a daily basis for a specified number of days, e.g., 10 minutes per day for the first two weeks after its installation. After that period, some watering may still be allowed on a reduced basis. The watering may also be restricted to certain times of day. All details will be determined based on the time of year and severity of the shortage.

The utility will publicize the rules for exemptions to the lawn and landscape watering restrictions. The customer will need to contact the utility with name and address, stating that they meet the conditions and will be watering their lawn and/or landscape. This should be done in writing, either via email or other means. The utility reserves the right to spot check on site for compliance.

New lawns and landscapes may also be installed after the date of the restrictions. To receive a watering exemption the minimum requirements for soil preparation must be met and a signed affidavit provided to that effect. Minimum soil preparation consists of cultivating into the top six inches of existing soil at least two inches of organic soil amendment, such as composted yard waste. The same restrictions for watering as above would also apply.

For purposes of this exemption, "new lawn" refers to a lawn newly installed during the current year only. Overseeded or otherwise renovated lawns will not be exempt from the lawn watering restrictions.

Note: The utility will not guarantee continued watering. If the water supply situation worsens, any exemptions may be revoked. In the event that the shortage continues to worsen and the Emergency Curtailment Stage is activated, this exemption would be revoked.

Sports Fields and Golf Courses (greens and tees only)

Sports fields and golf courses (greens and tees only) can be watered according to an evapotranspiration (ET)-based schedule, provided at least the following:

- ☐ The irrigation system must be audited between 0 to 60 days prior to the effective date of the watering restrictions, by an Irrigation Association-certified Irrigation Auditor.
- ☐ The audit must find that the system's lowest quarter distribution uniformity is at least 70%.

- ☐ Watering is prohibited during the warmest time of day. Specific times will be announced by the utility.
- ☐ Water running to waste is to be avoided.

Other Exemptions

For purposes of dust control, water may be applied to construction areas or other areas needing to comply with air quality requirements**.** If reclaimed water is available, consider requiring or promoting that it be used for dust control, if practical.

Ballfields and playfields may be watered at the minimum rate necessary for dust control and safety purposes.

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SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

I. WATER RESOURCES

APPENDIX E

RECLAIMED WATER OPPORTUNITIES

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BROWN AND CALDWELL

FINAL TECHNICAL MEMORANDUM

SPU 2007 Water System Plan Update
128901

TECHNICAL MEMORANDUM
RECLAIMED WATER OPPORTUNITIES

Date: July 13, 2006

To: Julie Burman

From: Colleen O. Doten
Andrew Lee
Copy to: Judi Gladstone, Joan Kersnar

Seattle Public Utilities (SPU) is currently reviewing opportunities for reclaimed water projects in the development of its 2007 Water System Plan Update. Reclaimed water, or wastewater that is treated to a high level such that it can be safely used for irrigation, industrial, groundwater recharge, and/or other non-potable (e.g. toilet flushing) applications, is currently used in numerous cities across the United States and the world.

Despite the many environmental attributes to re-using treated municipal wastewater, few instances in the Seattle service area have been found where the unit cost of reclaimed water is less than the unit cost of providing drinking water.

This technical memorandum provides a summary of the following:

- Past reclaimed water studies and/or evaluations for the Seattle service area
- Applicable regulations and legislation
- Overview of reclaimed water markets nationwide and locally
- Identification of reclaimed water sources for the Seattle service area
- Identification of reclaimed water opportunities for the Seattle service area
- Evaluation of reclaimed water opportunities in Seattle service area
- Considerations for implementing reclaimed water projects

BACKGROUND

Numerous reclaimed water feasibility studies have been performed over the last 10 years in the Seattle area. SPU's most recent comprehensive study was performed in 2003, and was titled *SPU Wastewater Reclamation and Rainwater Harvesting Study* (2003 Study). In 1995, the Seattle Water Department evaluated the feasibility of reclaimed water opportunities in the Duwamish Corridor, in a study tilted *Recycled Water Demand Study, Duwamish Corridor*. At approximately the same time, King County's Department of Natural Resources (DNR), along with the Seattle Water Department and the City of Renton, performed a study of reclaimed water opportunities in the King County metropolitan area titled *Water Reclamation and Reuse: A Feasibility Study for the King County Metropolitan Area*. Most recently, King County has made provision in the design and construction of the Brightwater Plant and pipeline project to produce reclaimed water. Each of these studies and/or on-going projects is described briefly below.

SPU 2003 Wastewater Reclamation and Rainwater Harvesting Study (2003 Study)

In 2002, SPU compiled a list of over 90 potential reclaimed water and rainwater harvesting opportunities in the SPU service area and water purveyor area. Eleven (11) of the projects were selected for further evaluation. For the reclaimed water opportunities, project descriptions and preliminary cost estimates were developed for each alternative. The project descriptions included the reclaimed water source, the end user, and the facility size, location and components. The projects were evaluated based on five criteria: annualized cost[1], annual purchased water reduction[2], initial capital cost[3], political complexity[4], and partnering potential[5].

A summary of the evaluation is provided in Table 1.

Table 1
2003 Study Project Evaluation

Reclaimed Wastewater Facility Project Name	Annualized Cost per CCF	Annual Purchased Water Reduction (CCF)	Initial Capital Cost	Political Complexity	Partnering Potential
West Seattle Golf Course Reclaimed Wastewater Facility "A"	$9.73	26,579	$2,672,000	moderate	low
West Seattle Golf Course Reclaimed Wastewater Facility "B"	$14.34	31,048	$4,837,000	moderate	low
Birmingham Steel/West Seattle Golf Course	$1.88	137,416	$2,141,000	moderate	high

[1] Annualized cost per hundred cubic feet (ccf) is the annual cost, in year 2002 dollars, for a 20-year life of the facility, divided by the annual reduction of purchased potable water realized by the operation of the facility. This cost includes estimated capital, operation and maintenance, and major component replacement cost.
[2] Annual Purchased Water Reduction is the estimated amount of reclaimed water produced annually by the facility.
[3] Initial Capital Cost is the estimated design and construction costs. It includes project administration, property/easement acquisition, design fees, construction management fees and construction costs.
[4] Political Complexity is a subjective "non-cost based complexity which may hinder or constrain implementation of the facilities."
[5] Partnering Potential is a subjective "potential for joint participation by public or private entities as a means to share the cost as well at the benefits."

Reclaimed Wastewater Facility Project Name	Annualized Cost per CCF	Annual Purchased Water Reduction (CCF)	Initial Capital Cost	Political Complexity	Partnering Potential
Calvary Catholic Cemetery	$17.92	20,364	$4,247,000	high	moderate
Myrtle Edwards Park	$63.79	2,304	$1,230,100	high	low
Washington Park Arboretum	$26.26	9,366	$2,427,800	high	moderate
South Seattle Community College	$64.33	1,996	$1,204,600	moderate	low
South Transfer Station	$18.05	3,480	$249,500	low	high
Green Lake Wading Pool	$21.59	9,320	$2,310,200	low	low

The 2003 Study also noted that SPU was involved in five reclaimed water projects that were currently in the design and/or construction phase.

The 2003 Study concluded that only the Birmingham Steel/West Seattle Golf Course alternative had a unit cost of water that was low enough to be worthy of consideration for implementation. The other projects' unit costs of water were considered too high to justify the projects, except on basis of other merits such as ease of implementation or other unique circumstances. Soon after the 2003 Study was published, the ownership of the Birmingham Steel facility changed to Nucor Steel Seattle, Inc., and the new owner was less interested in pursuing a reclaimed water project. In addition, new legislation passed by the Seattle City Council led to difficulties in pursuing the use of reclaimed water on the West Seattle Golf Course. Due to these factors, the Birmingham Steel/West Seattle Golf Course alternative was not implemented.

Nucor Steel Seattle, Inc. currently purchases almost 0.5 million gallons per day (MGD) of potable water from SPU. They have additional water sources through stormwater and groundwater collection systems, and an on-site well with an approved water right. Even with these alternative sources, there is potential to use reclaimed water in a variety of their steel production processes due to the continued high volume of potable water use. Since Nucor took over the former Birmingham Steel Corp. facility, they have not been in a position, financially, to consider retrofits necessary for a reclaimed water project. Based on their installation of a stormwater collection reuse system at their steel scrapyard, Nucor has shown a willingness to implement innovative projects. If the economics are compelling, Nucor would give serious consideration to a project that would provide long term stability in both water supply and water rates.

1995 Recycled Water Demand Study, Duwamish Corridor

In 1995, the City of Seattle Water Department published the *Recycled Water Demand Study, Duwamish Corridor* (Seattle Water Department, 1995). The study examined future demand for recycled water for customers along the Duwamish Corridor in the cities of Seattle and Tukwila. "The study concluded that due to high cost, technical challenges, and only modest water savings, the development of a large recycled water treatment and distribution infrastructure was impractical at the time" (Seattle Public Utilities, 2003).

King County Reclaimed Water Studies

In 1995, King County, the City of Seattle Water Department and the City of Renton published a study titled *Water Reclamation and Reuse: A Feasibility Study for the King County Metropolitan Area* (King County Department of Natural Resources, Seattle Water and City of Renton, 1995). The study concluded that under most conditions, the present cost of reclaimed water service would be higher than the Seattle marginal cost for developing new potable supplies. A successful project would have to serve a reasonably large demand (at least one MGD) and be located adjacent to a source of secondary treated effluent. Site-specific reuse projects could be economically feasible in the near term, with the Duwamish Corridor having the greatest potential. The report also stated that the King County Renton Effluent Transfer System (RETS) 96-inch pipeline in the Duwamish Corridor has twelve taps in place for reclamation and reuse.

In 2000, King County published another study titled *Reclaimed Water Program Demonstration Phase - Identification of Potential Satellite Projects for Direct Non-Potable Uses* (King County DNR, 2000). This study recommended completing a feasibility study for a Sammamish Valley Reclaimed Water Production Facility. More recently, however, the decision to have the future Brightwater Treatment Plant produce reclaimed water, led to the abandonment of plans to construct the Sammamish Valley facility.

Brightwater Project

King County is currently designing and constructing the Brightwater Wastewater Treatment Plant. This facility will treat wastewater with membrane bioreactor technology, resulting in a high quality effluent. The County plans to make this reclaimed water available to reclaimed water users. The *Draft White Paper: Reclaimed Water Backbone Project, Version 3.0* (King County DNR, 2006) describes proposed conveyance facilities to deliver reclaimed water to potential users. The plan consists of three phases. The first phase includes the construction of two backbone pipeline segments, the South Segment (to Sammamish Valley) and the West Segment (to Ballinger Way Portal). This phase includes bringing the South Segment on-line. Phase II includes increasing pumping capacity at the Brightwater Plant and bringing the West Segment into service. Phase III consists of constructing a distribution system from both backbones. King County currently considers implementation of Phase III the responsibility of end-users. This includes the costs to fund, install, operate, and maintain the pumps and distribution system from King County's Phase II backbone system to the end-users' sites. The white paper provides a review of alternatives evaluated, demand estimates and anticipated costs.

REGULATIONS AND LEGISLATION

Regulations governing the use of reclaimed water have been established by the Washington State Department of Health and Department of Ecology (Ecology). Recently passed legislation requires Ecology to develop new reclaimed water rules by December 31, 2010. On a local level, the City of Seattle has passed its own legislation regarding the use of reclaimed water in its service area. The following section summarizes application regulations and legislation.

1997 Water Reclamation and Reuse Standards

In 1997, Washington State Departments of Health and Ecology published the Water Reclamation and Reuse Standards. These standards define four classes (A, B, C and D) of reclaimed water. The standards specify the required levels of treatment (oxidation, coagulation, filtration and disinfection), by class as shown in Table 2, and the required class for the end use as shown in Table 3.

Table 2
Reclaimed Water Treatment Standards

Reclaimed Water Class	Oxidation	Coagulation	Filtration	Disinfection	
				Total Coliform Density 7-day Median Value	Total Coliform Density Single Sample
A	Required	Required	Required	≤ 2.2/100 ml	23/100 ml
B	Required	Not Required	Not Required	≤ 2.2/100 ml	23/100 ml
C	Required	Not Required	Not Required	≤ 2.2/100 ml	240/100 ml
D	Required	Not Required	Not Required	≤ 240/100 ml	No standard

The standards include the following definitions.
Oxidized wastewater is "wastewater in which organic matter has been stabilized such that the biochemical oxygen demand does not exceed 30 mg/L and the total suspended solids do not exceed 30 mg/L, is nonputrescible, and contains dissolved oxygen."
Coagulated wastewater is "oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated prior to filtration by the addition of chemicals or by an equally effective method."
Filtered wastewater is "an oxidized, coagulated wastewater which has been passed through natural undisturbed soils or filter media, such as sand or anthracite, so that the turbidity as determined by an approved laboratory method does not exceed an average operating turbidity of 2 nephelometric turbidity units (NTU), determined monthly, and does not exceed 5 NTU at any time."
Disinfected wastewater is "wastewater in which pathogenic organisms have been destroyed by chemical, physical or biological means."

Table 3

Treatment and Quality Requirements for Reclaimed Water Use

Use	Type of Reclaimed Water Allowed			
	Class A	Class B	Class C	Class D
Irrigation of nonfood Crops				
Trees and Fodder, Fiber, and Seed Crops	YES	YES	YES	YES
Sod, Ornamental Plants for Commercial Use, and Pasture to Which Milking Cows or Goats Have Access	YES	YES	YES	NO
Irrigation of Food Crops				
Spray Irrigation				
All Food Crops	YES	NO	NO	NO
Food Crops Which Undergo Physical or Chemical Processing Sufficient to Destroy All Pathogenic Agents	YES	YES	YES	YES
Surface Irrigation				
Food Crops Where There is No Reclaimed Water Contact With Edible Portion of Crop	YES	YES	NO	NO
Root Crops	YES	NO	NO	NO
Orchards and Vineyards	YES	YES	YES	YES
Food Crops Which Undergo Physical or Chemical Processing Sufficient to Destroy All Pathogenic Agents	YES	YES	YES	YES
Landscape Irrigation				
Restricted Access Areas (e.g., Cemeteries and Freeway Landscapes)	YES	YES	YES	NO
Open Access Areas (e.g., Golf Courses, Parks, Playgrounds, Schoolyards, and Residential Landscapes)	YES	NO	NO	NO
Impoundments				
Landscape Impoundments	YES	YES	YES	NO
Restricted Recreational Impoundments	YES	YES	NO	NO
Nonrestricted Recreational Impoundments	YES	NO	NO	NO
Fish Hatchery Basins	YES	YES	NO	NO
Decorative Fountains	YES	NO	NO	NO
Flushing of Sanitary Sewers	YES	YES	YES	YES
Street Cleaning				
Street Sweeping, Brush Dampening	YES	YES	YES	NO
Street Washing, Spray	YES	NO	NO	NO
Washing of Corporation Yards, Lots, and Sidewalks	YES	YES	NO	NO
Dust Control (Dampening Unpaved Roads and Other Surfaces)	YES	YES	YES	NO
Dampening of Soil for Compaction (at Construction Sites, Landfills, etc.)	YES	YES	YES	NO

Treatment and Quality Requirements for Reclaimed Water Use (Cont.)

Use	Type of Reclaimed Water Allowed			
	Class A	Class B	Class C	Class D
Water Jetting for Consolidation of Backfill around Pipelines				
Pipelines for Reclaimed Water, Sewage, Storm Drainage, and Gas, and Conduits for Electricity	YES	YES	YES	NO
Fire Fighting and Protection				
Dumping from Aircraft	YES	YES	YES	NO
Hydrants or Sprinkler Systems in Buildings	YES	NO	NO	NO
Toilet and Urinal Flushing	YES	NO	NO	NO
Ship Ballast	YES	YES	YES	NO
Washing Aggregate and Making Concrete	YES	YES	YES	NO
Industrial Boiler Feed	YES	YES	YES	NO
Industrial Cooling				
Aerosols or Other Mist not Created	YES	YES	YES	NO
Aerosols or Other Mist Created (e.g., Use in Cooling Towers, Forced Air Evaporation, or Spraying)	YES	NO	NO	NO
Industrial Process				
Without Exposure of Workers	YES	YES	YES	NO
With Exposure of Workers	YES	NO	NO	NO

Source: Washington State Department of Ecology, 1997.

Engrossed Substitute House Bill 2884

In March 2006, the Engrossed Substitute House Bill (ESHB) 2884 was passed. ESHB 2884 requires Ecology to adopt new reclaimed water rules by December 31, 2010. The bill is meant to address the fact that the 1997 standards are outdated and do not reflect recent developments in wastewater treatment technologies. The new rules are to address all aspects of reclaimed water use and shall be developed with consultation from an advisory committee. The advisory committee shall consist of "a broad range of interested individuals representing the various stakeholders that utilize or are potentially impacted by the use of reclaimed water; the advisory committee must also contain individuals with technical expertise and knowledge of new advancements in technology." In addition, the bill shifts regulatory responsibility for reclaimed water to Ecology. The Department of Health may still have a regulatory role after the new rules are adopted.

City of Seattle Resolution Number 30454

In April 2002, the City of Seattle adopted Resolution Number 30454. This resolution provides additional requirements for some wastewater reuse projects, as described below:

> "4) In developing wastewater reuse projects and programs, SPU (and other City agencies when involved) shall consult with the Washington State departments of Health and Ecology and U.S. Environmental Protection Agency (EPA) and other appropriate agencies, recognizing that regulations regarding reused or reclaimed waste water and rainwater are still being developed and at this time may be unclear or ambiguous in their application.

5) SPU shall monitor closely scientific and regulatory developments (including but not limited to the U.S. EPA's most current revision of reused water quality standards) regarding the risks associated with heavy metals, chemicals, residual pharmaceuticals and endocrine disruptors (separately and in combination) that may be present even in highly processed wastewater, and shall avoid actions that may result in the release of these residual substances into freshwater streams and lakes where they may be harmful to aquatic life, or where they would pose any risks to human health. Until there is more scientific certainty about treatment effectiveness or soil adsorption of such residual compounds, SPU shall take the following steps before developing projects that result in the use of reclaimed wastewater for irrigating parks or golf courses through which salmon-bearing streams flow:

(a) Identify the source of reclaimed water to be used for the project;
(b) Identify the treatment technology to be used, treatment capabilities and current applications of that technology;
(c) Measure the levels of both regulated and unregulated contaminants in the reclaimed water after treatment; and
(d) Identify and evaluate the manner in which the reclaimed water will be applied for the irrigation project in question and develop a monitoring program to demonstrate and ensure the safety of these practices.
(e) Submit the proposed irrigation project to a peer review panel composed of water quality experts from the USGS Toxic Substances Hydrology Program, the Washington State Department of Health and either the US Environmental Protection Agency or the Washington State Department of Ecology for an independent evaluation and a recommendation on whether to proceed with the proposed irrigation project."

The full text of this resolution is provided in Appendix A. One of the immediate impacts of the resolution was to impede the progress of any reclaimed water projects serving parks or golf courses with salmon-spawning creeks running through them. As described in a later section, this includes Longfellow Creek, a salmon-spawning creek which runs through the West Seattle Golf Course, and Thornton Creek, a salmon-spawning creek which runs through Jackson Park Golf Course. Therefore, as prescribed in the legislation, SPU would be required to perform a number of steps before using reclaimed water on parks or golf courses. In addition, the resolution requires that a reclaimed water project be cost effective.

SURVEY OF RECLAIMED WATER MARKETS NATIONWIDE AND LOCALLY

According to the WateReuse Association, ninety percent of reuse in the United States takes place in Arizona, California, Florida and Texas. Many other states, however, recognize the need to consider reclaimed water as a water source (AWWA, 2004). A number of factors drive this need:

- Arid climates and lack of water resources;
- Drought;
- Water conservation as a regulatory requirement;
- Population growth and increasing demand;
- More stringent wastewater treatment requirements (i.e. for the protection of aquatic species);
- Technological advancements leading to reduced costs of reclaimed water; and
- Having a dependable nonpotable water source at a predictable cost.

Some of the obstacles that have been encountered when trying to implement reclaimed water projects are:

- Economic infeasibility;
- End user concerns with on-site conversion costs;
- Perception of potential health risks; and
- Gaining public acceptance.

There are other obstacles that projects have had to overcome. In some instances, dual piping for domestic use has been difficult to implement due to concerns about cross connections. Also, mosquito breeding grounds has been a concern for the design of reclaimed water infiltration ponds.

Allowable uses of reclaimed water are based on the quality of the effluent. Each state's standards determine the effluent quality requirements. Table 4 summarizes the use of reclaimed water in Arizona, California, Florida and Texas. Appendix B provides more detailed information on the use of reclaimed water in each of these states.

Table 4
Reclaimed Water Usage Summary for

State	Total Usage (MGD)	Drivers	Uses	Implementation Issues
Arizona	> 100	-Lack of water supply -Increasing demand -Requirements of Assured Water Supply rules -Arizona Department of Water Resources incentives	Agricultural irrigation Aquifer storage and recharge Golf course irrigation Industrial cooling Maintenance of wildlife areas Park irrigation Recreational (lakes and ponds) Turf irrigation Wetlands enhancement	-Retrofitting is not cost effective -Parks and green belts are sometimes far from sources -Increased TDS in effluent can require greater (relative to portable water) application for turf irrigation
California	450	-Lack of water supply -Increasing demand -Salt water intrusion due to groundwater pumping	Agricultural irrigation (47%) Landscape irrigation (21%) Industrial use (5%) Groundwater recharge (9%) Seawater barriers (5%) Wildlife habitat or misc. (4%) Geysers/energy production (< 1%) Other or mixed type (3%)	-Public safety concerns -Concerns that water would only be supplied to low income neighborhoods

Table 4
Reclaimed Water Usage Summary for

State	Total Usage (MGD)	Drivers	Uses	Implementation Issues
Florida	630	-Reducing effluent and nutrient discharges to surface water -Increasing demand -Salt water intrusion due to groundwater pumping -Realizing that potable water is not necessary for irrigation -County and city requirements to install reuse systems for irrigation	Public Access Areas and Landscape Irrigation (49%) Groundwater Recharge and indirect potable reuse (16%) Agricultural Irrigation (14%) Industrial (14%) Wetlands (7%) Toilet Flushing (< 1%) Fire Protection (< 1%) Other Uses (< 1 %)	-Seasonal fluctuations which create cyclic shortages and surpluses
Texas	160	-Lack of water supply -Drought -Cost of new water supplies	Cooling towers Golf course irrigation Manufacturing	Unknown

Notes:
1. Usages are based on data from years 1998-2004 depending the state. See Appendix B for more information.
2. Implementation issues include examples and are not considered an exhaustive list.

Reclaimed Water Use in Washington State

According to a Department of Ecology 2005 Study, by the end of 2004 seventeen facilities had been constructed or upgraded to operate under the state's reclaimed water standards (Ecology, 2005) . The drivers for these projects were:

- Elimination or decrease in wastewater discharges for environmental purposes (i.e. shellfish);
- Additional water supplies including drought resistant supplies;
- Growth;
- Having a nonpotable water supply for irrigation; and
- Construction of new wastewater facilities.

As water demands increase, reclaimed water may be evaluated as an option to decrease potable water usage since "development of new surface water and groundwater sources is becoming more lengthy, costly and uncertain, given the multiple demands being made on a finite resource. Stringent environmental, regulatory and legal requirements are involved in establishing water rights and developing new supply facilities. Moreover, Ecology requires that water suppliers demonstrate that water conservation efforts have been duly considered, developed, and implemented prior to the granting of additional water rights (King County, 1995)." Future reclaimed water projects may also be driven by local ordinances. For example, in the City of Yelm water reuse can be required for new construction.

One of the seventeen permitted facilities in Washington State is in Seattle. King County generates and uses reclaimed water at the West Point Treatment Plant. The plant has a capacity of 0.7 MGD of Class A reclaimed water. It produces 0.5 MGD of reclaimed water which is all used at the plant for irrigation, tank cleaning and other processes (Ecology, 2005).

POTENTIAL RECLAIMED WATER SOURCES FOR SEATTLE SERVICE AREA

Five potential reclaimed water sources have been identified. The first three sources were also identified in the 2003 Study.

- SPU sewer conveyance lines;
- King County Interceptors;
- King County Renton Effluent Transfer System (RETS) pipeline;
- Brightwater Reclaimed Water Backbone; and
- Reclaimed water at West Point Treatment Plant.

Figure 1 shows the location of each of these potential reclaimed water sources. A brief description of the sources is provided below.

SPU Conveyance Lines and King County Interceptors

SPU sewer conveyance lines and King County interceptors are sources of raw sewage which would require a higher level of treatment than the other identified sources. These sources are located throughout the SPU service areas and the volume of available sewage would depend on the project location.

King County RETS Pipeline

The King County RETS pipeline conveys secondary treated effluent from the Renton Wastewater Treatment Plant, through the Duwamish Corridor, to its outfall in the Puget Sound. Since the wastewater in the King County RETS pipeline has already received secondary treatment at the South Treatment Plant, less treatment would be required to bring the wastewater to reclaimed water quality standards. The RETS pipeline is 96-inches in diameter and carries an average of 115 million gallons per day. There are taps along the pipeline for future effluent withdrawal connections.

Brightwater Reclaimed Water Backbone

The Brightwater reclaimed water backbone will contain Class A reclaimed water which requires no additional treatment. The nearest location of the backbone to the City of Seattle will be in the City of Shoreline at approximately 195th Street and Ballinger Way. Pumps and an additional conveyance line will be required to convey the reclaimed water south to users within the City of Seattle limits.

West Point Treatment Plant

SPU and Metro King County co-funded a reclaimed water project to produce up to 700,000 gallons per day at the County's West Point Treatment Plant in Seattle. All water produced is used at the plant for tank cleaning, treatment processes such as foam control, and irrigation. SPU and King County are considering an expansion of this project.

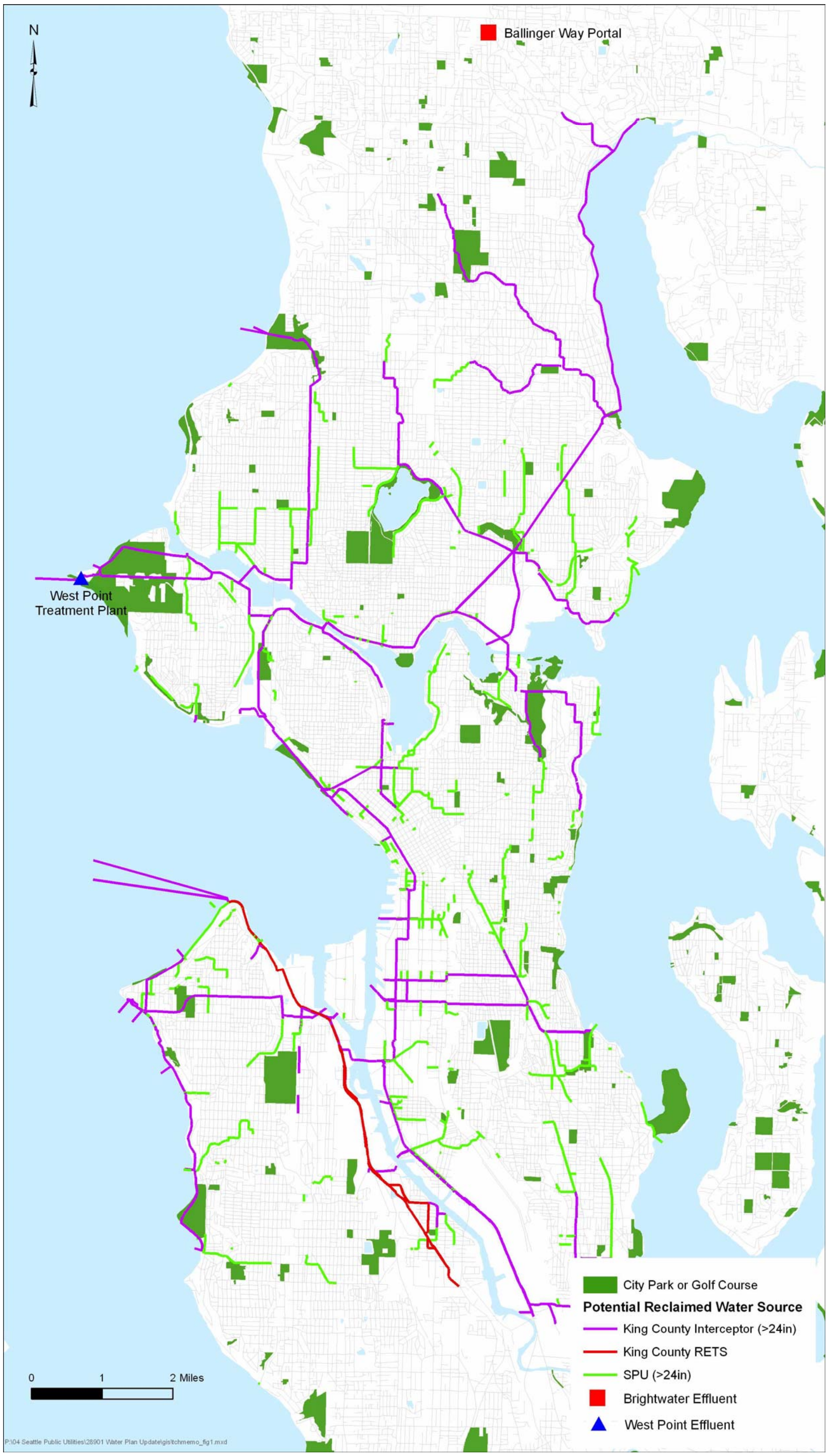


Figure 1. Potential Reclaimed Water Sources

IDENTIFICATION OF RECLAIMED WATER OPPORTUNITIES IN SEATTLE SERVICE AREA

In order to identify reclaimed water opportunities in the Seattle service area, potential reclaimed water users were first identified. Appendix C describes the process for identifying potential users of reclaimed water. Out of the list of potential users, five opportunities for generating reclaimed water and distributing it to potential users were selected for further evaluation. These opportunities are as follows:

1. Catholic Calvary Cemetery
2. Jackson Park Golf Course
3. Urban Commercial Core/Myrtle Edwards Park
4. West Seattle Golf Course Reclaimed Wastewater Facility "A"
5. West Seattle Golf Course Reclaimed Wastewater Facility "B"

The five opportunities were selected because of their proximity to a reclaimed water source, the size of their demand, and a preliminary assessment of cost feasibility from the 2003 Study. Figure 2 shows the location of each of these opportunities in Seattle.

Three of the five opportunities originated from the 2003 Study projects. These opportunities generally had the lowest unit costs for producing reclaimed water. The least expensive project from the 2003 Study, the Birmingham Steel and the West Seattle Golf Course alternative, was not selected for further evaluation because the current owners, Nucor Steel, are not in a financial position to consider retrofitting their facilities to add reclaimed water treatment. The next three projects, West Seattle Golf Course Reclaimed Wastewater Facilities "A" and "B", and the Catholic Calvary Cemetery were carried forward. The next project that was considered is a project based on an expanded facility at the Myrtle Edwards Park. This facility is proposed to address the non-potable water needs of the projected residential and commercial development in the downtown/urban commercial core, as well as provide water for irrigation of the park. Finally, the Jackson Park Golf Course alternative was evaluated because it was identified by King County as a potential user of reclaimed water from the Brightwater reclaimed water backbone.

Some projects were not included in this evaluation because they were not considered "reclaimed water projects." For example, the Green Lake Wading Pool project was left out of the evaluation because the project involves using on-site wading pool water as its source water, rather than wastewater from the sanitary sewer. Such projects which use on-site water as their source water are considered "re-use" projects and are evaluated in SPU's water conservation planning program.

Brief descriptions of the reclaimed water projects are provided below. All components of the projects would need to meet the September 1997 Washington State Departments of Heath and Ecology Water Reclamation and Reuse Standards, and all updates and revisions. For the facilities described below, all would need to treat water to "Class A" standards, as defined in Chapter 90.46 in the Revised Code of Washington.

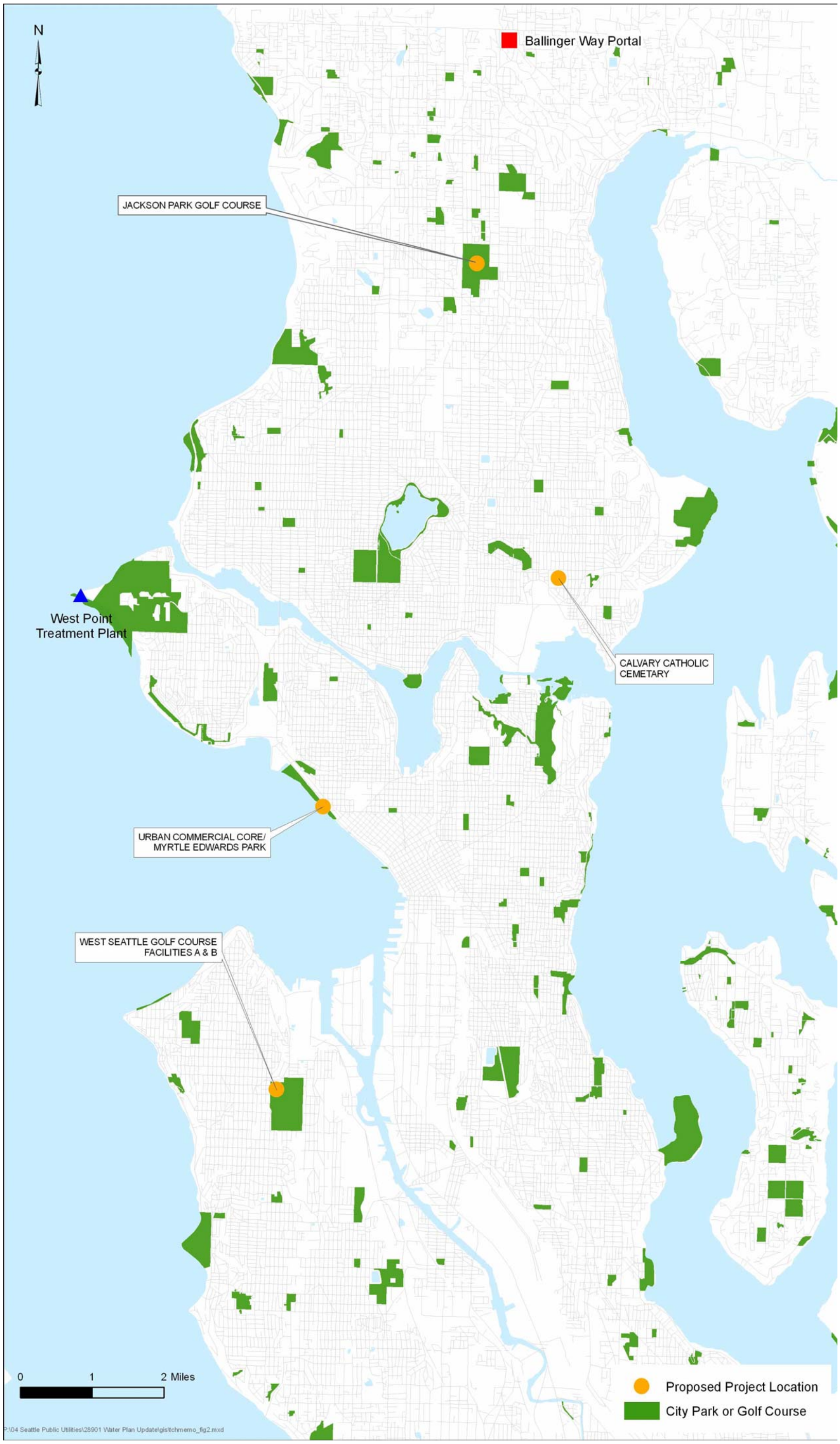


Figure 2. Reclaimed Water Opportunities in Seattle

Calvary Catholic Cemetery

This project was presented in the 2003 Study. As described in the Study, irrigation water for the cemetery would be replaced by reclaimed water treated by a MBR facility. This facility would draw raw sewage from a King County Interceptor adjacent to the cemetery. The facility would treat between 0.08 to 0.30 MGD and would meet all of the estimated irrigation demand of the cemetery. Since this facility is proposed for irrigation, it would run seasonally from June through October, which coincides with SPU peak water demands. In the 2003 Study, a location of the facility was not identified. The feasibility and cost estimate assumed a suitable site could be acquired. Refer the 2003 Study for additional information. For the evaluation of reclaimed water project opportunities for the 2007 Water System Plan update, the 2003 Study cost estimate, which was in 2002 dollars, was updated to 2005 dollars using the assumptions summarized on Appendix D - Table 1. Table 5 summarizes the costs associated with this reclaimed water alternative.

Jackson Park Golf Course

This project was proposed by King County in the *Reclaimed Water Backbone Project White Paper*, (King County DNR, March2006). Distribution facilities would need to be constructed, funded and maintained by SPU. A pump station will be located near the proposed Ballinger Way Portal where treated Brightwater effluent would be available. A distribution system would be constructed to convey the reclaimed water to the Jackson Park Golf Course. In the white paper, King County provided a demand estimate for the golf course, based on an assumed area of irrigation, a five month irrigation season, an agronomic application rate and an irrigation efficiency. This season was assumed to occur from June through October. SPU estimates the demand for golf courses, when accounting for the actual area irrigated and a turf application rate, is 33% of the King County demand. Actual use at Jackson Park is estimated because the golf course currently draws its irrigation water from Thornton Creek, and this is not metered.

Refer the Appendix E for project specific information on this reclaimed water alternative. Although costs for the pipeline from the Ballinger Way Portal to the golf course could potentially be shared between SPU and potential Shoreline reclaimed water users, it was conservatively assumed that SPU would pay for all the costs of a pipeline sized to handle only the golf course's water demands. Table 5 summarizes the costs associated with this reclaimed water alternative based on SPU's demand estimates. If King County's demand estimates are used instead of SPU's, the costs of the project double due to the increased size of the conveyance facilities. Application of reclaimed water on the Jackson Park Golf Course has a notable environmental concern, in that reclaimed water irrigation runoff could potentially flow into Thorton Creek, which is a salmon spawning creek. This could raise concerns regarding the impacts of endocrine disrupters on the salmon population.

Urban Commercial Core/Myrtle Edwards Park

A project for irrigating Myrtle Edwards Park was presented in the 2003 Study. The scope of this potential facility was expanded to include commercial and residential uses (primarily toilet flushing) in the downtown/urban commercial core area of Seattle, which is expected to experience significant development over the next 25 years.

Irrigation and toilet flushing water could be replaced by reclaimed water treated by a MBR facility located in Myrtle Edwards Park. This facility would draw raw sewage from a King County Interceptor adjacent to the park. The facility would treat between 0.58 to 0.61 MGD and would meet all of the estimated irrigation demand of Myrtle Edwards Park and the estimated toilet flushing water demands to accommodate growth projections outlined in the Comprehensive Plan (City of Seattle, 2005). The facility would operate year-round, and peak usage would occur during the summer months when Myrtle Edwards Park is irrigated.

Reclaimed water from the MBR facility would be distributed via reclaimed water pipelines to the users. Most users would require dual-piping inside their facility to distribute the reclaimed water inside their site. The project would consist of the following three components:

1. Reclaimed water facility (to treat wastewater and generate reclaimed water) at Myrtle Edwards Park
2. Reclaimed water distribution system piping on City roads (to distribute reclaimed water to the buildings or parks)
3. Internal dual-plumbing in buildings or parks

A cost estimate for this project was prepared and is provided in Appendix D - Table 1. The cost estimate does not include the costs of installing dual-plumbing inside buildings. It is assumed that this cost will be paid for by developers[6]. Table 5 summarizes the costs associated with this reclaimed water alternative. Appendix F provides more project specific information for the alternative.

West Seattle Golf Course Reclaimed Wastewater Facility "A"

This project was presented in the 2003 Study. As described in the Study, irrigation water for the West Seattle Golf Course would be replaced by reclaimed water treated by a membrane bioreactor facility (MBR). This facility would draw raw sewage from an SPU Wastewater Collection System adjacent to the golf course. The facility would treat 0.04 to 0.15 million gallons a day (MGD) to meet part of the estimated irrigation demand of the golf course, with the remaining demand supplied by the potable water system. Since this facility is proposed for irrigation, it would run seasonally from May through October, which coincides with SPU peak demands. Refer the 2003 Study for additional information. For the evaluation of reclaimed water project opportunities for the 2007 Water System Plan update, the 2003 Study cost estimate, which was in 2002 dollars, was updated to 2005 dollars using the assumptions summarized on Appendix D - Table 1. Table 5 summarizes the costs associated with this reclaimed water alternative. Application of reclaimed water on the West Seattle Golf Course has a notable environmental concern, in that reclaimed water irrigation runoff could potentially flow into Longfellow Creek, which is a salmon spawning creek. This could raise concerns regarding the impacts of endocrine disrupters on the salmon population.

West Seattle Golf Course Reclaimed Wastewater Facility "B"

This project was presented in the 2003 Study. As described in the Study, irrigation water would be replaced by reclaimed water treated by a MBR facility. This facility would draw raw sewage from a King County Interceptor adjacent to the golf course. The facility would treat between 0.04 to 0.40

[6] Currently, there are no incentives or regulatory requirements that would encourage developers to install dual-plumbing. If SPU chooses to pursue this opportunity, incentives or regulatory requirements for installing dual-plumbing in new developments should be considered (see Implementation Considerations).

MGD and would meet all of the estimated irrigation demand of the golf course. (This facility has a higher treatment capacity than Facility "A", which will only meet part of the irrigation demand.) Since this facility is proposed for irrigation, it would run seasonally from May through October, which coincides with SPU peak demands. Refer the 2003 Study for additional information. For the evaluation of reclaimed water project opportunities for the 2007 Water System Plan update, the 2003 Study cost estimate, which was in 2002 dollars, was updated to 2005 dollars using the assumptions summarized on Appendix D - Table 1. Table 5 summarizes the costs associated with this reclaimed water alternative. Similar to the West Seattle Golf Course Facility "A" alternative, this alternative would raise concerns regarding the potential impact of endocrine disrupters on the salmon population in Longfellow Creek.

All five projects were developed based on the current understanding of user demands. SPU is currently working will all the City's golf courses to evaluate efficiency improvements. Conservation efforts and improvements in efficiency could affect the golf course water needs and affect the project cost estimates.

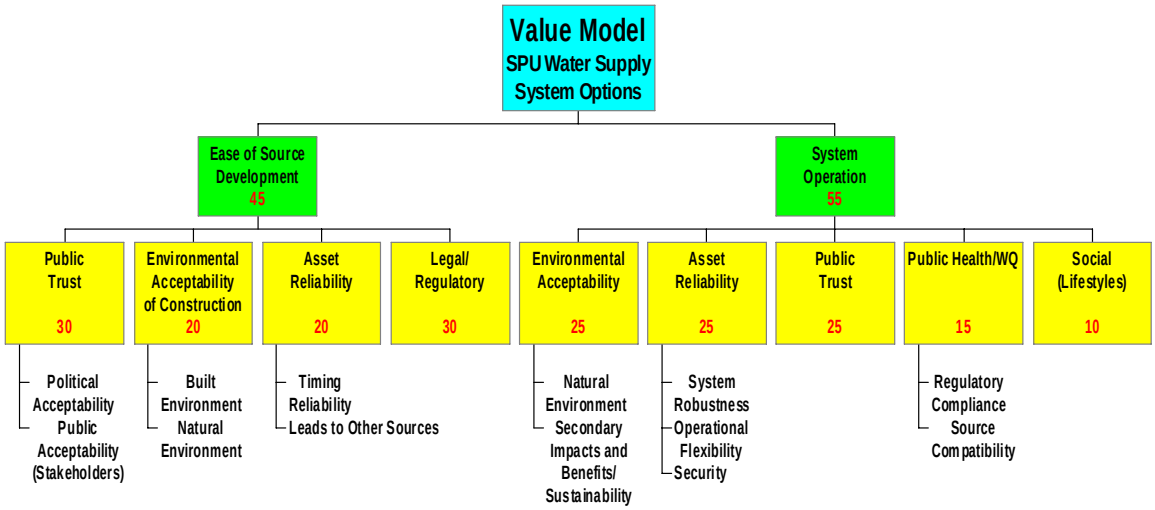
Table 5
Project Summary

Alternative	Average Annual Supply (MGD)	Average Daily Quantity (MGD)	Annual Treatment Volume (MG)	Pre-Construction[7] (includes Land Acquisition)		Design		Construction[8]		Annual Operations and Maintenance[9]	Levelized Cost ($/ccf)	Special Requirements
				Years	Costs	Years	Costs	Years	Costs			
1) Catholic Calvary Cemetery	0.04 June thru October	0.08-0.30	16	1.25	$656,000	1	$614,000	1.5	MBR $3,992,000 20-yr useful life Pumps $141,000 15-yr useful life Other $93,000 100-yr useful life Total: $4,226,000	$74,000/yr	$20.57	• Assumes MBR facility life of 20 years. • Assumes pumps will be replaced on the 15th year and MBR will be replaced on the 7th and 14th year.
2) Jackson Park Golf Course	0.1 June thru October	0.23	36	1	$585,000	1	$1,220,000	1.5	Pumps $322,000 15-yr useful life Other $6,861,000 100-yr useful life Total: $7,183,000	$182,000/yr	$12.63	• Assumes pumps will be replaced on the 15th year . • Assumes that King County will charge $1.35 per CCF for reclaimed water. (included in the Annual O&M costs)
3) Urban Commercial Core/Myrtle Edwards Park	0.4 Year-round, and seasonal	0.58-0.61	145	1.5	$1,004,000	1.5	$6,264,000	2	MBR $9,926,000 20-yr useful life Pumps $546,000 15-yr useful life Other $27,743,000 100-yr useful life Total: $38,215,000 Cost for dual plumbing in buildings not included	$175,000/yr	$13.66	• Assumes MBR facility life of 20 years. • Assumes distribution system life of 100 years. • Assumes pumps will be replaced on the 15th year and MBR will be replaced on the 7th and 14th year.
4) West Seattle Golf Course Reclaimed Wastewater Facility "A"	0.05 May thru October	0.04-0.15	20	1	$135,000	1	$435,000	1.5	MBR $2,772,000 20-year useful life Pumps $144,000 15-year useful life Other $74,000 50-yr useful life Total: $2,990,000	$70,000/yr	$11.55	• Assumes MBR facility life of 20 years. • Assumes pumps will be replaced on the 15th year and MBR will be replaced on the 7th and 14th year.
5) West Seattle Golf Course Reclaimed Wastewater Facility "B"	0.06 May thru October	0.04-0.40	23	1.25	$198,000	1	$794,000	1.5	MBR $5,057,000 20-year useful life Pumps $148,000 15-year useful life Other $259,000 50-yr useful life Total: $5,464,000	$107,000/yr	$17.56	• Assumes MBR facility life of 20 years. • Assumes pumps will be replaced on the 15th year and MBR will be replaced on the 7th and 14th year.

[7] Pre-Construction activities include environmental and engineering studies, water rights applications, permitting, land acquisition, and SEPA (EIS) compliance.
[8] Construction activities include construction, construction management, engineering support, environmental controls and mitigation work.
[9] Increased costs for treatment, transmission, and storage, as well as costs for maintaining/protecting new source facilities. Also includes annualized value of replacing key components during life of project.

EVALUATION OF RECLAIMED WATER OPPORTUNITIES IN SEATTLE SERVICE AREA

The five opportunities described in the previous section were evaluated in relation to the other supply alternatives available to SPU. This evaluation uses a methodology developed to analyze water supply alternatives as part of an update to SPUs water system plan[10]. It considers the unit cost of additional supply provided, as well a "value score" that captures the non-monetary benefits or impacts associated with each alternative. The value scores were determined using sixteen criteria related to social and environmental aspects of source development and system operation. The evaluation criteria are shown in the value model structure below. The numbers shown in red represent the relative weights applied to each of the criteria.



The projects were given performance scores ranging from a low of 1 (negative impacts) to a high of 5 (positive impacts) for each criterion. Appendix G provides the performance scores for each of the projects. A weighting scheme that expresses the relative importance of each criterion was applied to the performance scores to determine a single value score ranging from 0.0 (worse score) to 1.0 (best score) for each of the five projects.

Figure 3 shows the contribution from each criterion to the final score for the reclaimed water projects, along with SPU's other supply alternatives. The reclaimed water projects all have value scores in the middle of the scale, although Urban Commercial Core/Myrtle Edwards Park scored the lowest. Sensitivity analysis indicates that the relative scores and levels do not change significantly if the weights for any of the categories are varied.

[10] CH2M HILL. "SPU Water Supply Planning Model." April 2006.

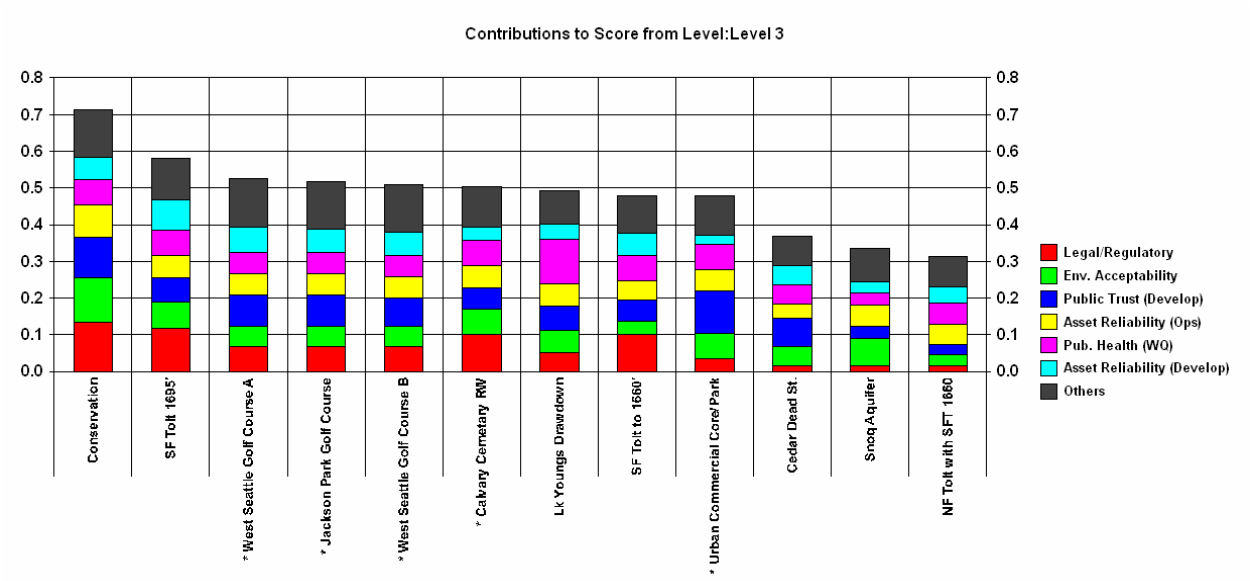
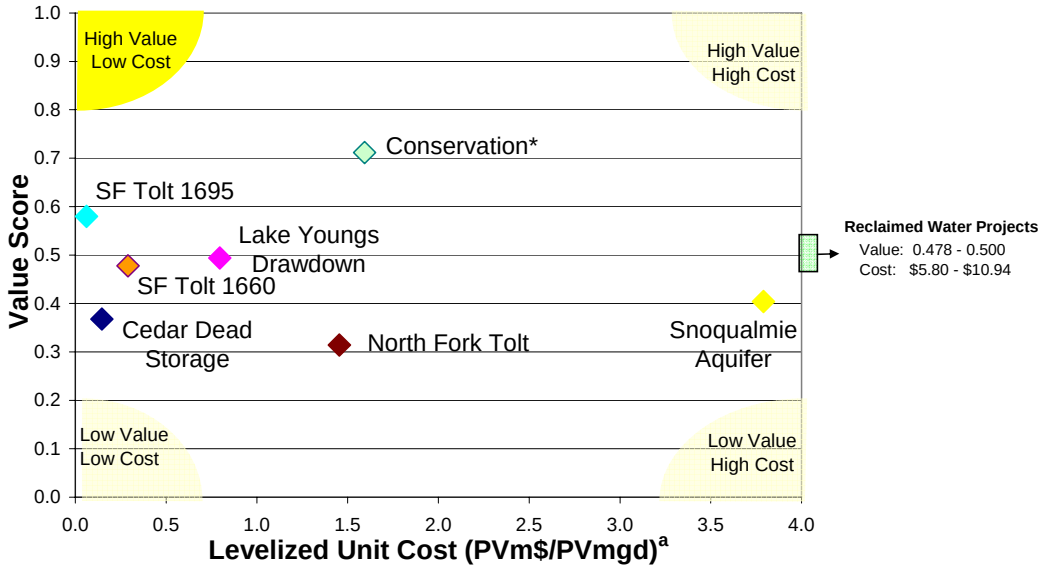


Figure 3 – Value Score Components

The value scores and levelized unit cost of the reclaimed water projects were compared against SPU's other drinking water supply alternatives, including conservation, as shown in Figure 4 and Appendix G. Preferred alternatives are in the high value, low cost quadrant (upper, left hand area) of the graphic. The reclaimed water projects all have levelized unit costs greater than the other alternatives analyzed. Conservation, South Fork Tolt Drawdown and Lake Youngs Drawdown have approximately the same value or higher, and at much lower costs, and would be preferred over any of the reclaimed water projects.



[a]Calculated assuming all sources online in 2050.
*4 mgd conservation program begins in 2045 and phases in over a 10-year period.

Figure 4 – Value Score vs. Levelized Unit Cost for Alternatives

Another important factor to point out when considering reclaimed water projects as viable supply alternatives is the quantity of water provided. The total amount of water provided by the four project locations is 0.6 MGD on an average annual basis. This is about 0.3% of SPU's current supply and significantly lower than the amount expected from other supply alternatives (Figure 5).

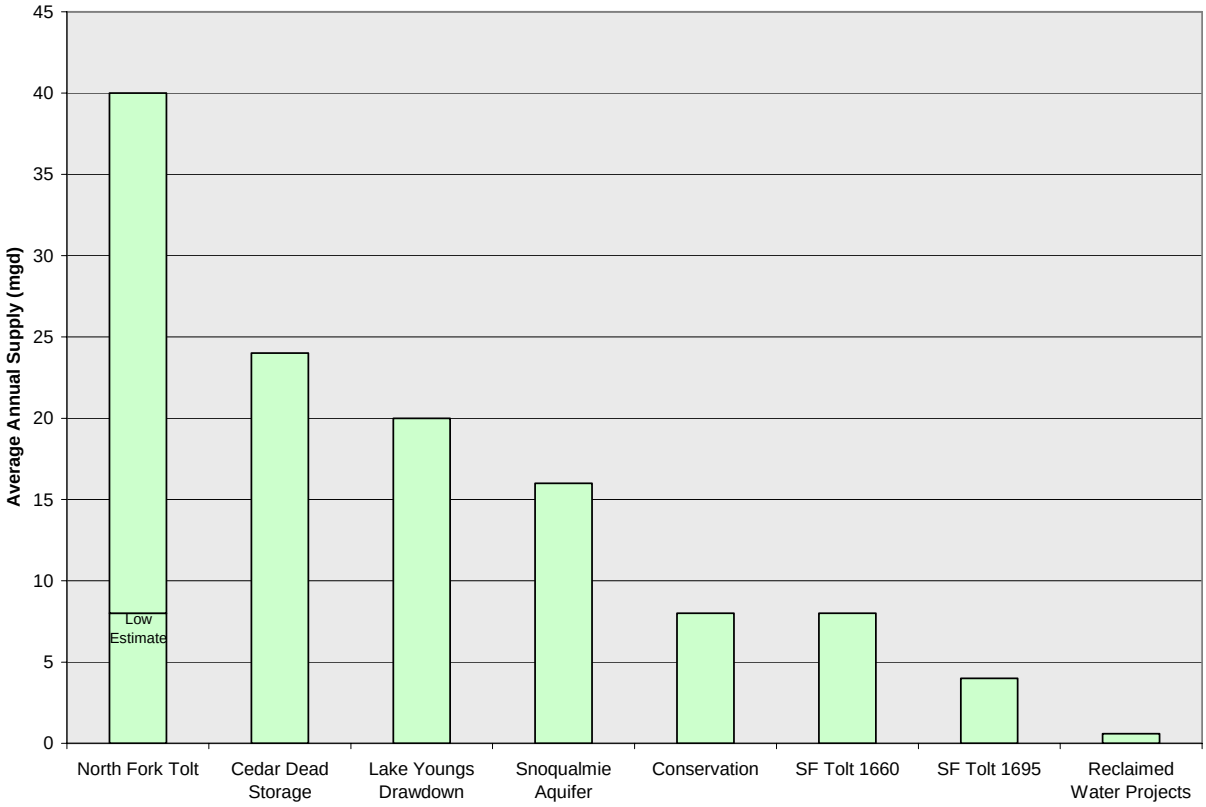


Figure 5 – Supply Provided by Alternatives

RECOMMENDED RECLAIMED WATER PROJECTS IN SEATTLE SERVICE AREA

Based on the evaluation described above, none of the reclaimed water alternatives discussed are currently considered as viable supply alternatives for SPU. This is due to the very high unit costs of these projects. Also, the small quantity of water would do little to offset future water demands in the SPU service area

The project costs for the Urban Commercial Core/Myrtle Edwards Park included an MBR facility as well as a lengthy distribution system throughout downtown Seattle. If the costs of the distribution system could be paid by others (e.g. developers[11]), then the cost of this alternative for SPU could drop significantly. Another opportunity for decreasing the costs of this alternative would be to install portions of the distribution system when other underground piping is being installed or

[11] Currently, there are no incentives or regulatory requirements that would encourage developers to install dual-plumbing and reclaimed water distribution piping. If SPU chooses to pursue this opportunity, incentives or regulatory requirements for installing dual-plumbing and distribution piping should be considered (see Implementation Considerations).

maintained. Similarly, the costs of the Jackson Park Golf Course alternative could be significantly reduced if the cost of the pipeline from the Ballinger Way Portal to the golf course could be shared with the potential users in the City of Shoreline. However, current efforts to improve irrigation efficiency would make this alternative less attractive.

IMPLEMENTATION CONSIDERATIONS

If SPU elected to implement any of these projects, there are a number of other issues that should be considered. These range from legislative issues to public concerns, coordination with other agencies such as King County, coordination with users, and the acquisition of land or easements to site the facilities. The following section briefly describes each of these implementation considerations.

Legislation

Water Reclamation and Reuse Standards and the City of Seattle Resolution should be considered and adhered to in the implementation of any of the reclaimed water opportunities.

Public concerns

As stated earlier, some projects in California were never implemented due to overwhelming public concerns. Projects would also need to take all the necessary precautions to ensure that the reclaimed water is used as intended.

Coordination with King County

Three of the projects propose using a King County Interceptor as the reclaimed water source. SPU would need to work with King County to determine if sewer scalping is possible. These projects would require coordination during the design phases to ensure the proposed facility is compatible with King County's distribution system operation and maintenance. A fourth project proposes using Brightwater effluent. SPU would need to work with King County to determine how the effluent would be extracted from the Ballinger Way Portal and what system limitations, if any, would exist. Ownership of the sewage effluent, the subsequent ownership of reclaimed water treatment and distribution facilities, the cost recovery of investments, and the avoidance of stranded SPU costs for existing service, will require close coordination between SPU and the County.

Coordination with users

All of the projects would require coordination with the end users. This coordination would need to occur during the facility siting and design to ensure the facility fits with their site uses and that the tie-into can be constructed. Also, for seasonal projects the facility operational schedule would need to be coordinated. The Urban Commercial Core/Myrtle Edwards project would require more coordination efforts, since there would be a larger number of end users. This project would require coordination with contractors installing internal dual plumbing and tapping into the reclaimed water distribution system. In addition, incentives or regulatory requirements infrastructure development and subsequent reclaimed water use would likely be needed to ensure usage.

Land acquisition

Some of the proposed projects are located on municipal golf courses (West Seattle Golf Course Reclaimed Wastewater Facilities "A" and "B") and Seattle parks (Myrtle Edwards Park). These projects would not require land acquisitions for the facility. Land would need to be acquired for the Jackson Park Golf Course pump station. A site for this facility has not been located. Easements may be necessary for the sewer scalping for the West Seattle Golf Course and the Urban Commercial Core/Myrtle Edwards projects. Easements may also need to be acquired for the Jackson Park Golf Course and Urban Commercial Core/Myrtle Edwards distribution systems. A site for the Catholic Calvary proposed facility has not been located. To implement this project a treatment site would need to be located and acquired. .

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APPENDICES

A – City of Seattle Resolution Number 30454
B – Reclaimed Water Use Nationally
C – Potential Reclaimed Water Users
D – Reclaimed Water Opportunities Cost Estimate
E – Urban Commercial Core/Myrtle Edwards project information
F – Jackson Park Golf Course project information
G – Reclaimed Water Projects Evaluation

APPENDIX A
City of Seattle
Resolution Number 30454

City of Seattle Legislative Information Service

Information updated as of April 18, 2002 11:04 AM

Resolution Number: h0h230454

A RESOLUTION relating to the City of Seattle's interest in the beneficial reuse of wastewater and reclaimed rainwater; setting policies related to wastewater reuse and rainwater reclamation; and calling for the development of pilot projects and the full and careful study of the public health and environmental impacts of wastewater reuse and rainwater reclamation.
Date introduced/referred: Mar 25, 2002
Date adopted: Apr 15, 2002
Status: Adopted As Amended
Vote: 9-0

Committee: Water and Health
Sponsor: PAGELER
Index Terms: STATING-POLICY, WATER-SUPPLY, CONSERVATION
Text

Note to users: {- indicates start of text that has been amended out
-} indicates end of text that has been amended out
{+ indicates start of text that has been amended in
+} indicates end of text that has been amended in

A RESOLUTION relating to the City of Seattle's interest in the beneficial reuse of wastewater and reclaimed rainwater; setting policies related to wastewater reuse and rainwater reclamation; and calling for the development of pilot projects and the full and careful study of the public health and environmental impacts of wastewater reuse and rainwater reclamation.

WHEREAS, the City of Seattle has an interest in promoting the cost-effective conservation and efficient use of natural resources, including existing drinking water supplies and in developing cost-effective and environmentally responsible alternative sources of water supply; and

WHEREAS, the citizens of the City and the Puget Sound region desire the most secure and reliable water supply system possible; and

WHEREAS, the City and its partners in the Central Puget Sound Water Suppliers' Forum, have examined regional and long-term water supply issues, including wastewater reuse, in the course of developing a Regional Water Supply Outlook; and

WHEREAS, the State of Washington, through the enactment of RCW 90.46 has encouraged the development of wastewater reclamation for a variety of beneficial uses by providing for the funding of demonstration projects through the Department of Ecology; and

WHEREAS, the use of either reclaimed wastewater or rainwater as a substitute for potable water in some industrial, sanitation and irrigation applications could increase regional water supply system reliability while helping to preserve and protect our high-quality drinking water supplies; and

WHEREAS, in many areas of the City, rainwater runoff from roofs and other impervious surfaces is discharged directly into the sewer system; and

WHEREAS, the capture of rainwater from roofs and other impervious surfaces may also provide a supply of water for uses such as landscape irrigation and toilet flushing in place of drinking water, thereby decreasing the demand on the City's existing drinking water supplies; and

WHEREAS, the use of collected rainwater for landscape irrigation during the late spring and early summer months when lawn and garden water demand increases could help the City and the region meet water conservation goals by lowering demand on existing drinking water supplies; NOW, THEREFORE,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SEATTLE, THE MAYOR CONCURRING, THAT:

Section A. City of Seattle Water Reuse and Reclamation Policies

1) The City, through its Comprehensive Plan, sustainable building program and its commitment to Leadership in Energy and Environmental Design (LEED) standards, encourages the efficient use of all resources.

2) The City is committed to wastewater reuse and rainwater reclamation where they can serve as cost-effective and environmentally beneficial sources of water for industrial processes, sanitation and irrigation and thereby increase the security and reliability of the City's and the region's drinking water supplies.

3) In analyzing the cost-effectiveness of potential water reuse and/or reclamation projects, Seattle Public Utilities (SPU) shall use the methodology now in place for assessing the cost-effectiveness of water conservation projects within the City of Seattle under the Saving Water Partnership (also known as the 1% per year conservation program), and shall pursue only projects or programs that compete favorably by that standard.

(a) In considering the cost-effectiveness of a water reuse or

reclamation project, the cost of the project shall be the full cost of producing and delivering the appropriate class of reclaimed water, including capital investments and operational costs.

(b) If reused water is to be purchased from an external supplier, the price paid shall be negotiated but the determination of the cost-effectiveness of the project shall be made based on the full cost of the reclaimed water as outlined in 3(a).

(c) Any water reuse or reclamation projects shall be designed and timed in such a manner as to avoid creating significant stranded water supply costs that would be borne by the remaining water ratepayers.

(d) This policy shall not apply to demonstration projects developed in 2003-2004 for the joint purposes of: i) educating the public about water reuse and reclamation and ii) developing and testing new technologies.

4) In developing wastewater reuse projects and programs, SPU (and other City agencies when involved) shall consult with the Washington State departments of Health and Ecology and U.S. Environmental Protection Agency (EPA) and other appropriate agencies, recognizing that regulations regarding reused or reclaimed waste water and rainwater are still being developed and at this time may be unclear or ambiguous in their application.

5) SPU shall monitor closely scientific and regulatory developments (including but not limited to the U.S. EPA's most current revision of reused water quality standards) regarding the risks associated with heavy metals, chemicals, residual pharmaceuticals and endocrine disruptors (separately and in combination) that may be present even in highly processed wastewater, and shall avoid actions that may result in the release of these residual substances into freshwater streams and lakes where they may be harmful to aquatic life, or where they would pose any risks to human health. Until there is more scientific certainty about treatment effectiveness or soil adsorption of such residual compounds, SPU shall take the following steps before developing projects that result in the use of reclaimed wastewater for irrigating parks or golf courses through which salmon-bearing streams flow:

(a) Identify the source of reclaimed water to be used for the project;

(b) Identify the treatment technology to be used, treatment capabilities and current applications of that technology;

(c) Measure the levels of both regulated and unregulated contaminants in the reclaimed water after treatment; and

(d) Identify and evaluate the manner in which the reclaimed water will be applied for the irrigation project in question and develop a monitoring program to demonstrate and ensure the safety of these practices.

(e) Submit the proposed irrigation project to a peer review panel composed of water quality experts from the USGS Toxic Substances Hydrology Program, the Washington State Department of Health and either the US Environmental Protection Agency or the Washington State Department of Ecology for an independent evaluation and a recommendation on whether to proceed with the proposed irrigation project.

6) Any demonstration or pilot projects and any other projects that may follow shall be developed in accordance with all applicable federal, state and local laws and regulations. Any reuse or reclamation project that is proposed to take place within five years from the effective date of this resolution shall be submitted to the City Council for review and approval.

Section B. Water Reuse and Reclamation Work Program

1) Survey of Water Reuse and/or Reclamation Opportunities

The City, through SPU, shall undertake and complete by the end of 2002 a survey of near-term water reuse/reclamation opportunities within the City of Seattle, including projects that can be developed by SPU alone or by SPU in partnership with other government agencies, King County Department of Natural Resources (DNR) or with private businesses, either as co-funders or as customers.

The survey of reuse/reclamation opportunities shall include projects involving highly treated wastewater and rainwater capture, shall analyze the drinking water conservation potential for each project and the costs and benefits of each (including quantifiable environmental benefits and benefits to other systems such as drainage), and shall rank them according to the greatest benefit per dollar.

2) Demonstration Project(s)

SPU, working in collaboration with other government agencies and private businesses where practical, shall, by the end of 2002, identify demonstration projects, at least one involving wastewater reuse and at least one involving rainwater reclamation, which will allow the City to test methodologies for and educate the public about water reuse and reclamation. The pilot projects to be selected will come from among the projects identified in Attachment A. SPU shall

present to the City Council a proposed funding plan or plans for the pilot projects identified, that includes a proposed cost allocation for each project on a case-by-case basis.

3) Proposed Code Revisions to Encourage Reuse and Reclamation

Insofar as the City supports the development and application of cost effective and environmentally beneficial wastewater reuse and rainwater collection programs and technologies and the removal of barriers to such development, SPU shall recommend to the City Council proposed changes to the City's land use and building codes that may be desirable in order to encourage the promotion of these programs and technologies.

Adopted by the City Council the _____ day of _____, 2002, and signed by me in open session in authentication of its adoption this _____ day of _____, 2002.

_____
President _____of the City Council

THE MAYOR CONCURRING:

_____
Mayor

Filed by me this _____ day of _____, 2002.

_____
City Clerk

Attachment A: Pilot Projects to be considered for Development and Implementation
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March 25, 2002
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Attachment A

Pilot Projects to be considered for development and implementation

Wastewater reuse opportunities

South Seattle Community College (SSCC) - Installation of an on-site membrane bioreactor treatment plant which would collect and convert raw sewage into class "A" water to serve irrigation needs of SSCC gardens.

South Transfer Station - Installation of a tertiary treatment facility, most likely a sand filter, which would divert treated

wastewater effluent from the Renton Treatment Plant effluent transmission line to the site for various uses. The facility would provide class "A" water for use at the transfer station, water that trucks would use to flush SPU sewer lines in the southern portion of Seattle, and possibly nearby bus washing needs for an adjacent and privately owned bus barn.

Rainwater reclamation opportunities

Sand Point Building #30 - Rooftop rainfall collection system. Water will be stored and conveyed to gardens/ballfields for summer irrigation. Sandpoint Building #30 will be re-roofed late Summer 2002 and the gardens adjacent to the building will be planted in Summer 2002.

Residential Rainfall Harvesting - A residential rainfall-harvesting example will be examined. A "pilot" program of installing 6-10 residential rainfall harvesting systems for monitoring may likely be recommended.

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APPENDIX B
RECLAIMED WATER USE NATIONALLY

According to the WateReuse Association, 90 percent of reuse in the United States takes place in Arizona, California, Florida and Texas. Many other states, however, recognize the need to consider reclaimed water as a water source (AWWA, 2004). A number of factors drive this need:

- Arid climates and lack of water resources;
- Drought;
- Water conservation as a regulatory requirement;
- Population growth and increasing demand;
- More stringent wastewater treatment requirements (i.e. for the protection of aquatic species);
- Technological advancements leading to reduced costs of reclaimed water; and
- Having a dependable nonpotable water source at a predictable cost.

Some of the obstacles that have been encountered when trying to implement reclaimed water projects are:

- Economic infeasibility;
- End user concerns with on-site conversion costs;
- Perception of potential health risks; and
- Gaining public acceptance.

There are other obstacles that projects have had to overcome. In some instances, dual piping for domestic use has been difficult to implement due to concerns about cross connections. Also, avoiding the creation of mosquito breeding grounds needs to be addressed when designing reclaimed water infiltration ponds.

Allowable uses of reclaimed water are based on the quality of the effluent. Each state's standards determine the effluent quality requirements.

Arizona

Reclaimed water is used for the irrigation of golf courses, landscapes, crops, parks, and siviculture, as well as wetlands enhancement. In addition, Arizona Department of Water Resources has a program to encourage water conservation through aquifer storage and recharge (ASR). Projects can receive Long Term Storage Credits for water used to recharge aquifers. These credits can be used after at least a year of storage, when the owner needs water. Due to the lack of water supplies and the increases in demand, reclaimed water will continued to be used as a water source in Arizona (AWWA, 2004).

California

According to a 2002 study conducted by the State Water Resources Control Board (SWRCB), California is currently recycling approximately 500,000 acre-feet of water annually. Table 1 and Figure 1 show the types of uses within the state. The long term goal of the 2002 California Recycled Water Task Force is to triple the amount of reuse by 2020 (AWWA, 2004).

Table 1
2002 Volume of Reclaimed Water Use in California

Types of Water Reuse	Volume (acre-feet/year)
Agricultural irrigation	240,951
Landscape and irrigation	111,100
Industrial Use	27,857
Ground water recharge	49,033
Seawater Barrier	25,651
Recreational Impoundment	33,103
Wildlife habitat or misc.	20,200
Geysers/Energy Production	2,198
Other or mixed type	15,369
Total	**525,462**

Source: Office of Water Recycling, California State Water Resources Control Board

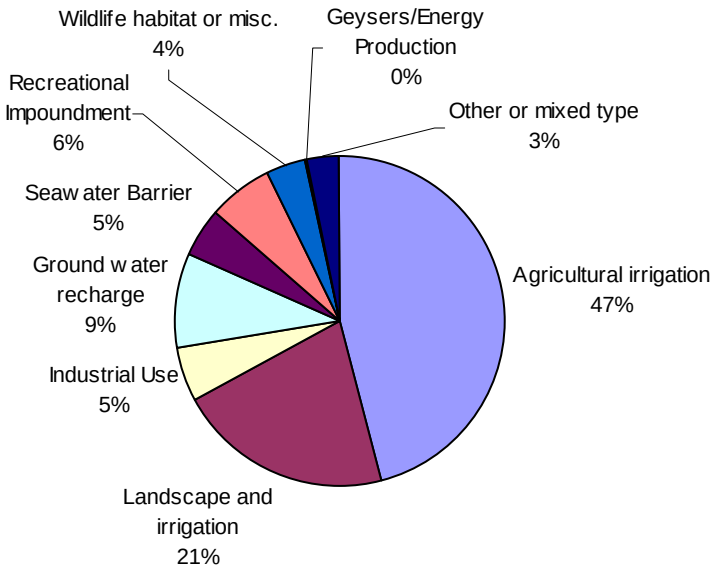


Figure 1
2002 Reclaimed Water Usage in California

Some projects in the state have been difficult to implement. For example, in 1999 the City of San Diego stopped plans for an indirect potable use of reclaimed water, due to questions about public safety and concerns that water would only be supplied to low income neighborhoods (Lee, 2005). Similarly, in 2002 the Dublin San Ramon Service District decided to use reclaimed water for landscape irrigation, instead of an ASR project in potable water groundwater basin. In other parts of the state, these projects have been easier to implement. For example, Orange County Water District is currently constructing an ASR project where reclaimed water will be injected in potable water groundwater basin (Lee, 2005). San Diego, which imports up to ninety percent of its drinking water, is still hoping to gain public acceptance for this type of project,

Florida

Water reuse systems have been developing in Florida for the last 20 years. Initially, reclaimed water was given away. Now there are hundreds of reuse projects (Table 2 and Table 3) and many of the communities that have developed systems are selling the water for as much as 80 percent of the cost of potable water.

Table 2
Summary of Florida Treatment/Reuse Facilities

Water Management District	No. of Treatment Facilities	No. of Reuse Systems	No. of Residences Irrigated	No. of Golf Courses Irrigated	No. of Parks Irrigated	No. of Schools Irrigated
Northwest Florida	53	52	821	22	4	1
South Florida	112	110	66,569	153	79	26
St. Johns River	143	135	43,260	118	148	72
Suwannee River	22	22	0	2	0	0

Table 2
Summary of Florida Treatment/Reuse Facilities

Water Management District	No. of Treatment Facilities	No. of Reuse Systems	No. of Residences Irrigated	No. of Golf Courses Irrigated	No. of Parks Irrigated	No. of Schools Irrigated
Southwest Florida	138	121	64,612	148	277	126
2004 Totals	**468**	**440**	**175,262**	**443**	**508**	**225**
2003 Totals	469	436	154,234	427	486	213
% Change	-0.21	+0.92	+13.6	+3.7	+4.5	+5.6

SOURCE: Florida Department of Environmental Protection, 2004 Reuse Inventory

Table 3
Summary of Florida Water Reuse Activities

Water Reuse Type	Number of Systems (1)	Reuse Capacity (MGD)	Reuse Flow (MGD)	Percent of Total
Public Access Areas and Landscape Irrigation				
Golf Course Irrigation	186	255.06	112.63	
Residential Irrigation	99	233.41	132.64	
Other Public Access Areas	101	135.67	63.85	
Subtotal	386	624.14	309.12	49
Agricultural Irrigation				
Edible Crops	19	46.87	14.71	
Other Crops	108	145.65	72.77	
Subtotal	127	192.52	87.48	14
Ground Water Recharge & Indirect Potable Reuse				
Rapid Infiltration Basins	171	159.65	85.45	
Absorption Fields	16	8.58	3.75	
Injection	1	10.00	8.61	
Subtotal	188	178.24	97.81	16
Industrial				
At Treatment Plant	94	117.70	56.11	
At Other Facilities	22	56.10	34.93	
Subtotal	116	173.80	91.04	14
Toilet Flushing	5	0.32	0.18	< 1
Fire Protection	1	0.10	0.10	< 1
Wetlands	16	92.13	40.38	7
Other Uses	9	11.82	4.07	< 1
Totals	**440**	**1,273.07**	**630.18**	

SOURCE: Florida Department of Environmental Protection, 2004 Reuse Inventory

Many communities have "public access" reuse systems that deliver direct nonpotable water to residential homes for irrigation. Many counties and cities require new developments to install reuse systems for irrigation. Treatment plants are required to provide Class 1 reliability, filtration and high level disinfection to provide high quality effluent for reclaimed water.

The key drivers to reuse in Florida have been:

- Discontinuing the practice of discharging effluent (and nutrients) to surface water;
- Increasing demand brought on by growth and compounded by salt water intrusion resulting from heavy groundwater pumping in coastal areas; and
- Realizing that potable water is not necessary for irrigation.

Since many of the projects are for irrigation, one of the challenges has been how to address the seasonal fluctuations which create cyclic shortages and surpluses. Sometimes these surpluses require a wet season discharge permit.

Texas

Based on a 1998 Water Use Survey conducted by Texas Water Development Board, one hundred ninety utilities reported municipal reuse totaling approximately 160 MGD (Texas Water Development Board, 2001). Golf course irrigation, manufacturing and cooling towers were the primary uses. Most of the reuse is occurring in the western half of the state, which receives significantly less rain than the eastern half. Data on reuse in the industrial sector was provided by 81 corporations/industries. These indicate reuse of 32 MGD, which likely underestimates the actual reuse since not all industries using reclaimed water responded. The major industrial reuse is in power plants, refineries, food processors, and chemical manufacturing operations. In addition, there are also over 600 no-discharge permits in Texas. These prevent an operation (most often agricultural and livestock) from discharging wastewater from its site. Texas water supplies are becoming increasingly scarce and more expensive. The state water plans calls for using current sources of water instead of developing new sources (AWWA, 2004).

Hawaii

According to the State of Hawaii Water Reuse Project Directory from November 2004, there are 68 reuse projects with a capacity of approximately 20 MGD (Table 4). These projects include irrigation of golf courses, agriculture and landscapes (parks, libraries, highways and schools) and dust control and other construction activities.

Table 4
Summary of Hawaii Reuse Projects

Types of Water Reuse	Number of Projects	Volume (MGD)
Agricultural irrigation	8	4.50
Landscape and irrigation	46	13.43
Industrial Use	6	1.60
Toilet Flushing	1	0.00
Other or mixed type	7	0.62
Total	68	20.14

SOURCE: State of Hawaii Water Reuse Project Directory, November 2004

Washington

According to a Washington State Department of Ecology (Ecology) 2005 Study, by the end of 2004 seventeen facilities had been constructed or upgraded to operate under the state's reclaimed water standards (Ecology, 2005) . The drivers for these projects were:

- Elimination or decrease in wastewater discharges for environmental purposes (i.e. shellfish);

- Additional water supplies including drought resistant supplies;
- Growth;
- Having a nonpotable water supply for irrigation; and
- Construction of new wastewater facilities.

As water demands increase, reclaimed water may be evaluated as an option to decrease potable water usage since "development of new surface water and groundwater sources is becoming more lengthy, costly and uncertain, given the multiple demands being made on a finite resource. Stringent environmental, regulatory and legal requirements are involve in establishing water rights and developing new supply facilities. Moreover, Ecology requires that water suppliers demonstrate that water conservation efforts have been duly considered, developed, and implemented prior to the granting of additional water rights (King County, 1995)." Future reclaimed water projects may also be driven by local ordinances. For example, in the City of Yelm water reuse can be required for new construction.

APPENDIX C
POTENTIAL RECLAIMED WATER USERS

In order to identify reclaimed water opportunities in the Seattle service area, potential reclaimed water users were first identified. The process for identifying potential reclaimed water users was as follows:

1. Identify major water users (see Table C-1) in the City of Seattle, based on 2004 records and obtain usage data including billed water consumption and billed sewer flow.
2. Estimate annual nonpotable water demand by subtracting sewer flow from water consumption. This number was used as an estimate of potential reclaimed water use. Actual reclaimed water use would depend on the type of water consumption at each site (i.e. irrigation, process water, etc.).

The potential reclaimed water users are mapped on Figure C-1, based on the parcel identification number (PIN). Users without PIN numbers are not shown. Users are mapped according to the nonpotable water demand estimate. For users with no billed sewer consumption the demand was not estimated. These are mapped in the demand "Unknown" category. Any demand that was estimated to be less than 500 ccf (100 cubic feet) per year was also included in the demand "Unknown" category, assuming that the water and sewer consumption were too close to include in the nonpotable demand categories.

In addition to the major water users, the projects identified in the 2003 Wastewater Reclamation and Rainwater Harvesting Study are also shown on Figure C-1. They are mapped according to the demand estimates in the 2003 Study (Table C-2).

Table C-1.
Major Seattle Water Users

Customer Name
ALEXANDRIA REAL ESTATE
AMERICAN PRESIDENT LINES
AMGEN INC
ARCTIC ICE CREAM
ASH GROVE CEMENT
BALLINGER COMMONS APTS
BENTALL CITY CENTRE LLC
BOEING COMMERCIAL AIRPLANE GROUP
BPB GYPSUM INC
BROADVIEW DEV ASSOC II
CAROLINE KLINE
CHILDRENS HOSPITAL
EDGEWATER INN
EDWARD J DEBARTOLO CORP
ELLIOTT BAY MARINA INC
EOP-COLUMBIA CENTER LLC
EQUITY OFFICE
FAIRMONT OLYMPIC HOTEL
FRED HUTCHINSON CANCER RESEARCH CENTER
GROUP HEALTH COOPERATIVE
HARBOR PROPERTIES INC
HARBORVIEW MEDICAL CENTER
HINES INTEREST LIMITED PARTNERSHIP
HORIZON HOUSE INC
HOSPITAL CENT SERV
IMMUNEX CORP
KING COUNTY DEPT METRO SVCS
KING COUNTY FACILITIES MANAGEMENT
KING COUNTY HOUSING AUTHORITY
L C FOSS SUNSET HOME INC
LAFARGE CORPORATION
LAKE WASHINGTON APTS LTD
METROPOLITAN TOWER
NORTHWEST HOSPITAL
NUCOR STEEL SEATTLE INC
OCEAN BEAUTY SEAFOODS INC
PARK-REGENCY WASH INC
PEPSI BOTTLING GROUP

Table C-1.
Major Seattle Water Users

Customer Name
PGC INTERBAY LLC
PIKE PLACE MARKET
PINE STREET DEVELOPMENT LLC
PORT OF SEATTLE
PROVIDENCE - MT ST VINCENT
PROVIDENCE HOSPITAL
PYRAMID BREWERIES INC
R C HEDREEN LLC
RADFORD COURT PROPERTIES
SAINT GOBAIN CONTAINERS
SEAFREEZE LTD PARTNERSHIP
SEATTLE CROWNE PLAZA
SEATTLE HOUSING AUTHORITY
SEATTLE MARINERS
SEATTLE MUNICIPAL TOWER
SEATTLE PARKS DEPARTMENT
SEATTLE SHERATON HOTEL
SEATTLE STEAM COMPANY
SHOREWOOD APTS
STEVEDORING SERVICE OF AMERICA
STOUFFER MADISON HOTEL
SUNSET VIEW APTS
SWEDISH MEDICAL CENTER
THE HIGHLANDS INC
THE WESTIN HOTEL SEATTLE
TODD SHIPYARDS
U VILLAGE LTD PARTNERSHIP
UNION SQUARE LIMITED PARNERSHIP
UNIVERSITY OF WASHINGTON
V A MEDICAL CENTER (04)
VINTAGE PARK APTS
VIRGINIA MASON MEDICAL CENTER
W SEATTLE
WASH ATHLETIC CLUB
WASH STATE TRADE & CONVENTION CENTER
WESTFARM FOODS
WESTLAKE CENTER ASSN
WOODLAND PARK ZOOLOGICAL SOCIETY

Table C-2.
2003 Study Demand Estimates for
Potential Reclaimed Water Project

Customer Name	Nonpotable Demand Estimate, ccf
NUCOR STEEL	106,311
MYRTLE EDWARDS PARK	2,304
ARBORETUM	9,366
MUNICIPAL GOLF OF SEATTLE - WEST SEATTLE	31,048
SOUTH SEATTLE COMMUNITY COLLEGE	1,996
CALVARY CATHOLIC	20,812
SOUTH TRANSFER STATION	3480
GREEN LAKE	n/a

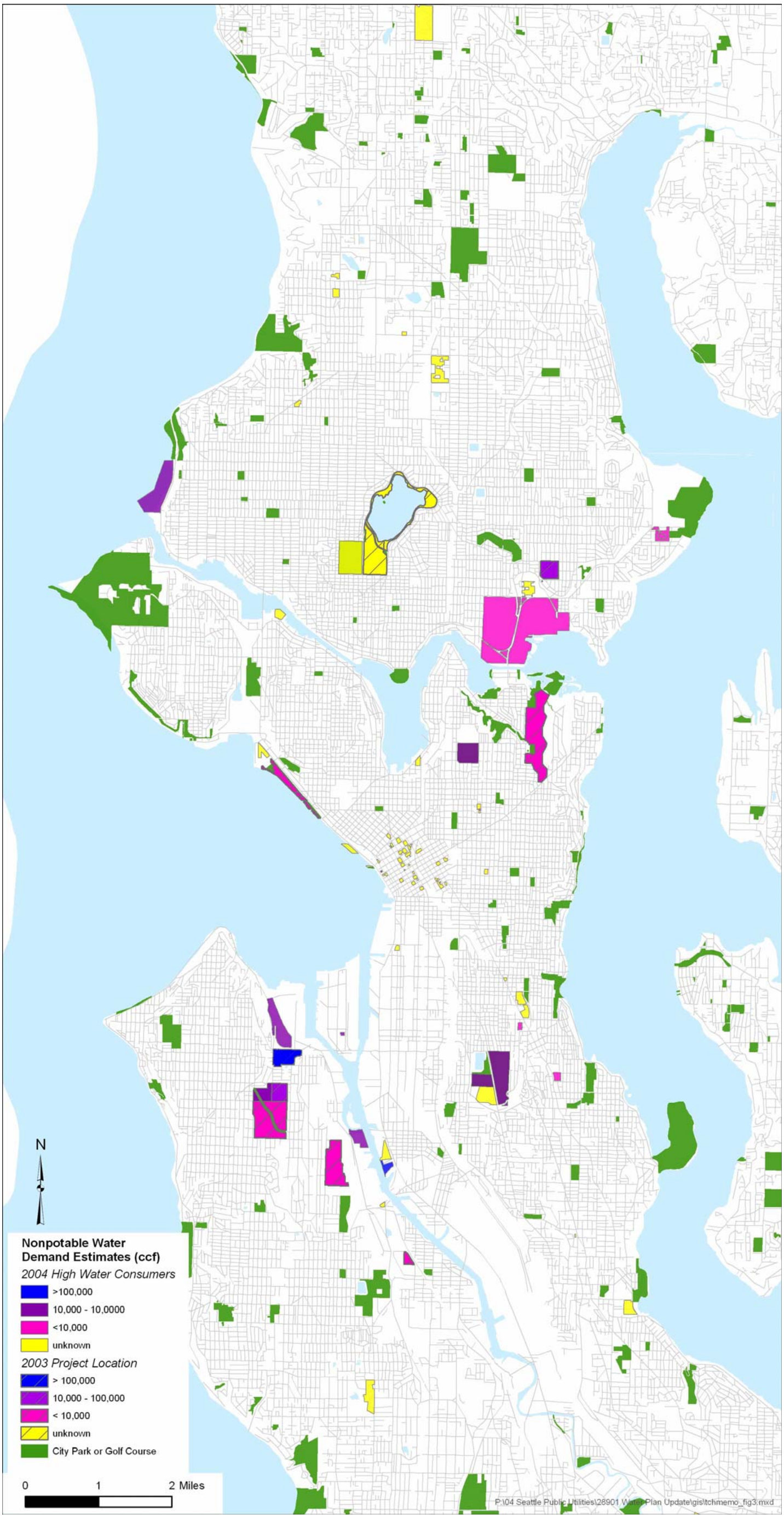


Figure C-1. Potential Reclaimed Water Users

APPENDIX D
Reclaimed Water Opportunities
Cost Estimate

Table 1
Reclaimed Water Oppurtunities
Cost Estimate

		2002			2005					
		West Seattle Golf Course Reclaimed Wastewater Facility A	West Seattle Golf Course Reclaimed Wastewater Facility B	Calvary Catholic Cemetery	West Seattle Golf Course Reclaimed Wastewater Facility A	West Seattle Golf Course Reclaimed Wastewater Facility B	Calvary Catholic Cemetery	Urban Commercial Core/Myrtle Edwards Park	Jackson Park Golf Course - KC Demand Estimate	Jackson Park Golf Course - SPU Demand Estimate
	Treatment Capacity (MGD)	*0.04-0.15*	*0.04-0.4*	*0.08-0.3*	*0.04-0.15*	*0.04-0.4*	*0.08-0.3*	*0.58-0.61*	*0.70*	*0.23*
	Treatment Volume (CCF)	*26,571*	*31,043*	*20,807*	*26,571*	*31,043*	*20,807*	*193,396*	*144,000*	*47,520*
	Percent of Construction Cost									
Pre-Construction										
Easement/Property Acquisition		$50,000	$50,000	$500,000	$57,600	$57,600	$547,300	$23,900	$400,000	$400,000
Planning/Permitting/SEPA	2%	$45,827	$83,732	$64,751	$51,106	$93,379	$72,211	$178,982	$6,468	$5,502
Administration/Project Management	1%	$22,913	$41,866	$32,376	$25,553	$46,690	$36,106	$89,491	$3,234	$2,751
Distribution System Planning	3%	$0	$0	$0	$0	$0	$0	$711,338	$367,575	$175,911
subtotal		*$119,000*	*$176,000*	*$598,000*	*$135,000*	*$198,000*	*$656,000*	*$1,004,000*	*$778,000*	*$585,000*
Design										
Design Services	15%	$343,699	$627,994	$485,634	$383,297	$700,346	$541,585	$1,342,364	$48,513	$41,261
Administration/Project Management	2%	$45,827	$83,732	$64,751	$51,106	$93,379	$72,211	$178,982	$6,468	$5,502
Distribution System Design	20%	$0	$0	$0	$0	$0	$0	$4,742,250	$2,450,500	$1,172,739
subtotal		*$390,000*	*$712,000*	*$551,000*	*$435,000*	*$794,000*	*$614,000*	*$6,264,000*	*$2,506,000*	*$1,220,000*
Construction										
MBR Facilty:										
Construction		$1,634,176	$2,981,120	$2,353,344	$1,822,452	$3,324,580	$2,624,477	$6,525,340	$0	$0
Construction Contingency	30%	$490,253	$894,336	$706,003	$546,736	$997,374	$787,343	$1,957,602	$0	$0
Construction Management	15%	$318,664	$581,318	$458,902	$355,378	$648,293	$511,773	$1,272,441	$0	$0
Administration/Project Management	2%	$42,489	$77,509	$61,187	$47,384	$86,439	$68,236	$169,659	$0	$0
subtotal		*$2,486,000*	*$4,535,000*	*$3,580,000*	*$2,772,000*	*$5,057,000*	*$3,992,000*	*$9,926,000*	*$0*	*$0*
Pumps										
Construction		$84,864	$87,040	$82,688	$94,641	$97,068	$92,215	$358,579	$248,784	$211,597
Construction Contingency	30%	$25,459	$26,112	$24,806	$28,392	$29,120	$27,664	$107,574	$74,635	$63,479
Construction Management	15%	$16,548	$16,973	$16,124	$18,455	$18,928	$17,982	$69,923	$48,513	$41,261
Administration/Project Management	2%	$2,206	$2,263	$2,150	$2,461	$2,524	$2,398	$9,323	$6,468	$5,502
subtotal		*$130,000*	*$133,000*	*$126,000*	*$144,000*	*$148,000*	*$141,000*	*$546,000*	*$379,000*	*$322,000*
Other										
Construction		$43,520	$152,320	$54,400	$48,534	$169,869	$60,668	$15,807,500	$9,425,000	$4,510,536
Construction Contingency[4]	30%	$13,056	$45,696	$16,320	$14,560	$50,961	$18,200	$7,903,750	$2,827,500	$1,353,161
Construction Management	15%	$8,486	$29,702	$10,608	$9,464	$33,124	$11,830	$3,556,688	$1,837,875	$879,554
Administration/Project Management	2%	$1,132	$3,960	$1,414	$1,262	$4,417	$1,577	$474,225	$245,050	$117,274
subtotal		*$67,000*	*$232,000*	*$83,000*	*$74,000*	*$259,000*	*$93,000*	*$27,743,000*	*$14,336,000*	*$6,861,000*
construction subtotal		*$2,683,000*	*$4,900,000*	*$3,789,000*	*$2,990,000*	*$5,464,000*	*$4,226,000*	*$38,215,000*	*$14,715,000*	*$7,183,000*

Notes:
(1) 2002 Costs from 2003 Study were modified to reflect a higher construction contingency.
(2) 2002 Construction costs updated to 2005 dollars with Engineering Record (ENR) construction cost ratio.
(3) 2002 Easement/Property Acquisition costs updated to 2005 dollars based on assumed King County Assessor Commercial Appraisal Reports
(4) 50% contingency used for the Urban Commercial Core/Myrtle Edwards Park due to the added uncertainity of installing a distribution system downtown.
MBR = Membrane Bioreactor
MGD = million gallons per day
CCF = 100 cubic feet

ENR Construction Costs

	Seattle	20 Cities
2002 ENR, 12 month avei	7,560	6,538
2005 ENR, Nov	8,431	7,630
Conversion	1.12	1.17

APPENDIX E
Jackson Park Golf Course
Proposed Project Demand and Cost Estimates

Contractor markups are allocated to the individual line items with the exception of Contingency and are based on conventionally accepted values, adjusted for project-area economic factors. The markups used are:

Item	Rate, percent
Prime contractor	
Labor (Employer Payroll Burden)	18
Materials and Process Equipment	15
Equipment (Construction related)	15
Subcontractor	5
Sales Tax (State & Local for Materials, Process Equipment & Construction equipment rentals, etc.)	8.8
Builder's Risk, Liability, and Vehicle Insurance	2.85
Material Shipping & Handling	2
Subcontractor Markups:	Same as Prime
Escalation to midpoint of construction:	3
Building Permits	1.5
Performance Bond	1
Payment Bond	1

SPU RECLAIMED WATER SYSTEM, 18 INCH PIPELINE

Item	Item Description	Quantity	Unit	Labor $/Unit	Labor Amount	Materials $/Unit	Material Amount	Subs Amount	Equip Amount	Other Amount	Grand Total
1101 - 18" PIPELINE ALTERNATE											
01 - GENERAL REQUIREMENTS											
01050 - Contractors Operations											
0050	Field personnel, superintendent	13.00	week	2,292.30	29,800						29,800
01160 - Office											
0040	Office, storage boxes, 28' x 10', rent per month	3.00	each			304.09	912				912
01170 - Field office expense											
0050	Field subcontract, utility underground locating service	0.50	week					772			772
0060	Field office expense, small tool allowance	3.00	each							11,482	11,482
01200 - General equipment rental											
0300	Rent toilet portable chemical	3.00	mo					257			257
0403	Rent truck pickup 3/4 ton 2 wheel drive, superintendent	3.00	mo					4,117			4,117
01240 - As-Built Drawings											
0010	As-built drawings,punch list, permits	1.00	lsum							8,748	8,748
01250 - Surveying											
0020	Surveying, crew for building layout, 3 person crew	1.00	day	1,306.61	1,307						1,307
	GENERAL REQUIREMENTS Total				*31,107*		*912*	*5,146*		*20,230*	*57,394*
02 - SITE CONSTRUCTION											
02160 - Rubbish handling											
9999	Dump Charge, typical urban city, fees only, bldg constr mat'ls	12.15	ton							439	439
02330 - Backfill, structural											
0080	Backfill, structural, 300 H.P., 300' haul, common earth	9.44	cuyd	0.45	4				12		17
02340 - Bedding											
0010	Bedding, crushed stone 3/4" to 1/2"	3.10	cuyd	7.65	24	28.02	87		6		117
02360 - Compaction											
0030	Compaction, vibratory plate, 8" lifts, Bedding	2.67	cuyd	1.79	5				1		6
0040	Compaction, vibratory plate, 8" lifts, Backfill	8.50	cuyd	1.66	14				4		18
0130	Compaction, walk behind, vibrating plate, 8" lifts, Subgrade	2.67	cuyd	2.56	7				2		9
02420 - Excavating, structural											
0030	Excavating, structural, mach excav, com earth, hyd backhoe, 1 CY bkt	15.61	cuyd	7.99	125				121		245
0030	Edge Excavating, structural, mach excav, com earth, hyd backhoe, 1 CY bkt	3.56	cuyd	7.99	28				28		56
02430 - Fill											
0080	Granular fill	2.67	cuyd	12.74	34	11.33	30		36		100

SPU RECLAIMED WATER SYSTEM, 18 INCH PIPELINE

Item	Item Description	Quantity	Unit	Labor $/Unit	Labor Amount	Materials $/Unit	Material Amount	Subs Amount	Equip Amount	Other Amount	Grand Total
02460 - Hauling											
0020	Hauling, LCY, no loading, 12 c.y dump truck, 10 MI RT, 0.60 lds/hr	12.15	cuyd	5.01	61				125		186
0900	Loading Trucks, F.E. Loader, 3 C.Y.	12.15	cuyd	0.63	8				16		24
	SITE CONSTRUCTION Total				*309*		*117*		*352*	*439*	*1,217*
03 - CONCRETE											
03090 - Forms place, slab grade											
0030	Forms in place, SOG, edge forms, over 12", wood	72.00	sfca	4.59	331	3.48	250				581
03130 - Reinforcing in place											
0070	Reinforcing in place, A615 Gr 60, slab on grade, #3 to #7	0.36	ton	802.28	289	2,162.40	778				1,066
0070	Reinforcing in place, A615 Gr 60, slab on grade, #3 to #7	0.03	ton	802.28	22	2,162.40	60				82
0070	Reinforcing in place, A615 Gr 60, slab on grade, #3 to #7	0.10	ton	802.28	82	2,162.40	221				303
03150 - Concrete, ready mix											
0030	Concrete, ready mix, regular weight, 4000 psi	8.89	cuyd			162.18	1,442				1,442
0030	Concrete, ready mix, regular weight, 4000 psi	0.40	cuyd			162.18	64				64
03170 - Placing concrete											
0120	Placing conc, incl vib, slab on grade, slab over 6" thick, pumped	8.89	cuyd	16.25	144				54		198
0120	Placing conc, incl vib, slab on grade, slab over 6" thick, pumped	0.40	cuyd	16.25	6				2		9
03180 - Finishing floors											
0030	Finishing floors, monolithic, screed, float & broom finish	152.00	sqft	0.68	103						103
	CONCRETE Total				*978*		*2,815*		*56*		*3,849*
11 - EQUIPMENT											
11090 - Pumps, general utility											
0240	Pump, cntfgl, horiz mtd, end suct,vert splt,sgl stg,1050GPM,40HP	4.00	each	1,567.93	6,272	6,410.84	25,643				31,915
	EQUIPMENT Total				*6,272*		*25,643*				*31,915*
13 - SPECIAL CONSTRUCTION											
13100 - Pre-engnrd Metal Buildngs											
0010	Pre-engd.bldg.,rgd.clr.span fr.,26 ga.rfg. & sdg.12'x12'w.	144.00	sqft					18,936			18,936
	SPECIAL CONSTRUCTION Total							*18,936*			*18,936*
15 - MECHANICAL											
15010 - Misc. Mechanical											
0530	Misc. Mechanical, allowance	1.00	each	5,094.00	5,094	6,757.50	6,758		1,332		13,183
15255 - Valves, iron body											

SPU RECLAIMED WATER SYSTEM, 18 INCH PIPELINE

Item	Item Description	Quantity	Unit	Labor $/Unit	Labor Amount	Materials $/Unit	Material Amount	Subs Amount	Equip Amount	Other Amount	Grand Total
0150	Valves, iron body, butterfly, lug type, 200 PSI, gear operated, 6"	6.00	each	313.59	1,882	406.86	2,441				4,323
15265 - Multipurpose valves											
0170	Valve, pressure relief, 8"	1.00	each	555.31	555	2,578.66	2,579				3,134
15300 - Automatic air vent											
0080	Auto air vent, CI body, sst internals, float type, 2" NP inl, 250psi	2.00	each	78.39	157	1,117.42	2,235				2,392
15515 - Misc HVAC											
0010	HVAC heating, cooling allowance	144.00	sqft					2,058			2,058
	MECHANICAL Total				*7,688*		*14,012*	*2,058*	*1,332*		*25,090*
16 - ELECTRICAL											
16195 - Electrical & Instrument											
0101	Electrical and Instrumentation, allowance	1.00	lsum					57,175			57,175
16225 - Vrbl frqn drv/ frqn drivs											
1180	Variable frequency drives custom-engineered, 460 V, 40 HP motor size	4.00	each	2,096.56	8,386	11,205.52	44,822				53,208
	ELECTRICAL Total				*8,386*		*44,822*	*57,175*			*110,383*
	1101 - 18" PIPELINE ALTERNATE Total				*54,739*		*88,322*	*83,315*	*1,739*	*20,668*	*248,784*

SPU RECLAIMED WATER SYSTEM, 10 INCH PIPELINE

Item	Item Description	Quantity	Unit	Labor $/Unit	Labor Amount	Materials $/Unit	Material Amount	Subs Amount	Equip Amount	Other Amount	Grand Total
1102 - 10" PIPELINE ALTERNATE											
01 - GENERAL REQUIREMENTS											
01050 - Contractors Operations											
0050	Field personnel, superintendent	13.00	week	2,292.30	29,800						29,800
01160 - Office											
0040	Office, storage boxes, 28' x 10', rent per month	3.00	each			304.09	912				912
01170 - Field office expense											
0050	Field subcontract, utility underground locating service	0.50	week					772			772
0060	Field office expense, small tool allowance	3.00	each							11,482	11,482
01200 - General equipment rental											
0300	Rent toilet portable chemical	3.00	mo					257			257
0403	Rent truck pickup 3/4 ton 2 wheel drive, superintendent	3.00	mo					4,117			4,117
01240 - As-Built Drawings											
0010	As-built drawings,punch list, permits	1.00	lsum							8,748	8,748
01250 - Surveying											
0020	Surveying, crew for building layout, 3 person crew	1.00	day	1,306.61	1,307						1,307
	GENERAL REQUIREMENTS Total				*31,107*		*912*	*5,146*		*20,230*	*57,394*
02 - SITE CONSTRUCTION											
02160 - Rubbish handling											
9999	Dump Charge, typical urban city, fees only, bldg constr mat'ls	8.84	ton							319	319
02330 - Backfill, structural											
0080	Backfill, structural, 300 H.P., 300' haul, common earth	8.27	cuyd	0.45	4				11		14
02340 - Bedding											
0010	Bedding, crushed stone 3/4" to 1/2"	2.15	cuyd	7.65	16	28.02	60		4		81
02360 - Compaction											
0030	Compaction, vibratory plate, 8" lifts, Bedding	1.85	cuyd	1.79	3				1		4
0040	Compaction, vibratory plate, 8" lifts, Backfill	7.45	cuyd	1.66	12				4		16
0130	Compaction, walk behind, vibrating plate, 8" lifts, Subgrade	1.85	cuyd	2.56	5				1		6
02420 - Excavating, structural											
0030	Excavating, structural, mach excav, com earth, hyd backhoe, 1 CY bkt	12.38	cuyd	7.99	99				96		195
0030	Edge Excavating, structural, mach excav, com earth, hyd backhoe, 1 CY bkt	2.96	cuyd	7.99	24				23		47
02430 - Fill											
0080	Granular fill	1.85	cuyd	12.73	24	11.33	21		25		69

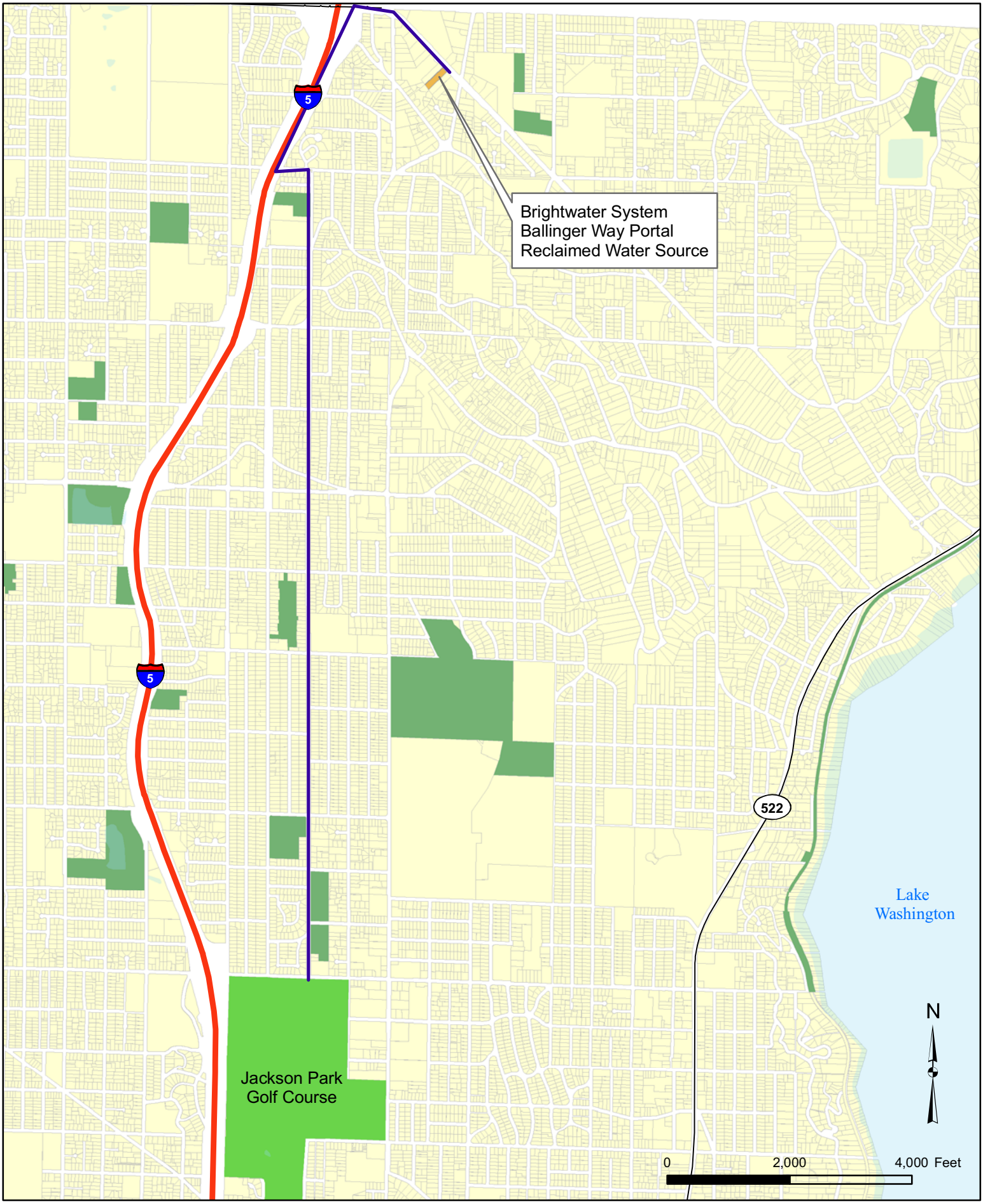
SPU RECLAIMED WATER SYSTEM, 10 INCH PIPELINE

Item	Item Description	Quantity	Unit	Labor $/Unit	Labor Amount	Materials $/Unit	Material Amount	Subs Amount	Equip Amount	Other Amount	Grand Total
02460 - Hauling											
0020	Hauling, LCY, no loading, 12 c.y dump truck, 10 MI RT, 0.60 lds/hr	8.84	cuyd	5.01	44				91		135
0900	Loading Trucks, F.E. Loader, 3 C.Y.	8.84	cuyd	0.63	6				12		17
	SITE CONSTRUCTION Total				*237*		*81*		*268*	*319*	*905*
03 - CONCRETE											
03090 - Forms place, slab grade											
0030	Forms in place, SOG, edge forms, over 12", wood	60.00	sfca	4.59	276	3.48	209				484
03130 - Reinforcing in place											
0070	Reinforcing in place, A615 Gr 60, slab on grade, #3 to #7	0.25	ton	802.28	203	2,162.40	548				752
0070	Reinforcing in place, A615 Gr 60, slab on grade, #3 to #7	0.02	ton	802.28	18	2,162.40	50				68
0070	Reinforcing in place, A615 Gr 60, slab on grade, #3 to #7	0.09	ton	802.28	68	2,162.40	184				253
03150 - Concrete, ready mix											
0030	Concrete, ready mix, regular weight, 4000 psi	6.67	cuyd			162.18	1,081				1,081
0030	Concrete, ready mix, regular weight, 4000 psi	0.33	cuyd			162.18	53				53
03170 - Placing concrete											
0120	Placing conc, incl vib, slab on grade, slab over 6" thick, pumped	6.67	cuyd	16.25	108				40		149
0120	Placing conc, incl vib, slab on grade, slab over 6" thick, pumped	0.33	cuyd	16.25	5				2		7
03180 - Finishing floors											
0030	Finishing floors, monolithic, screed, float & broom finish	106.67	sqft	0.68	72						72
	CONCRETE Total				*752*		*2,126*		*42*		*2,920*
11 - EQUIPMENT											
11090 - Pumps, general utility											
0220	Pump, cntfgl, horiz mtd, end suct,vert splt,sgl stg,500GPM,25HP	3.00	each	1,088.84	3,267	4,441.03	13,323				16,590
	EQUIPMENT Total				*3,267*		*13,323*				*16,590*
13 - SPECIAL CONSTRUCTION											
13100 - Pre-engnrd Metal Buildngs											
0020	Pre-engd.bldg.,rgd.clr.span fr.,26 ga.rfg. & sdg.10'x10'w.	100.00	sqft					13,150			13,150
	SPECIAL CONSTRUCTION Total							*13,150*			*13,150*
15 - MECHANICAL											
15010 - Misc. Mechanical											
0530	Misc. Mechanical, allowance	1.00	each	3,820.50	3,821	5,406.00	5,406		1,332		10,558
15255 - Valves, iron body											

SPU RECLAIMED WATER SYSTEM, 10 INCH PIPELINE

Item	Item Description	Quantity	Unit	Labor $/Unit	Labor Amount	Materials $/Unit	Material Amount	Subs Amount	Equip Amount	Other Amount	Grand Total
0160	Valves, iron body, butterfly, lug type, 200 PSI, gear operated, 8"	8.00	each	382.18	3,057	2,713.33	21,707				24,764
15265 - Multipurpose valves											
0170	Valve, pressure relief, 8"	1.00	each	555.31	555	2,578.66	2,579				3,134
15300 - Automatic air vent											
0080	Auto air vent, CI body, sst internals, float type, 2" NP inl, 250psi	2.00	each	78.39	157	1,117.42	2,235				2,392
15515 - Misc HVAC											
0010	HVAC heating, cooling allowance	100.00	sqft					1,429			1,429
	MECHANICAL Total				*7,590*		*31,926*	*1,429*	*1,332*		*42,277*
16 - ELECTRICAL											
16195 - Electrical & Instrument											
0101	Electrical and Instrumentation, allowance	1.00	lsum					45,740			45,740
16225 - Vrbl frqn drv/ frqn drivs											
1160	Variable frequency drives custom-engineered, 460 V, 25 HP motor size	3.00	each	2,096.56	6,290	8,777.07	26,331				32,621
	ELECTRICAL Total				*6,290*		*26,331*	*45,740*			*78,361*
	1102 - 10" PIPELINE ALTERNATE Total				*49,242*		*74,700*	*65,465*	*1,641*	*20,549*	*211,597*

Jackson Park Golf Course Alternative
Force Main Location Used for Cost Estimate



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APPENDIX F
Urban Commercial Core/Myrtle Edwards
Proposed Project Demand and Cost Estimates

SPU 2007 Water Plan Update
Reclaimed Water Opportunities
Jackson Park Golf Course

DEMAND ESTIMATE

	Estimated MGD			*Estimated CFS*			*Estimated GPM*		
Entity	*5 Mo Season*	*Peak Day*	*Peak Hour*	*5 Mo Season*	*Peak Day*	*Peak Hour*	*5 Mo Season*	*Peak Day*	*Peak Hour*
King County	0.70	1.08	3.25	1.1	1.7	5.0	489	753	2,259
SPU	0.23	0.36	1.07	0.4	0.6	1.7	161	248	745

Month	*Days in month*	***King County***			***SPU***		
		ADD (MGD)	Monthly Demand (MG)	Monthly Demand (CCF)	ADD (MGD)	Monthly Demand (MG)	Monthly Demand (CCF)
June	30	0.704	21.12	28,235	0.232	6.97	9,318
July	31	0.704	21.82	29,176	0.232	7.20	9,628
August	31	0.704	21.82	29,176	0.232	7.20	9,628
September	30	0.704	21.12	28,235	0.232	6.97	9,318
October	31	0.704	21.82	29,176	0.232	7.20	9,628
Total	*153*	*3.5*	*108*	*144,000*	*1.2*	*36*	*47,520*

MGD = million gallons per day
CFS = cubic feet per second
gallons per minut
MG = million gallons
CCF = 100 cubic feet

gal per cf
7.48

SPU demand adjustment
0.33

DEMAND ESTIMATE

Toilet Flush Flows

Age	*Type*	*Volume per Use (gallons)*
New	1.6 gal/flush	1.6

Source: Seattle Home Water Conservation Study, December 2000

Urinal Flush Flows

Age	*Type*	*Volume per Use (gallons)*
New	1.0 gal/flush	1

Source: Washington State 1993 Plumbing Code

Daily Toilet Usage

	Mean (uses/day)
Residential (1)	5.46
Commercial - women (2)	2.14
Commercial - men (2)	0.71

Sources: (1) Seattle Home Water Conservation Study, December 2000
(2) Vickers, Amy. Handbook of Water Use and Conservation, 2001
Notes: Commercial usage for women based on 3 uses/day during a 5 day work week
Commercial usage for men based on 1 use/day during a 5 day work week

Daily Urinal Usage

	Mean (uses/day)
Residential	NA
Commercial	1.43

Source: Vickers, Amy. Handbook of Water Use and Conservation, 2001
Note: Commercial usage based on 2 uses/day during a 5 day work week

Residential Toilet Flushing *(gal/day/person)*	8.74
Commercial Toilet/Urinal Flushing *(gal/day/person)*	3.00

Assumptions

	Fraction of Workforce	*Commercial Use (gal/day)*
Women	0.5	3.4
Men	0.5	2.6

Potential Reclaimed Water Daily Usage

	Residential			Commercial		*Total*
	Households Growth Target	*Population Growth Target*	*Toilet Flushing (gal/day)*	*Jobs Growth Target*	*Toilet Flushing (gal/day)*	*Use (gal/day)*
Denny Triangle	3,000	6,150	53,726	9,515	28,545	82,271
Belltown	4,700	9,635	84,171	4,000	12,000	96,171
South Lake Union	8,000	16,400	143,270	16,000	48,000	191,270
Uptown Queen Anne	1,000	2,050	17,909	1,150	3,450	21,359
Total (MGD)			**0.30**		**0.09**	**0.39**

Notes: Growth Targets are for the year 2024 and are from the City of Seattle Comprehensive Plan, 2005
Population Growth Target estimated as 2.05 People/Households * Household Growth Target
Average Household size is for the year 2020 and is from the City of Seattle Comprehensive Plan, 2005

Other Potential Uses

	Use
Irrigation of Myrtle Edwards Park	1.7 MGY (from May to November)

MONTHLY DEMAND ESTIMATE

Average Daily Demand (gal/day)

	Residential	*Commerical*	*Myrtle Edwards* (1)	*Total*	*Total (MGD)*
Jan	299,077	91,995	0	391,072	0.39
Feb	299,077	91,995	0	391,072	0.39
March	299,077	91,995	0	391,072	0.39
April	299,077	91,995	0	391,072	0.39
May	299,077	91,995	1,954	393,026	0.39
June	299,077	91,995	3,416	394,488	0.39
July	299,077	91,995	6,660	397,732	0.40
August	299,077	91,995	12,402	403,474	0.40
September	299,077	91,995	12,716	403,788	0.40
October	299,077	91,995	12,185	403,257	0.40
November	299,077	91,995	7,006	398,078	0.40
December	299,077	91,995	0	391,072	0.39
				Min	0.39
				Max	0.40

(1) Source: SPU Wastewater Reclamation and Rainwater Harvesting Study, 2003

Maximum Daily Demand (gal/day)

	Residential	*Commerical*	*Myrtle Edwards*	*Total*	*Total (MGD)*
Peak Factor	1.5	1.5	1.5		
Jan	448,615	137,993	0	586,608	0.59
Feb	448,615	137,993	0	586,608	0.59
March	448,615	137,993	0	586,608	0.59
April	448,615	137,993	0	586,608	0.59
May	448,615	137,993	2,932	589,540	0.59
June	448,615	137,993	5,124	591,732	0.59
July	448,615	137,993	9,989	596,597	0.60
August	448,615	137,993	18,603	605,211	0.61
September	448,615	137,993	19,074	605,682	0.61
October	448,615	137,993	18,278	604,886	0.60
November	448,615	137,993	10,509	597,117	0.60
December	448,615	137,993	0	586,608	0.59
				Min	0.59
				Max	0.61

Notes:
2003 Study assumed Monthly Irrigation PDD = 1.5 x ADD
Water System Design Manual PDD = (1.5 to 3.0)ADD

Peak Hourly Demand (gpm)

	Residential	*Commerical*	*Myrtle Edwards*	*Total (gpm)*
Peak Factor	1.7	1.7	1.7	
Jan	353	109	0	462
Feb	353	109	0	462
March	353	109	0	462
April	353	109	0	462
May	353	109	2	464
June	353	109	4	466
July	353	109	8	470
August	353	109	15	476
September	353	109	15	477
October	353	109	14	476
November	353	109	8	470
December	353	109	0	462
			Min	462
			Max	477

Water System Design Manual states PHD should be calculated as per equation 5-3. This calculation, however, is not appropriate for this analysis.

The generalized equation for PHD determinations is:

PHD = (MDD/1440)[(C)(N) + F] + 18 (equation 5-3)

Where:
PHD = Peak Hourly Demand, (gallons per minute, gpm)
C = Coefficient Associated with Ranges of ERUs
N = Number of Service Connections, ERUs
F = Factor Associated with Ranges of ERUs
MDD = Maximum Day Demand, (gpd/ERU)

SYSTEM SIZING BASIS

Component	*Sizing Basis*	*min*	*max*	*units*	*notes*
MBR	MDD	0.59	0.61	MGD	
Storage Tank	OS+SB+ES+DS	928,796	958,996	gal	Design Life = 50 years
Booster Pumps to end user	PHD	462	477	gpm	
Distribution Piping	PHD at 30 psi	12		inches	
Transmission Piping	PHD at 30 psi	6		inches	

Operational Storage, OS	Continuous Pumping: 0	0	0	gal	Volume to supply demands while MBR is off. Assume MBR is operating 24-hour/day, 365 days/year
Standby Storage, SB	2*ADD @ 20 psi	782,144	807,576	gal	Sizing for a single source
Equalizing Storage, ES	25% MDD	146,652	151,420	gal	Water System Design Manual: On-Call Demand: (PHD-Qs)*(150 min) @ 30 psi Continuous Pumping: Prepare Mass Analysis
Dead Storage, DS		0	0	gal	If volume booster is not capable of pumping at design flow rate.

Other Sizing Criteria
The entire system must meet MDD.
A pressure of 30 psi must be maintained in the distribution system when ES is depleted.
The maximum system pressure is 100 psi.

Notes
ADD = Average Day Demand
MDD = Maximum Day Demand
PHD = Peak Hourly Demand

Urban Village Element Appendix

Urban Village Appendix A

Growth Targets for Urban Centers, Center Villages, Manufacturing/ Industrial Centers, Hub Urban Villages, & Residential Urban Villages

Center or Village	Land Area in Acres	Households (HH)				Employment (Jobs)			
		Existing (2004)	Existing Density (HH/ Acre)	Growth Target (HH Growth)	2024 Density (Est.)	Existing (2002)	Existing Density (Jobs/ Acre)	Growth Target (Job Growth)	2024 Density (Est.)
Urban Centers & Center Villages									
Downtown Urban Center Total	**952**	**15,700**	**16**	**10,000**	**28**	**156,960**	**165**	**29,015**	**195**
Belltown	220	8,640	39	4,700	63	19,760	90	4,000	108
Chinatown/ International District	171	1,910	11	1,000	18	5,080	30	2,000	41
Commercial Core	276	3,070	11	300	13	103,790	376	10,000	412
Denny Triangle	143	1,290	9	3,000	30	18,020	126	9,515	189
Pioneer Square[1]	142	790	6	1,000	13	10,310	73	3,500	97
First Hill/Capitol Hill Center Total	**916**	**22,520**	**25**	**3,500**	**30**	**37,940**	**41**	**4,600**	**47**
12th Ave.	160	1,450	9	700	14	4,040	25	700	30
Capitol Hill	397	12,250	31	1,000	35	7,300	18	900	21
First Hill	228	6,020	26	1,200	33	22,020	97	2,000	105
Pike/Pine	131	2,800	21	600	27	4,580	35	1,000	43
Northgate Urban Center Total	**411**	**3,490**	**8**	**2,500**	**15**	**11,030**	**27**	**4,220**	**38**
South Lake Union Urban Center Total	**340**	**1,210**	**4**	**8,000**	**33**	**19,690**	**58**	**16,000**	**135**
University Community Urban Center Total[2]	**758**	**6,850**	**9**	**2,450**	**11**	**32,360**	**43**	**6,140**	**53**
Ravenna	123	1,400	11	450	14	1,960	16	500	21
University District Northwest	287	5,230	18	2,000	23	6,170	21	2,640	37
Uptown Queen Anne Urban Center Total	**297**	**4,580**	**15**	**1,000**	**20**	**15,570**	**52**	**1,150**	**56**

average household size in 2020 = 2.05 people

SPU WATER SYSTEM UPDATE

FACILITY LOCATED WITHIN MYRTLE EDWARDS PARK

prelinimary cost estimate

Prepared By Brown and Caldwell, December 7, 2005

Except for facility entrances, all facilities are assumed to be constructed below grade to midigate impact on park and associated views. Facilities to be earth covered and planted. Where screening is required, brick and precast concrete is assumed for cost estimate. Facility shall be provided with odor control by means of a biofilter and sound proofing of structures and buildings is to be provided

				Material		Labor				Equipment			
Item	**Description**	**Quantity**	**Unit**	**Unit cost**	**Amount**	**Labor Hr.**	**Total Hr.**	**Rate**	**Amount**	**Unit Cost**	**Amount**	**Total**	
INFLUENT PUMP STATION													
Division 2, Civil Site													
1	Sheeting/Shoring	1,800	SF	$14.00	$25,200	0	0	$55	$0	$0.00	$0	$25,200	
	Dewatering Allowance	1	LS	$0.00	$0	0	0	$55	$0	$10,000.00	$10,000	$10,000	
	Excavation	250	CY	$0.00	$0	0	0	$45	$0	$3.50	$875	$875	
	Material Disposal	250	CY	$0.00	$0	0	0	$45	$0	$20.00	$5,000	$5,000	
	Import Backfill	170	CY	$25.00	$4,250	0.16	27.2	$45	$1,224	$5.00	$850	$6,324	
2	110-Inch Precast Wet Well(18' Depth)	1	EA	$13,000.00	$13,000	0	0	$48	$0	$800.00	$800	$13,800	
3	12" Base Rock	8	CY	$25.00	$200	0.1	0.8	$48	$38	$2.50	$20	$258	
4	Pipe Excavation	900	CY	$0.00	$0	0	0	$45	$0	$3.00	$2,700	$2,700	
	Bedding	200	CY	$25.00	$5,000	0.1	20	$45	$900	$2.50	$500	$6,400	
	Import Backfill	350	CY	$20.00	$7,000	0.16	56	$45	$2,520	$5.00	$1,750	$11,270	
	Native Backfill	350	CY	$0.00	$0	0.16	56	$45	$2,520	$5.00	$1,750	$4,270	
	Surplus Disposal	550	CY	$0.00	$0	0	0	$45	$0	$25.00	$13,750	$13,750	
	Surface Restoration	666	SY	$10.00	$6,660	0	0	$45	$0	$0.00	$0	$6,660	
	Trench Safety Allowance	600	LF	$0.00	$0	0	0	$45	$0	$2.50	$1,500	$1,500	
	Trench Dewatering Allowance	1	LS	$0.00	$0	0	0	$45	$0	$5,000.00	$5,000	$5,000	
4	Not Used	1	EA	$0.00	$0	0	0	$45	$0	$0.00	$0	$0	
Subtotal Division 2, Civil					**$61,310**		**160**		**$7,202**		**$44,495**	**$113,007**	**$113,007**
Division 3, Concrete													
1	14' X 2' Base Slab	12	CY	$400.00	$4,800	0	0	$48	$0	$0.00	$0	$4,800	
2	Construct Top Slab Wet Well	8	CY	$1,100.00	$8,800	0	0	$45	$0	$5.00	$40	$8,840	
3	Cast in Place Utility Vault	1	EA	$0.00	$0	0	0	$45	$0	$5.00	$5	$5	
	Bottom Slab On Grade	3	CY	$400.00	$1,200	0	0	$45	$0	$5.00	$15	$1,215	
	Perimeter Walls	4	CY	$1,000.00	$4,000	0	0	$45	$0	$5.00	$20	$4,020	
	Top Slab Of Vault	1	CY	$1,100.00	$1,100	0	0	$45	$0	$5.00	$5	$1,105	
4	Wet Well Interior Grout Allowance	1	LS	$1,000.00	$1,000	0	0	$45	$0	$0.00	$0	$1,000	
5	Misc Allowance	1	EA	$500.00	$500	12	12	$45	$540	$250.00	$250	$1,290	
Subtotal Division 3, Concrete					**$21,400**		**12**		**$540**		**$335**	**$22,275**	**$22,275**
Division 5, Metals													
1	Allowance for Metals & Hatches	1	LS	$5,000.00	$5,000	24	24	$56	$1,344	$150.00	$150	$6,494	
Subtotal Division 5, Metals					**$5,000**		**24**		**$1,344**		**$150**	**$6,494**	**$6,494**

Division 11, Equipment

1	7.5 HP Submersible Pumps/Control PNL	2	EA	$10,000.00	$20,000	32	64	$56	$3,584	$50.00	$100	$23,684	
2	Not Used	1	EA	$0.00	$0	0	0	$56	$0	$0.00	$0	$0	
Subtotal Division 11, Equipment					**$20,000**		**64**		**$3,584**		**$100**	**$23,684**	**$23,684**

Division 15, Mechanical

1	18-Inch DIP Incoming Raw Sewage	500	LF	$50.00	$25,000	0.58	290	$56	$16,240	$8.00	$4,000	$45,240	
	18-Inch Fitting Allowance	5	EA	$1,000.00	$5,000	5.8	29	$56	$1,624	$75.00	$375	$6,999	
	18-Inch Valve Allowance	1	EA	$3,750.00	$3,750	0	15	$56	$840	$0.00	$0	$4,590	
2	6-Inch Pump Discharge to Vault	34	LF	$26.00	$884	0.571	19.414	$56	$1,087	$0.00	$0	$1,971	
	6-Inch Fittings	4	EA	$60.00	$240	1	4	$56	$224	$0.00	$0	$464	
	6-Inch Check Valves	2	EA	$600.00	$1,200	8	16	$56	$896	$0.00	$0	$2,096	
	6-Inch Plug Valves	2	EA	$650.00	$1,300	8	16	$56	$896	$0.00	$0	$2,196	
	6-Inch Flanges	10	EA	$78.00	$780	1.043	10.43	$56	$584	$0.00	$0	$1,364	
	6-Inch bolt and Gasket Sets	10	EA	$14.00	$140	0	0	$56	$0	$0.00	$0	$140	
3	8-Inch Discharge @ Vault	8	LF	$40.00	$320	0.65	5.2	$56	$291	$0.00	$0	$611	
	8-Inch Y	2	EA	$120.00	$240	1.143	2.286	$56	$128	$0.00	$0	$368	
4	1-Inch Relief Pipe	10	LF	$2.50	$25	0.151	1.51	$56	$85	$0.00	$0	$110	
	1-Inch Fittings	5	EA	$12.50	$63	0.615	3.075	$56	$172	$0.00	$0	$235	
	1-Inch Air Relief Valve	1	EA	$300.00	$300	0.5	0.5	$56	$28	$0.00	$0	$328	
	1-Inch Drain Pipe	10	LF	$2.50	$25	0.151	1.51	$56	$85	$0.00	$0	$110	
	1-Inch Plug Valves	2	EA	$80.00	$160	0.571	1.142	$56	$64	$0.00	$0	$224	
5	Vault Drain & Pipe Allowance	1	EA	$750.00	$750	12	12	$56	$672	$0.00	$0	$1,422	
6	8-Inch Discharge to Grinder (DIP)	100	LF	$20.00	$2,000	0.3	30	$56	$1,680	$4.00	$400	$4,080	
	8-Inch Fittings	5	EA	$285.00	$1,425	4.501	22.505	$56	$1,260	$0.00	$0	$2,685	
	8-Inch Isolation Valve	1	EA	$1,175.00	$1,175	9.6	9.6	$56	$538	$0.00	$0	$1,713	
	8-Inch Flanges	3	EA	$88.00	$264	1.412	4.236	$56	$237	$0.00	$0	$501	
	8-Inch Bolt and Gasket Sets	3	EA	$15.00	$45	0	0	$56	$0	$0.00	$0	$45	
7	Not Used	1	EA	$0.00	$0	0	0	$56	$0	$0.00	$0	$0	
Subtotal Division 15, Mechanical					**$45,086**		**493.408**		**$27,631**		**$4,775**	**$77,491**	**$77,491**

Division 16/17 Electrical/Instrumentation

1	Percent for Electrical	15.00%								$129,944.35	$19,492	$19,492	
Subtotal Division 16/17 Electrical/Instrumentation											**$19,492**	**$19,492**	**$19,492**

Base Cost of Influent Pump Station				**$262,443**
	Contractor Indirects	5.00%		$13,122
Subtotal				**$275,566**
	Contractor Overhead & Profit	15.00%		$41,335
Subtotal				**$316,900**
	Bonds	1.00%		$3,169
	Permits	1.00%		$3,169
	Insurance	2.00%		$6,338
Subtotal				**$329,576**
	Design Contingency	0.00%	**See Note 1**	$0
Subtotal				**$329,576**
	Wash State Sales Tax	8.80%		$29,003
Estimated Opinion of Construction Cost				**$358,579**

				Material		Labor				Equipment			
Item	**Description**	**Quantity**	**Unit**	**Unit cost**	**Amount**	**Labor Hr.**	**Total Hr.**	**Rate**	**Amount**	**Unit Cost**	**Amount**	**Total**	
WASTEWATER DISCHARGE PUMP STATION													
Division 2, Civil Site													
1	Sheeting/Shoring	1,200	SF	$14.00	$16,800	0	0	$55	$0	$0.00	$0	$16,800	
	Dewatering Allowance	1	LS	$0.00	$0	0	0	$55	$0	$5,000.00	$5,000	$5,000	
	Excavation	190	CY	$0.00	$0	0	0	$45	$0	$3.50	$665	$665	
	Material Disposal	190	CY	$0.00	$0	0	0	$45	$0	$20.00	$3,800	$3,800	
	Import Backfill	140	CY	$25.00	$3,500	0.16	22.4	$45	$1,008	$5.00	$700	$5,208	
2	96-Inch Precast Wet Well(12' Depth)	1	EA	$6,300.00	$6,300	0	0	$48	$0	$600.00	$600	$6,900	
3	12" Base Rock	8	CY	$25.00	$200	0.1	0.8	$48	$38	$2.50	$20	$258	
4	Pipe Excavation	700	CY	$0.00	$0	0	0	$45	$0	$3.00	$2,100	$2,100	
	Bedding	100	CY	$25.00	$2,500	0.1	10	$45	$450	$2.50	$250	$3,200	
	Import Backfill	300	CY	$20.00	$6,000	0.16	48	$45	$2,160	$5.00	$1,500	$9,660	
	Native Backfill	300	CY	$0.00	$0	0.16	48	$45	$2,160	$5.00	$1,500	$3,660	
	Surplus Disposal	400	CY	$0.00	$0	0	0	$45	$0	$25.00	$10,000	$10,000	
	Surface Restoration	666	SY	$10.00	$6,660	0	0	$45	$0	$0.00	$0	$6,660	
	Trench Safety Allowance	600	LF	$0.00	$0	0	0	$45	$0	$2.50	$1,500	$1,500	
	Trench Dewatering Allowance	1	LS	$0.00	$0	0	0	$45	$0	$5,000.00	$5,000	$5,000	
4	Not Used	1	EA	$0.00	$0	0	0	$45	$0	$0.00	$0	$0	
Subtotal Division 2, Civil					**$41,960**		**129.2**		**$5,816**		**$32,635**	**$80,411**	**$80,411**
Division 3, Concrete													
1	14' X 2' Base Slab	10	CY	$400.00	$4,000	0	0	$48	$0	$0.00	$0	$4,000	
2	Construct Top Slab Wet Well	6.5	CY	$1,100.00	$7,150	0	0	$45	$0	$5.00	$33	$7,183	
3	Cast in Place Utility Vault	1	EA	$0.00	$0	0	0	$45	$0	$5.00	$5	$5	
	Bottom Slab On Grade	3	CY	$400.00	$1,200	0	0	$45	$0	$5.00	$15	$1,215	
	Perimeter Walls	4	CY	$1,000.00	$4,000	0	0	$45	$0	$5.00	$20	$4,020	
	Top Slab Of Vault	1	CY	$1,100.00	$1,100	0	0	$45	$0	$5.00	$5	$1,105	
4	Wet Well Interior Grout Allowance	1	LS	$750.00	$750	0	0	$45	$0	$0.00	$0	$750	
5	Misc Allowance	1	EA	$500.00	$500	12	12	$45	$540	$250.00	$250	$1,290	
Subtotal Division 3, Concrete					**$18,700**		**12**		**$540**		**$328**	**$19,568**	**$19,568**
Division 5, Metals													
1	Allowance for Metals & Hatches	1	LS	$5,000.00	$5,000	24	24	$56	$1,344	$150.00	$150	$6,494	
Subtotal Division 5, Metals					**$5,000**		**24**		**$1,344**		**$150**	**$6,494**	**$6,494**
Division 11, Equipment													
1	5 HP Submersible Pumps/Control PNL	2	EA	$5,500.00	$11,000	24	48	$56	$2,688	$50.00	$100	$13,788	
2	Not Used	1	EA	$0.00	$0	0	0	$56	$0	$0.00	$0	$0	
Subtotal Division 11, Equipment					**$11,000**		**48**		**$2,688**		**$100**	**$13,788**	**$13,788**

Division 15, Mechanical

1	4-Inch DIP Discharge to Sewer	500	LF	$13.00	$6,500	0.2	100	$56	$5,600	$2.50	$1,250	$13,350	
	4-Inch Fitting Allowance	5	EA	$130.00	$650	2	10	$56	$560	$0.00	$0	$1,210	
	4-Inch Valve Allowance	1	EA	$335.00	$335	5.333	5.333	$56	$299	$0.00	$0	$634	
2	4-Inch Pump Discharge to Vault	34	LF	$26.00	$884	0.571	19.414	$56	$1,087	$0.00	$0	$1,971	
	4-Inch Fittings	4	EA	$130.00	$520	2	8	$56	$448	$0.00	$0	$968	
	4-Inch Y	2	EA	$153.00	$306	3	6	$56	$336	$0.00	$0	$642	
	4-Inch Check Valves	2	EA	$320.00	$640	5.3	10.6	$56	$594	$0.00	$0	$1,234	
	4-Inch Plug Valves	2	EA	$335.00	$670	5.333	10.666	$56	$597	$0.00	$0	$1,267	
	4-Inch Flanges	10	EA	$61.00	$610	0.696	6.96	$56	$390	$0.00	$0	$1,000	
	4-Inch bolt and Gasket Sets	10	EA	$9.00	$90	0	0	$56	$0	$0.00	$0	$90	
4	1-Inch Relief Pipe	10	LF	$2.50	$25	0.151	1.51	$56	$85	$0.00	$0	$110	
	1-Inch Fittings	5	EA	$12.50	$63	0.615	3.075	$56	$172	$0.00	$0	$235	
	1-Inch Air Relief Valve	1	EA	$300.00	$300	0.5	0.5	$56	$28	$0.00	$0	$328	
	1-Inch Drain Pipe	10	LF	$2.50	$25	0.151	1.51	$56	$85	$0.00	$0	$110	
	1-Inch Plug Valves	2	EA	$80.00	$160	0.571	1.142	$56	$64	$0.00	$0	$224	
5	Vault Drain & Pipe Allowance	1	EA	$750.00	$750	12	12	$56	$672	$0.00	$0	$1,422	
6	4-Inch Influent Pipe (DIP)	100	LF	$13.00	$1,300	0.2	20	$56	$1,120	$2.50	$250	$2,670	
	4-Inch Fittings	5	EA	$130.00	$650	2	10	$56	$560	$0.00	$0	$1,210	
	4-Inch Isolation Valve	1	EA	$335.00	$335	5.333	5.333	$56	$299	$0.00	$0	$634	
	4-Inch Flanges	3	EA	$61.00	$183	0.696	2.088	$56	$117	$0.00	$0	$300	
	4-Inch Bolt and Gasket Sets	3	EA	$9.00	$27	0	0	$56	$0	$0.00	$0	$27	
7	Not Used	1	EA	$0.00	$0	0	0	$56	$0	$0.00	$0	$0	
Subtotal Division 15, Mechanical					**$15,023**		**234.131**		**$13,111**		**$1,500**	**$29,634**	**$29,634**

Division 16/17 Electrical/Instrumentation

1	Percent for Electrical	15.00%								$69,483.34	$10,423	$10,423	
Subtotal Division 16/17 Electrical/Instrumentation											**$10,423**	**$10,423**	**$10,423**

Base Cost of Wastewater Pump Station				**$160,317**
	Contractor Indirects	5.00%		$8,016
Subtotal				**$168,333**
	Contractor Overhead & Profit	15.00%		$25,250
Subtotal				**$193,583**
	Bonds	1.00%		$1,936
	Permits	1.00%		$1,936
	Insurance	2.00%		$3,872
Subtotal				**$201,326**
	Design Contingency	0.00%	**See Note 1**	$0
Subtotal				**$201,326**
	Wash State Sales Tax	8.80%		$17,717
Estimated Opinion of Construction Cost				**$219,043**

				Material		Labor				Equipment			
Item	**Description**	**Quantity**	**Unit**	**Unit cost**	**Amount**	**Labor Hr.**	**Total Hr.**	**Rate**	**Amount**	**Unit Cost**	**Amount**	**Total**	
WATER TREATMENT FACILITY													
Division 2, Civil Site													
1	Sheeting/Shoring	8,300	SF	$14.00	$116,200	0	0	$55	$0	$0.00	$0	$116,200	
	Dewatering Allowance	1	LS	$0.00	$0	0	0	$55	$0	$15,000.00	$15,000	$15,000	
	Excavation	4,100	CY	$0.00	$0	0	0	$45	$0	$3.50	$14,350	$14,350	
	Material Disposal	4,100	CY	$0.00	$0	0	0	$45	$0	$20.00	$82,000	$82,000	
	Import Backfill	1,200	CY	$25.00	$30,000	0.16	192	$45	$8,640	$5.00	$6,000	$44,640	
2	6" Base Rock	70	CY	$25.00	$1,750	0.1	7	$48	$336	$2.50	$175	$2,261	
3	Not Used	1	EA	$0.00	$0	0	0	$45	$0	$0.00	$0	$0	
Subtotal Division 2, Civil					**$147,950**		**199**		**$8,976**		**$117,525**	**$274,451**	**$274,451**
Division 3, Concrete													
1	2' Base Slab	270	CY	$400.00	$108,000	0	0	$48	$0	$0.00	$0	$108,000	
2	Perimeter Walls of Gallery	260	CY	$1,000.00	$260,000	0	0	$48	$0	$5.00	$1,300	$261,300	
3	Perimeter Walls of Tanks	62	CY	$1,000.00	$62,000	0	0	$48	$0	$5.00	$310	$62,310	
4	Not Used	1	EA	$0.00	$0	0	0	$48	$0	$5.00	$5	$5	
5	Interior Walls of Tanks	18	CY	$400.00	$7,200	0	0	$48	$0	$5.00	$90	$7,290	
6	Second Floor (MCC) floor Slab	14	CY	$1,100.00	$15,400	0	0	$48	$0	$5.00	$70	$15,470	
7	Ground Floor Slab	45	CY	$1,100.00	$49,500	0	0	$48	$0	$5.00	$225	$49,725	
8	Stairs	10	CY	$900.00	$9,000	0	0	$48	$0	$5.00	$50	$9,050	
	Landings	10	CY	$1,100.00	$11,000	0	0	$48	$0	$5.00	$50	$11,050	
9	Tank Cover	30	CY	$1,100.00	$33,000	0	0	$48	$0	$5.00	$150	$33,150	
10	MCC Room CMU Wall	200	SF	$12.00	$2,400	0	0	$48	$0	$0.00	$0	$2,400	
	Bond Beams	100	LF	$5.00	$500	0	0	$48	$0	$0.00	$0	$500	
	Steel Reinforcement Allowance	1	LS	$750.00	$750	0	0	$48	$0	$0.00	$0	$750	
11	Misc Allowance	1	EA	$5,000.00	$5,000	0	0	$45	$0	$0.00	$0	$5,000	
12	Crane Use	360	DAY	$0.00	$0	0	0	$45	$0	$200.00	$72,000	$72,000	
Subtotal Division 3, Concrete					**$563,750**		**0**		**$0**		**$74,250**	**$638,000**	**$638,000**
Division 5, Metals													
1	Mezzanine Steel Frame	1	LS	$20,000.00	$20,000	0	0	$48	$0	$0.00	$0	$20,000	
	Grating	400	SF	$19.35	$7,740	0.032	12.8	$48	$614	$0.10	$40	$8,394	
	Steel Stair Risers @ Mezzanine	18	EA	$218.00	$3,924	1.067	19.206	$48	$922	$2.75	$50	$4,895	
2	Steel Stair Riser from MCC Room	18	EA	$218.00	$3,924	1.067	19.206	$48	$922	$2.75	$50	$4,895	
3	Not Used	1	EA	$0.00	$0	0	0	$48	$0	$0.00	$0	$0	
4	Roof Hatches	5	EA	$4,500.00	$22,500	8	40	$48	$1,920	$0.00	$0	$24,420	
5	Hand Rail	310	LF	$31.00	$9,610	0.234	72.54	$48	$3,482	$0.60	$186	$13,278	
6	Stair Well Railing to Basement	70	LF	$14.00	$980	0.15	10.5	$48	$504	$0.10	$7	$1,491	
7	Misc. Metals Allowance	1	LS	$10,000.00	$10,000	80	80	$48	$3,840	$0.00	$0	$13,840	
8	Not Used	1	EA	$0.00	$0	0	0	$48	$0	$0.00	$0	$0	
Subtotal Division 5				**$0.00**	**$78,678**	**0**	**254.252**	**$48**	**$12,204**	**$0.00**	**$332**	**$91,214**	**$91,214**

Division 6, Woods and Plastic

1	Frame and FRP Grate Or MBR Walks	320	SF	$20.00	$6,400	0.1	32	$48	$1,536	$0.00	$0	$7,936	
2	Trim/Woods Allowance	1	LS	$2,500.00	$2,500	0	0	$48	$0	$0.00	$0	$2,500	
3	Not Used	1	EA	$0.00	$0	0	0	$48	$0	$0.00	$0	$0	
Subtotal Division 5					**$8,900**		**32**	**$48**	**$1,536**		**$0**	**$10,436**	**$10,436**

Division 7, Thermal and Moisture Protection

1	Roof Membrane	2,800	SF	$0.00	$0	0	0	$48	$0	$0.00	$0	$0	
	Topping	26	CY	$375.00	$9,750	0	0	$48	$0	$0.00	$0	$9,750	
2	Misc Allowance	1	LS	$4,000.00	$4,000	40	40	$48	$1,920	$0.00	$0	$5,920	
3	not Used	1	EA	$0.00	$0	0	0	$48	$0	$0.00	$0	$0	
Subtotal Division 7, Thermal/Moisture					**$13,750**		**40**		**$1,920.00**		**$0**	**$15,670**	**$15,670**

Division 8, Doors and Windows

1	Double Man Doors	5	EA	$450.00	$2,250	8	40	$48	$1,920	$0.00	$0	$4,170	
2	Single Man Doors	2	EA	$800.00	$1,600	16	32	$48	$1,536	$0.00	$0	$3,136	
3	misc. Hardware Allowance	1	LS	$3,500.00	$3,500	0	0	$48	$0	$0.00	$0	$3,500	
4	Not Used	1	EA	$0.00	$0	0	0	$48	$0	$0.00	$0	$0	
Subtotal Division 8, Doors & Windows					$7,350		**72**		**$3,456.00**		**$0**	**$10,806**	**$10,806**

Division 9, Coating Systems

1	Equipment Paint Allowance	1	LS	$20,000.00	$20,000	0	0	$48	$0	$0.00	$0	$20,000	
	Pipe Painting Allowance	1	LS	$8,000.00	$8,000	0	0	$48	$0	$0.00	$0	$8,000	
2	Building Paint Allowance	1	LS	$20,000.00	$20,000	0	0	$48	$0	$0.00	$0	$20,000	
3	Not used	1	EA	$0.00	$0	0	0	$48	$0	$0.00	$0	$0	
Subtotal Division 9, Coating Systems					**$48,000**		**0**		**$0**		**$0**	**$48,000**	**$48,000**

Division 10, Specialties

1	Sign Allowance	1	LS	$1,500.00	$1,500	8	8	$48	$384	$0.00	$0	$1,884	
2	Fire Extinguisher Allowance	1	LS	$500.00	$500	4	4	$48	$192	$0.00	$0	$692	
3	Architectural Louver Allowance	1	LS	$10,000.00	$10,000	0	0	$48	$0	$0.00	$0	$10,000	
4	Sound Proofing	1	LS	$30,000.00	$30,000	0	0	$48	$0	$0.00	$0	$30,000	
Subtotal Division 10, Specialties					**$42,000**		**12**		**$576**		**$0**	**$42,576**	**$42,576**

Division 11, Equipment

1	MBR Equipment Package	1	LS	$850,000.00	$850,000	2500	2500	$56	$140,000	$600.00	$600	$990,600	
2	Sump Pump Package	1	LS	$6,000.00	$6,000	40	40	$56	$2,240	$0.00	$0	$8,240	
3	HVAC Equipment Allowance	1	LS	$40,000.00	$40,000	40	40	$56	$2,240	$200.00	$200	$42,440	
4	Supply/Exhaust Fan Allowance	1	LS	$3,000.00	$3,000	0	0	$56	$0	$0.00	$0	$3,000	
5	Bridge Crane	1	LS	$30,000.00	$30,000	60	60	$56	$3,360	$250.00	$250	$33,610	
6	UV Disinfection	1	EA	$86,000.00	$86,000	0	0	$56	$0	$0.00	$0	$86,000	
Subtotal Equipment					**$1,015,000**		**2640**		**$147,840**		**$1,050**	**$1,163,890**	**$1,163,890**

Division 15, Mechanical

1	Misc. Process Piping Allowance	1	EA	$5,000.00	$5,000	100	100	$56	$5,600	$0.00	$0	$10,600	
2	Potable Water Piping Allowance	1	EA	$3,000.00	$3,000	40	40	$56	$2,240	$0.00	$0	$5,240	
3	Reclaimed Water Pipe Allowance	1	EA	$3,000.00	$3,000	40	40	$56	$2,240	$0.00	$0	$5,240	
4	Air Piping Allowance	1	EA	$3,000.00	$3,000	32	32	$56	$1,792	$0.00	$0	$4,792	
5	Wastewater Pipe Allowance	1	LS	$20,000.00	$20,000	180	180	$56	$10,080	$0.00	$0	$30,080	
5	Drain Piping Allowance	1	EA	$3,000.00	$3,000	80	80	$56	$4,480	$0.00	$0	$7,480	
6	Emergency Eye Wash/Shower	2	EA	$1,600.00	$3,200	8	16	$56	$896	$0.00	$0	$4,096	
7	Permeate Pipe Allowance	1	LS	$10,000.00	$10,000	80	80	$56	$4,480	$0.00	$0	$14,480	
8	Agitation Air Pipe Allowance	1	LS	$7,500.00	$7,500	60	60	$56	$3,360	$0.00	$0	$10,860	
9	Backpulse Pipe Allowance	1	LS	$10,000.00	$10,000	80	80	$56	$4,480	$0.00	$0	$14,480	
10	WAS Pipe Allowance	1	LS	$12,000.00	$12,000	72	72	$56	$4,032	$0.00	$0	$16,032	
11	RAS Pipe Allowance	1	LS	$4,000.00	$4,000	40	40	$56	$2,240	$0.00	$0	$6,240	
12	FA Pipe Allowance	1	LS	$15,000.00	$15,000	90	90	$56	$5,040	$0.00	$0	$20,040	
13	Pipe Support Allowance	1	LS	$10,000.00	$10,000	80	80	$56	$4,480	$0.00	$0	$14,480	
14	Not Used	1	EA	$0.00	$0	0	0	$56	$0	$0.00	$0	$0	
Subtotal Division 15, Mechanical					**$108,700**		**990**		**$55,440**		**$0**	**$164,140**	**$164,140**

Division 16/17, Electrical/Instrumentation

1	Electrical	15.00%	EA	$0.00	$0	0	0	$52	$0	$1,328,030.00	$199,205	$199,205	
2	PLC/Program/Controls	1	EA	$0.00	$0	0	0	$52	$0	$150,000.00	$150,000	$150,000	
3	Not Used	1	EA	$0.00	$0	0	0	$52	$0	$0.00	$0	$0	
Subtotal Division 16/17, Electrical/Instrumentation											**$349,205**	**$349,205**	**$349,205**

Base Cost of Water Treatment Facility			**$2,808,388**
Contractor Indirects	5.00%		$140,419
Subtotal			**$2,948,807**
Contractor Overhead & Profit	15.00%		$442,321
Subtotal			**$3,391,128**
Bonds	1.00%		$33,911
Permits	1.00%		$33,911
Insurance	2.00%		$67,823
Subtotal			**$3,526,773**
Design Contingency	0.00%	**See Note 1**	$0
Subtotal			**$3,526,773**
Wash State Sales Tax	8.80%		$310,356
Estimated Opinion of Construction Cost			**$3,837,129**

				Material		Labor				Equipment			
Item	**Description**	**Quantity**	**Unit**	**Unit cost**	**Amount**	**Labor Hr.**	**Total Hr.**	**Rate**	**Amount**	**Unit Cost**	**Amount**	**Total**	
1,000,000 TREATED WATER STORAGE		**80' x 100' x 17' WATER DEPTH WITH 2' FREEBOARD**											
Division 2, Civil Site													
1	Sheeting/Shoring	11,000	SF	$14.00	$154,000	0	0	$55	$0	$0.00	$0	$154,000	
	Dewatering Allowance	1	LS	$0.00	$0	0	0	$55	$0	$15,000.00	$15,000	$15,000	
	Excavation	8,400	CY	$0.00	$0	0	0	$45	$0	$3.50	$29,400	$29,400	
	Material Disposal	8,000	CY	$0.00	$0	0	0	$45	$0	$20.00	$160,000	$160,000	
	Import Backfill	1,000	CY	$25.00	$25,000	0.16	160	$45	$7,200	$5.00	$5,000	$37,200	
4	Pipe Excavation	700	CY	$0.00	$0	0	0	$45	$0	$3.00	$2,100	$2,100	
	Bedding	100	CY	$25.00	$2,500	0.1	10	$45	$450	$2.50	$250	$3,200	
	Import Backfill	300	CY	$20.00	$6,000	0.16	48	$45	$2,160	$5.00	$1,500	$9,660	
	Native Backfill	300	CY	$0.00	$0	0.16	48	$45	$2,160	$5.00	$1,500	$3,660	
	Surplus Disposal	400	CY	$0.00	$0	0	0	$45	$0	$25.00	$10,000	$10,000	
5	Native Embankment over Structure	400	CY	$0.00	$0	0	0	$45	$0	$6.00	$2,400	$2,400	
6	Green Roof Cover	1,100	SY	$5.00	$5,500	0	0	$45	$0	$0.00	$0	$5,500	
7	Not Used	1	EA	$0.00	$0	0	0	$45	$0	$0.00	$0	$0	
Subtotal Division 2, Civil					**$193,000**		**266**		**$11,970**		**$227,150**	**$432,120**	**$432,120**
Division 3, Concrete													
1	Bottom Slab On Grade (24")	770	CY	$400.00	$308,000	0	0	$48	$0	$0.00	$0	$308,000	
2	Perimeter Walls (15")	345	CY	$1,000.00	$345,000	0	0	$45	$0	$5.00	$1,725	$346,725	
3	Interior Weir Wall (10")	44	CY	$1,000.00	$44,000	0	0	$45	$0	$5.00	$220	$44,220	
4	Top Slab (15")	333	CY	$1,100.00	$366,300	0	0	$45	$0	$5.00	$1,665	$367,965	
5	Not Used	1	EA	$0.00	$0	0	0	$45	$0	$0.00	$0	$0	
Subtotal Division 3, Concrete					**$1,063,300**		**0**		**$0**		**$3,610**	**$1,066,910**	**$1,066,910**
Division 5, Metals													
1	Allowance for Hatches	4	EA	$3,500.00	$14,000	8	32	$48	$1,536	$0.00	$0	$15,536	
2	Allowance for Misc Metals	1	LS	$3,000.00	$3,000	40	40	$48	$1,920	$500.00	$500	$5,420	
Subtotal Division 5, Metals					**$17,000**		**72**		**$3,456**		**$500**	**$20,956**	**$20,956**
Division 11, Equipment													
1	7.5 HP Submersible Pumps/Control PNL	2	EA	$12,000.00	$24,000	32	64	$56	$3,584	$100.00	$200	$27,784	
	VFD	2	EA	$9,000.00	$18,000	24	48	$52	$2,496	$100.00	$200	$20,696	
2	2 HP Process Water Pumps	2	EA	$2,500.00	$5,000	12	24	$56	$1,344	$90.00	$180	$6,524	
	Control Panel	1	EA	$2,000.00	$2,000	8	8	$52	$416	$0.00	$0	$2,416	
3	Sampler Unit	1	EA	$6,000.00	$6,000	8	8	$56	$448	$0.00	$0	$6,448	
4	12-Inch Inlet Gate	1	EA	$5,000.00	$5,000	32	32	$56	$1,792	$150.00	$150	$6,942	
5	Backup Generator	1	EA	$40,000.00	$40,000	8	8	$56	$448	$0.00	$0	$40,448	
Subtotal Division 11, Equipment					**$100,000**		**192**		**$10,528**		**$730**	**$111,258**	**$111,258**

Division 15, Mechanical

1	**6-Inch to Sprinkler System**	100	LF	$26.00	$2,600	0.571	57.1	$56	$3,198	$0.00	$0	$5,798	
	6-Inch Fittings	2	EA	$60.00	$120	1	2	$56	$112	$0.00	$0	$232	
	6-Inch Butterfly Valve	1	EA	$300.00	$300	4.8	4.8	$56	$269	$0.00	$0	$569	
	6-Inch Flanges	2	EA	$78.00	$156	1.043	2.086	$56	$117	$0.00	$0	$273	
2	**6-Inch Pump Discharge to Vault**	34	LF	$26.00	$884	0.571	19.414	$56	$1,087	$0.00	$0	$1,971	
	6-Inch Fittings	6	EA	$60.00	$360	1	6	$56	$336	$0.00	$0	$696	
	6-Inch Check Valves	2	EA	$600.00	$1,200	8	16	$56	$896	$0.00	$0	$2,096	
	6-Inch Butterfly Valves	2	EA	$300.00	$600	4.8	9.6	$56	$538	$0.00	$0	$1,138	
	6-Inch Flanges	10	EA	$78.00	$780	1.043	10.43	$56	$584	$0.00	$0	$1,364	
	6-Inch bolt and Gasket Sets	10	EA	$14.00	$140	0	0	$56	$0	$0.00	$0	$140	
3	1-Inch pressure/Air Relief Pipe	10	LF	$2.50	$25	0.151	1.51	$56	$85	$0.00	$0	$110	
	1-Inch Fittings	5	EA	$12.50	$63	0.615	3.075	$56	$172	$0.00	$0	$235	
	1-Inch Air Relief Valve	1	EA	$300.00	$300	0.5	0.5	$56	$28	$0.00	$0	$328	
	1-Inch Drain Pipe	10	LF	$2.50	$25	0.151	1.51	$56	$85	$0.00	$0	$110	
	1-Inch Plug Valves	2	EA	$80.00	$160	0.571	1.142	$56	$64	$0.00	$0	$224	
4	Vault Drain & Pipe Allowance	1	EA	$750.00	$750	12	12	$56	$672	$0.00	$0	$1,422	
5	**3-Inch Process Water Discharge**	200	LF	$7.00	$1,400	0.32	64	$56	$3,584	$4.00	$800	$5,784	
	3-Inch Fittings	5	EA	$25.00	$125	0.727	3.635	$56	$204	$0.00	$0	$329	
	3-Inch Butterfly Valve	2	EA	$125.00	$250	2	4	$56	$224	$0.00	$0	$474	
	3-Inch Check Valves	2	EA	$205.00	$410	3.556	7.112	$56	$398	$0.00	$0	$808	
	3-Inch Flanges	9	EA	$46.00	$414	0.516	4.644	$56	$260	$0.00	$0	$674	
	3-Inch Bolt and Gasket Sets	9	EA	$5.00	$45	0	0	$56	$0	$0.00	$0	$45	
7	Not Used	1	EA	$0.00	$0	0	0	$56	$0	$0.00	$0	$0	
Subtotal Division 15, Mechanical					**$11,107**		**230.558**		**$12,911**		**$800**	**$24,818**	**$24,818**

Division 16/17 Electrical/Instrumentation

1	Percent for Electrical	20.00%								$136,075.75	$27,215	$27,215	
Subtotal Division 16/17 Electrical/Instrumentation											**$27,215**	**$27,215**	**$27,215**

Base Cost of Treated Water Storage			**$1,683,277**
Contractor Indirects	5.00%		$84,164
Subtotal			**$1,767,441**
Contractor Overhead & Profit	15.00%		$265,116
Subtotal			**$2,032,557**
Bonds	1.00%		$20,326
Permits	1.00%		$20,326
Insurance	2.00%		$40,651
Subtotal			**$2,113,859**
Design Contingency	0.00%	**See Note 1**	$0
Subtotal			**$2,113,859**
Wash State Sales Tax	8.80%		$186,020
Estimated Opinion of Construction Cost			**$2,299,879**

				Material		Labor				Equipment			
Item	**Description**	**Quantity**	**Unit**	**Unit cost**	**Amount**	**Labor Hr.**	**Total Hr.**	**Rate**	**Amount**	**Unit Cost**	**Amount**	**Total**	
Biofilter 20' X 40'													
Division 2, Civil													
1	Excavation	170	CY	$0.00	$0	0	0	$45	$0	$2.50	$425	$425	
2	Surplus Disposal	170	CY	$0.00	$0	0	0	$45	$0	$25.00	$4,250	$4,250	
3	Liner	164	SY	$10.00	$1,640	0.1	16.4	$50	$820	$0.00	$0	$2,460	
4	Pea Gravel	74	CY	$25.00	$1,850	0.2	14.8	$45	$666	$5.00	$370	$2,886	
5	36" of Media	90	CY	$32.00	$2,880	0.18	16.2	$56	$907	$1.00	$90	$3,877	
6	6-Inch of lBark Material	20	CY	$28.00	$560	0.16	3.2	$45	$144	$0.00	$0	$704	
7	Not Used	1	EA	$0.00	$0	0	0	$45	$0	$0.00	$0	$0	
Subtotal Division 2, Civil					**$6,930**		**50.6**		**$2,537**		**$5,135**	**$14,602**	**$14,602**
Division 3, Concrete													
1	Concrete Blower Pad	1	EA	$1,000.00	$1,000	0	0	$48	$0	$0.00	$0	$1,000	
2	Drainage Sump	1	LS	$2,500.00	$2,500	16	16	$45	$720	$100.00	$100	$3,320	
Subtotal Division 3, Concrete					**$3,500**		**16**		**$720**		**$100**	**$4,320**	**$4,320**
Division 11, Mechanical													
1	Blower Unit	1	EA	$25,000.00	$25,000	24	24	$56	$1,344	$100.00	$100	$26,444	
2	Mister Unit	1	EA	$10,000.00	$10,000	24	24	$56	$1,344	$50.00	$50	$11,394	
3	Sound Proof Enclosure	1	EA	$5,000.00	$5,000	32	32	$56	$1,792	$0.00	$0	$6,792	
Subtotal Division 11, Mechanical					**$40,000**		**80**		**$4,480**		**$150**	**$44,630**	**$44,630**
Division 15, Mechanical													
	FA Pipe Within Biofilter	1	EA	$0.00	$0	0	0	$56	$0	$0.00	$0	$0	
1	20-Inch HDPE FA Pipe	48	LF	$45.00	$2,160	0	0	$56	$0	$0.00	$0	$2,160	
	20-Inch Fittings	3	EA	$1,475.00	$4,425	0	0	$56	$0	$0.00	$0	$4,425	
	Welding Labor Per Joint	5	EA	$0.00	$0	1.73	8.65	$56	$484	$0.00	$0	$484	
2	10-Inch HDPE FA Pipe	300	LF	$20.00	$6,000	0	0	$56	$0	$0.00	$0	$6,000	
	10-Inch Fittings	4	EA	$430.00	$1,720	0	0	$56	$0	$0.00	$0	$1,720	
	Welding Labor Per Joint	48	EA	$0.00	$0	1	48	$56	$2,688	$0.00	$0	$2,688	
3	Welder Rental	4	DAY	$0.00	$0	0	0	$56	$0	$480.00	$1,920	$1,920	
4	Irrigation Piping Within top 6" Allowance	1	LS	$6,000.00	$6,000	0	0	$56	$0	$0.00	$0	$6,000	
5	20-Inch Buried HDPE to Biofilter	150	LF	$0.00	$0	0	0	$56	$0	$0.00	$0	$0	
6	Connection @ Blower Allowance	2	EA	$250.00	$500	2	4	$56	$224	$0.00	$0	$724	
7	20-Inch Butterfly Valves	2	EA	$1,850.00	$3,700	24	48	$56	$2,688	$0.00	$0	$6,388	
	20-Inch Flanges	4	EA	$1,250.00	$5,000	1.73	6.92	$56	$388	$0.00	$0	$5,388	
6	6-Inch HDPE Drain Pipe	160	LF	$100.00	$16,000	0	0	$56	$0	$0.00	$0	$16,000	
	Welding Labor Per Joint	6	EA	$0.00	$0	0.635	3.81	$56	$213	$0.00	$0	$213	
7	Misc. Allowance	1	LS	$1,000.00	$1,000	40	40	$56	$2,240	$0.00	$0	$3,240	
Subtotal Division 15, Mechanical					**$46,505**		**159.38**		**$8,925**		**$1,920**	**$57,350**	**$57,350**

Division 16, Electrical

1	Electrical Allowance	1	LS	$0.00	$0	0	0	$52	$0	$3,000.00	$3,000	$3,000	
Subtotal Electrical					**$0**		**0**		**$0**		**$3,000**	**$3,000**	**$3,000**

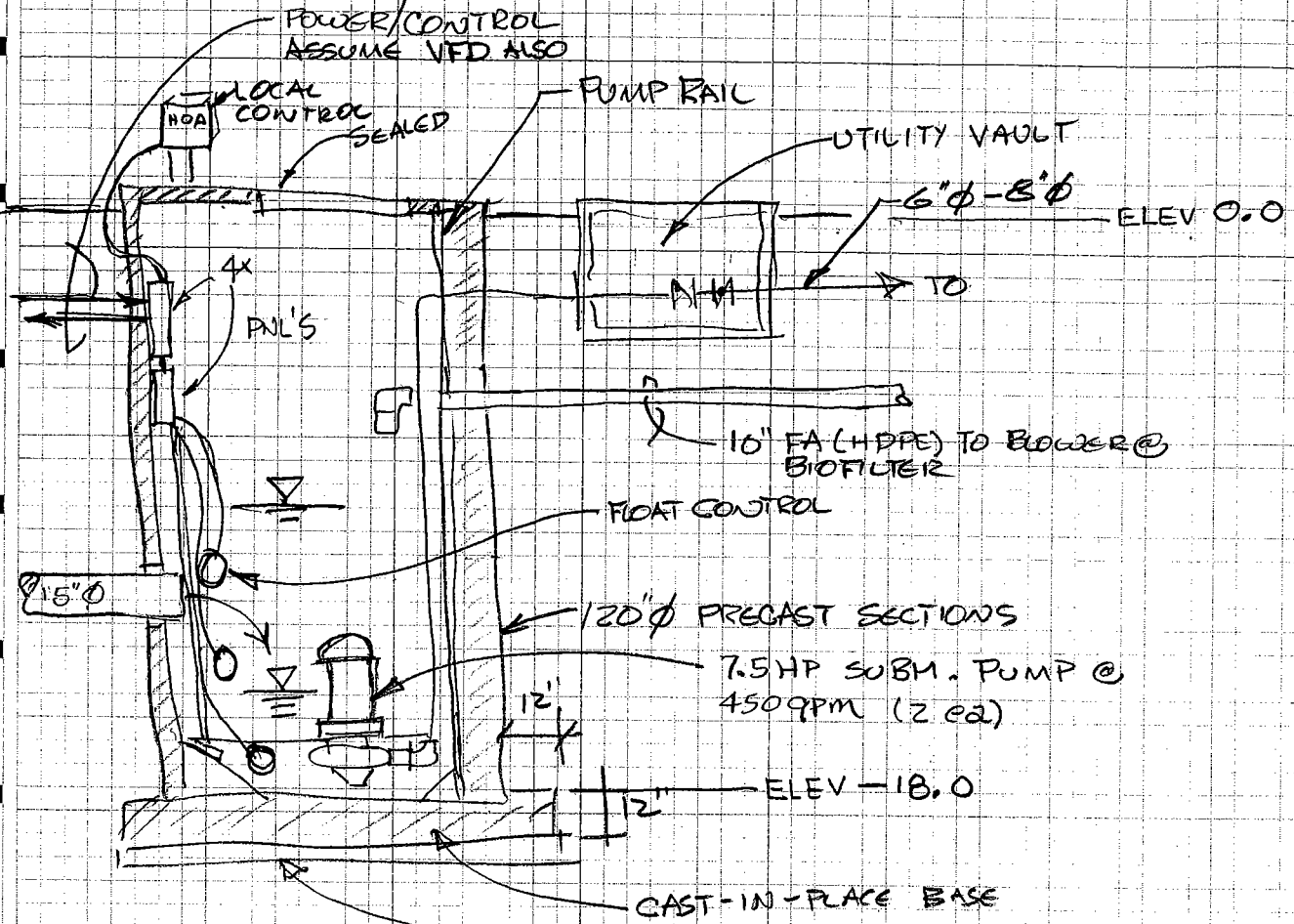
Base Cost of Biofilter			**$123,902**
	Contractor Indirects	5.00%	$6,195
Subtotal			**$130,098**
	Contractor Overhead & Profit	15.00%	$19,515
Subtotal			**$149,612**
	Bonds	1.00%	$1,496
	Permits	1.00%	$1,496
	Insurance	2.00%	$2,992
Subtotal			**$155,597**
	Design Contingency	0.00%	**See Note 1** $0
Subtotal			**$155,597**
	Wash State Sales Tax	8.80%	$13,693
Estimated Opinion of Construction Cost			**$169,289**

Estimated Construction Cost of Facility **$6,883,919**

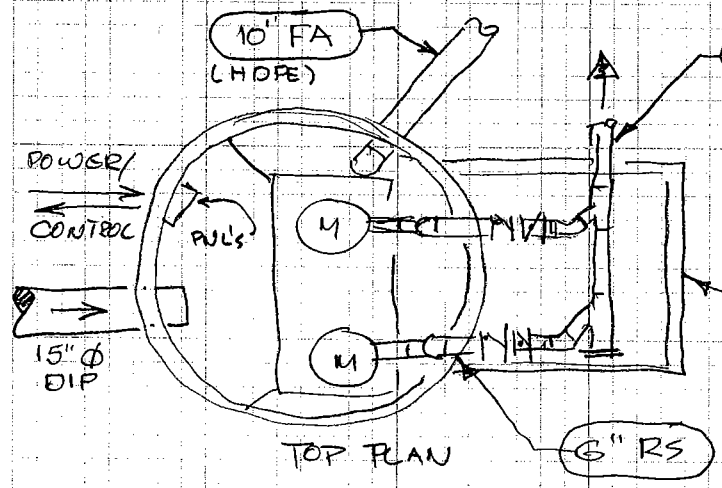
Note 1: Design contingency accounted for elsewhere
Note 2: Does not include distribution piping

2003 Date: _____ Subject: _____ Name: _____ Page: 1/2

PROVIDE FOR TWO PUMP STATIONS



TYPICAL PUMP STATION



TOP PLAN

CONDITIONS

1. ASSUME WATER CONDITION - IE DEWATER
2. SHEET & SHORE
3. ALL IMPORT BACK FILL

MYRTLE EDWARDS PARK LOCATION
TYPICAL PUMP STATION
SPU WATER SYSTEM PLAN UPDATE

JANUARY
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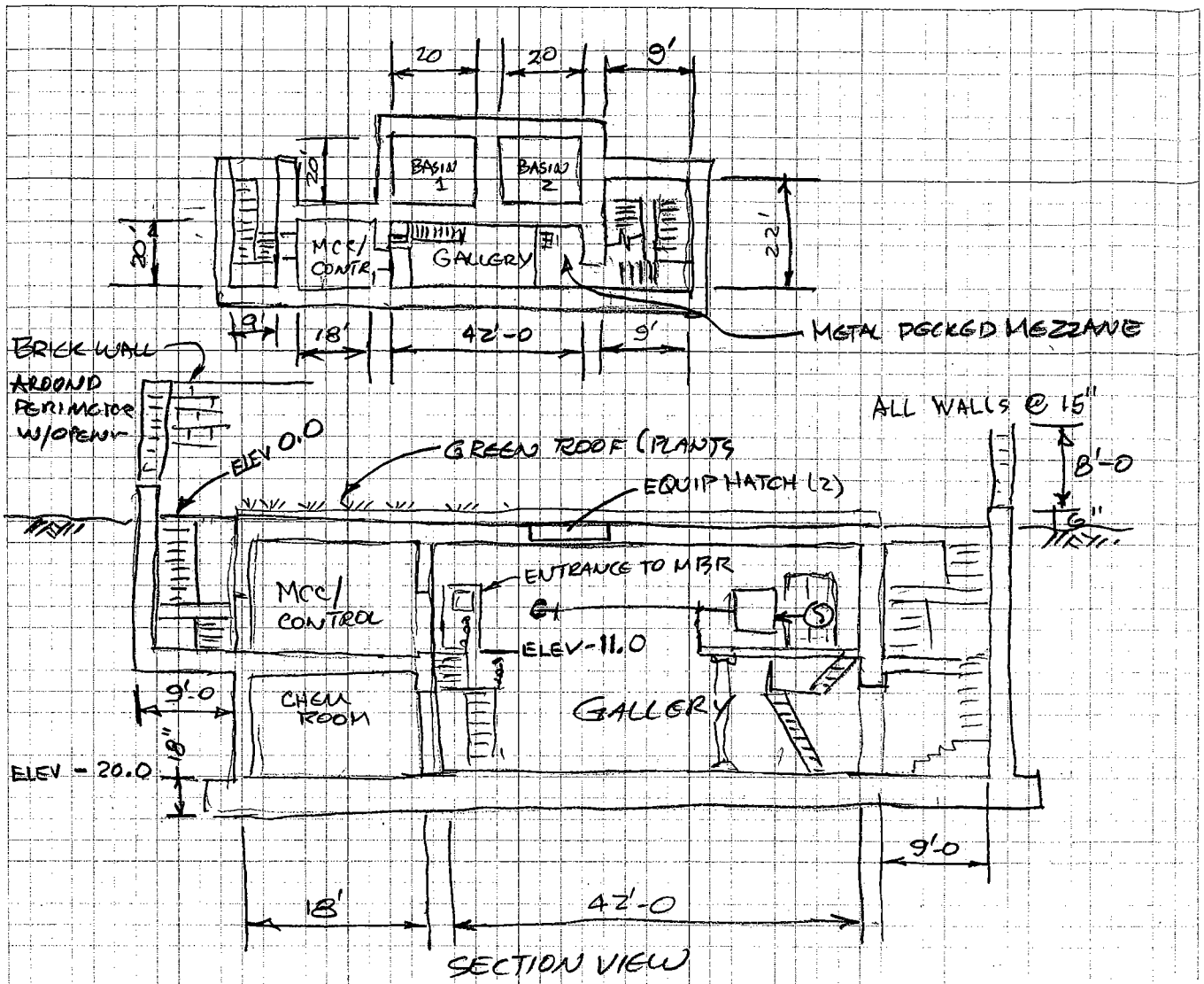
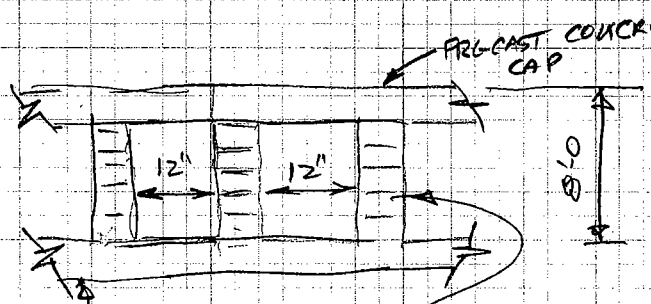
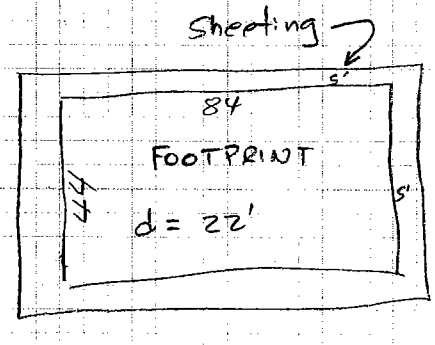


SECTION VIEW





CALLOW TO SEE THROUGH TO WATER (SOUND)

BRICK

BULDING OR PERIMETER CURB AROUND OUTSIDE

PROVIDE 8'-0 HIGH METAL GATES TO STAIRWELLS

1824
1085

MYRTLE EDWARDS PARK LOCATION
SPU WATER SYSTEM PLAN UPDATE — TREATMENT FACILITY

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AUGUST
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SEPTEMBER
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DECEMBER
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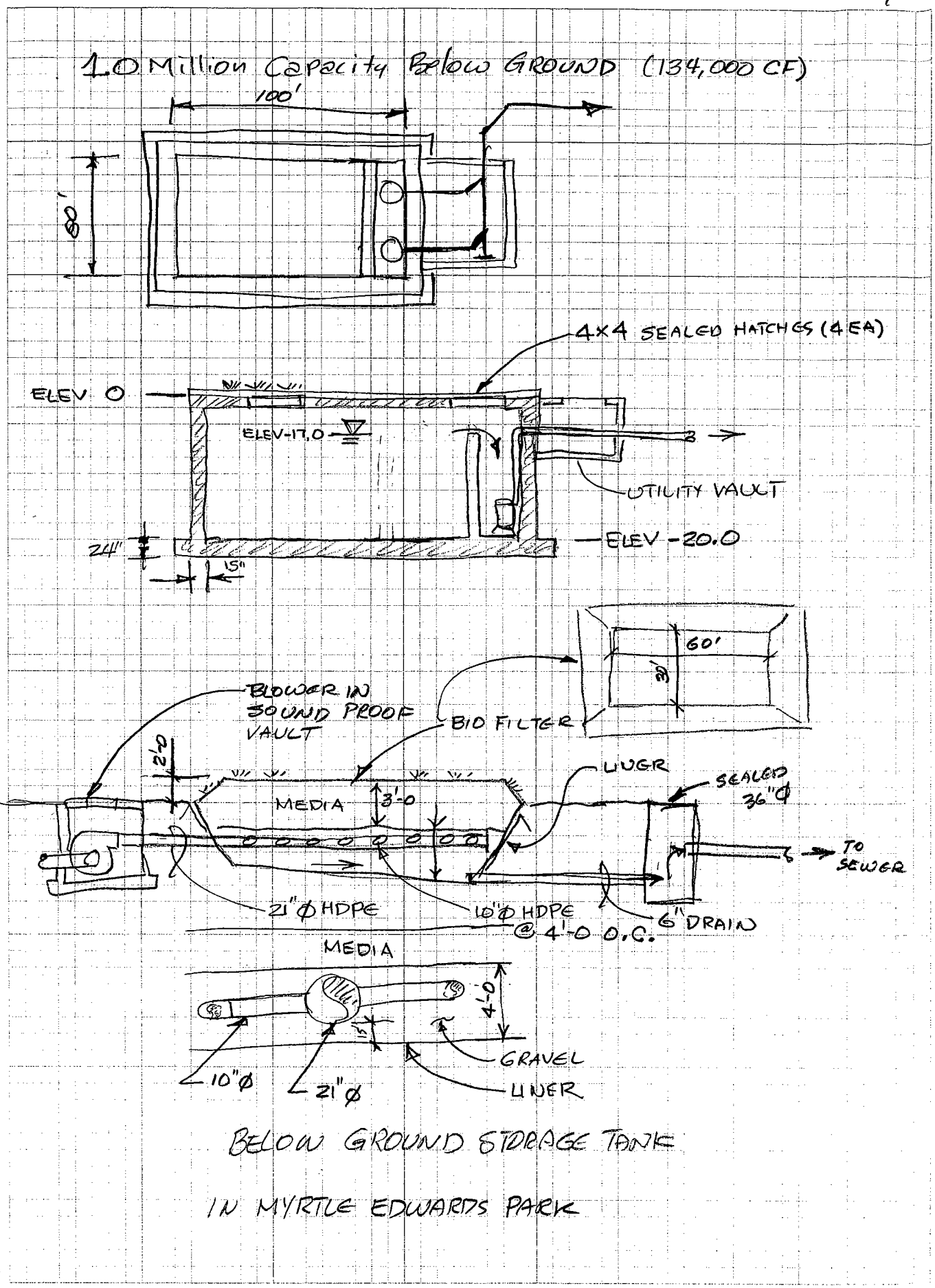
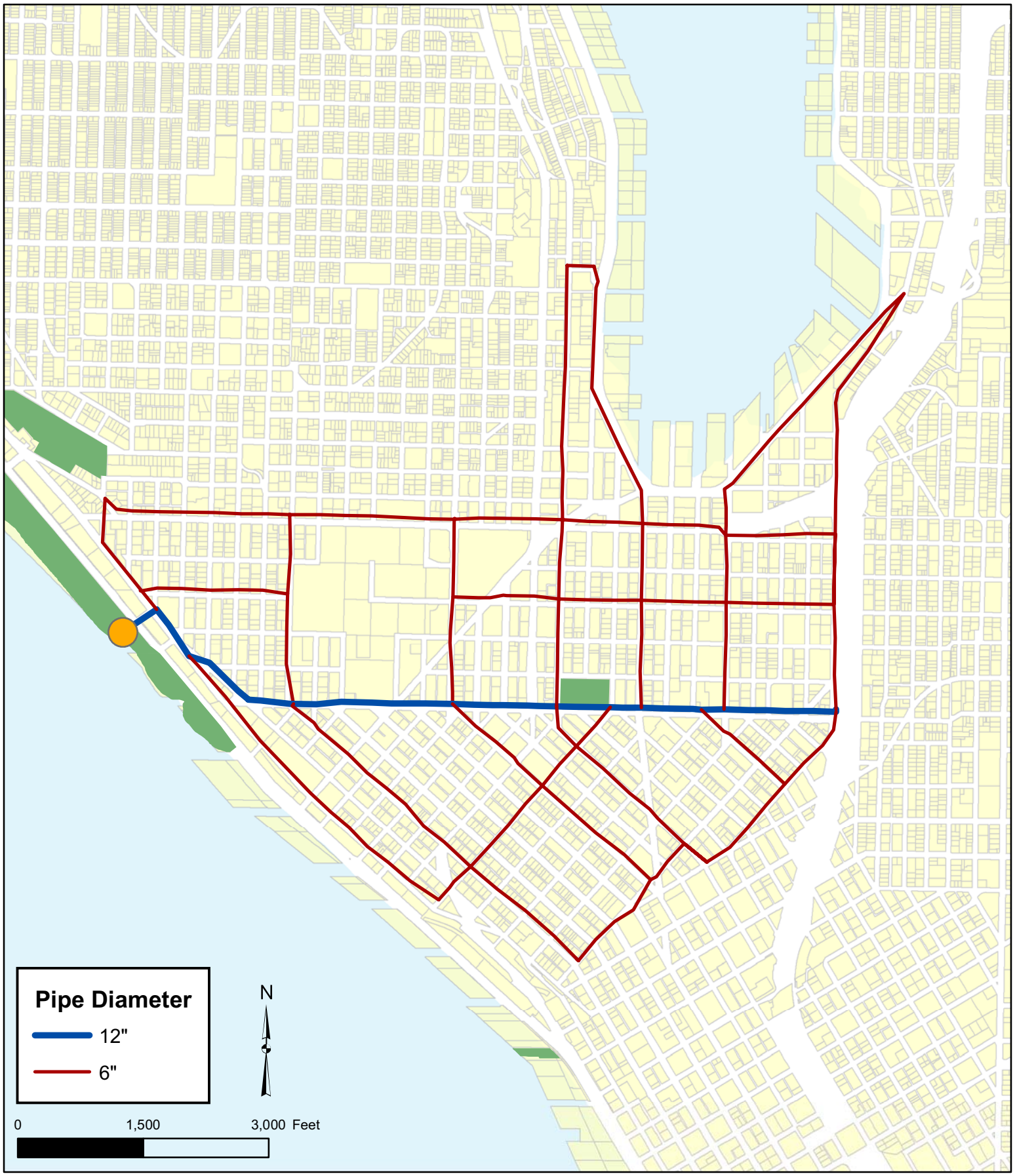


BELOW GROUND STORAGE TANK

IN MYRTLE EDWARDS PARK

Urban Commercial Core/Myrtle Edwards Park Alternative Distribution System Used for Cost Estimate



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APPENDIX G
Reclaimed Water Projects Evaluation

Performance Scales for Value Hierarchy

Results from January 26, 2006, Workshop with Joan Kersnar an

			Performance Scales (1-5 for Each Value)					Initial Scoring					Comments				
			5	4	3	2	1	Calvary Catholic Reclaimed Water	Jackson Park Golf Course Reclaimed Water	Urban Commericial Core/Myrtle Edwards Park	West Seattle Golf Course Reclaimed Water Facility "A"	West Seattle Golf Course Reclaimed Water Facility "B"	Calvary Catholic Reclaimed Water	Jackson Park Golf Course Reclaimed Water	Urban Commericial Core/Myrtle Edwards Park	West Seattle Golf Course Reclaimed Water Facility "A"	West Seattle Golf Course Reclaimed Water Facility "B"
	Attribute	**Attribute Description**	**Enhanced/ Advantaged**	**Improvement some of the time, in some cases**	**No change from existing conditions or offsetting impacts**	**Some negative impacts in some cases that may be fairly easy to resolve**	**Severe negative impact or some impact in many cases that are difficult to resolve**						- 0.08-0.3 MGD treament facility for irrigating the cemetery - approximately 20,807 ccf treated annually - facility source is King County Interceptor	- X MGD treament facility for irrigating the golf course - approximately 47,520 ccf treated annually - facility source is Ballinger Portal (Brightwater effluent)	- 0.58-0.61 MGD treament facility for irrigating the park and residential/ commercial toilet flushing - approximately 193,396 ccf treated annually - facility source is King County Interceptor	- 0.04-0.15 MGD treament facility for irrigating the golf course - approximately 26,571 ccf treated annually - facility source is SPU wastewater collection system	- 0.04-0.4 MGD treament facility for irrigating the golf course - approximately 31,043 ccf treated annually - facility source is King County Interceptor
A.	**Ease of Source Development**																
1	**Public Trust**	Related to how it meets or counters public expectations															
	Political Acceptability	Related to political pressure or reaction of electeds and media exposure	Accolades and desire to emulate from other municipalities. Exuberant political support.	Positive news coverage and strong support by elected officials in retail and wholesale service areas.	No news coverage, media call but no follow up story. Little involvement or reaction by electeds.	Mixed support from City Council. Negative news story expected, at least one somewhat influential person would negatively react	Active opposition from City Council, high possibility of intervention from external sources, state or federal legislation, daily local negative news stories could be generated, possible negative national news coverage	3	3	4.5	4	3.5	Not a visible project, and the City does not own the Cemetary.	Because of on-going costs to King County for reclaimed water supply (Brightwater). Project will require considerable coordination with King County and City of Shoreline.	Council would likely support this environmental initiative; however, there could be some issues raised over costs.	No involvement of King County. City Council more likely to support a 100% City effort.	Will be a good news story, but will require management of the risks of pharmaceuticals and PCPs. There are treatment options (i.e. RO) to remove pharmaceuticals and PCPs
	Public Acceptability (Stakeholders)	Related to customer or stakeholder reactions to the option	Customers and stakeholders gleefully support and encourage action.	Customers and stakeholders support action.	Customers and stakeholders show little interest	Public opinion survey might show a negative rating, a fair number of calls or letters expected, would take a short time to mitigate problem	Customers and specific stakeholders vocal and actively oppose utility action	2.5	4	4.5	3	3	Some of the current family members of buried ones at the Cemetary would have concerns re: respecting the deceased.	There would be some supporters because of environmental supporters of Brightwater. However, there would also be opponents because of costs.	Would likely be supported as a cutting-edge, show-cased use of reclaimed water by developers. Only disadvantage would be grumbling about costs.	Some supporters and some negative response expected.	Some supporters and some negative response expected.
2	**Environmental Acceptability of Construction**	Related to potential for temporary harm to life forms as a result of changes made to the environment during construction.															
	Built Environment	Impacts to people and existing infrastructure such as water outages, traffic, noise, odor, air quality	Substantial improvement	Moderate improvements	Negligible or no impacts	Moderate impacts	Deterioration, substantially worse and can't be mitigated	2.5	2.5	1.5	2.5	2.5	There would be construction impacts. However, facility size is small and therefore impacts are considered small.	There would be construction impacts. However, facility size is small and therefore impacts are considered small.	There would be increased street disruptions in a dense urban area, especially if the construction of pipelines is not coordinated with other reasons for tearing up the streets.	There would be construction impacts. However, facility size is small and therefore impacts are considered small.	There would be construction impacts. However, facility size is small and therefore impacts are considered small.
	Natural Environment	Impacts to ecosystems (e.g., rivers)	Improvements to habitat or ecosystem function		No measurable harm to environment or contribution to pollution, release of non-harmful substances or release, but within legal limits, clean up achieved easily	Small area of ecosystems disturbed, but function not significantly impaired, release of substances contained or impacts confined	Major ecosystem destruction, erosion or sedimentation, releases of substances in toxic quantities	3	3	3	3	3	Any impacts can be mitigated.	Any impacts can be mitigated.	Any impacts can be mitigated.	Any impacts can be mitigated.	Any impacts can be mitigated.

Performance Scales for Value Hierarchy

Results from January 26, 2006, Workshop with Joan Kersnar an

			Performance Scales (1-5 for Each Value)					Initial Scoring					Comments				
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	Attribute	**Attribute Description**	**Enhanced/ Advantaged**	**Improvement some of the time, in some cases**	**No change from existing conditions or offsetting impacts**	**Some negative impacts in some cases that may be fairly easy to resolve**	**Severe negative impact or some impact in many cases that are difficult to resolve**						- 0.08-0.3 MGD treament facility for irrigating the cemetery - approximately 20,807 ccf treated annually - facility source is King County Interceptor	- X MGD treament facility for irrigating the golf course - approximately 47,520 ccf treated annually - facility source is Ballinger Portal (Brightwater effluent)	- 0.58-0.61 MGD treament facility for irrigating the park and residential/ commercial toilet flushing - approximately 193,396 ccf treated annually - facility source is King County Interceptor	- 0.04-0.15 MGD treament facility for irrigating the golf course - approximately 26,571 ccf treated annually - facility source is SPU wastewater collection system	- 0.04-0.4 MGD treament facility for irrigating the golf course - approximately 31,043 ccf treated annually - facility source is King County Interceptor
3	**Asset Reliability**	Related to reliability of the potential utility asset in its implementation															
	Timing Reliability	Intangible issues around starting and stopping a project, such as confusion, agency relations, momentum, etc.	Requires no additional resources or measures to stop & restart.	Could be easily stopped and started again.	Has ability to be stopped and started again, but it would be somewhat difficult		Cannot be stopped and started	2	4	1	4.5	4	Coordination with the cemetary would be an issue.	Starting and stopping the project will have some cost impacts. Coordination with King County will be necessary.	The timing of the project is critical, especially with other development plans and construction in the street. If the project is delayed, it could impact the viability of the overall project.	No coordination with King County necessary, b/c sewer line is SPU's.	Starting and stopping the project will have some cost impacts. Coordination with King County will be necessary.
	Leads to Other Sources	Opens up or closes opportunities for other sources for SPU.	Includes additional supply readily accessible with additional development.	Opens up opportunities for other source options.	Has no impact on the possibility of other sources		Closes off other source opportunities	3.5	3.5	4	3.5	3.5	Could lead to other opportunities with private entities.	Could potentially open up opportunity for other reclaimed water projects in the area.	New/Re-development opportunities in the downtown area could also use reclaimed water.	Could potentially open up opportunity for other reclaimed water projects in the area.	Could potentially open up opportunity for other reclaimed water projects in the area.
4	**Legal/Regulatory**	Related to legal or regulatory obstacles to developing a new source such as new legislation or variance required, lawsuits, condemnation	No legal or regulatory issues exist, or they have already been resolved		There are standard legal or regulatory matters to address that can be resolved in reasonable amount of time.	There are many minor legal or regulatory obstacles to overcome to implement the source option that may be difficult to overcome.	There are major legal or regulatory obstacles that will either be difficult to resolve or cannot be resolved.	4	3	2	3	3	The City of Seattle Resolution does not apply since the reclaimed water will not runoff into a salmon-bearing creek. Other regular permits and SEPA will still apply.	There are RW permit requirements, fulfilling requirements of the Pageler resolution, and SEPA.	The legal/regulatory issues would be greater because there are more dual-plumbing issues with developers and building owners.	There are RW permit requirements, fulfilling requirements of the Pageler resolution, and SEPA.	There are RW permit requirements, fulfilling requirements of the Pageler resolution, and SEPA.

Performance Scales for Value Hierarchy

Results from January 26, 2006, Workshop with Joan Kersnar an

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B.	**System Operation**																
1	**Environmental Acceptability**	Related to potential for permanent harm to life forms as a direct result of changes made to the environment from the existence and operation of the new source															
	Natural Environment	Related to impact on ecosystems (e.g., instream flows and wetlands)	Provides net improvement to ecosystems. Establishes a sustainable ecosystem.		Maintains existing ecosystems.		Has severe impact on ecosystems and cannot be mitigated.	3	2.5	3	2.5	2.5	No application on salmon-bearing stream.	Again, some potential impacts to Thornton Creek because of endocrine disrupters and PCPs.	No application on salmon-bearing stream.	The project could have impacts on salmon-bearing Longfellow Creek.	The project could have impacts on salmon-bearing Longfellow Creek.
	Secondary Impacts and Benefits/ Sustainability	Related to benefits or impacts other than drinking water such as power generation, energy savings, or recreation, which are not monetized.	Substantial secondary benefits.	Some secondary benefits.	No net secondary benefits or impacts.		Potential negative secondary impacts.	3	3	3	3	3	Small reduction in wastewater discharge to the Puget Sound and small increase in energy consumption. Both are minimal and therefore would be negligible.	Small reduction in wastewater discharge to the Puget Sound and small increase in energy consumption. Both are minimal and therefore would be negligible.	Small reduction in wastewater discharge to the Puget Sound and small increase in energy consumption. Both are minimal and therefore would be negligible.	Small reduction in wastewater discharge to the Puget Sound and small increase in energy consumption. Both are minimal and therefore would be negligible.	Small reduction in wastewater discharge to the Puget Sound and small increase in energy consumption. Both are minimal and therefore would be negligible.

Performance Scales for Value Hierarchy

Results from January 26, 2006, Workshop with Joan Kersnar an

			Performance Scales (1-5 for Each Value)					Initial Scoring					Comments				
			5	4	3	2	1	Calvary Catholic Reclaimed Water	Jackson Park Golf Course Reclaimed Water	Urban Commericial Core/Myrtle Edwards Park	West Seattle Golf Course Reclaimed Water Facility "A"	West Seattle Golf Course Reclaimed Water Facility "B"	Calvary Catholic Reclaimed Water	Jackson Park Golf Course Reclaimed Water	Urban Commericial Core/Myrtle Edwards Park	West Seattle Golf Course Reclaimed Water Facility "A"	West Seattle Golf Course Reclaimed Water Facility "B"
	Attribute	**Attribute Description**	**Enhanced/ Advantaged**	**Improvement some of the time, in some cases**	**No change from existing conditions or offsetting impacts**	**Some negative impacts in some cases that may be fairly easy to resolve**	**Severe negative impact or some impact in many cases that are difficult to resolve**						- 0.08-0.3 MGD treament facility for irrigating the cemetery - approximately 20,807 ccf treated annually - facility source is King County Interceptor	- X MGD treament facility for irrigating the golf course - approximately 47,520 ccf treated annually - facility source is Ballinger Portal (Brightwater effluent)	- 0.58-0.61 MGD treament facility for irrigating the park and residential/ commercial toilet flushing - approximately 193,396 ccf treated annually - facility source is King County Interceptor	- 0.04-0.15 MGD treament facility for irrigating the golf course - approximately 26,571 ccf treated annually - facility source is SPU wastewater collection system	- 0.04-0.4 MGD treament facility for irrigating the golf course - approximately 31,043 ccf treated annually - facility source is King County Interceptor
2	**Asset Reliability**	Related to operational reliability of the source option															
	System Robustness	Related to confidence and predictability in system's ability to meet demand (drought, critical seasons, infrastructure)	Enhances ability of supply system to withstand different kinds of droughts, and is able to contribute to system during peak season. It can also provide continuous service during infrastructure outages or failures.	Can either enhance ability of supply system to withstand different kinds of droughts, or is able to contribute to system during critical seasons, or is able to provide continuous service during infrastructure outages or failures.	Does not add anything to ability of system to withstand different kinds of droughts, does not contribute to system during critical seasons, and does not provide continuous service during infrastructure outages or failures.		Detracts from ability of system to withstand different kinds of droughts, is not always available during critical seasons, and is more susceptible to outages or failures.	3	3	3	3	3	Benefit of increased reliable RW supply. However, the entire system's reliability is not increased substantially.	Benefit of increased reliable RW supply. However, the entire system's reliability is not increased substantially.	Benefit of increased reliable RW supply. However, the entire system's reliability is not increased substantially.	Benefit of increased reliable RW supply. However, the entire system's reliability is not increased substantially.	Benefit of increased reliable RW supply. However, the entire system's reliability is not increased substantially.
	Operational Ease and Flexibility	Relative ease of moving water around the system	Enhances operational flexibility		No impact on system operation	Creates additional work for system operation.	Reduces operational flexibility	2	2	1.75	2	2	Requires 0.5 FTE of City-paid employee to operate and maintain the MBR Tretament Plant.	Requires 0.5 FTE of City-paid employee to operate and maintain the MBR Tretament Plant.	Year-round 0.5 FTE and dual-plumbed building.	Requires 0.5 FTE of City-paid employee to operate and maintain the MBR Tretament Plant.	Requires 0.5 FTE of City-paid employee to operate and maintain the MBR Tretament Plant.
	Security	Related to physical security of supply system	Significant improvement in the security of the supply system		Has no effect on security of the system	May introduce a security risk to the system	Presents a significant security risk	3	3	3	3	3	No impact on system security.	No impact on system security.	No impact on system security.	No impact on system security.	No impact on system security.
3	**Public Trust**	Related to customer or stakeholder confidence in and opinions of the option as a result of curtailments or rate stability or general acceptability of source	Customers and stakeholders have high confidence and high opinions of system and SPU's ability to provide them with water		No change in confidence or opinions of system and SPUs ability to provide them with water		Customers and specific stakeholders have low confidence or poor opinions of system	3	4	3	4	4	Not very visible project.	Public would appreciate golf course during drought; there might be some confusion regarding why the golf course is green during the drought.	Most likely, support would be neutral. The water is not as visible (i.e. landscaping).	Public would appreciate golf course during drought; there might be some confusion regarding why the golf course is green during the drought.	Public would appreciate golf course during drought; there might be some confusion regarding why the golf course is green during the drought.

Performance Scales for Value Hierarchy

Results from January 26, 2006, Workshop with Joan Kersnar an

			Performance Scales (1-5 for Each Value)					Initial Scoring					Comments				
			5	4	3	2	1	Calvary Catholic Reclaimed Water	Jackson Park Golf Course Reclaimed Water	Urban Commericial Core/Myrtle Edwards Park	West Seattle Golf Course Reclaimed Water Facility "A"	West Seattle Golf Course Reclaimed Water Facility "B"	Calvary Catholic Reclaimed Water	Jackson Park Golf Course Reclaimed Water	Urban Commericial Core/Myrtle Edwards Park	West Seattle Golf Course Reclaimed Water Facility "A"	West Seattle Golf Course Reclaimed Water Facility "B"
	Attribute	**Attribute Description**	**Enhanced/ Advantaged**	**Improvement some of the time, in some cases**	**No change from existing conditions or offsetting impacts**	**Some negative impacts in some cases that may be fairly easy to resolve**	**Severe negative impact or some impact in many cases that are difficult to resolve**						- 0.08-0.3 MGD treament facility for irrigating the cemetery - approximately 20,807 ccf treated annually - facility source is King County Interceptor	- X MGD treament facility for irrigating the golf course - approximately 47,520 ccf treated annually - facility source is Ballinger Portal (Brightwater effluent)	- 0.58-0.61 MGD treament facility for irrigating the park and residential/ commercial toilet flushing - approximately 193,396 ccf treated annually - facility source is King County Interceptor	- 0.04-0.15 MGD treament facility for irrigating the golf course - approximately 26,571 ccf treated annually - facility source is SPU wastewater collection system	- 0.04-0.4 MGD treament facility for irrigating the golf course - approximately 31,043 ccf treated annually - facility source is King County Interceptor
4	**Public Health (Water Quality)**	Related to temporary or permanent harm to humans from water supply															
	Meets Regulations	Inherent qualities of source in meeting current and near-future drinking water quality regulations to protect public health or secondary benefits	Provides clear public health protection benefits and/or significant secondary water quality benefits		Meets current and near-term future regulations		Compromises ability to meet current water quality standards and is at risk of not meeting anticipated future water quality regulations	3	2.5	3	2.5	2.5	No concerns re: future regs on endocrine disrupters.	Small possibility that restrictions on endocrine disrupters would drive treatment to RO, thereby increasing operations costs significantly.	No concerns re: future regs on endocrine disrupters.	Small possibility that restrictions on endocrine disrupters would drive treatment to RO, thereby increasing operations costs significantly.	Small possibility that restrictions on endocrine disrupters would drive treatment to RO, thereby increasing operations costs significantly.
	Source and Treatment Compatibility	Degree to which source and treatment process is consistent with SPU's other sources and policies	Improves water quality with the addition of new source and/or treatment capacity		Is compatible with existing sources	Requires minor additional treatment or changes in operation to allow for source compatibility	Is not compatible with existing sources so major changes to existing system or treatment processes would be necessary	3	3	3	3	3	No change to drinking water quality. RW is suitable for use as irrigation water.	No change to drinking water quality. RW is suitable for use as irrigation water.	No change to drinking water quality. RW is suitable for use as irrigation water.	No change to drinking water quality. RW is suitable for use as irrigation water.	No change to drinking water quality. RW is suitable for use as irrigation water.
5	**Social (Lifestyles)**	Related to impacts on how customers live, work, play, and relate to one another	Improves customer lifestyle		Has no change to customer lifestyles		Requires significant change to customer's lifestyles	3	3	3	3	3	No change to customer lifestyle.	Some benefit from green golf course during drought. Some additional training on purple pipe required for Golf Course staff. No drinking/swimming allowed in golf course ponds, etc.	No change to customer lifestyle.	Some benefit from green golf course during drought. Some additional training on purple pipe required for Golf Course staff. No drinking/swimming allowed in golf course ponds, etc.	Some benefit from green golf course during drought. Some additional training on purple pipe required for Golf Course staff. No drinking/swimming allowed in golf course ponds, etc.

Value Score and Cost Summary of Reclaimed Water Alternatives

Alternative	Value Score	PV Cost ($m)[a]	Levelized Unit Cost ($m/MGD)[b]
Catholic Calvary Cemetery	0.500	$1.1	$10.94
Jackson Park Golf Course	0.518	$1.5	$5.80
Urban Comerical Core/Myrtle Edwards Park	0.478	$6.2	$6.10
West Seattle Golf Course Facility A	0.525	$0.8	$6.32
West Seattle Golf Course Facility B	0.510	$1.4	$9.16

Notes:

[a]Present value of pre-construction, construction, and O&M costs for each alternative at a 3% discount rate assuming online date of 2050, and accounting for the remaining useful life of MBR, Pumps, and Other costs. Online date of 2050 was selected to be consistent with cost estimates prepared for other SPU water supply options in the Water System Plan.

[b]Levelized unit costs are calculated by dividing the present value (PV) of cost by the PV of annual yield (mgd) for each alternative at a 3% discount rate assuming online date of 2050.

Pre-Construction activities include environmental and engineering studies, water rights applications, permitting, land acquisition, and SEPA (EIS) compliance.

Construction activities include construction, construction management, engineering support, environmental controls and mitigation work.

Increased costs for treatment, transmission, and storage, as well as costs for maintaining/protecting new source facilities. Also includes annualized value of replacing key components during life of project.

SEATTLE PUBLIC UTILITIES
2007 WATER SYSTEM PLAN

I. WATER RESOURCES

APPENDIX F

GROUNDWATER ELEVATIONS AT SEATTLE WELL FIELDS

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Groundwater Elevations at Seattle Well Fields

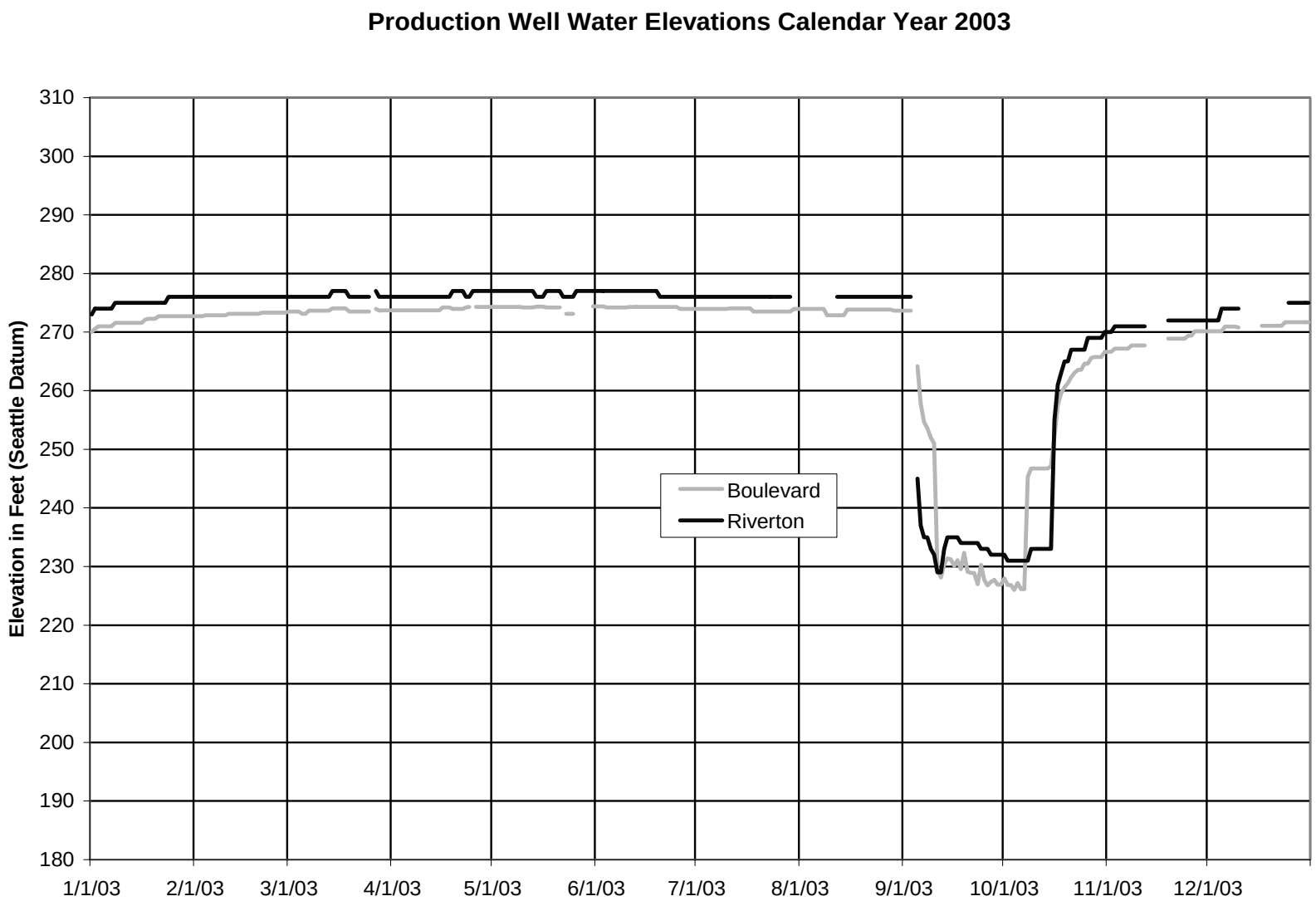
May 2006

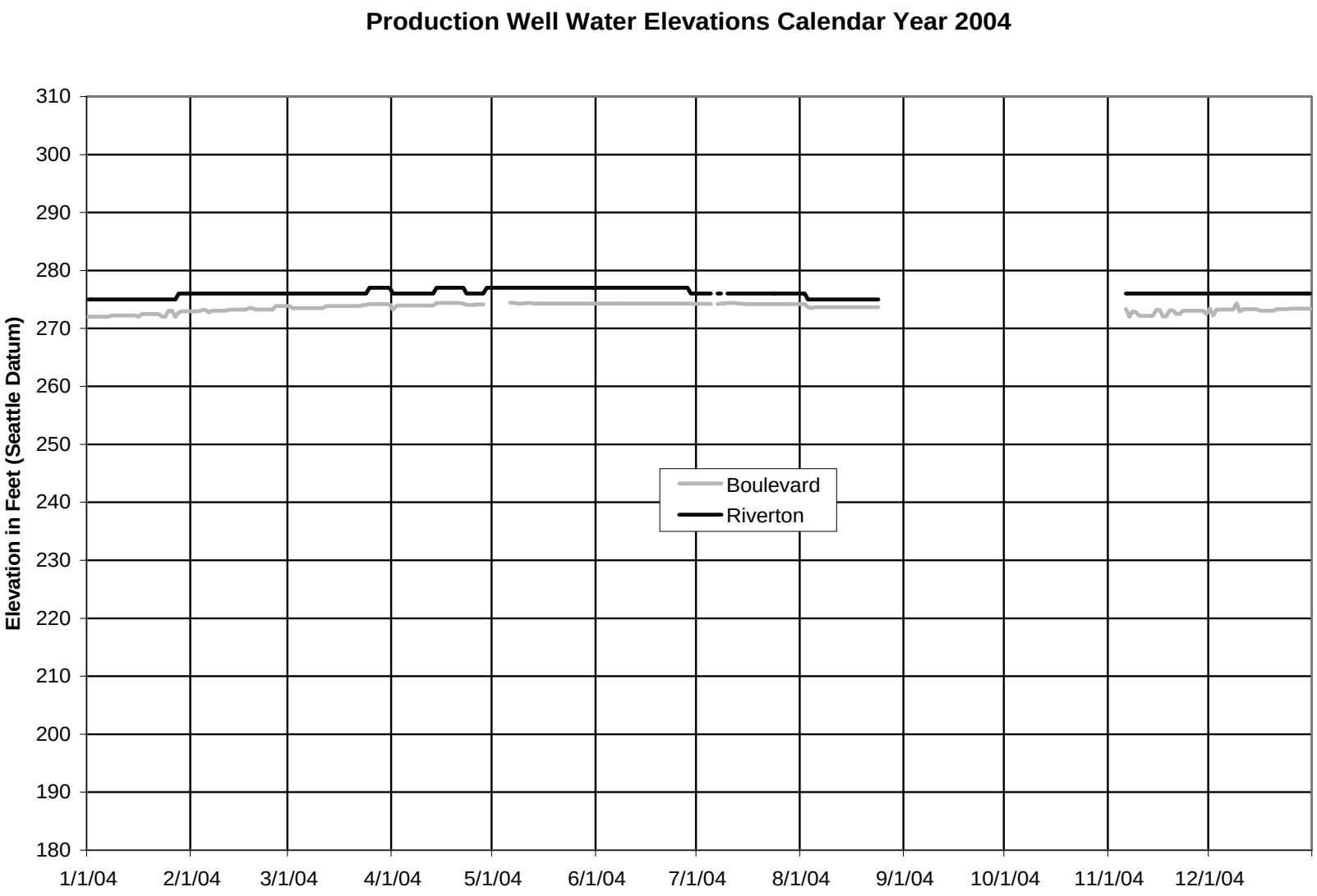
SPU monitors groundwater levels in the vicinity of the Riverton and Boulevard Park Well Fields as part of its management of this source of supply. Underlying the area are three water-bearing, sand and gravel formations now known as the Shallow, Intermediate and Deep Aquifers. The aquifers are arranged in layers and separated by much less pervious, silt and clay layers which act as aquitards. At the land surface, over much of the Highline area, is a highly compacted layer composed of glacial till. SPU has three production wells tapped into the Intermediate Aquifer.

In addition to the production wells, SPU has a network of six monitoring wells in the Well Fields. Three of these wells can monitor water levels in the intermediate aquifer, two in the shallow aquifer, and one in the deep aquifer. Data loggers collected continuous elevation data from the monitoring wells from late 1991 through late 1999, primarily during and immediately after the ASR demonstration project. Routine collection of water level data from the observation wells was suspended in early 2000. In the absence of recharge operations, it was felt that levels recorded continuously in the three production wells by the SCADA system would adequately track trends in the intermediate aquifer. However, well field SCADA data prior to January 2003 was lost during the upgrade of the system in 2005. As a result, there is no elevation data available for 2000, 2001, or 2002, either from SCADA or the monitoring wells.

The attached graphs show the ground water elevations from the SCADA system at the Riverton and Boulevard Park Well Fields from January 2003 to May 2006. No long term trends appear in the data. Short term decline occurred in September and October 2003 when the wells were placed in service, but levels quickly recovered when pumping ceased. The short-term decline in July 2005 resulted from test pumping of Boulevard Park as part of well rehabilitation.

SPU will continue to monitor the elevations in the production wells for any trends, and will re-activate the monitoring well network if recharge operations are undertaken.


Production Well Water Elevations Calendar Year 2003
Elevation in Feet (Seattle Datum)
310
300
290
280
270
260
250
240
230
220
210
200
190
180
1/1/03
2/1/03
3/1/03
4/1/03
5/1/03
6/1/03
7/1/03
8/1/03
9/1/03
10/1/03
11/1/03
12/1/03
Boulevard
Riverton


Production Well Water Elevations Calendar Year 2004
Elevation in Feet (Seattle Datum)
310
300
290
280
270
260
250
240
230
220
210
200
190
180
1/1/04
2/1/04
3/1/04
4/1/04
5/1/04
6/1/04
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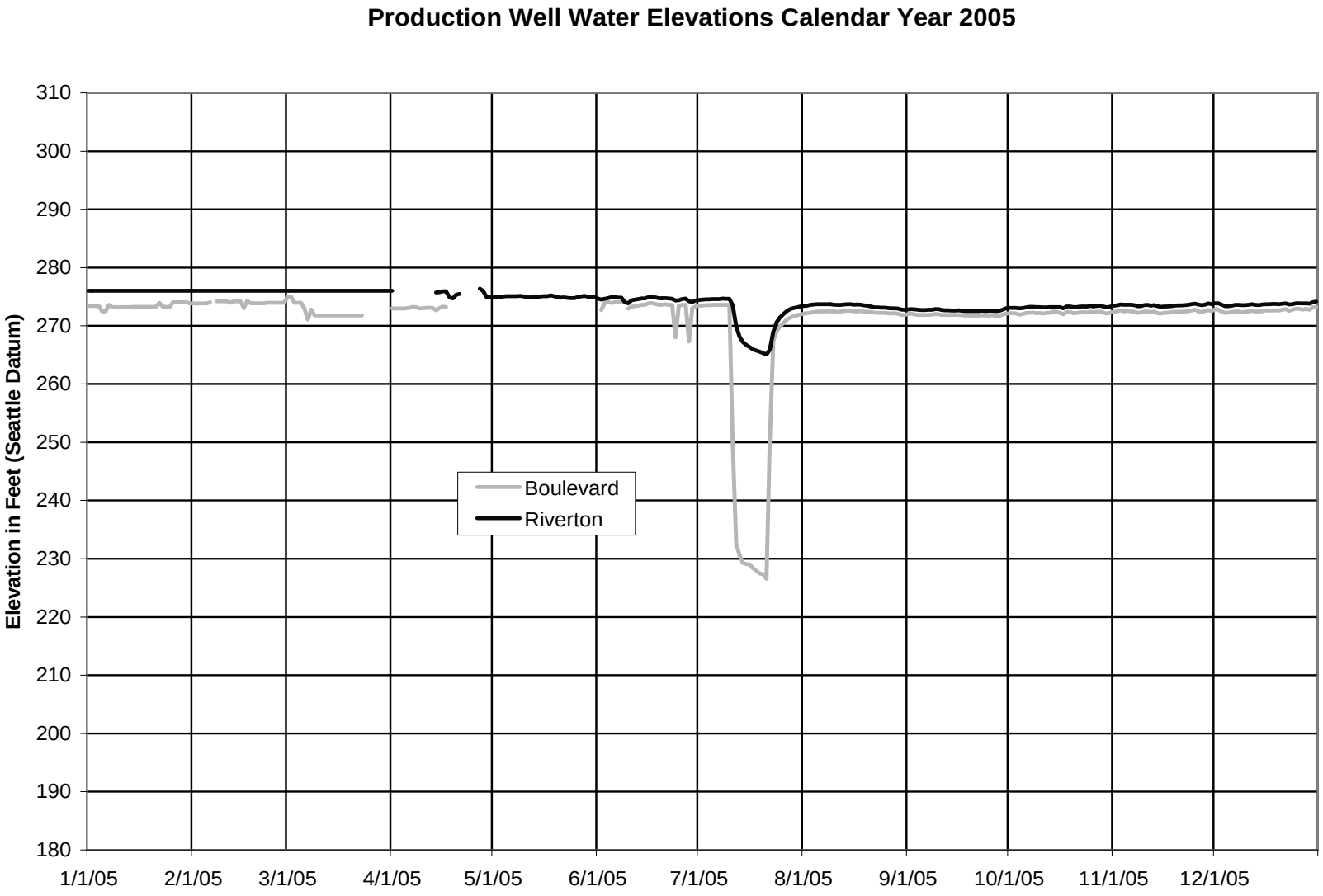
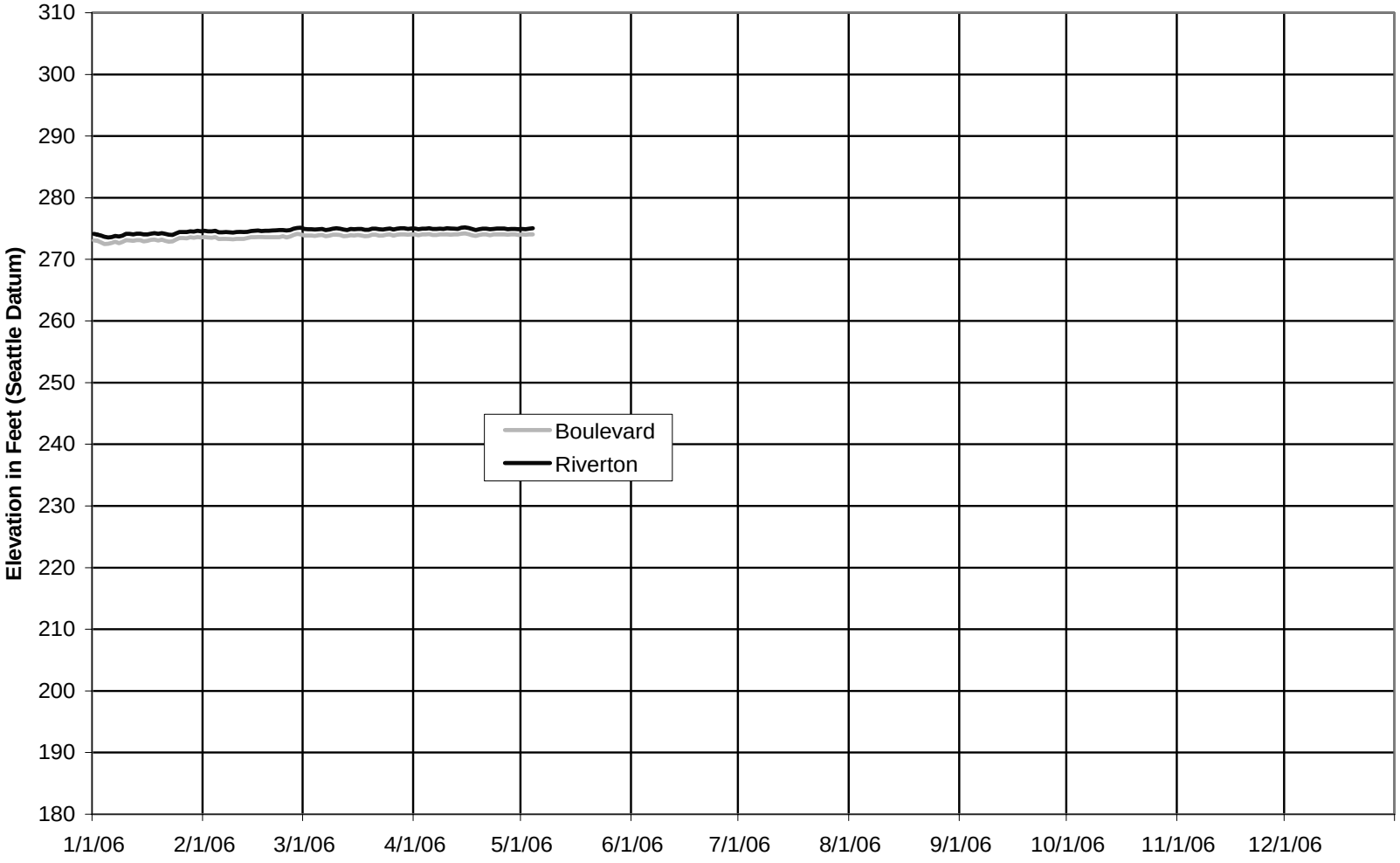
8/1/04
9/1/04
10/1/04
11/1/04
12/1/04
Boulevard
Riverton


Production Well Water Elevations Calendar Year 2005
Elevation in Feet (Seattle Datum)
310
300
290
280
270
260
250
240
230
220
210
200
190
180
1/1/05
2/1/05
3/1/05
4/1/05
5/1/05
6/1/05
7/1/05
8/1/05
9/1/05
10/1/05
11/1/05
12/1/05
Boulevard
Riverton

Production Well Water Elevations Calendar Year 2006



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